Human Resource Capacity Planning in a Technology driven Multi-Program Environment based on a Process Master Plan

A case study in the German automotive manufacturing industry

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EXECUTIVE SUMMARY

This research project aimed at performing an examination of the current HR capacity planning practices in the multi-program environment at a large Germany car manufacturer and the opinions about HR capacity planning in the investigated department in order to confront the findings with main tenets from literature to generate recommendations about an HR capacity planning process in the German automotive industry. Accordingly, the main research question was defined as

How can a conceptual process design for the planning of human resource capacity need in a technology driven multi-program environment, organized in a matrix organization based on a PMP, be structured?

Additionally, four sub-questions were defined as guidance through the research project. These are

1. Which obstacles and difficulties need to be dealt with in the planning of HR capacity need?
2. Which drivers and factors influence the HR capacity planning process?
3. Which methods and processes can be used to plan the HR capacity need in multi-program environments of technological products?
4. Which requirements should an HR capacity planning system in an environment based on a PMP fulfill in order to enable a flexible and efficient planning process?

Data that should support answering the research questions were collected in scientific literature as well as through structured interviews and observations in focus groups at the client company. The Theory found in scientific literature is then compared to the IST to define the SOLL (as can be seen in the graph on the left), meaning that scientific answers to the research topic are compared to best practices and current approaches which were found in the analyzed case, the IST.

Main complexity and challenges in human resource capacity planning that were found are: the correct choice and evaluation of planning characteristics and the planning process, a successful system implementation, the continuously changing environment of a department and human factors in the data collection and planning process. Empiric data showed that the interviewed and observed participants were mostly unaware of difficulties that might arise due to the chosen planning methodology.

The research on influential factors showed that there are many factors that have an influence on the needs of human resource capacity, but for several of the factors it might be difficult to estimate them accurately considering the effort and effect of
the determination process. This is especially the case for the influence of factors depending on human influences and project related influences. Further factors that were found are: influences due to changes in the automotive industry, factors outside of the company and factors that specially need to be considered for the investigated case of an automotive manufacturing company.

The investigation on the third sub-question proposed several methodologies described in literature as well as approaches applied in the company of the studied case. Approaches for planning the need of human resource capacity were found in theory on project management, project portfolio management, activity based costing and HR controlling. The approaches that were found in empiric data were found to be all specially designed for the applied departments and didn’t show a direct application of the approaches found in theory. However, the approaches that were found in theory could partly be recognized in the empiric data. The analysis of the empiric data showed that the taken approaches vary with the size of the department. Departments of similar sizes were found to have similar approaches or similar underlying reasons for their choices.

The analysis and comparison of Theory and IST data led to several conclusions that could be drawn which were formulated to requirements, the SOLL, in order to be able to implement them into a process design. A major conclusion describes, that the planning of HR capacity need is not a single step which can easily be done, but is part of a larger process as can be seen in the figure below.

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System Design → System Implementation → HR Capacity Planning → Result Communication & Application
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The whole process should not only contain the planning undertaking itself, but also the system design and implementation phase before the actual planning phase. These two phases can also be conducted in parallel in order to commit all necessary and involved actors to the planning process by including their perceptions and opinions in the system design when possible.

Further important conclusions are that a capacity planning system always needs to be adapted to the applied case so that a planning approach should provide enough room for flexibility. Flexibility was also found to be important due to changing influential factors to which the planning process needs to be adapted.

Following from the drawn conclusions, two planning processes were designed which can be used to plan the human resource capacity need in a technology driven multi-program environment based on a process master plan. Approach 2 is the favored approach as it is
assumed to provide a higher degree of accuracy. However, as the approach is based on recorded times from previously conducted programs it takes several years until first planning results can be achieved.

The application of approach 1 enables the planning entity to reach earlier planning results as the methodology is based on management estimations on the effort which is needed for individual work packages.

Both approaches are based on the capacity which is needed for one program along the process master plan. The capacity for the individual programs is then summed according to the timewise ordering of the programs. Further, both described processes include the necessary involved actors to assure the acceptance of and commitment to the process by all involved actors.

Overall, the research project answered the proposed research question and sub-questions and a design was developed in order to enable an application of the conclusions which were drawn from the collected data.
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Chapter 1
Introduction and Research Description

1. Introduction and Research Description

The competitiveness of high-tech firms in the market is highly dependent on their human resources. The availability, choice and management of human resources within a company can be the crucial factor that decides between market failure and success. A successful human resource management can therefore be seen as a very important duty of every enterprise. The ability of gaining competitive advantage based on an effective human resource management to increase human resource competitiveness is essential for labor intensive work environments (Van & Zhongbin, 2010). Human resource competitiveness is defined by many factors such as costs, turnover, planning or employee development (Xiang & Bo, 2010).

The management of human resources is of such high importance, as economic growth is driven by human creativity. Economic growth is important for a country, companies and other economic entities as it ensures their market competitiveness. Sustainable growth and gaining sustainable competitive advantage can only be achieved on the long run with a plan that includes a strategic management of human resources which ensures an efficient usage of the right resources. Such a strategy enables a company to obtain good performance and long-term profit (Xiang & Bo, 2010).

As part of human resource management, the available resources need to be scheduled and the quantity of human resources needs to be adapted in case of a deviation between needed and available resources.

Compared to traditional manufacturing processes, the knowledge and people-dependent nature of work in a high-tech environment adds several factors to the scheduling process which increase the complexity and accuracy. Most of the existing human resource planning methods do not take into account differences between human resource capabilities and capacities in process execution (Xiao et al., 2008) and make such a planning process a not trivial undertaking.

With the planning, a company may aim – next to the larger goal of sustainable competitive advantage – at stability and reliability of the work force in order to increase efficiency. Xiao et al. (2008) describe four major problems when scheduling human resources. First of all, it is difficult to describe the capability of human resources. Secondly, the availability and capacity of human resources needs to be described in order to be able to start its planning. Further, it is unknown which boundary conditions need to be satisfied while scheduling human resources. Lastly, a method for the planning process that takes the above mentioned problems into account needs to be chosen.

This research explores possible methods for planning the need of human resource capacity in general and in a studied case which is a department in the multi-program environment of a German automotive manufacturer. Further, the research explores factors and drivers which determine the capacity need for both, the HR capacity need in general and in the automotive industry. Afterwards, the research project examines obstacles and difficulties that occur of HR capacity planning.
1.1 Research Problem and Context Settings

1.1.1 Research problem from the client’s perspective

The client which initiated this research project is responsible for the procurement activities of a major fraction of the client corporation's products which accounted for approximately 22 billion € in 2011. The employees of the department support the company's engineers with organizing the purchase of components and materials. In different stages of the development cycle of a product, different experts from the procurement department are needed by the development departments with diverse and changing capacity loads. Furthermore, the company has several product lines (source: company website) which results in a multi-program environment. Currently, around 10 to 15 programs are under development, but in different stages of the development cycle. The programs are conducted in parallel according to a pre-fixed corporation-wide time line.

The planning of human resource capacity in the multi-program environment of the procurement department is not ideal for several reasons. Firstly, a lack of knowledge in the planning of human resource capacity for the department led to an insufficient consideration of the capacity drivers and other factors. Secondly, the available planning system doesn’t fit with the changed organization anymore. Further, the system is too detailed and therewith too complex. This complexity is not necessary as the threshold of the planning cannot be considered accurately due to uncertainty and human factors in the according project work.

The management team of the department assumes that the available planning tool is not appropriate for the department and therefore it doesn't find the necessary acceptance among the management team. This led to a lack of commitment for the strategic planning of HR capacity need. Additionally, the process structure changed in the past and the considered factors were not updated anymore. There are influential factors which are known, but it is unclear which influence these factors have on the capacity availability and need.

The lack of structure in the planning and distribution of human resource capacity in the department made the issue a highly political topic which led to power struggles for human resources among the department’s top management. In order to avoid this, the department leader is looking for a possibility to determine the amount of human resources that are needed in every unit of the department. This not only eases the process for him to assign headcounts to units, but would also strengthen his position when arguing with the CEO for a raise in the department's headcount. Further, the ever increasing worldwide interconnectedness between companies which includes common projects requires an accounting possibility to share costs of human resources according to the organization's work share. Additionally, the scarcity of highly qualified human resources requires a more and more efficient usage of the available resources. A HR capacity planning system should therefore indicate how to distribute the available resources in an organization.

Scientific literature on (human) capacity planning is available, but it is found to be either formulated very generally or regards different situational conditions which makes it difficult to apply it to this case. This condition makes it demanding to design an accurate
planning system based on the available literature. Especially the approaches of (multi-) program management seem to be suitable for the planning purpose. However, the environment at the client company proposes a special environment where all working activities are defined along a process master plan (PMP) as will be described in chapter 1.1.2. The repetitive similar work processes might enable an easier planning possibility that proposed my project management theory.

Further, several scientific articles describe difficulties that might arise during capacity planning. These distributed factors need to be found and then considered in the design for a planning process in technology driven multi-program environments. Next to the obstacles and difficulties, influential factors need to be researched on in order to be able to take them into account in the planning process. The research should not only provide insight in the factors that need to be taken into account, but also in the possibilities to handle them.

Due to confidentiality reasons, the client will be referred to in the following as Organization O.

1.1.2 Development at Organization O

Organization O is a large German car manufacturer in the medium to premium segment. The vehicles are developed and produced by Organization O in a multi-project and multi-program environment.

One program equals the development of one vehicle type and is pre-structured by the PMP, the Process Master Plan (see Figure 1) which defines all activities that need to be done in the 55 month time frame of the development. Every involved unit and department has to follow the tasks that were defined as their responsibility along the time schedule of the PMP.

*Figure was deleted due to confidentiality restrictions.*

**Figure 1 – PMP (Process Master Plan) (source: Organization O internal document)**

The PMP is a static framework for one program, but is adapted constantly to organizational, technological and environmental changes. This means that projects which are conducted at the same time, but started at a different point in time may be working according to different PMP frameworks.

There are many programs going on at the same time, but with different start and finish dates. Each lead series is followed by its derivates which are variations of the lead series. The differentiation can be seen in Figure 2. Each derivate is planned as an own program and needs to follow the PMP as guideline as well. Derivates are variations of the lead vehicle (e.g. C class) such as a coupé or an estate car. In a derivate, several parts are taken over from the lead vehicle. The utilization of the same components is called modularization and can reach a degree of more than 80%.

*Figure was deleted due to confidentiality restrictions.*

**Figure 2 – Division of Lead vehicle and derivates at Organization O (source: author)**
A benchmark study which was conducted internally at the procurement department showed, that these approaches were also chosen by other German automotive manufacturers.

The procurement department of Organization O employs around 700 associates with diverse qualifications and is divided in three main groups: (1) procurement of components for vehicles, (2) series management and (3) strategy development and top management support. For this research project the series management is investigated in detail and the findings and conclusions should primarily be applicable for this part of the department. Further investigations for the capacity planning of the department in total can then be based on these results.

1.1.3 Trends in the automotive industry

The automotive industry in Germany is of high importance for the economic growth and stability of the country. There is almost no country on the globe, where the automotive industry is of such high importance for the economy as a whole. The high export rate in the automotive products of 50 to 60% contributes as important fraction to Germany's overall strong export rate which is one of the main reasons for the country's economic strength.

The research and development in the automotive industry contributes to Germany's leading position as a research and innovation nation. The world's top 10 of the largest researching corporations include four large German companies of the automotive industry – VW, Daimler, Bosch and BMW. Following from this, the automotive industry is in Germany the most important exporter of technological knowledge and contributes to the world wide diffusion of technologies.

This success is currently achieved with the competitive advantage on specialization in high end products in all vehicle categories and an advanced productivity rated compared to other western and emerging countries (Leger et al., 2009). However, emerging countries are catching up quickly and especially low wage levels and an increasing knowledge base in those countries compromise the current strong position of the German automotive industry. At the same time, customer requirements increase and vehicles need to fulfill more and more individual requests that fit each customer individually. This leads to a permanent conflict between efficiency and variety which needs to be solved in order to maintain the current advantageous competition position (Hüttenrauch & Baum, 2008).

The trends in the automotive industry are not only influenced by technological trends, but also by continuous changes in the environment. The economic environment renews itself continuously including the increasing raw materials prices and other macro economical influences. Further, changes in the political environment, such as upcoming emerging markets, global warming and religious conflicts have impact on the automotive industry and the industry in general. A changing social environment has a strong impact on the customer demand. The changes include social trends such as increased communication between humans and the usage of a car as living or working area (Hüttenrauch & Baum, 2008). In a speech, Krämer (2012), an upper manager at Daimler AG, defined the most influential changes for the company to be resource shortage, metropolization and
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legislative modifications. Additionally, the variety in vehicles at Daimler’s car brand Mercedes tripled in the last 30 years and will rise further. Concluding from these trends, the main challenges for the automotive industry are societal changes, new emerging markets, derivatization caused by the need of increased variety, high technological complexity, the need for a high level of quality and the need for steady or increased company profitability (Krämer, 2012; Daimler AG, 2011).

The automotive industry in Germany needs to consider and deal with these trends and challenges in order to keep or enlarge the current advantageous position. The factors are the permanent basis for new development projects and organizational changes. The industry reacts to those trends with several solutions, such as modularization of components to enable an easy exchange of commodities and increase the variety of vehicles (Hüttenrauch & Baum, 2008). Further, automotive manufacturers started to cooperate with competitors as well as with suppliers in different stages from the research and development of future technologies up to the distribution of vehicles to increase their competitiveness. For efficiency reasons, more technological competence will be transferred to suppliers (Daimler, 2011).

With the aim to overcome the resource shortage and deal with a changing environmental mind within society, the automotive industry worldwide invested for decades and increasingly invests in alternative power train technologies such as electric and hybrid vehicles. These changes require new processes that issue many organizational challenges which need to be overcome and demand a lot of additional effort.

Efficiency evaluation is based on many factors such as production speed and development effort, but eventually it will be measured in financial terms. The procurement departments of automotive manufacturers are important parties in the achievement of financial goals as they are responsible for the largest share of the corporate expenditures and are in the position to influence them.
1.2 Objective, Scope and Questions

1.2.1 Research objective

The objective of the research project is defined as following.

The research aims at performing an examination of the current HR capacity planning practices in the multi-program environment at Organization O and the opinions about HR capacity planning in the client’s department. These findings should then be confronted with main tenets from literature to generate recommendations about an HR capacity planning process in the German automotive industry.

The findings will be the basis to develop a human resource capacity planning tool in the client’s department.

1.2.2 Scope

For a closer demarcation of the research project and a closer definition of the upcoming tasks, the scope is defined in the following.

- Determination of obstacles and difficulties in the planning of HR
- Analysis of the environment to find all necessary influential factors which need to be considered for the determination of the needed HR capacity
- Research on available principles for HR capacity planning in theory and within the corporation and determination of common success factors
- Aiming at determination of the quantitative HR capacity which is needed to fulfill all tasks which are to be done within the department
- Conceptual planning system development considering all relevant data / information / factors found

- Analysis of potential quantitative capacity optimization which can be concluded from the results of the designed system
- Possible fulfillment of the needed HR capacity (e.g. bottlenecks in qualified employees due to lack of specialized workers) is not regarded
- Detailed requirements and system development are out of scope. Quantitative system inputs are not regarded
1.2.3 Research question and sub-questions

The research is guided by one main research question and four sub-questions. The four developed sub-questions serve as support for the main question and should, in combination, answer the research question in a sufficient way.

**Research Question**

In accordance with the defined research objective the research question is defined as following:

How can a conceptual process design for the planning of human resource capacity need in a technology driven multi-program environment, organized in a matrix organization based on a PMP, be structured?

The question aims at the qualitative definition of system functionalities for the planning of HR capacity need which can be applied at the client in the automotive industry. For this case, functionalities are not only defined in terms of software functionalities, but also in terms of managerial, usage and steering purpose functionalities.

**Sub-Questions**

The HR capacity planning process is not an easy undertaking and has to deal with many obstacles and difficulties. The knowledge of these difficulties enables the involved persons and planner to handle them and develop countermeasures and a mitigation plan. Therefore, the first sub-question is defined as:

1. Which obstacles and difficulties need to be dealt with in the planning of HR capacity need?

The planning process can only function properly with thorough knowledge of the factors that contribute to the capacity need. Further, identifying the main drivers is the basis for steering the needed HR capacity on a properly developed foundation. With the aim to gain this knowledge, the second sub-question is defined as:

2. Which drivers and factors influence the HR capacity planning process?

Understanding the interdependencies between the identified capacity drivers and influential factors increases the ability to steer the needed HR capacity. With the knowledge of interdependencies between the examined factors and drivers, the effect of one changing driver is easier to be estimated. This sub-question should lead to a map that shows how the determined factors influence each other and further describe their influence on the HR capacity need.

A major part of the research regards a system with which HR capacity can be planned. The system is assumed to be a SW tool which will enable the user to calculate the future capacity need in a multi-program environment of the automotive industry. Therefore, existing theories on planning methods will be studied. Further, HR capacity planning
systems which are already in use at the client company will lead to an answer to the first sub-question:

3. Which methods and processes can be used to plan the HR capacity need in multi-program environments of technological products?

With the analysis of HR capacity planning systems at the client, the research aims at gaining insight in best practices and ensuring the practicability and alignment of the later on developed system with the department's preconditions.

Each of the above described sub-questions includes a confrontation of the data found in theory and the data gathered in empiric data collection. The results of this confrontation and analysis will then be combined in one HR capacity planning system which considers the specific environment of the department in the studied case. The fourth sub-question is therefore defined as:

4. Which requirements should an HR capacity planning system in an environment based on a PMP fulfill in order to enable a flexible and efficient planning process?

The purpose of this last sub-question is the alignment of the previous found data with the pre-conditions at the client and in the automotive industry in order to achieve a fitting and complete design for the HR capacity planning in the automotive industry.

