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HUMAN RESOURCE ALLOCATION IN A MULTIPLE PROJECT ENVIRONMENT

Master's Thesis in
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TABLE OF CONTENTS **page**

LIST OF FIGURES **page**

LIST OF TABLES

page

ABBREVIATIONS

BFCI	Balanced Critical Factor Index
CFI	Critical Factor Index
E	Engineer
HR	Human Resource
HRM	Human Resource Management
IMPL	Implementation Index
LE	Lead Engineer
PM	Project Manager
R&D	Research and Development
SD	Standard Deviation
UM	Unit Manager
VTT	ValtionTeknillinenTutkimuskeskus (Technical Research Center)
WBS	Work Breakdown Structure

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ABSTRACT:

Resource management on a master level, this is how one can describe the task to manage resources in a multiple project environment. Beside the common responsibilities of a human resource manager like planning, allocating, monitoring and developing resources, the multiple project environment also offers constrains on several levels, success and failure interdependencies and extreme variations on workload demand and capacities. What is common to all projects, no matter if single or multiple, processed in sequence or simultaneously, the assigned human resources are a central success driver. In order to maximise every project objectives it is essential to plan the available resources as best as possible.

This study shall contribute to the understanding about what kind of difficulties organisations are facing by managing their human resources in the multiple project environment. Firstly the case company's processes has been observed and tested in order to identify the department's specific difficulties. Secondly an in depth literature review will provide a comprehensive overview about recently discussed theory and proposed solutions concerning processes and procedures about the issue in question. Thirdly the identified, department specific, difficulties have been compared to external processes and procedures in order to seek for feasible solutions. Therefore the data- and the methodological triangulation have been applied. As the research model will show later, grounded theory, qualitative and quantitative methods were used. Therefore data was gathered company internal and external.

In summary the most influential attributes, for the human resource management process in a multiple project environment, could be identified as the reliability and validity of time schedules, the poor visibility of current and future workloads, the high dependency on external factors and supporting software tools.

KEYWORDS: Human resource allocation, multiple project environment, influence factors, management process

1. INTRODUCTION

1.1. Background of the study

Today, project work is a common mode of operation in various types of organisations. The range of project work can vary from single to multiple to simultaneous multiple projects. Whereas there are many standardized procedures how to organize and execute such projects, the link to standardized human resource practices for this environment is widely neglected. The issue is becoming even more complex if simultaneous projects have to share the same pool of human resources. Even though general guidelines to project processes are available, most organisations nevertheless have developed their own unique procedures. What is common to all projects, no matter if single or multiple, processed in sequence or simultaneously, the assigned human resources are a central success driver. In order to maximise every project objectives it is essential to plan the available resources as well as possible. Projects which need to share common resources have to cope not only with time pressure, profit maximisation, external and internal interferences but also with constant uncertainties about their resource usage. As the workload during the project's life cycle can increase or decrease almost on daily basis the workforce is in constant movement between the different projects that they are assigned too. Thus complications in one project can have major influence on the processes of other projects. Therefore organisations seek to find methods, supporting software tools or simply improve their existing processes, in order to stay competitive, keep their promised time schedules and guarantee a successful completion of every single project.

As the above stated situation applied also to the case company, which initiated this study, a profound investigation has been conducted. The company or in fact one of its departments is processing about 20 customer projects per year and often more than 10 projects at the same time. Project sizes vary from less than 1.000 working hours for small projects to over 10.000 hours for big projects and therefore can last between a few

months to more than two years. Therefore, the department managers have to manage about 40 employees who are usually assigned to 2-3 projects simultaneously. Bigger projects require 10-20 employees whereas small projects can be processed by 2-3 employees. In most cases the case company is a minor stakeholder of the customer's entire project and therefore holds not more than 10 percent of the whole. That means for the department that they are highly dependent on other players within the project and thus must adjust very often their project schedules to the progress of major project stakeholders. In summary the resource managers are facing a multitude of restrictions and influence factors, and therefore would like to know how to develop their internal processes to be able to better respond to the constraints and constant changes.

1.2. Research problem

As indicated above the case company is interested in developing their existing procedures in managing human resources for multiple projects. Therefore the following question is in main focus of this research:

> *(1) What are the main challenges in allocating human resources in a multiple project environment?*

In order to respond to this question in a profound manner, also the following questions were asked:

> (2) *What are the main challenges in planning human resources in a multiple project environment?*
> *(3) What are the main challenges in monitoring human resources in a multiple project environment?*

In addition, the company wanted to know if their own difficulties in managing human resources were common to such a working environment. Therefore tentative hypotheses have been created and consequently tested during this study.

1.3.Research objective

This study shall contribute to the understanding about what kind of difficulties organisations are facing by managing their human resources in the multiple project environment. Firstly the case company's processes shall be observed and tested in order to identify the department's specific difficulties. Secondly an in depth literature review shall provide a comprehensive overview about recently discussed theory and proposed solutions concerning processes and procedures about the issue in question. Thirdly the identified department's specific difficulties shall be compared to external processes and procedures in order to seek out feasible solutions.