The four sub-questions are expected to answer the overall research question sufficiently in all aspects which are defined to be in scope of the research project.
1.3 Research Methodology

The research methodology describes the approach which was chosen for this research project. It contains the research structure and framework, the case study design and the data collection methods as well as the limitations of the research project.

1.3.1 Research structure and framework

The research is conducted based on the TSI framework (see Figure 3). The TSI framework includes three parts:

- **Theory**: The description and theory of the studied topic in scientific literature.
- **IST**: The positive approach. The situation how the studied topic is applied in best practices by the units which are studied.
- **SOLL**: The normative approach. The situation how it should be in an ideal state.

![Figure 3 – The research framework](image)

In this research *Theory* is compared to the *IST* to define the *SOLL*, meaning that scientific answers to the research topic are compared to best practices and current approaches which were found in the analyzed case, the *IST*. Further, the opinions of managers within the client’s department, which seeks for recommendations, are used as *IST*. This comparison should then lead to recommendations for improvements and describe the favorable situation for an HR capacity planning tool in the automotive industry, the *SOLL*.

The framework is used for each research questions individually, meaning that each of the three chapters which deal with the research results is based on this framework.

1.3.2 Case study design and nature

The study is defined as case study research as defined by Yin (2003):

“*A case study is an empirical inquiry that investigated a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident.*”

“The case study inquiry relies on multiple sources of evidence, with data needing to converge in a triangulating fashion and as another result benefits from the prior development of theoretical propositions to guide data collection and analysis.”
Unit of analysis
This case study is defined by Yin as embedded single-case study (Yin 2003, p. 40), meaning that the study contains one case in one context, but the case contains multiple individual units of analysis. According to Yin, the subunits add significant opportunities for analysis and enhance the insight into the single case.

The unit of analysis of this study is defined as the HR capacity planning process at Organization O. The defined subunits are the HR capacity planning process in four chosen departments.

1.3.3 Data collection method
In case studies, the validity of the research results can be increased by the usage of triangulation. Therefore, the research is based on several sources of data. The sources are described in the following.

Literature
The collected information from literature include several types of literature such as scientific articles gathered from databases and scientific journals such as Scopus and the International Journal of Project Management. These data are mainly used to support theoretical background knowledge for every research question, which represents the Theory part of the TSI framework.

Focus groups
Focus groups were arranged as workshops with managers of the department for which final recommendations should be made. In these workshops, the managers discuss about the topic of HR capacity planning within their area of responsibility. These workshops were carried out independently of the research project. The workshops were mainly used to get a good insight in the topic and in management opinions as they were found to be an essential success factor to the HR capacity planning. In the workshops, data were mainly gathered by observations and unstructured interview questions.

Observations during these workshops are expected to provide further information about perceptions, opinions and attitudes towards the topic and the reason for failure of the current capacity planning tool. The results of these observations are expected to give an overview of the connections between the teams and the inter-team difficulties with the capacity planning. Further, a more honest, open and free conversation and therewith better results than from personal interviews are expected to be gained.

The questionnaire which was prepared for the structured interviews was used as a broad guideline to understand the opinion of the managers within the department. The opinions about the topic are influencing the conclusions and recommendations as managerial support for the HR capacity planning process is of major importance.

Interviews
Structured interviews were conducted with managers and employees of the unit of analysis, as described in the case study design. The
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Interviews are the main source of data for the IST part of the TSI framework and contribute as a large majority to the empirically collected data.

The interview questions can be found in the appendix. The interview structure was developed based on the gathered literature and the data gathered in previous workshops and observations. The interviews focused on three main topics:

- The difficulties which occur when planning the HR capacity need
- The influential factors which need to be considered in the HR capacity planning process
- The HR capacity planning approach

The interviews were conducted with employees from departments which already established an HR capacity planning system. The interviewed employees are the contact person for the HR capacity planning of the investigated department.

Each interview lasted about 60 minutes and was conducted in a meeting room on site. As interviews could not be recorded, notes were made during the interviews. After each interview, an elaborated interview protocol was prepared. They can be found in the appendix in chapter 1.

Observations
Observations were conducted during the work day. They mainly include statements and opinions of colleagues about the topic. The data were gathered during work, in discussions in the hallway and meetings which were not based on structured or unstructured interviews. Direct observations in daily life are no planned activity, but will be conducted next to the other data collection activities. The observations mainly include the general structure of the department and give the possibility to discover factors that are unknown to the management. Observations are noted down when made and used during the analysis and evaluation of the other empiric data. These observations are only a minor part of the research and not necessarily required for the data analysis as they are based on coincidence.

Documentation
Documentation contains data which are available in written format such as presentations, descriptions, guidelines and explanations. These data are expected to give information about the SOLL situation within the investigated units of analysis which is distributed of created by Organization O.
1.3.4 Sub-units of analysis in the research environment

The case contains four subunits of analysis, representing the HR capacity planning processes in several departments at Organization O. In the following, the area of responsibility and general information about each department is provided.

**Department A**
Department A is situated in the central development of Organization O and deals with the electronic system of the vehicles. The department contains around 700 employees, of which around 500 employees have a permanent contract and are therefore the fix work force of the department. The other employees are mainly contracted temporarily or loaned from external contractors. The department's current tasks depend on the vehicles which are under development and the PMP phase in which a vehicle is currently situated.

**Department B**
Department B is responsible for the central cost estimation of vehicle components. The department's current tasks depend on the vehicles which are under development and the PMP phase in which a vehicle is currently situated. The department contains around 350 employees of which most are employed in a fixed working contract.

**Department C**
Department C is responsible for the quality control of several vehicle components. The department's current tasks depend on the components which need a quality approval and the PMP phase in which the component is currently situated. The department employs seven employees and is constantly responsible for the quality check of 15 to 25 components.

**Department D**
Department D is responsible for the central IT administration within the corporation. The department contains currently 35 employees which are working on IT tasks which are assigned by other departments within Organization O around the world. The employees are partially employed with fixed contracts and partially employed through external contractors.

The four sub-units act independently on and do not follow common guidelines about the investigated topic. Further departments were contacted with the request for an interview about the topic. However, no other department took part in the research project as no approach of HR capacity planning was used expected for the four investigated ones.
1.4 Thesis Outline

The thesis consists of seven main chapters overall. In this first chapter, the research problem and environment, the objective, scope and research questions as well as the research methodology were described. The core of the research contains three major blocks with overall five chapters. In the first of these three blocks, theoretic and empiric data should provide evidence about complexities and challenges in HR capacity planning, show factors that influence the need of HR capacity and possibilities of manage HR capacity in a corporate multi-program environment. The found data will be analyzed so that individual conclusion can be drawn for every individual topic. These data are afterwards combined, so that overall conclusions can be drawn. These conclusions should provide the SOLL of the research framework (see Figure 3). Afterwards, in chapter 5 a system design is proposed that considers the previously defined requirements. Following, the thesis is completed with final remarks. This process is described in the following.

The chapters 2 to 5 aim at answering the research sub-questions 1 to 4 respectively.
2. Complexity and Challenges in HR Capacity Planning

Knowing the challenges and source of complexity in human resource capacity is essential in investigating and designing planning systems and processes in order to consider them adequately. In this chapter, the occurring difficulties are described and analyzed. The chapter is the first part of the building block in which Theory and IST data are compared accordingly to the TSI framework (see Figure 3) and analyzed in order to contribute to the development of requirements for an HR capacity planning process.

This chapter aims at answering research sub-question 1:

Which obstacles and difficulties need to be dealt with in the planning of HR capacity need?

First, in the Theory section the challenges which are described in different types of literature are shown. Afterwards, the identified difficulties that occur during the HR capacity planning in the responsible departments at Organization O are described in the IST section. Finally, the data will be compared and analyzed so that requirements can be developed from the analysis later on.
2.1 Scientific Background

In this chapter, potential challenges and sources of complexity before, during and after the planning process of human resource capacity need that can be found in scientific literature are described. The findings of this chapter are the Theory part of chapter two as described in the TSI framework on page 9.

Why planning the need of HR capacity?
Planning of human resources is a widespread topic in scientific and managerial literature as it is of high importance for almost every company. A reason for the importance is the close interdependence of human resources with a company’s budget. The budget within a company serves as a control mechanism for the actual and planned use of resources. The more detailed and exact the HR capacity planning, the more accurate also the budget planning (Preißner, 2003). The budget is a means to implement an organizational policy (Meredith and Mantel, 2010, p.293) and is therefore mainly the top management’s responsibility. Middle management is mostly not interested in budget constraints, but only in the availability of resources. In order to avoid conflicts of interests, the responsibility for human resources should be combined with the budgeting responsibility (Lisge & Schübbe, 2009, p.136).

The introduction of a human resource capacity planning system is advisable in large high-tech companies as development and production cycles decrease constantly and the cost factor of human resources becomes more important considering the constant rise of competition of labor costs and associated employer outlay, especially for high wage countries. However, it is difficult to estimate whether HR capacity planning is financially beneficial as it is complex to demonstrate a complete correlation between cause and effect (Lisge and Schübbe, 2009, p.17). A major advantage of an appropriate HR capacity planning system is the knowledge about the available HR capacity and the HR capacity demand. The comparison of the available HR capacity and the demand forecast can determine potential capacity bottlenecks and overcapacities (Wytrzens, 2010) so that necessary counteraction can be undertaken already in the planning phase (Kessler, 2012). With this knowledge and the according actions, the expensive and scarce human resource can be utilized with an ideal workload (Litke, 2007). A planning system helps to minimize undesirable events and surprises for the top management that could have negative effects on the company (Meredith and Mantel, 2010, p.293).

Challenges in planning HR capacity need
The difficulty of planning the needed human resources capacity is discussed by several authors from different perspectives. Many of them address with their paper one main problem in the planning process: The accuracy of planning results. The accuracy of planning predictions is increasingly getting more attention and is looked at from different perspectives (Jia & Liu, 2010). Another challenge in planning human resource capacity is the process implementation which often includes many stakeholders with various interests. In the following, these and further challenges are displayed and solution possibilities are described.
2.1.1 Accuracy of planning results

The accuracy of planning results is described in literature by several authors to be influenced by diverse factors which make the planning of HR capacities a challenge. These are:

- **Choice of correct characteristics that define the HR capacity need**
- **Choice of the right planning method**
- **Human factors in the data collection process and system usage**
- **Human factors in the planning process.**

In the following, these factors are described in detail.

**Choice of correct characteristics that define the HR capacity need**

The accuracy of the planning process is influenced by several factors which are partly in control of the planner, but the future development of most factors is outside of his control. The development of changing factors needs to be estimated for the planning process in order to achieve accurate and suitable results. Depending on the characteristics of the planned work, the degree of difficulty varies. Goddard (1985) describes in his paper on practical capacity planning principles several characteristics which need to be taken into account when planning the HR capacity need in a production environment. Several of them are displayed in Table 1 below. Depending on the nature of each characteristic, the source of complexity in the planning process changes and the challenge to achieve accuracy shifts.

<table>
<thead>
<tr>
<th>Degree of Difficulty</th>
<th>EASY</th>
<th>TOUGH</th>
<th>TOUGHER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CHARACTERISTIC</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competition</td>
<td>Few</td>
<td>Many</td>
<td>Better than us</td>
</tr>
<tr>
<td>Marketplace</td>
<td>Stable</td>
<td>Demanding</td>
<td>Constantly changing</td>
</tr>
<tr>
<td>Delivery time</td>
<td>Long</td>
<td>Short</td>
<td>Off-the-shelf</td>
</tr>
<tr>
<td>Product line</td>
<td>Limited</td>
<td>Wide</td>
<td>Rapidly changing</td>
</tr>
<tr>
<td>Space &amp; money</td>
<td>Little required</td>
<td>Accessible</td>
<td>Required and costly</td>
</tr>
<tr>
<td>Bottlenecks</td>
<td>Obvious</td>
<td>Hard to predict, but operators and equip. flexible</td>
<td>Hard to predict, operators and equip. inflexible</td>
</tr>
</tbody>
</table>

Table 1 – Characteristics that determine the degree of difficulty in capacity planning (Goggard, 1985)

The sources of complexity differ for every planning case and even change over time. As influential factors might vary unexpectedly over time, they need to be reconsidered regularly and individually for every planning case.

Next to these mainly external and technological positioned factors, there do also exist internal and human factors which need to be considered to increase the accuracy. Difficulties occur due to the choice of the most relevant factors from inside and outside of
an organization. These factors and their values need to conform to the actual condition within the company. The chosen characteristics also need to suit other internal plans such as a company’s development and business plan (Jia & Liu, 2010). Influential factors that might need to be considered will be further described in chapter 3.

**Choice of the right planning method**

The accuracy of the planning process is not only influenced by the choice of the right characteristics and their values, but also strongly depends on the planning method which is chosen. The right forecasting technique needs to consider the scientific nature, economy and feasibility of the issue in order to take all necessary aspects into account (Jia & Liu, 2010). Different behavioral and quantitative forecasting models have been developed already for decades. The most commonly used and referred to methods include regression analysis (Meehan & Ahmen, 1990), Delphi procedures (Milkovich et al., 1972) and stochastic models (Kwak et al., 1977) (Kao & Lee, 1996). According to Wortman et al. (1996), the planning approach which is chosen needs to deal with three characteristics which all need to be considered in the methodology to lead to a result with an acceptable accuracy: reliability, robustness and nervousness of data and the planning system.

Purely mathematical models such as the approaches described by Yang & Sun (2005), Aghezzaf et al. (2011) and Hasanzadeh et al. (2009) often used in production environments run the risk of disregarding the variation of characteristics due to human factors in the work environment. Further, they might lack the flexibility to include newly occurring characteristics which emerge from the ever changing environment and movements in the workforce. Several methods exist for the estimation of HR capacity need for a work package such as scaling, parametric estimation, earned value analysis and analogy method (Meredith and Mantel, 2010, p.296). Each method requires specific preconditions and the advantages and disadvantages should be considered individually in every case. Further planning methods in theory and practice will be described and analyzed in chapter 4.

**Human factors in the data collection process and system usage**

For most planning processes, data need to be provided by humans. This provides the challenge to deal with unpredictable human factors that need to be dealt with and later on considered in the planning process.

Data collection methods including Delphi procedures have the disadvantage of potential subjectivity of participating and consulted persons. Such methodologies often include estimations which are provided by the interviewed participants.

Every determination of an effort including interview techniques needs to be regarded as estimation with subjective influences, not as an exact value. Estimations bring several factors of uncertainty with them which the planner needs to be aware of when evaluating the result. These are described in the following:

- Estimations are always influenced by the person that determines the values. Influencing factors can be a general character attribute such as being an optimist or pessimist or personal interest;
- The Mc Murphy principle: Humans add high safety margins on estimations due to their safety desideratum;
Incomplete or false basis of information might lead to a false situational assessment and therewith to an estimation based on incorrect assumptions;

Completely new products or processes are difficult to estimate accurately due to a high level of uncertainty;

Self-fulfilling prophecies influence a person’s working style: An activity takes at least the time that it was assumed to take;

Lack of time in the estimation process is a reason for a quick and inaccurate result determination;

Synergies that result from parallelism of projects resulting are often not considered by interviewed persons;

Urgent undesired tasks asked for by the management during the project execution that increase the capacity need are hardly possible to be pre-estimated by interviewees in the planning process.

(Litke, 2007; Drews and Hillebrand, 2010).

Further, when using a system to collect data, the system usage might provide challenges. The difficulty of a correct operational usage not only includes the lack of knowledge among the end users, but also further human factors. The motivation of the system's users is one of the key issues that influence accuracy of the planning results. A lack of quality in data at this stage of the planning process can hardly be compensated later on. As minimizing these effects increases the value of the planning results, Vilpola (2008) suggests a design approach that sets the end user in the center of the design phase. User-centered design (UCD) targets at improving the work conditions of the end users as much as possible by the use of methods such as user observation or usability testing.

**Human factors in the planning process**

Next to the inaccuracy in data due to subjective estimations, human factors have a major influence on the planning process and the schedule. In the planning process, the planner has to deal with a large complexity which is based on four main factors. These are firstly the large amount of contradicting factors he has to take into account at the same time; secondly, the planner has to deal with a high uncertainty in many factors like demand level or sickness of labor force. As a third factor, most planners don’t receive enough feedback on their planning so that the process is not controllable enough for them. As a fourth factor, Wortman et al. (1996) mention the high causal dependency of tasks in a working chain.

A schedule is influenced by human factors as a working environment also includes communicating, negotiating, compromising and learning. Moreover, unforeseen circumstances that occur in dynamic processes influence the schedule in an uncontrollable manner (Wortman et al., 1996). These circumstances might be challenging for the planner to deal with, even in the case that he has precise data and a qualitatively high planning tool.

**2.1.2 The process implementation phase**

The transition from an informal trial of a planning system to a formal and official system is considered to be a difficult undertaking for the responsible planning person. Goddard
(1985) describes the transition as being "a necessary part [...] that will be the toughest part of it".

There are some indications how to handle the implementation process of a planning system in order to succeed. The implementation process needs to be prepared carefully. Involved persons have to be informed about the purpose of the undertaking and they need to recognize that the system actually benefits them in the future. The support of an organization's employees can only be achieved through explanation and incentives which are accomplished through personnel education and motivation (Goddard, 1985).

The success of larger system implementations, such as the introduction of an enterprise resource planning system (ERP), depends to a major extent on the project management of the implementation process. Many authors describe the project management to be one of the critical factors in ERP implementation (Gargeya & Brandy, 2005; Kim et al., 2005; Stratman & Roth, 2002) and that system success depends on the rigor of the project management process. This is especially important as many implementation projects suffer from the overrun of costs or/and time (Al-Turki, 2011). In a study Al-Turki (2011) found that many organizations suffer a large cost and time overrun in the ERP implementation phase. Further, he describes that management commitment and a clear strategic objective are essential for a successful system implementation. Further challenges which are known and need to be handled in the implementation process are scope creep, poor risk management and vendor management (Chen et al., 2009).

Next to the project managerial challenges, process managerial topics need to be considered separately in detail. However, the project and process managerial activities need to be combined to consider all necessary aspects for a successful implementation phase.

During the implementation process, the process responsible persons may experience the refusal of different stakeholders to cooperate. One reason for this is the final effect of the planning process for the individual stakeholder. As long as not every involved actor finds his or her own benefit and positive outcome of the process it is not likely for him or her to support it. From a process managerial point of view, it is also undesirable that some stakeholders lose by participating in the implementation process as they are then less willing to cooperate in future processes (de Bruijn & ten Heuvelhof, 2009). The repetitive interdependencies between stakeholders in the work environment of large companies therefore ask for a sensitive handling of different interests. Otherwise some stakeholders might start to behave strategically and jeopardize the successful implementation of the planning process (de Bruijn et al., 2010).

The HR capacity planning cannot only be regarded as the problem of the planning and its accuracy and correctness, but needs to be considered as a highly political topic where the top management is involved. The planner or implementing team probably has little influence on the ongoing politics and almost no decision power so that they totally depend on the management's support (de Bruijn & ten Heuvelhof, 2009). To improve the chance of a successful implementation, the implementation process needs to be accompanied with a detailed plan mainly including a communication strategy with an individual framed message for every stakeholder (de Bruijn et al., 2010).
A successful implementation is one of the first steps towards a successful HR capacity planning system. Following from this, the quality of the planning process needs to be proven. The implementation of the planning system might be a threat to productivity of the involved employees. Depending on how much share of their work the planning process takes, the cut in productivity can be large in the beginning, but increases again after the familiarization with the system (Vilpola, 2008).

2.1.3 Short analysis of scientific background

The challenges found in literature can be divided in methodological challenges and challenges that occur due to the involvement of humans in the process. Challenges that occur due to methodological reasons are, firstly, the choice of the right planning method and, secondly, the correct choice of necessary planning characteristics that need to be considered. The underlying reasons for the ever changing environment are mainly not possible to be influenced by persons that are involved in the planning process itself and a lot of attention needs to be paid to the correct choice of influential factors as a basis for the planning process. The planning process (including the planning system) therefore needs to be thought through well and provide the capacity planner with the necessary flexibility to react to potential changes. This also indicates that every planning phase is an individual undertaking which cannot be automated. Further, it will probably be difficult to find one planning system which can directly be applied to every case and only a general planning structure and principle can be provided. A planning system that fits a single entity can then be built upon this basic planning system.

Further, challenges occur due to human involvement over the whole process duration in every process step. One reason for this is that the process cannot be automated due to constant changes in the environment, but also the constant changes in the labor force. Almost every human that is involved at any step in the planning process has a stake in at, even if it is just the time it takes him or her to participate. This might lead to strategic behavior and intended influences on the planning results. However, the influence that humans have on the planning process is not necessarily intentional as many examples of reasons for subjectivity describe. The planning responsible persons need to be made aware of this fact in order to take them into consideration and be trained how to handle them. This increases the quality of the collected data and therewith the accuracy of the planning results. A high accuracy of the planning results is especially important due to the possible effect that according measures might have on a company's budget and on each individual employee's job situation.
2.2 Empirics

Following the literature research, interviews and observations were conducted in this research project to gather data about best practices and opinions on the topic. The interviews and workshops that were conducted for this research project (referred to as IST in the research framework) demonstrate several challenges which were experienced or are expected to occur in several steps of the HR capacity planning process. The data gathered from structured interviews are based on the answers to questions 3 to 6 as described in appendix A. In the following, these difficulties are described and further the strategies to handle these difficulties are explained. The collected data are in the following described in three main categories: constant environmental changes, human factors in the planning process and commitment of involved employees and managers.

*Paragraph was deleted due to confidentiality restrictions.*
### 2.3 Summary

The previous chapters 2.1 and 2.2 described the source of complexity and challenges in human resource capacity planning as described in scientific literature as well as by empiric data. In the following overview, the collected data are summarized. Additionally, for each challenge the underlying reason and possible counteractions are listed below.

<table>
<thead>
<tr>
<th>Complexity and Challenges in HR Capacity Planning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Challenges found in scientific literature</td>
</tr>
<tr>
<td>1. Correct choice and evaluation of planning characteristics</td>
</tr>
<tr>
<td><strong>Reasons</strong></td>
</tr>
<tr>
<td>Too many planning characteristics available;</td>
</tr>
<tr>
<td>Ever changing planning environment;</td>
</tr>
<tr>
<td>Human factors are difficult to predict and evaluate;</td>
</tr>
<tr>
<td><strong>Possible counteractions</strong></td>
</tr>
<tr>
<td>Consideration of influential factors individually for every single case and every planning process;</td>
</tr>
<tr>
<td>2. Choice of the right planning method</td>
</tr>
<tr>
<td><strong>Reasons</strong></td>
</tr>
<tr>
<td>Every planning environment provides different involved factors and different organizational pre-conditions;</td>
</tr>
<tr>
<td><strong>Possible counteractions</strong></td>
</tr>
<tr>
<td>Individual adaptation of a planning method for every case;</td>
</tr>
<tr>
<td>3. Human factors in data collection</td>
</tr>
<tr>
<td><strong>Reasons</strong></td>
</tr>
<tr>
<td>Humans are subjective (intentionally and unintentionally);</td>
</tr>
<tr>
<td><strong>Possible counteractions</strong></td>
</tr>
<tr>
<td>Involved actors need to be aware of the fact and influence of subjectivity;</td>
</tr>
<tr>
<td>Data collection systems should be developed according to user behavior (user-centered design);</td>
</tr>
<tr>
<td>4. Human factors in the planning process</td>
</tr>
<tr>
<td>----------------------------------------</td>
</tr>
<tr>
<td><strong>Reasons</strong></td>
</tr>
<tr>
<td>Large complexity due to many involved</td>
</tr>
<tr>
<td>factors at the same time;</td>
</tr>
<tr>
<td><strong>Possible counteractions</strong></td>
</tr>
<tr>
<td>Training of the planning responsible</td>
</tr>
<tr>
<td>person;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. Unsuccessful system implementation</th>
<th>4. Managerial commitment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reasons</strong></td>
<td><strong>Reasons</strong></td>
</tr>
<tr>
<td>Lack of employee and managerial support;</td>
<td>HR is a highly political topic and basis for power struggles;</td>
</tr>
<tr>
<td>Poor project management (e.g. time/cost overrun);</td>
<td>Management might behave strategically and defend the own stake;</td>
</tr>
<tr>
<td><strong>Possible counteractions</strong></td>
<td><strong>Possible counteractions</strong></td>
</tr>
<tr>
<td>Inform and explain employees and mgmt. team about personal benefit of the system;</td>
<td>Communicate benefits for management team;</td>
</tr>
<tr>
<td>Development of a process managerial approach for the implementation phase;</td>
<td>Base planning on good foundation to avoid subjective discussions;</td>
</tr>
<tr>
<td>Implementation of strict project management processes;</td>
<td>Only discuss changes in HR capacity need, not changes in headcount during the result communication;</td>
</tr>
<tr>
<td>Overall: careful preparation of the implementation process;</td>
<td></td>
</tr>
</tbody>
</table>
2.4 Analysis

In literature and empirical research several challenges were found that might occur before, during and after the planning process of human resources. Some of the discovered challenges were found in theory only, some in the empirically collected data only and several challenges were described by both sources.

The correct choice and evaluation of planning characteristics was mentioned by Goddard (1985) to be a crucial factor to determine accurate planning results. Three major reasons were found in literature for this to be a challenge. The empirically collected data describe the awareness of the interviewees about the choice of correct influential factors. However, only one of the characteristics found in literature – ever changing planning environment – could also be found in empirics and was presented in the summary as its own category. Both types of data describe similar countermeasures that can be applied individually in every round of the planning process, meaning that influential factors should be reconsidered and adapted regularly according to potential changes in the environment. Additionally to these preventive actions, the empiric data describe the usage of flexible working hours as reactive measure for the case of an incorrect choice and evaluation of influential factors.

The influence of human factors was found to be a highly influential and important challenge in both types of data. In literature, human factors in the data collection and during the planning process were found to be of influence due to human subjectivity and capabilities of individual persons. These characteristics could also be found in the empiric data. Further, empiric data describe the challenge of strategic behavior of individual actors in both stages of the process. Strategic behavior is mentioned by de Bruijn et al. (2010) to be a characteristic that might jeopardize a successful planning process of human resource need, but focus only on the implementation phase. In both types of data, according counteraction could be found. All of them are aiming at reducing the subjectivity of individuals. The counteractions described in literature are found to be of a preventive nature which aims at handling the challenge before the data collection and planning process starts. In contrast, the counteractions found in empiric data are mostly of a more reactive nature so that are applied on-the-job during the data collection and planning process.

Employee and managerial commitment were found in empiric data to be an important characteristic for a successful planning process. Literature showed this characteristic as well, but only as one challenge in the system implementation phase. Empiric data show that the commitment of employees and the management team need to be considered in the planning and communication phase of the process. The implementation phase, in contrast, was not found in empiric data to be of importance during the implementation phase. However, during the research, resistance from the management team at the client's department was perceived against several potential planning processes. This commitment was further perceived to be indispensable in the implementation phase to achieve commitment during a later stage of the process. The reason for a lack of awareness about the importance of commitment in the implementation phase of the process among the interviewees is believed to be the fact that (besides one of the interviewees) all of them took over the planning process after it was already implemented in the department. This
might lead to an underestimation of the challenges that the implementation process provides, also including the importance of a well performed project management in this phase.

The choice of the right planning methodology for the process is a characteristic only found to be a challenge in literature research. The reason for this gap in the empirically collected data is assumed to be the lack of awareness about this characteristic. As previously mentioned the interviewees were only involved in the data collection and planning processes. This implies that they were not participating in the process and system design so that they could not have experienced any occurring challenges and obstacles in this phase.

Overall, the challenges and sources of complexity found in literature and empiric data are comparable, but not the same. Empiric data describe the underlying reasons to mostly depend on the influence of human factors and the highly political nature of the topic of human resource management. In contrast, data collected in literature describe next to human factors challenges that are related to the correctness of the planning approach itself and implementation process. These characteristics with preventive measures propose the approach of front loading in this undertaking, meaning that the planning process should be thought through well before its application.
3. Influential Factors on HR Capacity Need

The HR capacity demand of a company is described in literature and by empiric data to depend on a variety of factors which need to be considered in the determination phase to achieve a qualitatively high result. In the following, the main influential factors which are described by literature and empiric data are displayed with background information.

This chapter aims at answering research sub-question 2:

**Which drivers and factors influence the HR capacity planning process?**

Firstly, factors found in literature are provided in the *Theory* section. Afterwards, the findings in empiric data gathered in interviews and observations, the *IST*, is described. The succeeding summary and analysis are further used as basic input for later on designed system and process requirements.
3.1 Scientific Background

Scientific and non-scientific literature describes many factors that influence the need of human resources and therefore need to be considered for the capacity planning process. In the following, several findings from literature are presented representing the Theory section of the research framework.

Firstly, trends in the automotive industry are described that have an influence on the need of HR capacity. Afterwards, different general phenomena and possible characteristics are described that are not specific for the German automotive manufacturing industry.

3.1.1 Trends in the automotive industry

The automotive industry is currently undergoing a revolution that is driven by two main characteristics which are tried to be achieved in order to be able to compete in the highly competitive market of the automotive industry: efficiency and diversity (Hüttenrauch & Baum, 2008). Efficiency is a necessary characteristic in order to persist with the increased competitiveness in the market caused by several properties originating from changes such as globalization. The pressure of an increased diversity in the product portfolio rose by increasing customer demands to have an individualized product. These two characteristics need to be considered by car manufacturers in order to succeed in the market on the long run. The difficulty in achieving both characteristics is their perceived opposing thought.

Diversity in the product portfolio is a phenomenon driven by the customer demand. The demand of consumers increased over the last years and they ask for diversity in several characteristics such as diversity in brands, models, derivates and equipment options (Hüttenrauch & Baum, 2008). The adaptation of the product portfolios is a continuous process which can clearly be seen in the automotive industry. Since 1980, the number of vehicles and derivates in the portfolio of Mercedes Benz more than tripled and is planned to grow further by one third until the year 2020 (Krämer, 2012). The future success of the automotive industry is based on the degree to which the customers’ individuality is given priority (Hüttenrauch & Baum, 2008).

Efficiency can be divided into two main categories: coordination and motivation efficiency (Frese, 2000). In efficiency theory, the relative advantage of different alternative structures needs to be evaluated so that decisions of efficient approaches can be made. Coordination efficiency can further be sub-divided to market, process, resource and hierarchical efficiency (Frese, 2000). The improvement of each of these efficiency sections might lead to an increase in the overall coordination efficiency. The higher the efficiency of an employee, the less HR capacity is needed to a task or work package.

The desire for an increased efficiency, but also high diversity in the product portfolio leads to several constructs in the automotive industry which are expected to achieve the set targets. The efficiency is tried to be increased within a car manufacturing company,
between car manufacturers and between car manufacturers and their suppliers (Hüttenrauch & Baum, 2008). Efficiency is related to financial benefits, but doesn't imply for every activity also a decrease in HR capacity. Depending on the undertaken activities, the coordination activities are increased so that additional HR capacity is needed.

Within car manufacturing companies, the main source of inefficiency is situated in the product development phase. The strongly project oriented working method burdens the efficiency. For some car manufacturers, the tough price competition on the market even leads to losses in several vehicles series. One of the reasons for this is often the only little utilized synergies between vehicle series (Hüttenrauch & Baum, 2008). A solution to this problem is the increasingly occurring modularization of components, meaning that several vehicle series contain identical or similar components.

Another measure which was taken by several large car manufacturers are cooperations. Cooperations are mergers in diverse legal forms, e.g. as loose partners for information exchange or as legal company for a joint development, production and sale of products. Maniak and Midler (2008) describe in the diversity of mergers to be available between product-oriented co-development up to knowledge-oriented R&D cooperations. Currently, companies in the automotive industry are trying to include product and knowledge stakes in the collaboration projects to conduct co-innovation projects (Maniak & Midler, 2008). Cooperations among companies reduce effort for the processing of work packages by sharing them. Additional effort for communication and data exchange (including the establishment of these possibilities) this undertaking needs to be considered in the planning of HR capacities (Hellingrath et al., 2009).

Next to these cooperation projects the relocation of all value-adding steps to lower cost countries is an integrated strategy to achieve the targeted efficiency (Hüttenrauch & Baum, 2008). Such a step has mainly financial purposes as the wage costs in most chosen countries are lower. Further, the decision for the production of vehicles in other markets enables the company to produce close to the end-user and therefore save shipping expenses. Such localizations often mean less HR capacity need in Germany which can lead to depletion in the labor force (Barthel et al., 2010).

Next to these trends, Hüttenrauch and Baum (2008) describe several main categories that cause the need for efficiency and diversity as shown in Figure 4. Many of them can be found to have an influential effect on the capacity of human resources in the following chapters.

![Figure 4 - Characteristics leading to the volition of an increased efficiency and diversity](source: Hüttenrauch & Baum, 2008)
3.1.2 Company external factors

Factors that emerge from outside a company do often have a large impact on the company, but it is hardly impossible for the company itself to influence them. In her paper on sustainable human resource management, Kirschten (2008) mentions diverse external factors that need to be considered in the management of human resources. Several of these factors are described in Figure 5.

![Figure 5 - External influential factors on HR capacity need (Kirschten, 2008; EMCC, 2004)](image)

The knowledge about external factors and an accurate forecast of their development is of importance for the German automotive industry in particular as the sector is highly sensitive to changes of external factors, especially to changes in the macroeconomic situation (Leger et al., 2009). This could be observed during the last economic crisis. The economic crisis starting in 2008 had tremendous influences on the whole industry, including car manufacturers as well as suppliers and retailers. The crisis caused a sale collapse of almost 30% in the whole car manufacturing industry (SpiegelOnline, 2008) and the conveyor belts were stopped in many production plants (Süddeutsche.de, 2008). This meant a decrease in the HR capacity need in procurement environments. But also the HR capacity in other departments such as R&D, procurement or logistics was decreased to reduce personnel costs. Most companies reduced the weekly working hour of their employees in order to keep the skilled labor force within the company (ZeitOnline, 2010).

The competition in the automotive industry around the world is high. With around 40 car manufacturers offering their products, the European market has the highest variety and competition in the world (EMCC, 2004). A possible solution for this is the already previously described increase of efficiency. The steadily rising investment costs require an increase in the economic scale to reach its optimum (Rees, 1999) or at least its minimum efficient scale. As described in chapter 3.1.1, this leads to cooperative ventures which, for example, share R&D expenditures in the automotive industry (EUCAR, 2000). Further trends such as lean manufacturing and outsourcing support the trend of a higher efficiency. These new organizational forms can cause, depending on the considered entity in a company, an increase or a decrease in HR capacity need.

The legislation in Germany becomes more challenging for the automotive industry due to changes in the European legislation which is compulsory for all member states. Legislation on emissions and recycling have a strong impact on the construction and technology of vehicles (EMCC, 2004). The legislation changes mean a permanent further investment in R&D on emissions and recycling technologies.

The technological development is unstoppable and the German automotive industry needs to follow the current trends in order to stay competitive. A major trend in the automotive industry and in several other branches is the electrification which is caused by the shortage of oil as necessary resource. This means for the automotive industry that electric power trains need to be designed and new vehicle concepts need to be developed. This
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effort can only be stemmed by the R&D departments with an increase in headcount. Several sources indicate that solely the Germany automotive industry will need to hire several 10,000 new employees for this undertaking (Christoph Ruhkamp, 2011; Global Press, 2011).

3.1.3 Personnel and soft factors

Companies are mainly businesses and have to deal with numbers and hard facts. However, the drivers of a company are often its employees who are individuals with different abilities and targets. In order to successfully manage a company, also its human resources need to be managed. When regarding factors that influence the need of HR capacities in a company many human factors need to be considered.