1.4.Definitions and delimitation

As this study has been carried out in cooperation with an engineering company, the research has a strong focus on the specific difficulties the organisation is facing. All interviews, which have been carried out during this case study, were conducted with engineering companies only. Furthermore the study focused on customer related projects and not on R&D or internal development projects. Whereas R&D projects often have interdependencies on several levels, the project environment observed in this research only had interdependencies on a human resource level. Therefore the multiple projects can be defined as single projects running simultaneously. It means on the one side that fewer constraints have to be considered, for example compared to R&D projects, but on the other hand the resource usage is even more in focus. As stated before, human resources are a vital success driver in every project and therefore need to

be managed well. Therefore the study will concentrate on identifying major influence factors which makes the resource allocation so difficult.

1.5.Structure of the study

The following chapters represent the structure of this case study and give a short summary about the content of each section.

1.Introduction

The introduction section will lead the reader to the topic of human resource allocation within a multiple project environment. From there onto the research problems and objectives as well as the definitions and limitations which are involved.

2. Literature review

The literature review concentrates on the three questions stated in 1.2 Research problems. As the project environment in general is a subject to constant changes in terms of processes and procedures,more recent publications have been considered for this study. In the end of the literature review the tentative hypotheses are stated.

3.Research methods

In this section all applied methods for investigating the resource allocation process will be presented. Especially the balanced critical factor index (BCFI) methodology will be explained in depth as the method has been developed further for this research.

4. Findings

The findings are presented in two separate sections. The first part will give the findings of the external perspective and the second part presents the internal findings.

5. Conclusions

The conclusion starts with a comparison of the findings from the different research approaches. In addition conclusions are drawn on explorative findings from all approaches. Last of all the thesis will be finalized by further research proposals.

2. LITERATURE REVIEW

Resource management on a master level, this is how one can describe the task to manage resources in a multiple project environment. Beside the common responsibilities of a human resource manager like planning, allocating, monitoring and developing resources, the multiple project environment also offers constrains on several levels, for example, success and failure interdependencies, extreme variations on workload demand and capacities. In order to get a more profound understanding about the variety of challenges involved in such a working environment the following chapters will concentrate on the task of managing common resources for simultaneous multiple projects. The overall managing process has been divided into three major steps; resource planning, allocating and monitoring, these will be discussed respectively.

Before we will go into details let us briefly scratch the surface of project management. The literature suggests that the matrix organisation is one of the most suitable organisational structures for a multiple project environment (Hendriks, Voeten & Kroep 1999; Turner 1999; Zohar & Goldberg 2008). Contraire to the literature we still find in industrial oriented organisations line- or functional organisation structures, this might indicate missing clearly defined procedures and processes for the multiple project environment. First attempts in providing new structured processes and organisational forms are undertaken and presented from several researchers. For example are Keegan, Turner and Huemann suggesting new HRM practices and processes especially in terms of flexibility and individuality (Turner 2008). Dooley, Lupton and O'Sullivan emphasize in their research the importance of developing a framework for multiple project management and arguing that alignment management, communication, control, learning and knowledge management are the key drivers for a successful management portfolio (2005). However the recent developments are still very limited and mostly remain as theoretical approaches. This short excursion, away from the main focus of this study, shall help to understand the overall difficulties project oriented organisations are facing.

2.1. Resource planning

According to John Payne, most of the literature on project management is dedicated to single-projects (1995). Although Payne identified this gap in scientific research more than fifteen years ago, very little efforts have been taken place until today. In 2007, Huemann et al. pointed out the missing link between the HRM and PM (Project Management) literature, most of the HRM literature concentrates on routine organizations, the importance of new functions and practices for project based organisations have been neglected (2007: 321). Consequently the perspectives on the planning procedure for multiple projects are very limited. However, in this research only projects with interdependencies in terms of common resources will be considered, therefore even multiple projects can be planned in a single-project manner with some small but distinct exceptions.

2.1.1. Resource definitions

In the beginning of every project the question is which kind of resources are needed to successfully complete the project (Reiss 1995: 84 – 85). In general the scope, cost and schedule of a project are defining the overall needs of human resources (Leach 2000: 4). The following figure presents the triangulation interaction between those attributes according to Leach.

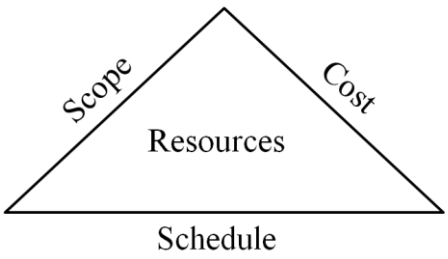

Figure 1. The three attributes defining the resource needs.