There are hard facts which are comparably easy to determine such as absence due to holidays or illness or the fluctuation of employees (Kirschten, 2008). The data of these factors can be gathered internally and statistics can support in forecasting their development. Countermeasures to the expected developments are e.g. an increase in HR capacity and trials to decrease the factors.

Next to these factors, there are characteristics which are related to human resources and are of a more soft nature. These are e.g. changes in values and standards, motivation, qualification and working conditions (Kirschten, 2008). The factors are more difficult to grasp as they are not able to be determined in numbers. These factors vary for each individual employee and therefore influence the working style of each employee differently. In the following, the influence of the factors on an employee's working style and the effect on the needed HR capacity are described.

The motivation of a human is strongly related to the person's attitude and behavior. Motivation of a person can be divided in two different motivational types: intrinsic and extrinsic motivation. The difference in the two types of motivation is their scheme of reward. While extrinsic motivation is given by rewards such as pay, intrinsic motivation is caused by the reward with pleasure (Robbins & Judge, 2010). Many different theories exist on motivation. One characteristic that many of them have in common is the statement that intrinsic motivation is more valuable and leads to higher performance than extrinsically caused motivation. The cognitive evaluation theory even proposes that the introduction of extrinsic rewards tends to decrease the overall motivation of a person (Deci et al., 1999).

The motivation of an employee will be risen by increasing their confidence in successfully completing the task, meaning that the management style and a company's culture is of high importance for an employee's motivation and performance (Robbins & Judge, 2010). Motivation is also found to depend on an individual's self-efficacy. This may lead an individual to a higher level of job performance and therewith to a higher company performance (Locke & Latham, 2002). A higher performance can be related to higher efficiency and therewith to less needed HR capacity.

Several measures are available to influence an individual's motivation. One possibility to increase the motivation of an employee is the redesigning of the job when it is not challenging enough for the employee anymore. This can be achieved through measures such as job rotation, job enlargement or job enrichment. Further, alternative work arrangements which can be gliding time, job sharing or telecommuting can have a positive
influence on a person's motivation. Further, employee involvement and the utilization of different kinds of reward systems can be used as a measure in order to increase the motivation of employees (Robbins & Judge, 2010). However, the utilization of the measures should be thought through well and adapted to the individual situation to achieve a successful implementation. The implementation of measures should consider that humans have different motives for motivation, meaning that a measure that motivates one employee doesn’t necessarily motivate another employee as well. The job characteristics model developed by Hackman and Oldham (1976) describes five core dimensions of every job. These are skill variety, task identity, task significance, autonomy and feedback. When varying these dimensions, every job can be described. As every individual employee has different sources of motivation, these five dimensions should be adapted to employees individually as much as possible in order to achieve a high level of motivation.

Another important influential factor on an individual’s working style is the experience on the job. This includes professional knowledge, but also networks to colleagues, suppliers and other important stakeholders who might be able to ease the daily work. The so called learning curve describes this appearance and has been researched for many decades. It is mostly used to calculate the production costs of a product over time or over product units. In operations management, the learning curve refers to an increased efficiency which is obtained by repetitions of operations (Badiru, 1992). This means, the more often an employee does one task, the less time he/she needs to process it. From a learning curve point of view it is ideal if one employee does one job for a long period of time. In contrast, constant turnover and changes in the working process diminishes the effect of the learning curve (Torwill, 1982).

Although this has already been known for several decades, this factor was almost never considered in the scheduling context (Janiak & Rudek, 2009). The shape of the S-curve varies with the area of application. In general, the learning curve tends to be steeper in manpower dominated activities than in capital equipment dominated activities (Dance & Jarvis, 1992).

Additionally, as already described in chapter 3.1.2, communication is of major importance for a successful and efficient project progress. This means, the higher the communication skills of every individual employee in a project, the more efficient the collaboration is.

### 3.1.4 Project environmental factors

At automotive developers and manufacturers the majority of work is organized in projects (Hüttenrauch & Baum, 2008). Work which is carried out in form of projects is steadily increasing. This rise in project management utilization brings two main characteristics with it: Firstly, some business that never had to manage projects before are now handling large portfolios of projects and, secondly, the demand for qualified project managers surmounted the available and qualified specialists in this discipline (No author, 2001). Planning and allocating the HR capacity in projects is of high importance as the used HR capacity is directly related to a project’s budget (Meredith & Mantel, 2010) which means that a change in budget can also have influence on the HR capacity which is assigned to a project.
The basic HR capacity needed for a project is defined by the work packages which are assigned to a project. Each work package needs a defined or estimated amount of human resource capacity. Added up, these work packages lead to a first estimation of the overall needed HR capacity (Meredith & Mantel, 2010). This approach, which only considers the activities per project phase, is perceived by several authors to be too abstract and mathematical as it neglects several other important (especially human) project characteristics (Wortman et al., 1996).

Considering the project-scatter-factor, the number of staff needed to fulfill the project tasks in one year, the size of a project team needs to be considered when determining the needed HR capacity. The project scatter factor describes how many employees work for a project to process the workload of one man year. The higher the project scatter factor, the more people are needed on a project as each individual team member has a lower work share. The rise in staff per project decreases the devotion of an individual team member to the project which increases the needed HR capacity of the project. Hence, the project scatter factor has great influence on the project progress. A project team should therefore be small and functional (Hammer & Champy, 1993). A project scatter factor of 1, meaning that all project members work full-time for the project, is desirable from the project devotion point of view (Hendriks et al., 1999).

In contrast, a project scatter factor higher than 1 has the advantage of higher flexibility between projects as experts can be exchanged and team members can work in their fields of expertise. This means, that the team members can work more efficiently by using their knowledge effectively. In projects with a small scatter factor, team members need to work on broader topics which are not always their fields of expertise (Hendriks et al., 1999). This proposes a trade-off between efficiency/effectiveness in the work processes and project devotion. The choice of the project scatter factor therefore directly influences the HR capacity need of a project.

The approach of a high project scatter factor to increase the efficiency of experts on their work is mostly applied in large organizations with a multi-project environment (Payne, 1995; Ghomi & Ashjari, 2002). Such companies are mainly working with a functional matrix organization which enables a bundling of knowledge. The knowledge is then temporarily transferred to defined projects that need the expertise (Katz & Allen, 1985). Multiple projects are then competing for the best resources as experts are the most scarce resource of each project (Vals et al., 2009). This might lead to disagreement within a company (Laslo & Goldberg, 2008) and the enhancement of lobby activities (Bernasco et al., 1999). However, sharing experts and having several projects in parallel also enables a company to benefit from synergies between those projects. Synergies between projects can, if used in the right way, benefit the resources of a project in several ways. Sharing materialistic resources among projects leads to financial benefits over the project duration. Further, project costs as well as the project duration can be cut through modularization by the definition of common work packages and centralized knowledge (Chai et al., 2010).

Next to synergies between projects also the synergies within projects are of importance. A higher synergy within a project can be of quantitative and of qualitative nature and are believed to complement each other. Combined, they are able to achieve a higher effectiveness in projects. Qualitative synergies include factors such as project
commitment, coordination, supportiveness, integration and participation as well as the project members morale. Quantitative measures that result from synergies in projects are a structured and on-task team. A high synergy in a project decreases costs, leads to a better performance and/or a shorter project duration (L. Lai, 1997). This benefits the productivity and efficiency of a project team and therewith the need of HR capacities.

Communication in projects is of high importance as it is strongly associated with success or failure in projects (Belout & Gauvreau, 2004). Communication barriers are a threat to projects and little communication leads to less successful projects or a longer project duration which is often directly related to a budget overrun. Communication barriers can be of physical nature such as spatial distance which require a communication medium. The better the communication medium fits the projects purpose the lower are the physical barriers and the more efficient the project communication can take place (Ferreira, 1996). Further, psychological communication barriers can hinder project work. These barriers were categorized by Fox (2001) in environmental, verbal and interpersonal as well as emotional reactions. The ability for lower communication barriers in projects increases the efficiency of projects which leads to a lower needed HR capacity to achieve the same performance (Patrashkova-Volzdoska et al., 2003).
3.2 Empirics

Next to data collection in literature, data were also collected empirically in interviews and workshop with employees of Organization O. The following data gathered from structured interviews are based on the answers to questions 7 to 10 as described in appendix A. The collected data provide a detailed insight on factors which are currently, and need prospectively to be, considered in the capacity planning process of the studied case.

The analysis of the collected data identifies four main categories of influential factors on the HR capacity need. These four categories are displayed in Figure 6 and are described separately in more detail below.

Paragraph was deleted due to confidentiality restrictions.
### Chapter 3
Influential Factors on HR Capacity Need

#### 3.3 Summary

The previous chapters 3.1 and 3.2 described the factors and drivers that influence the need of human resource capacity as described by scientific literature and empiric data. In the following overview, the collected data are summarized. For each category, the included factors are listed as further explanation and elaboration.

<table>
<thead>
<tr>
<th>Influential Factors on HR Capacity Need</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Factors found in scientific literature</strong></td>
</tr>
<tr>
<td>1. Trends in the automotive industry</td>
</tr>
<tr>
<td>▪ Efficiency vs. Diversity</td>
</tr>
<tr>
<td>▪ Need for increased efficiency due to competitive pressure</td>
</tr>
<tr>
<td>▪ Increased customer demand → Modularization</td>
</tr>
<tr>
<td>▪ Cooperations (vertical and horizontal)</td>
</tr>
<tr>
<td>▪ Localizations</td>
</tr>
<tr>
<td>2. Company External Factors</td>
</tr>
<tr>
<td>▪ Macroeconomic situation</td>
</tr>
<tr>
<td>▪ Competitive situation</td>
</tr>
<tr>
<td>▪ Legislation, Policy</td>
</tr>
<tr>
<td>▪ Technological development</td>
</tr>
<tr>
<td>▪ Customer demand</td>
</tr>
<tr>
<td>3. Personnel and Soft Factors</td>
</tr>
<tr>
<td>▪ Hard facts (absence due to holidays, illness, ...)</td>
</tr>
<tr>
<td>▪ Individual's attitude and motivation (extrinsic &amp; intrinsic; influenced by rewards)</td>
</tr>
<tr>
<td>▪ Experience on the job (learning curve)</td>
</tr>
<tr>
<td>4. Project Environmental Factors</td>
</tr>
<tr>
<td>▪ Project scatter factor (efficiency vs. flexibility; individual devotion to a project)</td>
</tr>
<tr>
<td>▪ Synergies between projects</td>
</tr>
<tr>
<td>▪ Synergies within a project</td>
</tr>
<tr>
<td>▪ Communication within a project</td>
</tr>
<tr>
<td><strong>Factors found in empiric data</strong></td>
</tr>
<tr>
<td>1. Trends in the automotive industry and permanent changing tasks</td>
</tr>
<tr>
<td>▪ Modularization</td>
</tr>
<tr>
<td>▪ Localization</td>
</tr>
<tr>
<td>▪ Cooperation projects</td>
</tr>
<tr>
<td>▪ Unpredicted short-term trends</td>
</tr>
<tr>
<td>2. Factors outside of a department</td>
</tr>
<tr>
<td>▪ Quality of R&amp;D department's work</td>
</tr>
<tr>
<td>▪ Company's economic situation</td>
</tr>
<tr>
<td>3. Human factors in the work environment</td>
</tr>
<tr>
<td>▪ Experience of interface colleagues.</td>
</tr>
<tr>
<td>▪ Experience of employees</td>
</tr>
<tr>
<td>▪ Efficiency/capability of every individual employee</td>
</tr>
<tr>
<td>4. Standard work environment</td>
</tr>
<tr>
<td>▪ Degree of process standardization of work packages</td>
</tr>
<tr>
<td>▪ No. of derivatives</td>
</tr>
<tr>
<td>▪ No. of components per vehicle and modularization</td>
</tr>
<tr>
<td>▪ Degree of innovation</td>
</tr>
<tr>
<td>▪ Regular communication</td>
</tr>
</tbody>
</table>
3.4 Analysis

Several factors that have an influence on the HR capacity need of a car manufacturing company in Germany and in general were found in literature as well as in empiric data.

The influence of trends in the automotive industry was found in both types of data to be a constantly changing factor which can have a major influence on a department's headcount. Managers in the department were experienced to be aware of the major trends as they have to deal with them on a daily or weekly basis. Also the responsible capacity planners of department A and C were found to directly include trends in the capacity planning system in a flexible, as well as in an inflexible, approach. The main trends that were found are modularization of components, localization and cooperation projects. As underlying reason for this, literature described the need for a higher degree of efficiency at the same time as a higher diversity in the product portfolio. This could not be found as reasoning in the empiric data. The cause for the missing description can be the self-evidence that the topic brings with it from the viewpoint of the interviewed and observed participant. Further, the interviewees and observed persons are not directly involved in the development of strategies that design measures that serve as counteractions to trends in the industry branch. Therefore they might know the designed measures, but not all underlying reasons for it. The trends that were found are temporarily the main strategies to achieve the set company goals and stay competitive in the market. However, the ever changing environment proposes that these factors need to be permanently reconsidered and new influential factors might have to be added in the capacity planning process. The influential trends in the automotive industry as described in literature and empiric data combined are displayed in the influential map displayed in Figure 7.

The factors which were found to be of influence in the automotive industry highly depend on the external factors that influence many companies, also outside of the automotive industry. The trends in the automotive industry are an adaptation of the industry branch to the external changing factors. Some of the found factors, such as the future macroeconomic situation and customer demand are hard and time intensive for a single capacity planner without specific knowledge to predict. Scientific and non-scientific literature describes many external factors that influence the capacity need. Many of the
economic influences could be found in the daily press of the last economic crisis as the rapid economic slump had a large influence on the HR capacity need which directly affected a large number of employees all over Germany. The measures and the underlying reason for their decision are assumed to be known to many of the interviewees and observed managers, but could hardly be found in the empiric data and never are directly taken into account in the capacity planning methodology. As those measures usually affect the whole company and not solely single departments within a company, the department can be assumed to have no influence on the taken measures, but is dependent on the decisions of the company’s top management team. The top management team can decide upon new vehicle series, the number of derivates and the degree of innovation in each series or directly on capacity changes in extreme situations. This is the adaptation of external changes to the company’s actual situation. These factors need to be considered by the planning expert, but usually do not need to be gathered from outside of the company. Yet, instructions by the management that have influence on a department’s headcount might relate to the overall economic and the company’s financial situation, but might still have a different influence on the human resource capacity actually needed. This is assumed to be the case for R&D close departments in the automotive industry as programs and projects are scheduled a long time in advance. The capacity planner should be aware of the external factors that influence the company’s decision for measures and the factors influence on the capacity need within the department. Further, empiric data describe that departments not only depend on company external factors, but also on factors within a company but outside of the department. However, the data describe as well (as can be read in more detail in chapter Fehler! Verweisquelle konnte nicht gefunden werden.) that none of the approaches which were chosen in the investigated departments takes these factors directly into account. A reason for this can be the difficulty to operationalize the actual influence and its quantitative effect. The external factors as described in literature and empiric data combined are displayed in the influential map displayed in Figure 8.

Figure 8 – Influential map of external factors on HR capacity need

Another important influential factor which was found is the human influence on the work process. Both, literature and empiric data provided evidence that human behavior and attitude strongly influences the capacity need of an organization. Especially the motivation of a single employee affects an employee’s attitude towards work and his or her work attitude. These factors can hardly be found in empiric data and were only discovered in
Influential Factors on HR Capacity Need

Conversations besides interviews and focus group observations. Compared to other influential factors, these seemed to be of little importance to the management team of the department. The factor of an individual person’s experience is described by literature as well as by empiric data. However, the planning approaches of departments A, B and C do not include the factors in their planning process. A reason for this cannot be found in the collected data, but is assumed to be, again, the difficulty to operationalize the characteristic to measurable factors so that its quantitative effect on the overall capacity need can be determined. Further, motivation was found in literature to be of high influence on the working efficiency and effectiveness, but can neither be found in interviews and observations nor is the employees’ motivation included in any of the investigated planning approaches. The human and personnel factors as described in literature and empiric data combined are displayed in the influential map displayed in Figure 9.

![Influential map of human and personnel factors on HR capacity need](image)

Project related factors are described in literature to have a high influence on the needed human resource capacity in project dominated environments. Depending on the degree to which a company is organized in a project structure, the project managerial influences on the capacity need can vary. Although, the work environment at the department (and in the automotive industry in general) is organized distinctly project managerial, related factors were neither mentioned in the interviews with capacity planners nor in the observed workshops with the department managers. However, it is assumed that the factors have an influence on the capacity need due the matrix organization which is applied in a major part of the organization. However, as department D and C are comparably small, the effect of the factors within their department is assumed to be minor compared to the influence in larger entities such as department A and B. Even so, none of the interviewed planners considers such factors for the own planning process. This can be caused by a lack of knowledge as well as by the complexity to operationalize the effect that the factors have on a department’s headcount. The project related factors as described in literature and empiric data combined are displayed in the influential map displayed in Figure 10.
A large factor that was not found in literature, but in empirics, are the standard work processes. The work processes differ between work environments. However, in the automotive industry the processes which are applied at all German car manufacturers are similar which eases the objective of this research project to propose a capacity planning system which can be applied for the whole industry branch. The factors which were described to influence the standard work processes were found to depend on the top management and central process design departments in a company. The process design departments define the processes themselves while the top management decides on new projects and programs that should be undertaken. The case specific factors as described in literature and empiric data combined are displayed in the influential map displayed in Figure 11.