Beside the number of participants the project plan should furthermore include clearly defined roles, authorities, responsibilities and competencies (PMBOK 2004: 207). Without these clear definitions project team members tend to establish their individual roles and responsibilities (Chin 2003: 39). From the practical point of view a role simply states your position in the project, for example you can be assigned as a project manager, an engineer, an assistant or something similar. The authority clarifies which rights or duties a team member has within the project. The responsibility defines the task or work of an individual member which he or she has to accomplish in order to complete the project. Last but not least are the required skills or competencies a key success driver for each project and therefore need to be considered carefully within the planning phase. To visualize the structure of the project team it is beneficial to plot a project specific organisation chart, especially for bigger projects (PMBOK 2004: 207).

Another important step for resource planning is the integration of a WBS (Work Breakdown Structure) into the project plan. As the name already indicates the total workload of a project will be divided into many small components in a hierarchical order (Kasse 2004: 89 –90). That allows a more detailed view and increases the reliability of the project plan. Each work package can now be analysed separately, for example concerning duration, cost, risk and resource demand (PMBOK 2004: 112). Furthermore, through the implementation of the WBS it will be easier to identify the required competences for relatively small work packages compared to unspecified work tasks.

2.1.2. Different time perspectives

Hendriks et al. identified five elements which are vital for human resource planning in multiple project environments (1999: 182 – 185). They divided the overall planning into three different time periods; long term, medium and short term planning. Furthermore they point out the importance of links between the different periods and the necessary feedback in order to improve the planning process. In general the long term planning is done once a year and should include estimations on demand of resources according to numbers and expertise, available budget and individual development plans. If individual

development needs are not considered, employees might look for new chances themselves (Turner 2008: 659). The quarterly held medium planning should consider the current state of the project portfolio. Engwall and Jerbrant identify the resource allocation problem as a result of insufficient project portfolio planning and general organizational problems (2003: 408). Therefore the overall difficulties within several projects and the project environment should be addressed on such a level. Furthermore the rough estimations about future workload and its distribution should be clarified in the medium term planning phase. The short term or day to day planning has a perspective of about six weeks and should be done at the very last every other week. This stage goes hand in hand with the resource allocation process and can be done together.

2.1.3. Common difficulties in planning resources

One of the most frequently stated challenges in project management is the uncertainty factor which has negative influence on the project success (Belout & C. Gauvreau 2004; Engwall et al. 2003; Eskerod & B.S. Blichfeldt 2005; Hendriks et al. 1999; Huemann et al. 2007; Leach 2000; Newbold 1998; Zohar et al. 2008). The uncertainty factor can have very different dimensions, for example Eskerod et al. are emphasizing the uncertainty concerning roles, norms and communication (2005: 500), whereas Belout et al. argue that the management uncertainty has major influence on the project success (2004: 2). Huemann et al. are stating that the pure nature of projects entail greater uncertainty on a general level, comparing to routine work procedures (2007: 317). However, it is clear that uncertainties can have internal and external causes and therefore are difficult to handle.

Furthermore are the lack of competences (Elonen & Artto 2003: 400), communication procedures (Chin 2003: 53 – 58) and suitable software tools (Gordon & Tulip 1997) are often discussed as attributes in connection with challenges in planning resources. As companies use the same human resources for multiple projects it is obvious that they create interdependencies. Moreover persons can be assigned to more than one project at

a time and even have different roles in different projects (Huemann et al. 2007: 317). Disturbances in one project can have huge influence on other projects (Viktorsson, Sundström & Engwall 2006). Therefore more and more organisations resort on software tools with the hope of enhancing the visibility of current and future conflicts. According to Gordon et al. the first available software for resource scheduling with multiple project functions was RAMPS (Resource Analysis and Multi-Project Scheduling), additionally they stated: *"It was claimed at the time that the results produced by the system were optimal; nobody would make that claim today"* (1997: 359). The difficulty in usage of software tools comes with the unique individual organisational structures, processes and project procedures in the multi project environment. Whereas an increasing number of human resource software providers are offering specified software solutions, little research has been published in terms of usability and value added.

As projects tend to be smaller in the multi project environment compared to single projects the complexity for managing those is increasing (Payne 1995). From management point of view the same work has to be done for small as well as for big projects. Withmore, but smaller projects, with interdependencies on resource level, the workload for the management team is increasing drastically.

2.2. Resource allocating

The first role to be allocated in almost every project is the project owner, in most organisations that will be the project manager (from the organisation internal perspective). Whereas Turner and Müller found a gap in project management literature concerning the impact of the project manager to the project success (2005: 59), the researchers Patanakul and Milosevic identified the project assignment to the project leader as one of the most crucial steps in the resource allocation process (2006). The following figure illustrates their theoretical framework.

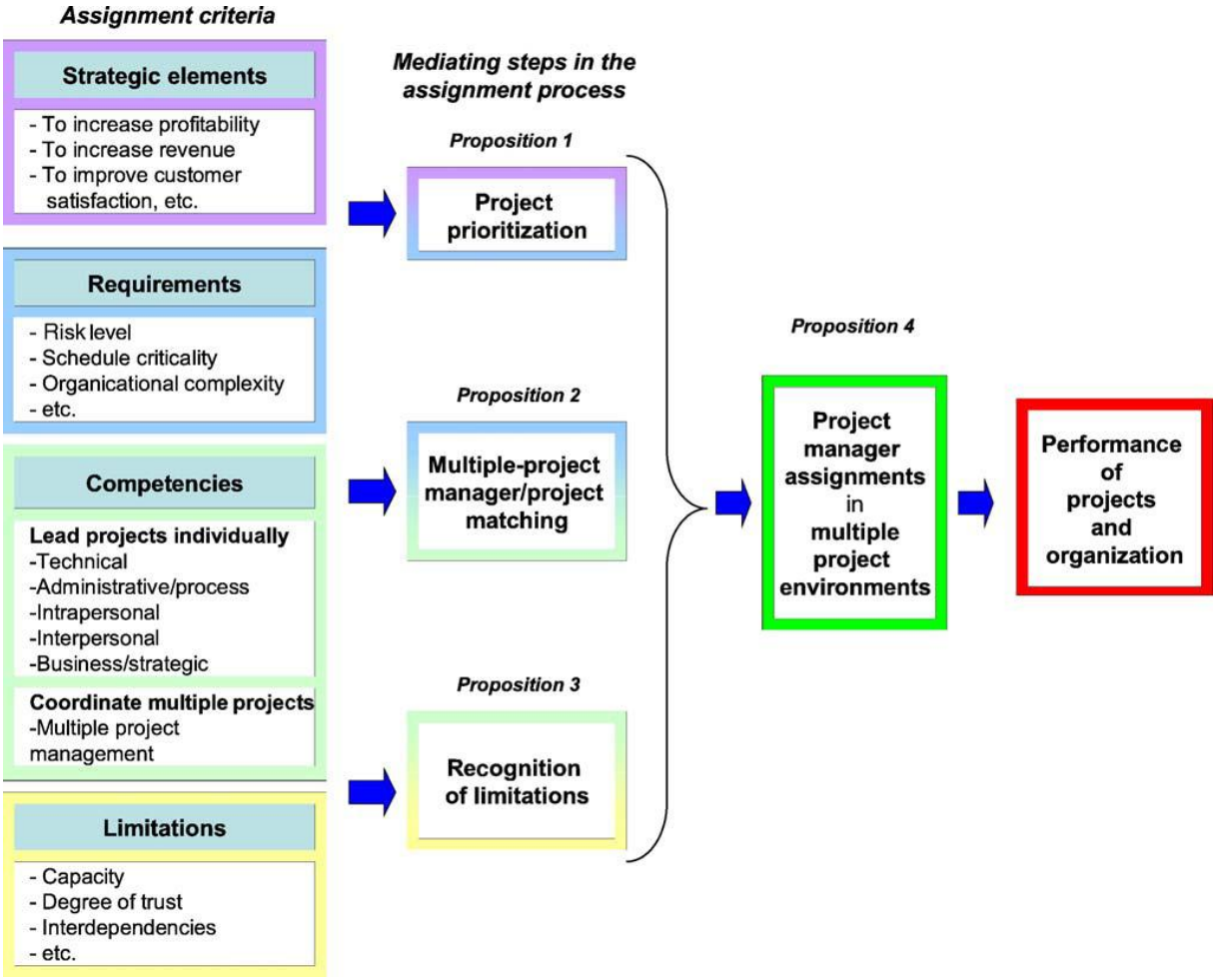

Figure 2. Framework for understanding project assignments.

They argue that, if organisations pay attention to project priorities, project requirements, project manager's competences, organisational and personal limitations, the overall performance of the project as well as the performance of the organisation will improve, see figure 2 (2006: 59 – 65).

2.2.1. Assignment of project team members

Hendriks et al. are arguing that it is vital for the project to allocate the right human resources. Furthermore they state that the higher the number of simultaneous projects, which require specific knowledge, the more important but also the more complex the allocation process will be (1999: 181). One reason for the increase of complexity is the project interdependency on the resource level. Therefore it is important that all necessary information, embedded in the project plan, is up to date, otherwise the outcome of the planning phase is useless (Hendriks et al. 1999: 182).

With the inputs from the planning phase like schedule, scope or WBS of a project, the project manager now has to actually assign employees to each defined role, position or task. This can be done by communicating the project needs to the resource manager of the organisation, thereby the management should consider, as discussed before, the required competencies, the individual as well as the organisational development needs (Turner 2008: 656).