Overall, many influential factors that were found in literature are known to the department’s management team as well as to the capacity planners of other departments. However, the knowledge doesn’t automatically incorporate that the factors are also utilized in the planning process itself.
4. Managing HR Capacity Planning in a Corporate Multi-Program Environment

The subject of capacity planning in general is a wide field which proposes a diversity of approaches to handle the planning process. There are two main fields which are described: the planning with mathematical methods and the consideration of human factors. The mathematical methods, such as the approach of Kara et al. (2000) are mostly used in the scheduling of large-scale production environments whereas other methods are proposed for multi-project environments in an R&D organization. More and more authors criticize the engineering approaches that are used in capacity planning processes. They argue that human and situational factors are missing in those approaches which makes them unreliable. In general, capacity planning is guided by the core questions of who is doing what, when, where and for how long (Wytrzens, 2010). The outcome of the planning process gives an overview about how many human resources are planned to be occupied by a project in a defined time range. The need of further operating resources such as machinery and buildings can be planned as well (Kessler, 2012).

In this chapter, data gathered from literature (the Theory section) and empirically collected data (the IST state) are presented, summarized and analyzed. As final step, conclusions are drawn which should support the following development of requirements, the SOLL as shown in the following graph.

This chapter aims at answering research sub-question 3:

Which methods and processes can be used to plan the HR capacity need in multi-program environments of technological products?
4.1 Scientific Background and Best Practices

Human resources are planned in diverse working environments and for diverse reasons. In the following, main approaches from different areas of application are described including their advantages and disadvantages. The presented findings represent the Theory part of the TSI framework.

Firstly, the methodologies of human resources planning in project and project portfolio environments are described. Afterwards, the HR capacity planning methods of activity based costing and HR controlling are presented.

4.1.1 Project management

Managing a project can be a difficult and complex undertaking, depending on the expectations and goals of a project, but an efficient project management supports companies to achieve competitiveness and customer demand closeness and increase the speed of response at the same time as maintaining productivity and (Arauzo et al., 2010). The boundaries of each project are performance, costs and time (Wysocki et al., 1995) and are the main variables that a project manager has to deal with. A project manager needs to find a satisfying trade-off between those three variables in order to complete a project successfully. An increase of performance leads to a qualitatively higher product, but might result in an overrun of the project’s budget and time limit. In turn, keeping the due date of a project might lead to a cost overrun in the project or a poor performance. Keeping the costs within a low planned budget might also result in poor performance and exceeding the time schedule. In projects where human resources represent the majority of the costs in the project budget, such as advisory projects, the effect of this trade-off needs to be regarded carefully. Therefore, the overall needed human resource capacity is of great interest for a project manager and should be determined as precise as possible in the planning phase of a project.

**Project efforts over the project duration**

For more precise planning possibilities, the capacity need over the project duration is of interest to define how much capacity is needed at which state of the project or at which point of time to complete the project within the set time, costs and performance. The effort which is required for a project, and therewith the needed HR capacity, is not distributed equally over the project life cycle, but depends on the project phase.

In literature there are several models available describing the distribution of the capacity need over the project duration (Meredith & Mantel, 2003; Meredith & Mantel, 2010; Cronenbroek, 2004). However, how the actual HR capacity need over the project duration differs in an individual curve for every project. In general it can be said, that there is no universal rule on how the effort of a project is distributed over the duration of the project. This is individually for every project and is influenced by the project management and planning approach.
The influence, risks and uncertainty of stakeholders is highest in the beginning of a project and decreases with the project duration. At the same time, the costs for changes are low at the start of a project and increase with the project duration (PMI, 2008).

In order to avoid high costs of change, more focus and effort should be put on the beginning of a project, where uncertainty and risks are dominating, but also the possibility to steer the project into the right direction. Therefore, Bleier and Heathcote (Bleier & Meathcote, 2011) propose, as many other authors, the approach of front end loading, meaning that an increased effort and importance should be attached to the beginning of a project to already identify and avoid potential upcoming difficulties and additional costs.

The high influence of the amount of human resources on the project budget and general planning makes the determination of human resource capacity need an important topic in the planning phase of a project. The project planning phase is situated before the project itself is carried out and includes next to several other tasks the planning of human resources within the project (PMI, 2008). However, by this time, the project budget is often already approved as well as the commitment of deliverables for a deadline. This might make the planning of human resources within a project problematic if the needed resources do not coincide with the available project budget and might then lead to negotiations with involved stakeholders (Kerzner & Belack, 2010).

**Human resource planning methods in project management**

The human resource capacity planning process contains mainly the determination of the needed effort to finalize a task (Litke, 2007). Main planning software tool include features such as the calculation of the available resources, deficits and buffers. The output of the systems is the input for the management team to take action when needed. Additionally, tasks can be allocated to certain roles if they cannot be processed by every employee in the project pool (Informatik Forum Simon, 2012). A homogeneous pool of employees simplifies the allocation process and reduces costs as human resources can be allocated to projects more efficiently so that idle time can be minimize (Preisner, 2003).

In the approach of the load diagram which is displayed in Figure 12, work packages are defined and needed HR capacity is assigned to each package (Litke, 2007).

![Figure 12 – Load diagram (Meredith & Mantel, 2010)](image-url)
The packages can be placed in the diagram and flexibly be moved so that HR capacity is used as efficiently as possible. An unavoidable capacity deficit can be balanced by purchasing external HR capacity. However, these capacities usually implicate high costs by reason of the selection process, necessary qualification, orientation, billing, administration and further factors (Kessler, 2012). In the planning process, minor capacity drivers are not negligible as they quickly sum up to a considerable amount of capacity.

Additionally, the planning method with bar charts can be used to schedule and plan resources. The approach is of advantage when multiple projects run in parallel and allocated human resources cannot fulfill the same task. In this approach, every (resource) role can only be allocated once to a project within a time slot. A lack of human resources leads to the necessary trade-off between money and time (Preißner, 2003).

The inaccuracy of estimations requires the principle to be traceable to achieve a wide acceptance and to enable a reproduction. A further advantage of a traceable approach is the possibility of a systematic correction of estimations during the project progress (Drews & Hillebrand, 2010). The more often a correction occurs, the more exact the overall estimation is as risks and uncertainties can be excluded with the project progress.

4.1.2 Project portfolio management

The human resource capacity planning in projects is not only limited to the planning of one single project, but is also valuable for a larger organization with several projects. Multiple projects which run in parallel in an organization can bring several advantages such as a more effective and efficient use of scarce resources (Shou & Huang, 2010). In the car manufacturing industry, every company has to manage a portfolio of several vehicles which are under development at the same time and share their resources.

A group of projects or programs which are collected to enable an efficient work environment are called a portfolio (PMI, 2008). Whereas project control focuses more on operational entities such as effort, duration and staffing level, the control of portfolios deals with values which can for example be expressed in financial terms (Vogelzang, 2008). Managing a project portfolio includes tasks such as controlling portfolio variables and the selection of new projects to complete the portfolio. In literature, project portfolio management is often defined as “the managerial activities that relate to (1) the initial screening, selection and prioritization of project proposals, (2) the concurrent reprioritization of projects in the portfolio, and (3) the allocation and reallocation of resources to projects according to priority” (Blichfeldt & Eskerod, 2008). As named by de Marco (2011), successful portfolio management includes three main activities:

- Scheduling of projects according to their interrelations
- Estimation and Forecasting of resource requirements and usage
- Continuous monitoring and re-scheduling.

Often, a project portfolio is set up to handle the uncertainty and risks that are involved with projects (Meredith & Mantel, 2010). The choice of projects for a portfolio should meet the objectives of the parent organization. Combined with a continuous evaluation, it is the basis for successful allocation and reallocation of scarce resources in the portfolio (Meredith & Mantel, 2010, p.41), such as human resources.
Project Selection in Project Portfolio Management

The installation of a project portfolio management team has proved to be successful regarding the increase of efficiency and effectiveness of resource usage. In the case of the project portfolio management implementation at AOL, the yearly demand of man-hours could be reduced from 200,000 to 120,000 while the portfolio ROI could be increased in the same time period. This success was achieved by selecting the right and dropping the wrong projects (Dougherty, 2005).

A work of a portfolio manager includes several tasks such as the comparison, selection and prioritization of projects and programs (de Marco, 2011). The selection of projects which complement a project portfolio is widely supported by computer software, but in the end the decision for a selection is always done by people. Models are only able to support the decision, but are never sufficient enough to represent reality completely (Meredith & Mantel, 2010, p.43).

Project selection models are divided by Meredith and Mantel (2010, p.42) in numeric and nonnumeric types and should fulfill the following five most important criteria: Realism, capability, flexibility, ease of use, costs and easy computerization (Souder, 1973). Many of the models which were developed in the 1950s mainly use financial metrics to measure the accuracy of management decisions. This approach is still widely used by many authors in project portfolio literature (Vogelezang, 2008) and profitability is one of the major evaluation criteria (Meredith & Mantel, 2010). There are multiple methods available which can be used for the assessment of financial criteria. Widely used methods and values are Earned Value Analysis, payback period, Internal Rate of Return, Net Present Value or Return on Investment. This focus on financial goals might implicate some difficulties. The focus on only quantitative measures can result in not ideal achievements as important qualitative aspects might have been left out in the consideration (Chen, 2008). Therefore, Meredith & Mantel (2010, p.44) describe project evaluation factors of five main categories: Production factors, marketing factors, financial factors, personnel factors and administrative factors of which each consists of several contributing factors. As one attribute of personnel factors change in size of labor force is named as characteristic that influences the decision for projects in the portfolio.

These factors are all strongly related to human resource capacity planning, as it is a scarce resource in many project environments. Mostly, there are more projects available for selection than there are resources available (Archer & Ghasemzadeh, 1999; Cooper et al., 1999; Mors et al., 2010). Available over-capacity of human resources in portfolio environments is undesirable as well as this would signify a large cost factors and therefore a waste of other available resources such as budgets. This means, that enough projects should be included to the portfolio in order to use the available resources. Otherwise, the amount of available (human) resources needs to be adapted to the actual overall portfolio demand.

The correct allocation of (financial as well as human) resources is of high importance as an incorrect allocation of resources might lead to insufficient availability of resources in a project. Putting a project on hold can delay the project and put the project time boundary at risk (Levine, 2005).

The objective of human resource capacity planning in a multi-project environment of a portfolio is an ideal distribution of the available capacity. The planning enables an
organization to detect bottlenecks and establish according counteractions. Further, resources can be allocated to projects more optimal in the case of occurring peak loads by positioning projects strategically in the overall organizational time plan. A useful tool for this approximation and evaluation is the previously described load diagram (Winkelhofer, 1997). As projects are not a static entity and are not always running according to the pre-defined planning, monitoring portfolios is of importance (Cooper et al., 2000). Monitoring projects can give an overview of their current status and the performance of the whole portfolio. The results of the project monitoring can lead to a re-prioritizing and re-planning of resources in single projects or the portfolio. Tracking the (interim) results of projects also supports the optimization of future screening, selection, prioritization and reprioritization and the resource allocation (Mors et al., 2010).

### 4.1.3 ABC – activity based costing

Activity based costing is an element of cost and performance calculation in the field of business economics. The main field of application of the method is cost determination of working processes. It is used in diverse work environments such as production planning or service industries (Horwarth, 1998). The main pre-condition that needs to be fulfilled by a case to qualify for the application for the method are repetitive work procedures and the existence of defined processes. In several literatures it is also used as support tool in the project planning phase and as general instrument for planning and controlling processes (Schawel & Billing, 2009).

The method of activity based costing consists of three main tasks (see also Figure 13): (1) Analysis of all activities that are done, (2) Defining of partial processes which contain several of the previous defined activities and (3) Defining of main processes which contain several partial processes (Hoitsch & Lingnau, 2007).

![Figure 13 – Activity based costing (Horsch, 2010)](image)

The basis of activity based costing is the process analysis. With the definition and estimation of each activity, the overall process costs can be determined and main cost drivers can be identified (Bauer & Hayessen, 2006).
The application of activity based costing increased the transparency of cost distribution in processes. The direct assignment of costs to tasks enables an easy control of main cost drivers. However, the result accuracy of the ABC approach is dependent on the quality of basic data, which can be derived from estimations or measurements (Hoitsch & Lingnau, 2007).

This method can also be applied for the HR capacity need determination of process when the estimation and measurement of costs is substituted by the estimation of measurement of HR capacity.

### 4.1.4 HR controlling

Controlling human resources is an undertaking to support a company’s top management in steering and optimizing the company’s resources. Generally, human resource planning and controlling is future-oriented and predicts the required organizational scale (Li, 2011). It regards human resources from various perspectives including qualitative and quantitative human resource capacity needs. Qualitative human resource controlling mainly concerns soft factors such as qualification and motivation of employees. Quantitative human resource planning on the contrary regards the topics related to a company’s headcount comprising the current and future assessment of demand, the current headcount and deviation factors from the company’s planning. The intention of human resource controlling for the management team is to achieve the company objectives with value creation, effectiveness, cost efficiency and quality (Jansen, 2008).

Increasing cost restraints, faster innovation cycles and the globalization of markets force a company to enable a successful and effective human resource work through forward-looking actions (Lisge & Schübbe, 2009). Further, the planning of human resources is an effective method to link an organization’s strategic objectives to its human resource policies (Miles & Snow, 1984). The importance of human resource controlling increases with the steady rise of the relevance of the cost factor human resource. However, Lisge & Schübbe (2009) remark that it is difficult to say whether human resource controlling is financially profitable as confirmation of a cause-and-effect coherence complex are often impossible.

The task of human resource controlling is the determination of the current HR situation, building an early-warning system for potential deviations from the planning and reacting to social and market changes by analyzing available data and indicators. With this planning approach trials, coincidence and surprises are attempted to be reduced to a minimum.

There are several methods available to assess the future demand of human resources quantitatively that can be or not be based on previously collected data. Past oriented methods include estimations by managers and regular employees which are based on previous experiences. Further, predictions can be based on simple forward projection from previous data by using standard calculation methods such as arithmetic mean and the adaptation of previous used factors. A more complex determination of future demands can be supported by statistical trend extrapolation methods. The planning of quantitative human resource capacity need without previous available HR data can be achieved by using other central internal factors such as turn over, and creation of value as well as their predicted further development (Jansen, 2008).
The assessment of future HR capacity demands cannot be determined exactly as there will always be uncertainties and risks that cannot be controlled entirely. Developing several scenarios can take the uncertainties and risks into account and lead to best and worst case scenarios as well as to a most probable scenario. For a more precise planning, available as-is-data can be used as basis for a more precise determination. As-is-data can be recorded time or task descriptions as a result of interviews (Jansen, 2008). Especially for a feedback on previous estimations replicable as-is-data are indispensable. When using previously collected data, attention should be paid to the data quality and validity to ensure a proper basis. A lack of quality and validity might not only lead to inaccurate results, but also decreases their acceptance. For methods that are including any type of recorded times complex systems are usually needed. There are several standard tools available on the market for this application. However, standardized planning tools cannot be used for every case as this activity has an individual environment and individual specifications at every company (Lisge & Schübbe, 2009).

Capacity planning is an activity that needs to be done regularly to achieve highly credible results. Activities that need to be done on a regular basis contain the comparison of planned and actual HR capacity need. The analysis of past estimations is the basis for adjustments for future planning (Lisge & Schübbe, 2009). Capacity planning systems need to fulfill certain characteristics positively such as reliability, robustness and nervousness (Wortman et al., 1996).

The impact of human resource controlling depends a lot on the data which are delivered to the top management for action decisions. As the interpretation of controlling purpose and data might differ between analyzing employees and the management team, the deliveries need to be explained to the recipient in order to avoid false decisions (Lisge & Schübbe, 2009).
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Managing HR Capacity Planning in a Corporate Multi-Program Environment

4.2 Empirics

In the following, the results of interviews and workshops about managing HR capacity planning at Organization O are presented. The data gathered from structured interviews are based on the answers to questions 1 and 2 as well as 11 to 15 as described in appendix A. The findings contribute to the research as IST part of the research framework.

*Paragraph was deleted due to confidentiality restrictions.*
4.3 Summary

The data collection from scientific literature and through interviews as well as observations provided several planning approaches which can be applied for the determination of HR capacity need.