The required competencies are seen as a key issue in the allocation process, however to make sure that the needed competencies are available the resource management need to understand the importance of personal development needs. The overall competence level should match the requirements of all projects and furthermore, as stated earlier, employees might leave the organisation if important development opportunities are not offered (Turner 2008: 659).

Another high influence on the allocation process is the project priority. Naturally projects with high priorities will get preferably more, easier and higher skilled team members as compared to projects with a low priority (Engwall et al. 2003: 408). This might lead to a management conflict between project- and resource managers. Whereas resource managers are more concerned about the overall organisational objectives the project managers are looking for the individual project success (Zohar et al. 2008). In some cases the project managers start to compete against each other in order to get the scarce resources (Payne 1995), in the research of Engwall et al. they even found cases in which project managers led their projects in deep crises just to get a higher project

priority (2003: 408). To avoid such competitions it is important to clearly communicate the organisations overall objectives to all project managers and team members.

2.2.2. General implications for allocating resources

The distribution of workload, which reflects the allocation process from the team member perspective, can lead to complications. First of all the workload for each team member varies differently throughout the life cycle of the project. Workload peaks can arise quite unexpected due to internal or external factors and are therefore hard to predict. Naturally the peaks for engineers or PMs differ according to the project stage. Whereas engineers are highly occupied during the execution stage the PMs have high workloads in the starting and closing stage of a project. However, Hovmark and Nordqvist are suggesting based on their research that the most attention should be paid to the recapturing phases after workload peaks in order to avoid work overload and stress for employees (1996: 394 – 395). In a multiple project environment employees are most often assigned to several projects and therefore this is a difficult issue to manage. One peak can just come after another as the projects are progressing simultaneously. Viktorsson et al. are arguing that project overload has negative influence on personal development and psychological condition (2006: 391). Similar to the findings of Hovmark et al. were the opportunities for recuperation by far the most significant parameter. The following figure presents the proposed influences model of their study (2006: 387).

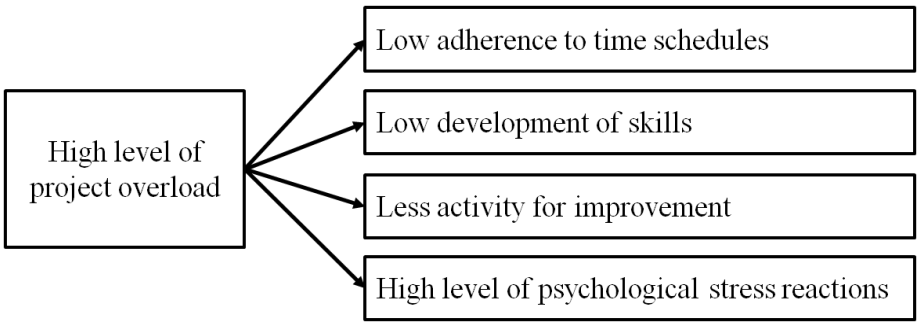

Figure 3. Proposed model of project overload and outcome relationship.

Secondly complications of project overload can lead to management conflicts and lack of trust in schedules and goals but also in leadership (Newbold 1998: 41 – 44). If a project manager does not feel responsible for the failure of a project due to lack of resources, the project team might lose faith in the competences of the team leader and leadership in general. In the research of Sörderlund and Bredin the importance of trust and competences, concerning leadership attributes, are stressed among others (2006: 258 – 260). They found in their case studies that the lack of competences on HRM practices led to conflicts in project teams. Beside the resource allocation they emphasized the importance of appraisal, development and team building.

Beside the requirements of availability, ability, experience, interest and costs of human resources (PMBOK 2004: 210), the project manager needs to take into account the collaboration behaviour and working attitude of employees during the allocation process. Team conflicts in the project environment are common and a highly discussed topic in literature (Billows 2009; Ohlendorf 2001; SKM 2009). Whereas Ohlendorf is concentrating on the individual issues like attitudes, needs, expectations, perceptions or personalities (2001), Billow is more concerned about the effect and influence of conflict on the overall project success (2009). Nevertheless, team conflict can have negative impact on the project progress and therefore need to be observed carefully.

2.3. Resource monitoring

The main objective of resource monitoring is to get reliable information about current and future workload status on individual as well as on general level. The motivation is defined quite differently. While from the PM perspective it is important to see if enough resources are available in order to proceed with the upcoming projects, the interest from higher management concentrates mainly on utilization rates. As the main focus of this study is the allocation process we will concentrate on the implications of monitoring resources from the PM’s perspective.

While there are many different techniques and tools for how to measure and report the project progress, they all have a common basement; frequently report meetings (Newbold 1998; PMBOK 2004; Reiss 1995; Turner 1999). Reiss argues that if there is no reporting system implemented, during the execution phase of a project, than there is also no use to plan the project (1995: 99). Furthermore he divides the monitoring process into two categories; DIY and OPE. DIY stands for "do it yourself" whereas OPE means "other people's effort". In the first approach it is the PM's task to go around the project team and discuss the progress of the individual tasks. It is suggested that the update to be made on a weekly bases in order to identify irregularities quite early on and to avoid bigger disturbances. The second approach is presented as an alternative in which other people report the progress to the PM. The identified problem here will be the right measurement data. Whereas some programmer might report how many rows he or she has been producing for the program the PM is more concerned about the overall progress of the program (Reiss 1995: 99 – 100).

In addition to the right measurement data, Turner points out the importance of the right technique. For example when the data in question is well defined it is essential that the data is measured against the original plans and not the updated version. Otherwise the measurement is losing its validity and only indicates the latest developments of the project. Therefore the data should always be calculated against the initial plans to show the real progress of the project (Turner 1999: 226).

Newbold emphasizes the possible implications for the implementation of measurements. He points out the danger of choosing the wrong or illogical measurement technique and the possible consequences. For example he states that implementing measurements which can create competitions between employees can lead to a working climate of noncooperation. Another important aspect is that the employees understand the significance of the measurements and furthermore that they can also make sense of it from their point of view, otherwise, as Newbold argues, anything can happen (1998: 206 – 207). The following points are stated as a key

concept in his book, “Project Management in the Fast Lane”, and should be considered before implementing new measurement tools or techniques.

“Key concepts

- *Tell me how you measure me, and I will tell you how I will behave.*
- *If you measure me in an illogical way... do not complain about illogical behaviour.*
- *Local measurements must relate to global measurements.*
- *Before implementing a measurement, first understand its derivation, application and effects.*
- *Throughput dollar days can be useful as an informal local performance measurement.*
- *WIP is an important global measurement due to its impact on throughput. “*

Not only is the reporting process essential for the project in question it also enables the management to do future planning and forecasts (PMBOK 2004: 96). Especially in the multi project environment, in which employees are working on several projects simultaneously, the progress reporting process will prove indispensable.

2.4. Tentative hypotheses

After the comprehensive literature review as well as the pilot studies have been conducted following tentative hypotheses were created:

Hypothesis 1: The lack of clear responsibilities or structures in multiple project management processes leads to suboptimal flow of information and disturbances of the human resource process.

Hypothesis 2: High dependencies on external factors will cause major difficulties in the resource management process for multiple projects.

Hypothesis 3: Limited level of expertise complicates the resource allocation process in the multiple project environment.

Hypothesis 4: Poor visibility of current and future workloads aggravates the allocation process.

Hypothesis 5: Organisations have major difficulties with the usage of HR-tools in the multiple project environment.

All hypotheses are closely connected with the main difficulties observed within the case company and reflect the impression of the management team of the department about their internal processes.

3. RESEARCH METHODS

In the beginning of every research one of the most crucial decisions is which method is to be used in order to get the best possible results. Once the decision is made there is no return, the method is chosen, the data gathering process is defined and the researcher has to rely on the method to work.

If a researcher feels that the choice for only one method would limit the possible outcomes he or she can choose to follow the principle of research triangulation. In 1970 Denzin introduced the concept and defined four different types of triangulation as follows; data-, investigator-, theoretical- and methodological triangulation. The idea behind the concept is, by using the data triangulation for example, a researcher can use multiple data sampling strategies in order to get different perspectives in terms of variety of people, times and social situations (Denzin 1970). The same principle applies also to the other three types of triangulation. Advantages like developing new perspectives on a certain topic, combining theories and methods to get a deeper insight or the more profound understanding of it (Jick 1979: 602 – 603) are accompanied by disadvantages like vast amounts of data, inconsistencies between findings of the different approaches, the difficulty for a researcher to stay impartial concerning the methods in use and the understanding of why and when to use triangulation (Thurmond 2001: 256).

However, in this case study the data- and the methodological triangulation have been applied. The choice for the two types of triangulation originated from practical matters. Firstly the literature about the given topic was very limited. Secondly the unique working environment of the case company needed to be considered. As the research model will show later, the grounded theory, qualitative and quantitative methods were used. For this case study data has been gathered company internal and external.

This research followed in general the theory of the inductive reasoning approach. According to Trochim, the idea is that the researcher begins to gather data for a specific topic. Then, while analyzing the gathered information, the researcher then searches for patterns within the data. Given that the researcher finds patterns, the next step is to create tentative hypotheses and subsequently test them. If necessary, changes will be made and new theory or theoretical frameworks can be created (Trochim [A] 2006). The following figure shows why the inductive reasoning approach is also called the bottom-up approach (Burney 2008).