For the methodologies found in scientific literature, the purpose, field of application and the planning approach itself are summarized below.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Purpose</th>
<th>Field of application</th>
<th>Planning approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HR Controlling</strong></td>
<td>Controlling of HR in term of quality and quantity in order to develop a stable basis for an organization's future;</td>
<td>Environments where human resources play an important role in a company's development;</td>
<td>Permanent analysis of the current status of defined variables; Comparison of the determined values with the planned values and then entity's strategy; Definition of measures to achieve the set objectives;</td>
</tr>
<tr>
<td><strong>Activity Based Costing</strong></td>
<td>Standardization and easy calculation of process costs;</td>
<td>Environments with standardized and repetitive processes;</td>
<td>Detailed analysis of all process steps/activities; Determining the costs per process step; Determination of overall project costs by building part and main processes of the single process steps;</td>
</tr>
<tr>
<td><strong>Project Portfolio Management</strong></td>
<td>Determination of the capacity need in a multi-project/project portfolio environment; Levelling the resources between the projects to achieve max. efficiency in HR capacity usage;</td>
<td>Environments with many projects where a central entity maintains the portfolio of projects;</td>
<td>Shifting projects and projects schedules timewise within the possible time schedules until all resources are ideally used and only a minimum of resources idle;</td>
</tr>
<tr>
<td><strong>Project Management</strong></td>
<td>Determination of the capacity need along the schedule of a project to allocate the right headcount to a project;</td>
<td>Environments where project management is used;</td>
<td>Estimation of effort for every work package of the project; Assignment of the work packages to the work schedule and summation of the estimated efforts;</td>
</tr>
</tbody>
</table>

Based on the interview structure and the findings in empiric data collection, the found data are summarized in the following in the categories reasons for planning the HR capacity need, responsible entity for HR capacity planning, planning approach and managerial involvement in the planning process. Each of the investigated departments chose a different approach based on different reason which can be found in the table below as well.
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Managing HR Capacity Planning in a Corporate Multi-Program Environment

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Reasons for planning the HR capacity need</th>
<th>Responsible entity for HR capacity planning</th>
<th>Planning approach</th>
<th>Managerial involvement in the planning process</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Department A</strong></td>
<td>Determination of needed headcount for next year to determine the amount of needed external labour; Having a clear basis for argumentations for mgmt. conviction;</td>
<td>Expert of the controlling department carries out planning process; Employees are involved gathering in data;</td>
<td>Gathering of data from previous series dev. through recording of effort; Usage of these data as basis for effort estimations of next series; Yearly adaptation through interviews with lower mgmt. and employees;</td>
<td>Lower mgmt. involved in estimations of extra work packages; Top mgmt. not involved in planning process, just in result communication and decision of measures;</td>
</tr>
<tr>
<td><strong>Department B</strong></td>
<td>Detecting short- and long-term bottlenecks in the available HR; Possibility to take counteractions such as task prioritization and an increase of headcounts;</td>
<td>Expert of the department that needs to be planned carries out planning process; Employees are involved gathering in data;</td>
<td>Gathering of data from previous series dev. through recording of effort; Usage of data as basis for estimations of next series; Yearly estimation of effort based on nr. of work packages/calculations for estimated time frame;</td>
<td>Mgmt. not involved in planning process; Only involved in result analysis and communication and decision of measures;</td>
</tr>
<tr>
<td><strong>Department C</strong></td>
<td>Prioritization of tasks within the department (re-scheduling and re-assigning of work packages); Enable re-scheduling of not work-related activities to avoid bottlenecks;</td>
<td>Department leader is responsible for planning process; Employees are involved in data gathering and have a saying in the planning process;</td>
<td>Gathering of estimated effort per commodity (standardization); Categorization of commodities; Summation of HR capacity need of all commodities; Revising once a year;</td>
<td>Department leader is process responsible; Higher mgmt. is not involved at all;</td>
</tr>
<tr>
<td><strong>Department D</strong></td>
<td>Give insight in future work load and take according measures (project prioritization, involvement of external labour, resource levelling, ...);</td>
<td>Team leader of the department that needs to be planned carries out planning process; All team leaders and employees are involved gathering in data;</td>
<td>Estimation the work load of every employee separately every six weeks to six months; Estimation includes team leaders and according employees; Usage of analogy method; Summation of all determined efforts;</td>
<td>Only team leaders are involved in estimations; Department leader involved in result communication and decision of measures; Top mgmt. not involved at all;</td>
</tr>
</tbody>
</table>
4.4 Analysis

All four departments are using complex software tools which are almost all developed solely for the studied departments. This is caused by the special environment of every department which requires diverse specifications and lead to different planning approaches. As described by Lisge und Schübbe (2009), an HR capacity planning tool always needs to be adapted to the applying entity to enable an accurate planning process.

The planning approaches which were chosen by the departments are all (except for the PMP independent IT department) based on the PMP schedule for each series which is the basic framework for most of the activities done in the company. With this framework, the timing of each series is pre-defined and cannot be delayed before or during the capacity planning process.

Comparison amongst the scientific and best practice approaches

The previously described approaches which were found in different types of literature vary in their purpose, their field of application and their planning approach.

The purpose of the project management and ABC approaches target very detailed planning processes which are based on work steps or work packages. The methods which are used for the determination vary with the two approaches. The mostly estimation based approach of project management can be assumed to be less accurate than the approach of ABC where in very accurate cases even the time for each process step is measured. The usage of these two methodologies is only possible with a detailed knowledge or estimation of tasks and work packages that are included in the overall work effort. As ABC is mainly only applicable for environments with standardized and repetitive processes it is hardly possible to solely use this approach in R&D environments as the work in this environment is structured, but tasks cannot always be foreseen and planned on such a detailed basis.

For those environments, the planning approach of project management is more suitable as the planning is oriented on general project steps and larger work packages, but the effort can be determined on a higher abstraction level. This enables rough and easy estimation with the usage of the analogy method by comparing the new work packages to previously processed ones with similar tasks.

Project portfolio management is an interesting planning approach if a company has many projects running at the same time. The HR capacity planning of a project portfolio needs to be done by another entity than the leaders of single projects. The conflict of limited overall resource availability and the need for as many resources as possible for a single project clash with each other, so that a conflict of interests can be expected. To avoid a resource shortage in projects of an increased need in headcounts, the planning of each individual project needs to be conducted in close reconcilement with the overall portfolio planning. It is possible for a project to plan its capacity need and allocation solely without the availability and support of a portfolio management team. However, the portfolio management team relies on the planning input of projects to enable a resource leveling and redistribution of available resources.

The approach of HR controlling is mostly related to the project portfolio management methodology as it considers the overall workforce and not single projects or tasks. The approach can be seen to be more long-term oriented than the approaches of ABC and
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Project management as it also includes the further qualitative development of the workforce. This might be a more sustainable planning approach considering a whole company and its future development. However, it is also a more costly approach as many more people are involved in the planning process and also later on in the implementation process as employees need to be educated and selected to achieve the previously defined targets.

**Comparison of empirically investigated approaches with scientific and best practice approaches**

Although each department chose a different and for its need adapted planning approach, they can all partly be found in literature.

Department A chose an approach which can be found in literature of HR controlling. The determination of the department scale and the recording of times are typical approaches from HR controlling (Jansen, 2008; Li, 2011). Further, the summation approach and resource leveling can be found in literature on project and project portfolio management (Cooper et al., 2000; Meredith & Mantel, 2010).

Department B chose a more project and program managerial approach. The definition of cost calculations as single work packages and the average effort estimation combined with the scheduling over time are an example of the load diagram usually used in project and project portfolio management for the overall effort estimation (Winkelhofer, 1997; Meredith & Mantel, 2010).

Department C chose the approach of activity based costing with breaking down the overall process to sub-processes and a further break down to tasks. The estimation and summation of the efforts for these tasks are similar to the ABC approach of Hoitsch & Lingnau (2007). The estimation of single work packages, here in terms of commodities, and their distribution and leveling in the overall time schedule, shows similarities with the earlier described approaches of project management and project portfolio management.

Department D chose again an approach which can be found in the literature on project management with the detailed effort definition of each work package (Meredith & Mantel, 2009). The approach is more detailed and on this detailed level probably also more accurate than the approach of department B where the effort for one work package is averaged over all processed work packages.

**Comparison amongst the empirically investigated planning approaches**

The results that were found in the interviews don’t have any relevant statistical impact as the data basis it too small for such conclusions. However, in the following, the data are compared and presented in a way that case specific propositions can be drawn.

The analysis of the interviews shows that several variables depend on one variable: the size of the department for which the HR capacity needs to be planned. A clear difference between the departments A + B and departments C+D can be seen. These departments also have a comparable size. The number of employees in each department is displayed again in Table 2 below.
Department A and B are considered as large whereas the size of department C and D are considered to be small.

When regarding the flexibility that the planning processes and systems provide for the departments, Figure 14 displays the tendency that the small departments are able to achieve a higher flexibility within their workforce by using their capacity planning system.

There are several reasons that can explain this result. Firstly, the timewise task distribution of departments C and D is less strict than the one of departments A and B. Department D doesn't even have a fixed long-term schedule, but processes short-term assignments so that the department needs to be flexible in the available capacity. Departments A and B might not have any short-term flexibility in overall headcounts, but it might be possible that work packages or employees are shifted in the department as countermeasure to occurring bottlenecks which the interviewees were not aware of. Due to the involvement of the top management and the needed compliance with internal processes, departments A and B have only very limited if not no possibility to change the headcount as the planning process is only performed once a year. Department C is able to increase its available capacity on the short-run by a holiday ban. Further the department leader is able to instantly adapt the available HR capacity to the needed capacity with flexible working hours. Department D is very flexible on the short run, as the department leader has the possibility to hire (and also fire) external contracted labor as support for his employees.
When looking at the degree of closeness to and employee involvement in the planning process, there is again a clear differentiation between the small and large departments (see Figure 15). In all departments the employees are involved in the whole capacity planning, such as through weekly recording of hours. For this analysis only the involvement in the actual (often yearly) planning process where results and potential measures are determined. The analysis shows that the employees of the large departments are not at all (except for the planning responsible person in department B) involved in the planning process. In contrast, all employees of the departments C and D are involved in and therewith close to the planning process.

An explanation for these findings is the effort that it takes to involve the employees in the planning process. It is almost impossible for the planning responsible person the consult every employee of a large department. The results of such an undertaking might also be debatable as all employees have various experiences and estimate efforts therewith differently. In the large departments the overall strategic program schedule might not be known to all employees so that they are not always able to include information about future work packages, trends and developments. Additionally, it is questionable whether the effort for the involvement of all employees in a large department is worthwhile considering the accuracy that can be achieved through estimations. This approach, especially as departments A and B use the weekly recording of hours per work package as control mechanism and as means to increase the accuracy, is very similar to the methodologies which are described in the literate on HR controlling. The small departments include their employees as the capacity is planned for every employee individually. Further, the interviews showed that the planning responsible persons of departments C and D look for the commitment of the effected employees in case that the department needs to make use of its available short-term flexibility by increasing or reducing the weekly working hours.

Looking at the managerial involvement in the planning process, the difference between the small and large departments can be made again. The analysis shows that the small departments have a high managerial involvement in the planning process, whereas the managerial involvement in the large departments is nonexistent.
The management team in the smaller departments is directly involved in the planning process by either being the planning responsible person or by supporting that person in collecting and processing data. In the larger departments, the management team is only involved in deciding measures to handle the results and in implementing the earlier decided procedures. This can be explained by the hierarchy of the department manager. Whereas the highest responsible managers of departments C and D are situated in the lower management, the highest responsible managers of departments A and B are situated in the middle to higher management. For the managers of department A and B it might be difficult to find enough free capacity to involve themselves in the actual planning phase of the process.

Considering the underlying reasons for planning practices, the differentiation in small and large departments in this analysis is not only a matter of department size but needs to be expanded to factors such as managerial interests and possibilities, flexibility and the flexibility need as well as the effort that can and should be invested in the planning process.

**Time Recording – Worth the effort?**

Two of the four investigated planning approaches use recording of time as the basis for their planning activities. Time recording is a typical tool used in the field of HR controlling (Jansen, 2008) and software tools such as Augeo which is used by department B are available on the market. The application of this software tool can bring a lot of advantages with it, including transparency and a proper planning basis which can be used as support in the discussion about the planning results in this highly emotional topic.

However, the software tool also brings several difficulties with it. Firstly, not all employees feel comfortable with recording what they used their time for as they might feel observed by the management. This goes in line with privacy issues which require the approval of the work council. Secondly, the summation of benefits and efforts in capacity availability cannot be clearly determined as the effect of such a tool is contested in literature (Lisge & Schübbe, 2009) and also empiric research. The effort which is needed for the weekly recording with the applied tools was estimated by the interviewees between 5 to 15 minutes, depending on the diversity of tasks and the complexity of the tool. Further, the
management team within the client’s department is skeptical whether the benefits for such a tool really countervail the effort. Considering the whole planning intention, one manager even cited the phrase “Planning is the possibility to already be wrong beforehand”.

The introduction of a software tool for recording time needs to be handled with care in the communication phase. Of importance is the support of the top management which increases the acceptance within the middle management and amongst the employees. Further, employees need to be informed about the future usage of the collected data and their benefit of HR capacity planning in total. Additionally, employees need to be trained in the usage of the tool to avoid an unnecessary waste of time. The training also aims at increasing the validity of the recorded data and therewith the accuracy of future planning results.
5. Requirements Development

The data collection and analysis in chapter 2 to 4 represent the Theory and IST sections of the TSI framework. In this chapter, conclusions to the findings will be drawn and requirements will be developed, meaning that the Theory and IST sections will be used as basis to develop the SOLL situation in human resource planning in large multi-program environments.

The conclusions and requirements developed in this chapter aim at answering research sub-question 4:

Which requirements should an HR capacity planning system in an environment based on a PMP fulfill in order to enable a flexible and efficient planning process?

The process design and the following chapters draw conclusions from the previously collected and analyzed data. The target is to combine the Theory and IST sections to the SOLL (according to the TSI framework) in form of conclusions and requirements for an HR capacity planning process in a large multi-program environment where work flows are based on a process master plan. Firstly, an overview of the whole process will be given followed by a more detailed description of each step.
5.1 Process Design

From the found and analyzed data it can be concluded that for successful planning of HR capacity, not only the planning phase itself is of importance, but the planning process consists of several stages from the system design to the result communication and application as shown in Figure 17.

Figure 17 – Complete Process of HR Capacity Planning (source: author)

In each phase of the process several challenges might appear that can be handled with according countermeasures which the process responsible person needs to be aware of. The occurring difficulties can mainly be divided into process and project managerial challenges. System design and system implementation are not necessarily two sequential steps, but might occur in parallel to achieve a neat process where the system design is supported by all involved actors.

For the design of a planning process in PMP driven environments, the descriptions and analysis in this chapter provide information about success factors which should be considered in the design of the whole process. The success factors contain system implications as well as managerial implications. System implications include success factors that need to be considered while developing the system design, while managerial implications include the success factors when communicating with the management or employees indicating the success of the process design. The managerial success factors are most important in the phase of system implementation. This means, that the success of the HR planning undertaking not only depends on the planning activities itself, but also depends highly on the effort and activities undertaken in the phases before the actual planning process starts.

The analysis, as described in chapter 4, shows that the size of a department and its organizational structure has an influence on the planning process. The larger a department, the more stakeholders with different interests are involved that need to be handled. Further, the more employees a department contains, the higher the influence that the planning process might have on the department’s headcount which implies a higher probability of power struggles among managers within the department. The conclusions and requirements described in the following consider the environment of a large department (such as department A and B in the case) which works on several programs that follow a PMP in a matrix organization.

In the following, conclusions and requirements are described individually for the four steps. Conclusions directly related to requirements are highlighted in italics, while requirements are highlighted in bold print letters.
5.2 System Design

The investigated planning approaches that are described in literature and by empiric data are widely used and approved in many cases. Each of the methodologies has a very special field of application which makes it difficult to apply them in slightly different cases. It is hardly possible to apply any of the approaches directly to the planning of the HR capacity in the automotive industry or PMP driven environments in general. However, several of the methodologies include valuable steps and ideas that are interesting for a newly designed approach. The system design, as first step of the process, is a step that adapts a planning approach individually for every entity for which the HR capacity need will be planned as every case requires special adaptations.

There is no optimal planning approach which can be used for every situation. An HR capacity planning tool needs to be developed or adapted to each environment individually. This means that a planning process needs to show the flexibility for such an adaptation to each environment that fulfills the previously set conditions.

The planning method which will be developed and described in chapter 6 can fit to the automotive industry or other industries using a PMP as basis for their planning in general, but will still need some individual adaptations.

In the case that the planning process later on includes employees of the department, they already need to be taken into account in the planning process in this stage.

The user interface to involved systems should be developed together with the end user.

This increases the quality of gathered data later on as the system is adapted according to user behavior and understanding.

5.3 System Implementation

As described earlier, the system implementation is not necessarily a step sequentially following the system design, but can also be carried out in parallel. The implementation phase of the planning system and process is challenging from a project as well as from a process managerial point of view. The system implementation needs to be planned carefully in order to achieve the expected success within the constraints of cost, quality and time. From a process managerial perspective, there needs to be focus on the involvement of all significant stakeholders in the process in order to achieve enough commitment for the upcoming planning phases and planning results. The commitment of all stakeholders can be achieved by giving them an understanding of their potential benefit when participating and training them in necessary topics such as purpose and effect of the planning process. As the empiric data show, this is necessary as many managers are very critical with the planning process and purpose itself. Little commitment might lead to strategic behavior and political discussions of the planning results. By including the management team and its perceptions, ideas and views into the design and implementation phase of the project this should be avoided by committing them to the planning approach and process as soon as possible.
Chapter 5
Requirements Development

Top managerial support is a necessary part to the success of the HR capacity planning in general, as middle management and employees tend to be very critical with the topic.

A commitment from the top management team might increase the willingness of lower hierarchy levels and regular employees to support and participate in the planning process. However, a forced implementation of the planning system might lead to difficulties as described in chapter 2.1.

The planning of HR capacity is not only a planning and managerial undertaking, but might also depend on the employees' commitment to the planning process. Therefore, the implementation of a planning system needs to be arranged carefully and the involved employees need to be trained in the usage of the process and related tools. Further, the employees need to be informed about the intentions of the process. This increases the potential commitment of each individual to the process in case that they should contribute in any way to it. Too little information and solely instructions might be counterproductive due to the potential decline in the employees' motivation.

5.4 HR capacity planning

In the planning phase of the process, the quality of collected data has a large influence on the planning results. Depending on the collection method, the collection might be of higher or lower quality.

As the data quality is strongly influenced by the subjectivity of the humans that are involved in the data collection process, the data collecting person needs to be aware of this and try to avoid subjective estimations as much as possible.

If this is not possible, the planner needs to at least be aware of the situation in order to countervail the subjectivity in the planning phase.

Many of the factors described in chapter 3 have an influence on the human resource capacity need. The utilization of all of these factors in the planning process is of advantage as it increases the accuracy of the planning results. However, it is difficult to incorporate all involved factors as the data collection and processing is complex and time-consuming for several of these. Further, the operationalization and determination of the actual influence of several factors might be difficult. A low accuracy in collected data also leads to a decreased difficulty in the final planning result. Therefore, the system/process designer needs to include as many factors as possible in the planning process, but needs to find a balance between the effort that needs to be put in an accurate data collection process and the actual effect that can be achieved with the gained level of accuracy. The prioritization and choice of factors needs to be done individually in each case and requires knowledge and experience with the involved influential factors. Factors continuously need to be exchanged and adapted due to continuous changes in the environment.

The continuous changes imply that the previously required system flexibility needs to include the flexibility regarding the application of influential factors.
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Requirements Development

The planning responsible person needs to have the necessary sensibility and experience to be able to assess the necessity of influential factors correctly.

As many of the factors are analyzed in automotive and other large organizations centrally by strategy departments and applied to companywide strategies that influence the capacity need (such as the quantity of new derivatives, the degree of innovation, ...), not every single capacity planner needs to constantly analyze the changes in the environment. However, department specific characteristics will always have to be analyzed individually.