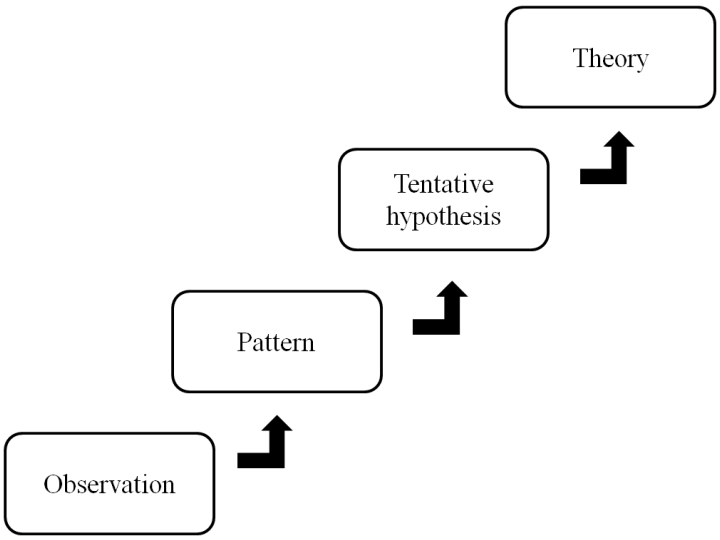

Figure 4. The Inductive Reasoning Model.

The following chapters will highlight each method used in this case study individually and furthermore explain how they were carried out in practice.

3.1. Research model

During the starting phase of the study the department manager as well as two section managers had been interviewed. At the same time an in-depth literature review had been

carried out. At this stage the research questions were defined, expectations were uttered, possible outcomes were discussed and a research plan had been established. Built on the gathered information the tentative hypotheses were created and subsequently tested with different methods. The following figure shows the structure of the entire research.

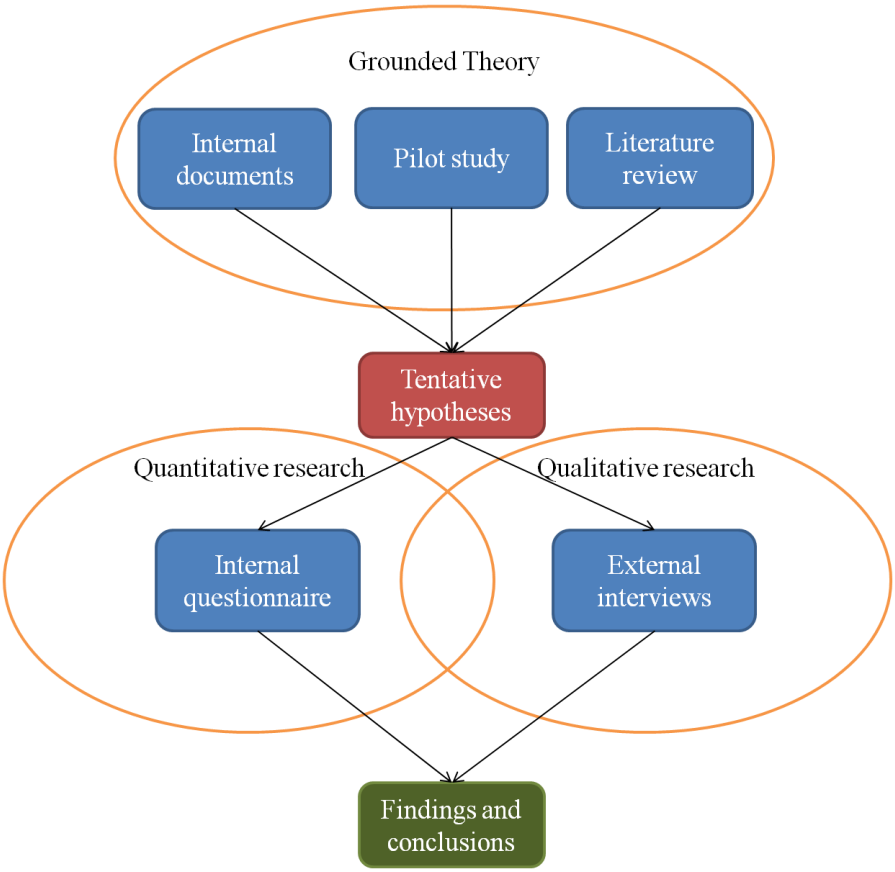

Figure 5. The Research Model.

The internal questionnaire addressed the case company's specific problems as well as common difficulties within the area of human resource allocation. The external interviews were held to test if the case company's specific problems applied also to other companies or units and to gather further information on how to overcome the complications. Furthermore a method to measure which particular practice of the human resource allocation process should be improved was included in the internal

questionnaire. The sense and respond method relies on the experience and expectations of the company's employees and indicates critical factors (CFI) within business processes. The different research methods were then analyzed separately and afterwards compared with each other. Conclusions were then drawn on the findings of the single approaches as well as on the comparison between them.

3.2. Qualitative approach

"Qualitative research is research that involves analyzing texts and interviews in order to discover meaningful patterns descriptive of a particular phenomenon."