Each large German automotive car manufacturer is using a process master plan (PMP) such as the PMP at Organization O. The schedule provides a planning base which is common for all programs (lead vehicle or derivate). The capacity planning need should be based on the basic work packages of a planning entity such as the process master plan (PMP) for each program. This provides a reliable and repetitive framework of basic effort that is needed in the planned department. The utilization of the PMP and the projects also already provides information about the number of projects and their operation over time.

A division of tasks into sub-tasks leads to a more detailed planning process and provides the possibility for an easier control of the organization through prioritization of tasks. With the effort determination of sub-tasks it is easier for the management team to decide on countermeasures in case of an undesirable situation. The division into small work packages or process tasks enables them to see what the needed or actually used capacity is utilized for.

This basic capacity need for each program then needs to be adapted individually to the factors that the capacity planner (as well as the management team and potential interviewees) considers to be important enough to utilize the data in the planning process. This adaptation should be done individually for every planning. Further, the additional factors need to be reconsidered regularly to adapt the planning results to potential changes.

Human factors have a large influence on the efficiency and work behavior of each individual employee and therefore strongly influence the capacity need. This factor is difficult to take into account as it is time-consuming to examine the efficiency and work behavior of every single employee. Again, the capacity planner needs to trade-off between the effort that is needed for the data collection and the effect that the achieved accuracy proposes. This means that more general presumptions need to be made in order to handle the process. A possibility for this is the categorization of teams or projects. However, such a handling needs to be managed with care as it could cause political discussions and evaluations which are not supported by team managers. Further, such analysis needs to be done regularly as rotations within the company lead to permanently changing project teams. The planner should also be aware of the fact that such a categorization can never achieve the accuracy that might be desirable, but provide only trend-setting information about the actual influence on the capacity need.
Additionally, project related factors should be considered in the planning process. The correlation of these factors with the influence of human behavior on the planning results makes it difficult to gather exact estimations about the actual influence. The previously described approach of categorization can also be applied here. Synergies between projects and programs, such as between lead vehicles and derivates, can be taken into account by expert estimations on the potentially achieved capacity savings.

Considering influential factors overall, it can be said that the capacity planner needs to make choices in factors that ease the planning process. Choices always decrease the accuracy of the planning results. The accuracy in gathered data might also depreciate due to uncertainty which always occurs due to humans in the work environment. The right weighing of the found factors and their accuracy lies in the responsibility of the capacity planner. All involved actors need to be aware of the fact that HR capacity planning can never be completely accurate to avoid the rise of false expectations. This accuracy can be handled through flexibility in the labor force e.g. by holiday assignment, flexible working time or subcontracted employees.

The influential factors change continuously due to several reasons such as external shifts as well as organizational restructurings. A planning system is ideally designed in a way that enables the planner to adapt the results to these changes in the planning process.

Planning is a continuous and repetitive process that should be performed at least once a year. The more often the planning process is carried out, the more accurate the short-term planning results will be. Therefore, the planning process needs to provide the possibility for repetitive alignments of planning results and the flexibility for adaptation of changing factors.

At each revision of the planning result, the previous planning needs to be confronted with the actual development and adapted according to the assessed deviations. In case of deviation between the forecasted HR capacity need and the available capacity, the management has to decide on according countermeasures.

In order to be able to consider and adapt planning results to the actual development of influential factors up to date as-is-data need to be gathered. These data can also provide the basis for new HR capacity need determinations.

A feedback loop which provides information about the up to date as-is-data improves the accuracy of the planning results.

A time recording system which is used by every involved employee, such as in department A and B of the case, is an appropriate and the most exact option. However, the correct usage of the system needs to be assured in order to base the planning on correct data and assure the accuracy of the planning results. Incorrect data in this early stage of the planning process can hardly be countervailed in the following process steps. This also means that the planning process cannot be automated, but needs to be support by a human planner in order to take all involved factors and data into account. This is a complex job with a lot of responsibility considering the effect that an incorrect planning result could have a major influence on a company and its labor force. The planning
responsible person needs to select all influential factors carefully and base the determination of their influence on credible data.

5.5 Result Communication and Application

The result communication is again a critical phase in the whole planning process as many stakeholders, mainly with political interests, are involved. The acceptance and interpretation of the data strongly depends on the stakeholder’s earlier commitment to the undertaking. As a highly political discussion of interests might lead to countermeasures that are undesirable from an HR managerial point of view, according measures need to be designed to avoid this.

During the result communication discussions about the results of the planning should be avoided when possible. The process and system should be designed in a way to provide only little possibilities for discussions.

A good and logical planning approach which is developed in consultation with the involved stakeholders, such as middle managers, is able to avoid these discussions. The involved stakeholders should already be tried to commit to the planning approach in advance as described previously in chapter 5.3.
6. System Design of an HR Capacity Planning System

This chapter aims at designing an approach to plan human resource capacity in the German automotive industry.

In the following, a design will be proposed that can be used for planning the HR capacity in large Germany car manufacturing companies. The system takes the previously found challenges, factors and possible planning approaches into account.

Two individual planning approaches will be described which can be applied, combined and separated from each other. Both approaches have advantages and limitations that will be described later on in detail. However, considering the previously analyzed challenges related to accuracy and management, the approach that will be described as long-term approach is the preferred approach. It brings the limitation with it that it will take several years until the first capacity planning can be done due to a long data collection phase. Therefore, a second approach was designed which can fill this time gap as it leads to direct results.

<table>
<thead>
<tr>
<th>Approach 1</th>
<th>Approach 2</th>
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<tr>
<td>Short-term planning</td>
<td>Long-term planning</td>
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</table>

Decision for HR capacity planning: 2-4 years
6.1 Approach 1 – Short-Term Planning

The first proposed approach can be applied instantly after the decision for planning the HR capacity in an entity is taken. The approach can be applied to environments where time limitations demand for rapid planning results. In the following, the methodology is described as well as a process in which it can be embedded, followed by the benefits and utilization options that the approach provides and closes with the limitations that the involved stakeholders need to be aware of when deciding for this approach.

6.1.1 Planning methodology

The first approach is based on the process master plan which provides the basic framework for the process. In this approach the capacity need for every lead vehicle and derivate will be determined separately based on the PMP.

For each phase of the product development, basic work packages are defined in the PMP which are similar for all programs. As these work packages and processes are standardized, this is a fixed capacity which will be needed for every program. Further, several variable efforts, such as the varying effort for all components in a vehicle, will be estimated and added to the fixed effort. These two blocks of capacity build the basic capacity need which will be needed for every developed vehicle. For projects with extra efforts, such as localization or cooperation projects an additional block can be added to the heretofore defined capacity need. This basic framework of capacity need planning per vehicle is displayed in Figure 18.

![Figure 18 – Basic capacity planning per vehicle of planning approach 1](image)

The effort for every work package is estimated by the management team and potentially employees of the department for which the capacity is planned. To enable the correctness of collected data, the capacity planner needs to be trained beforehand on how to recognize incorrect estimations and the way to handle these in the following step. After finalizing the capacity need for every lead vehicle and derivate, the capacities for the vehicles are added up on a time scale according to their dates of market launch (see Figure 19).
The summation of all capacities in the projects and programs include only project relevant working time. Additionally, 10% of the calculated capacity is added up to the result to consider time that is spent otherwise such as in further internal meetings or as personal allowance.

External factors and trends in the automotive industry that influence the HR capacity need can be included as extra work packages in form of estimations according to project managerial capacity planning.

Human and project managerial influential factors are included by categorizing the influence on the effort. For human factors, the utilization of 5 categories is proposed while for project managerial factors only 3 categories are proposed as described in Figure 20.

The influence of human factors is defined to be assigned to 5 categories as it is assumed that the planner and other involved actors are able to decide between this many categories. Insight in project and program teams can be gained through interview and previous experience of the capacity planner. This is assumed not to be as easy for the categorization of project managerial factors. Therefore, only three categories are proposed to be used. For supporting purposes the planner will receive a definition for each category.
According to the categorization, the overall effort for each project and program will then be stretched or shrunken with rates assigned to each category.

### 6.1.2 Process design

The process from the system design until the result communication is defined based on the framework as described in chapter 5.1. In the following, step 2 to 4 of the framework will be described in detail, including the involved stakeholders with their position and responsibility. Step 1, the system design, will not be described further as this is covered by the previous descriptions in chapter 6.1.1.

The involved stakeholders and resource requirement are described for every process step individually in the following.

**System/Process adaptation in order to commit all involved stakeholders to the process.**

- Leading the implementation process; Gathering of management opinions; Adaptation of system design including as many opinions as possible;
- Get informed about the process and commit to it;
- Get informed/trained about the process and commit to it;
- Give opinions on system design;
- Expert on tool implement; Capacity planning tool;

**Regular (at least yearly) planning and adaptation of HR capacity need through interviews with the middle and lower management.**

**Communication of the determined planning results and application of according measures.**

**Regular revision**

**Result Communication**

- Communication and explanation of planning results
- Receiving planning results; Deciding on measures to be taken;
- Implementation of decided measures;
- Receiving information on measures;

The process aims at including all necessary stakeholders into the process as early as possible in order to achieve an early commitment to the process which aims at easing the communication and application step later on.
The planning results should be revised at least once a year to assure the up-to-dateness of the data. The revising includes the adaptation of the main efforts to potential changes in processes and the environment as well as adapting the efforts to incorrect estimations which can be corrected by then due to gained experience.

6.1.3 Methodological benefits

The benefits of this method are

- First capacity planning can be derived within a relatively short time frame;
- Only a limited amount of employees is involved implying a low investment of HR capacity;
- Changes are easy to implement through adding or deleting work packages;
- The absence of an implementation phase of a department-wide tool avoids the challenges that were described in chapter 2 to potentially occur in this time frame;

6.1.4 Methodological limitations

The methodology has several limitations which make it difficult in some environments to be used. These are described in the following:

- The result accuracy depends on the accuracy of the estimations of each work package;
- Data are gathered through estimations in form of interviews. This lacks confirmability and the planning result enable discussions in case of undesirable results and little managerial commitment;
- In case of process changes, every changed work package has to be revised;
- Next to the capacity planner, the interviewed team needs to spend a lot of time on the planning process;
6.2 Approach 2 – Long-Term Planning

Approach 2 is proposed as favorable methodology for environments where no time restraint is set for the utilization of first planning results. In the following, the methodology is described, followed by the utilization options and benefits that the approach provides and closed with the limitations that the users need to be aware of when deciding for this approach.

6.2.1 Planning methodology

The methodology is based on the fact that every vehicle is developed according to a process master plan. The PMP may change over time, but its basic framework will still remain the same.

In order to process this approach, all employees of the department to be planned need to record what they are spending their time for weekly. They need to record which program (e.g. a series and which vehicle of that series in the environment of automotive manufacturers) they were working for. Further, they need to cluster their effort into basic categories such as meetings, strategy development, change management etc. This recording enables the department to track how much time is currently spent on each vehicle and which tasks the employees were working on. With these data, the effort for each program and task can be recorded along the process master plan. These data are then used as basic input for the future planning process. As the accuracy of the resulting capacity need depends to a large extent on the accuracy and quality of the data delivered by employees, the employees need to be trained how to correctly record data. Additionally, the further usage of the data needs to be explained to employees in order to avoid intentional delivery of incorrect data and to increase the motivation to take part in the planning process.

In the planning process for a new vehicle, the data of the vehicle’s predecessor are analyzed and taken as basis data for the future planning. These data are then adapted to changes of influential factors that were found in an examination. The change in capacity can be determined in several ways. The effort for new technologies and trends that were not yet considered similarly in other programs can be determined through interviews with lower managers and employees that are able to give accurate estimations about the effort for new tasks and work packages. These are then added (or subtracted) from the overall capacity need similar to the extra efforts in Figure 18. Other factors such as human and project related factors are applied similar to the methodology in approach one. In this approach the changes in project and program teams are evaluated, meaning that the new team is compared to the previous team. Based on this, the each project and program can be categorized to need more or less capacity than the previous one. Figure 21 describes the categories chosen for the evaluation.
Chapter 6
System Design of an HR Capacity Planning System

<table>
<thead>
<tr>
<th>Categories for human influences</th>
<th>Lot of more negative influence</th>
<th>Little more negative influence</th>
<th>Neutral</th>
<th>Little more positive influence</th>
<th>Lot of more positive influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Categories for project mngt. influences</td>
<td>Lot of more negative influence</td>
<td>Neutral</td>
<td>Lot of more positive influence</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 21 – Categories for categorization of human and project mngt. factors in approach 2

For supporting purposes the planner will again receive a definition for each category. According to the categorization, the overall effort for each project and program will then be stretched or shrunken with rates assigned to each category.

Similar to approach one, the effort for the individual lead vehicles and derivates is then summated to the overall capacity need.

As the planning results are able to cover several years of future capacity need the planning results should be revised at least once a year to assure the up-to-dateness of the data and correct potential detected deviations and environmental changes. The revising includes the adaptation of the main efforts to potential changes in processes and the environment as well as adapting the efforts to incorrect estimations which can be corrected by then due to gained experience. The further the determined data are situated in the future, the more uncertainty it contains. The regular revisions should decrease the uncertainty of the determined future capacity need by comparing the previously determined forecasts with the actual capacity need that was recorded by employees since the last revision.

6.2.2 Process design

The process from the system design until the result communication is defined based on the framework as described in chapter 5.1. In the following, step 2 to 4 of the framework will be described in detail, including the involved stakeholders with their position and responsibility. Step 1, the system design, will not be described further as this is covered by the previous descriptions in chapter 6.2.1.

The involved stakeholders and resource requirement are described for every process step individually in the following.

The process aims at including all necessary stakeholders into the process as early as possible in order to achieve an early commitment to the process which aims at ease the communication and application step later on.
Chapter 6  
System Design of an HR Capacity Planning System

System/process adaptation in order to commit all involved stakeholders to the process. 

Regular (at least yearly) planning and adaptation of HR capacity need through previously recorded times as well as interviews with the middle and lower management. 

Communication of the determined planning results and application of according measures. 

<table>
<thead>
<tr>
<th>System Implementation</th>
<th>HR Capacity Planning</th>
<th>Result Communication &amp; Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>† Leading the implementation process; Gathering of management opinions; Adaptation of system design including as many opinions as possible; † Get informed about the process and commit to it; † Get informed about the process and commit to it; Give opinions on system design; † Receive information and training on time recording process and purpose; ♦ Expert on system/tool development and implementation;</td>
<td>† Guiding the data gathering process; Processing of collected data; Determination of HR capacity need; † Provide needed data through estimation on new work packages; Discussion about the influence of changing factors; † Recording times regularly (preferably on a weekly basis);</td>
<td>♦ Communication and explanation of planning results † Receiving planning results; Deciding on measures to be taken; ♦ Implementation of decided measures; ♦ Receiving information on measures;</td>
</tr>
</tbody>
</table>

The planning results should be revised at least once a year to assure the up-to-dateness of the data. The revising includes the adaptation of the main efforts to potential changes in processes and the environment as well as adapting the efforts to incorrect estimations which can be corrected by then due to gained experience.

6.2.3 Possibilities of usage 

The methodology provides several possible ways in which the gathered and determined data can be used. These are as described below:

- As target, the planning approach can determine the capacity need and headcount of a department for the upcoming years;
- The recording of effort enables department and team managers to see what their teams are currently working on. In the case that this is not what was expected by the management team it can decide on countermeasures to shift the capacity within the team;
6.2.4 Methodological benefits

The benefits of this method are:

- The data basis for the approach is more accurate than the estimations in approach 1 as it is mainly not based on management estimations, but on information from each individual employee;
- The approach is based to a major extent on actual (not estimated) data which reduces discussions on the data and power struggles between the managers of projects and programs about the HR capacity that will prospectively be assigned to their entity;
- The approach does not involve a large yearly managerial involvement to estimate all efforts, but only one central person is needs to spend time on data analysis and several interviews;
- The processing of data is only of little subjectivity as the capacity planner (as only highly involved person) has little stake in the results of the planning process;

6.2.5 Methodological limitations

The methodology has several limitations which make it difficult in some environments to be used. These are as described in the following:

- First results of this method will only be available after data have been gathered for several years. This means a long and high investment which not all departments are willing and able to spend. Further, the system requires a high initial financial investment;
- The accuracy of data is higher compared to approach 1. However, the accuracy of planning results still depends on the accuracy of the data that are provided by the employees. Training of employees takes a lot of time in the initiation phase of the planning process. However, as the correctness of data cannot be controlled, the actual accuracy and quality of the planning results show ambiguity;
- The methodology might give the management team the perception of being able to achieve the accuracy up to 1 in headcount that actually can’t be met as human factors are too unpredictable to achieve.
6.3 Evaluation of the Designs

Both described designs were developed according to the proposed requirements in chapter 5 with the aim to fulfill them with the presented processes. In the chapters 6.1 and 6.2 the benefits and limitations of each approach were already described and give an indication of their potential fields of application. In the following, the quality of the two designs will be evaluated regarding their fulfillment of the determined requirements.

Both process designs consist of the four process steps as described in chapter 5.1. The processes and planning approaches are designed in a way so that they are able to provide the flexibility in the design which might be needed, but is still planned along a PMP with and individual course for each program along the time line. However, this high degree of flexibility can only be achieved through a very open design which requires an adaptation of the processes of each case individually. This is especially necessary as each environment has different influential factors and potentially individual requirements.

Considering the choice of influential factors, both planning methodologies do not provide enough guidance to ensure the correct selection. The reason for this is the lack of information which the previous research provided and the difficulty to design a general approach as the choice is considered to be a case specific issue. This field will be proposed later on in chapter 7.3.4 in the outlook for potential further research.

When regarding the phase of system implementation it can be said that as many stakeholders as possible are involved in the process to achieve an early commitment in order to diminish the political difficulties which might occur in a later step of the process. Only in process design 1 the employees are not involved in the implementation phase as they are not involved during the whole process despite for the taken measures following from the planning results. An involvement of the employees in this implementation phase would probably be contra productive as unnecessary discussions could turn up.

Subjectivity in the planning results is tried to be avoided through the application of a strict methodology which the estimation of all work packages and programs needs to follow. However, subjectivity can never be avoided completely in processes where humans are involved. In planning methodology 1 subjectivity can occur due to incorrect expert estimations which might have various causes as described in chapter 2.1.1. These need to be avoided by the behavior of the capacity planner who needs to learn how to handle this challenge with gained knowledge and experience. This means, that the accuracy of the planning results might increase over time. Planning methodology 2 provides a more mathematical approach which might give the intention of a higher result accuracy as the data are not based on expert estimations, but on collected data sets. However, one has to be careful with this assumption as the data are not estimated by managers, but by every employee himself when he enters the weekly time distribution into the data base. These estimations might be more accurate that the management estimations, but the data accuracy is also more difficult to control and balance out.
Chapter 7
Conclusion, Final Remarks and Outlook

7. Conclusion, Final Remarks and Outlook

In the previous chapters, the results of an extensive literature research as well as of empiric data collection were described and analyzed for success factors, interdependencies and possible cases of application. The research intended at answering the posed research question with the elaborated sub-questions and developing requirements to enable a system and process design for human resource planning in a multi-program environment which is based on a process master plan. With the answers to the research questions, the process was designed and evaluated in chapter 6 with consideration of the initially introduced background information.

In the following, the answers that could be found to the research questions will be analyzed and evaluated and managerial implications will be given. Further, the generalizability and limitations of the research results are discussed which will lead to the determination of the academic contribution which could be achieved through this research project. Additionally, an outlook will be given on further research possibilities to complement the results that could be achieved in this research project. Finally, a reflection on the research project itself will be provided.
7.1 Summarized Answers to Research Questions

In the beginning of this research project, a main research question with several sub-questions was defined as line which was leading through the project and through this report. In the following, the results which were found to answer each question will be described shortly.

In chapter 1.2.3 the first sub-questions were defined as following:

1. Which obstacles and difficulties need to be dealt with in the planning of HR capacity need?

The findings in literature and in empiric data that aim at answering this question were presented in-depth in chapter 2. Several challenges could be found in literature and in empiric data, but while literature mainly focused on a correct methodological approach and on the influence of human factors in several stages of the planning process, the analysis of empiric data showed that the capacity planners perceive the commitment of involved employees and managers to be of highest importance. The analysis showed that all of these challenges should be considered when opting for an optimal HR capacity planning process. Further, the analysis showed that HR capacity planning not only contains the planning itself, but is a whole process in which the planning is included as individual step. In each of these process steps (also also described in chapter 5.1) different challenges need to be considered to enable a smooth HR capacity planning process. The many challenges that were found make the process complex, but also provide a basic framework for the process and the system design.

Following from the considerations of influential factors as one of the main challenges in HR capacity planning, the second sub-question aimed at identifying the necessary influential factors that need to be taken into account. The question was defined as:

2. Which drivers and factors influence the HR capacity planning process?

Chapter 3 provides a thorough insight in the main influential factors that were found in literature as well as in empirically collected data. Many factors that were found in literature could also be found in empiric data and vice versa. However, additionally, the empiric data describe several factors which are special to the studied case and might not be applicable to other companies (especially not to those outside of the automotive industry). The analysis of the collected information showed five main categories of factors which could be determined in the research. These main categories are Trends in the automotive industry, External factors, Human and personal factors, Project related factors and Case specific factors. In the further analysis in chapter 3.4, influential maps were designed which describe the sources of capacity variances and their interdependencies for each of the five defined categories. The amount of influential factors that were found in the research proposes that a choice for the most importance ones needs to be made in order to achieve an efficient planning process. This also implies that the results of the HR capacity planning can never be completely accurate.

As last sub-questions which includes literature research and empiric data collection, chapter 4 aimed at answering questions 3 which was defined as in the following:
3. Which methods and processes can be used to plan the HR capacity need in multi-program environments of technological products?

Firstly, several HR capacity planning methodologies of related environments were investigated including project management, project portfolio management, activity based costing and HR controlling. Based on the findings in literature, the empiric data were described and analyzed afterwards in the four main categories. The analysis showed that all approaches that were found in literature could also be found (at least partly) in the approaches which the investigated departments were using. Further, in the analysis could be found that several decisions that need to be made in the design of a planning system or methodology, such as involvement of employees and managerial involvement, are correlated with the size of a department.

Following from the previous three questions, the fourth sub-questions aims at the development of requirements which need to be considered in the development process of an HR capacity planning tool in a PMP based environment. The question was defined as in the following:

4. Which requirements should an HR capacity planning system in an environment based on a PMP fulfill in order to enable a flexible and efficient planning process?

The requirements which were developed firstly propose that HR capacity planning is not a single process, but needs to be embedded in a larger process including the system design, system implementation as well as result communication and application.

For each of these process steps the requirements were defined separately in the following as the challenges and sources of complexity were found to differ from phase to phase. Most of the developed requirements follow from the challenges that were found to be necessary to be handled in chapter 2. The in-depth requirements and their explanation can be found in chapter 5.

The main research questions which this research project aimed to answer was expected to be able to answer by a combination of all previously described sub-questions. The main research question was defined as in the following:

How can a conceptual process design for the planning of human resource capacity need in a technology driven multi-program environment, organized in a matrix organization based on a PMP, be structured?

In chapter 6, two process designs were proposed for the planning of the HR capacity need in an environment which is based on a PMP.

While the preferred approach 2 which is based on time recording of efforts per work package and program is the preferable methodology, approach 1 is proposed to be firstly applied. As approach two depends on previously recorded data, planning results can only
be expected after some years to have a thorough basis for the planning process. This disadvantage can be compensated by approach one which is mainly based on expert estimations as basic data. However, as estimations always include a personal bias, they are not able to achieve the accuracy that could be achieved by approach 2.

Overall, it can be said that the research project could answer the posed research questions. However, there is still some research which can be undertaken in this field to complement the findings. These potential further fields of research will be described in chapter 7.3.4.

### 7.2 Managerial Implications

This research showed that HR capacity planning is not an easy undertaking but one which requires the investment of some effort in order to achieve proper planning results. This effort not only affects the capacity planner as well as the (potentially) interviewed employees and managers, but also the top management team. As the topic is of a highly political nature, top managerial commitment and support is essential for a successful planning process. This is especially important during the data collection period as the quality of the planning results can only be as high as the quality of the collected data. A higher accuracy normally implies higher investment in terms of time and potentially also money. A lack of hierarchical support might also lead to a low commitment and understanding among middle and lower management teams and, therefore, harm the planning process. Top managerial support is also of importance in the result communication process to diminish power struggles in the decision of measures that follow from the planning results. Managerial commitment also eases the application of upon decided measures.

Further, planning HR capacity has to deal with many obstacles and challenges as described in chapter 2. The constant changing environment, which was found to be one of the major challenges, implies that HR capacity planning is not a singular undertaking but needs to be carried out regularly to adapt previous planning results to occurring changes and data that were found to be inaccurate. The more often the planning process can be carried out, the more updated the results are considering the environmental influences. However, a compromise needs to be found again between the effort that is needed for a planning round and the effect that can be achieved as the planning, communication and measure application process can be time-consuming. Therefore, a process that is carried out yearly might be suitable for many departments. The larger a department, the more effort the process brings with it, but in a larger department the effect of small inaccuracy has larger effects on the headcount and the capacity distribution within the department.

The involved management team should be aware of the condition that complete accuracy can never be achieved, as the influence of human factors on the planning results is too high and unpredictable. This means that the planning results can only give an indication about the required headcount in a department, but not a definite answer. The more effort a department puts into the planning process (e.g. through more exact forecasts of the effect of environmental conditions), the higher the accuracy is that can be achieved. However, one should here, again, consider the effort and the effect of the accuracy that can be achieved.
Aside from these points, the management team should be aware of the fact that a planning system can never replace managerial conditions, but only give indications based on made more or less accurate assumptions. The final interpretation and decision still needs to be made by the management team. Likewise, the management team needs to decide upon measures that should be taken. One reason for this is the degree of accuracy that can be achieved by the planning result which might not be able to determine the exact amount of HR capacity which is needed which means that power struggles might still occur. The determined planning methodologies aim at diminishing these power struggles when managerial commitment is available, but they can never be completely suppressed.

The decision for measures that should be taken as consequence of the planning results cannot always directly be derived from the output of the planning system. The proposed planning systems only take the actual HR capacity need of a department into account, but neglects factors such as the actual availability of HR capacity in the department, company or the market. Further, the current financial situation might not allow a company to hire as much HR capacity as actually needed which can have further consequences such as the rejection of new projects which is part of a larger strategy. Involved actors, not only including the top management team, therefore need to be aware of the consequences that an incorrect planning result can imply.

### 7.3 Scientific Value of the Research Results

The determination of scientific value of the research results is of importance to describe the field of application of the research results and further research possibilities. In the following, the generalizability of the research and its limitations are analyzed and an overview of the academic contribution of this research project will be given. Additionally, an indication of future research potential is given including fields which can complement the results of this research project.

#### 7.3.1 Generalizability

The research findings of chapter 2 to 4 are generalizable to many work environments where human resource capacity need should be planned. Especially the literature research can be used as basic input for the development of any HR capacity planning system and process. The managerial opinions and behavior in the empiric data can give an indication to capacity planners and researchers in related fields about challenges that might be faced in corporate environments when dealing with processes that include the middle and lower management. Further, it can serve as basic framework for continuous research on HR capacity planning in multi-program environments.

The developed requirements as well as the system design and process design can be applied to any case in environments which are based on a PMP that described the basic work packages and processes in a program or project. The environments do not necessarily need to be technology driven. However, a repetitive work flow needs to be available. The application to branches outside of the automotive industry is possible, but requires further research on potential influential factors which are typical for the industry, company or department to which the methodology is applied to. As every department provides special requirements and circumstances regarding its HR capacity need, the
developed approaches always need to be adapted to a new case before it can be implemented. The general principles of the processes as described in chapter 6 remain during and after the application.

The designed approaches can also be used in environments that are not structured by a PMP, but are based on individually structured projects or programs. However, the determination of the effort for every project/program might then take longer as each of them needs to be considered individually. This means, that the efficiency in the planning process that can be achieved through the standardization of work packages and processes in a PMP environment. As this might also decrease the accuracy that can be gained in the initially planned application environments the approaches should only be used for rough and first estimations here. The methodologies provide the advantage that rough estimations might be determined relatively quick. It also provides the possibility to give indications about the necessary HR capacity quickly based on the analogy method.

In general it can be said that the less project/program managerial and repetitive structures an environment possesses, the less applicability of the developed processes can be achieved.

### 7.3.2 Limitations

Although the research results are generalizable, they also bring certain limitations with them which need to be considered when applying the results to a specific case or while carrying out further research.

The proposed approaches can be applied to multi-program or project environments which are based on a PMP, but it might be difficult to apply them to other cases. The approaches aim at an efficient planning process by using standardization of work packages and process over all programs. Further, repetitive process and work packages are needed for exact results when basing the planning on previously collected data of analogy based estimations meaning that processes should not change much over time. A change in processes and work packages would diminish this advantage of standardization and lead to an extended or less accurate planning process. This limitation was opted for to enable the design of an HR capacity planning process with an optimum efficiency.

The capacity planning and interpretation process is largely based on the experience of all involved actors meaning that the accuracy and correctness of taken measures might not be available from the first planning period on, but will increase over time. The accuracy over time might achieve an acceptable quality, but can probably not achieve the precision of one in headcount. The planning results can therefore only give an indication of the future HR capacity need and its distribution. This implies, as previously described in the managerial implications, that the planning approaches cannot take over managerial decisions, but are only able to support them. A consequence of this is the decrease of power struggles, but not its prevention.

Another limitation is the direct applicability of the processes to a specific case. They can be applied to cases with environments that are based on a PMP, but still need to be adapted to every case individually. The reason for this is the ever changing and very specific environment of each case. In cases outside the automotive industry, case specific factors still need to be defined and their influence should be determined. Further, the influential
factors have various diverse effects on different departments which also need to be determined individually. This means, that the capacity planner has to be aware and needs to have the knowledge of many influential factors and their effects. The limitation of little possibilities for a direct application is opted for to enable a high generalizability of the research results.

Further, the output of the planning process does not include topics which are related with HR management, but do not indicate the actual need of HR capacity. These factors, such as the actual availability of human resources or the current financial situation of a company, are not taken into account in the HR capacity planning process, but need to be taken into account by the management team in the decision process afterwards. Leaving out these factors is based on the assumption that this might be difficult for the responsible planning person to make decisions on measures of such highly political and often confidential topics. Further, an incorporation of such factors would imply to take over the managerial decisions and implicate that it is possible to mathematize the political decision around it.

### 7.3.3 Academic contribution

As this work is a scientific research project it aims at contributing to the body of knowledge. In the following, the academic value and contribution of this master thesis is described.

In this research project a thorough literature review was conducted and this thesis provides an in-depth synthesis of many related topics. The *Theory* sections of this research integrate different streams of literature to an overall insight in HR capacity planning. The conducted literature review does not only describe HR capacity planning challenges, influential factors and methodologies in environments which are based on a PMP, but gives an overview of the topic in general.

Research on HR capacity planning was conducted so far, but quite separated from each other. This project combined and compared the different fields and streams of the topic in one academic report. These results make it possible to build further theories and conduct other research project which do not only stay in their field of research, but which are aware of the limitations of their field of research and can make use of the benefits of other streams as displayed in Figure 22.

![Figure 22: Scientific contribution and further research possibilities](image-url)
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This was used in this research project to design a first process which can be applied to a field which has not been researched thoroughly so far: the HR capacity need planning in a multi-program environment which is based on a process master plan.

This research provides information about a topic which might be considered to be a niche by many, but HR capacity planning is of importance for every company and organization. Further, the planning based on a PMP occurs in many industries where similar products are developed repetitively according to company internally defined standard processes.

Additionally, the empirically collected data give an in-depth insight in the practical process management in large engineering environments when dealing with highly political topics which are of interest for many stakeholders in an organization. The presented data also provide insight in why and how important the managerial commitment is in organization political discussions.

7.3.4 Outlook and future research

The research field of this project proposes several further research projects which can deepen the findings based on the already achieved results and might increase the quality of the planning process as well as its results. The proposed further fields of research mainly include potential accuracy improvements as well as the influence and handling of human factors in all steps of the planning process.

The research can firstly be deepened by identifying possibilities on how to increase the accuracy of the planning results. This might aim especially at the consideration of human factors as they introduce a high volatility to the planning process. Of interest is also the determination of factors which need to be considered in the data collection and processing phases.

Next to factors that influence and should be included in the collected data themselves, the human factors that influence the process of data collection and data processing are of interest. Knowing these factors might diminish their influence simply by being aware of them or by taking according measures to avoid them.

Further, research on an efficient and effective prioritization of influential factors might be of interest to achieve an ideal trade-off between the invested effort and the achieved effect on the result accuracy.
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7.4 Reflection

After finishing this research project, the following paragraph will reflect critically on the project and propose potential for improvement if someone would have the opportunity repeat the research.

Firstly, the time distribution over the project duration was not ideally. A lot of time was spent in the beginning of the project for a thorough literature research and the collection of empiric data. It was important to spend a lot of time on this phase of the project as this is a large part of it, but it left comparably little time for the requirements development and system design which is supposed to be the major output. Further, a shorter period of literature research and data collection would provide the possibility for an even more thorough analysis of the information which could benefit the quality of the research results.

Further, it was planned to first conduct the literature research and then start with the empiric data collection. Due to company internal schedules of other related project this was not always possible so that the empiric data collection through interviews and observations already started earlier than planned. This might have led to missing out significant topics for the interviews that could have been asked or that the interviewees mentioned without the recognition of the interviewer. As the overlap was not very large, the consequences for the research result are estimated to be minor, but it would still be favorable to first complete the literature research. This does not exclude the literature research during the empiric data collection to look for scientific evidence of findings.

With the aim to improve the strength of the research results regarding their generalizability further interview partners from other companies in the automotive and non-automotive industry would be desirable.

When considering to conduct this research on a larger project with a longer time duration it would be of interest to implement the research results and collect actual data on the quality of the two approaches and whether the needed degree of accuracy in the planning results can be achieved. In a research over several years the accuracy of planning results as well as the development of the accuracy could be researched. This would also help to improve the process designs. In this research, some of the research fields mentioned in 7.3.4 could be included as the research on the influences of human factors on the accuracy and potential counteractions would benefit the planning process. In this way, the research results could be improved incrementally until the results are able to achieve an expected level.

Despite these potential improvements of the research project, the results can be considered to be good as the client is satisfied with the results which are significant for him and valuable for the investigated department. The client company decided and already started to implement the process and system design 1 which might be followed by the process and system design 2 in the coming years.
Bibliography


Bibliography


Appendices

Appendix A – Interview Structure

The Interviews are structured in three main parts according to the research questions. The questions of each part should sufficiently enable the researcher to answer the research questions from the company’s IST point of view.

1. What is your responsibility within your department?
2. What is your responsibility in the planning process of the investigated department?

Research Questions I

3. What are the difficulties that occur during the planning process?
4. How do you handle these difficulties?
5. Are there any difficulties that you can’t handle?
6. Why is it not possible to handle these difficulties?

Research Question II

7. Which factors (external, human,...) do you take into account when planning the needed HR capacity?
8. How do you handle these factors?
9. Are there any factors that influence the HR capacity need which are not considered in your approach?
10. Why did you exclude these factors?

Research Question III

11. Who is responsible for the planning process in the investigated department?
12. Why is the planning in the investigated department planned?
13. Which planning approach was chosen in the planning of HR capacity in the investigated department?
14. How does this approach include the management into the planning process?
15. In which steps of the planning process is the managerial support important? And why?