Carl F. Auerbach (2003: 3)

Qualitative research in general is targeting the questions what is the problem and why is it a problem rather than the question is the identified problem a common problem. Auerbach described the qualitative approach similar by using the expression *hypothesis-generating research* in comparison to the quantitative approach, which he named *hypothesis-testing research* (2003: 4). This view is underlined by Denzin and Lincoln who are arguing that qualitative researchers are more likely to reveal pattern within the everyday social world comparing to quantitative researches (2000: 10). As the case study ought to reveal pattern in managing human resources, the choice for the overall qualitative approach was simple. The aim of the research was to give answers to the question, what are the main challenges in allocating human resources to multiple projects. Therefore the qualitative research seemed to be an appropriate method. To build the tentative hypotheses different methods of collecting data have been applied. As the research model indicates internal documents, literature review as well as pilot studies have been used to gather necessary background information. The use of different data gathering methods as well as different research approaches indicates that the study followed the philosophy of post positivism (Trochim [B] 2006). The post positivism philosophy takes the internal and external validity of a subject into focus and follows the logical-deductive or grounded theory (Denzin & Lincoln 2000: 22).

The usage of interviews is a common approach to gather datain the qualitative research method (Kvale 1996). In this case study interviews as a research method has been used for the pilot studies as well as for the external data gathering. The following two chapters will explain more detailed how the interviews have been conducted.

3.2.1. Pilot study

In the beginning of this case study three key persons of the HR management process have been interviewed. The head of the department as well as the head of the engineering and site unit have been answering the questions of the semi-structured interviews. In all interviews the same standard questions have been asked, which led to further individual questions and discussions. The purpose was to explore and to identify internal proceedings and difficulties within the subject. Especially the issue of HR-allocation has been stressed. Each interview lasted about one to one and a half hours and has been transcribed. The different perspectives helped to understand the department specific problem areas and also the unit specific requirements. Subsequent to the pilot study the internal process has been identified, visualized and presented to the interviewees. During this phase of the study the tentative hypotheses have been created. Also the further research process, management expectations and research objectives have been discussed and agreed on.

3.2.2. Interviews

In total six semi-structured interviews have been conducted. The interviews lasted between one and a half hours to over two hours. Every interview has been audio-recorded and subsequently transcribed. The transcribed data comprises about 90 pages of interview material. The guideline questionnaire for the interviews has been created after the pilot studies as well as the literature review have been conducted. The guideline questions have been reviewed and revised by the management of the case

company, by VTT and by the thesis supervisor of Vaasa University. Interview 1, 3 and 4 were hold in different departments (business units) of the same cooperation whereas interview 2, 5 and 6 has been conducted in other companies.All organisations which have been interviewed are operating globally and belonging to the top class of their respective core competences. After the transcribing process has been finalized all interviews have been read three times. The first review helped to recall the interview and get a profound understanding about the individual procedures concerning managing human resources. During the second review the tentative hypotheses were in focus whereas the 3rd round was dedicated to reveal further pattern within the subject in question. The following table gives an overview about the key parameters, important for the research, of each interview.

Table 1. Interviews overview.

Company	1	2	3	4	5	6
Interview Type	Single	Single	Single	Group	Group	Single
Participants	Section Manager	Department Manager	Department Manager	2x Section Manager	2x Department Manager 2x Section Manager	Department Manager
Simultaneous projects	ca. 20	ca. 50	10 – 15	ca. 20	120 – 160	15 – 20
Duration of projects (in months)	6 – 18	1 – 24	4 – 30	6 – 24	6 – 18	5 – 36
Own employees involved(per project)	4 – 15	1 – 20(+)	4 – 15	2 – 8	10 – 20	4 – 6
Resource pool (intern)	40 – 50	ca. 50	ca. 40	ca. 90	ca. 150	15 – 20
HR-usage	Shared resources	Shared resources	Shared resources	Shared resources	Shared resources	Shared resources

3.3. Quantitative approach

The research model indicates that the quantitative approach was used to test the tentative hypotheses. Even though the quantitative method is considered to follow the deductive reasoning approach (Casebeer & Verhoef 1997), in this case study it was applied to serve the overall inductive approach. The survey mode of quantitative methods was chosen to collect internal data, more precisely in the form of a questionnaire. The main objective of this questionnaire was to gather information about internal experiences on the subject of human resource allocation in a multiple project environment. The process of how the allocation is planned, executed and monitored was the centre of the questionnaire. The following table about the advantages and disadvantages of questionnaires is taken from the book Media and Communication Research Methods of Arthur Berger (2000).

Table 2. Self-Administered Questionnaires.

Advantages	Disadvantages
Inexpensive	People may misinterpret questions
No Interviewer bias to worry about	Low response rates the norm
You can ask about very personal matters	You don't know who actually filled out the questionnaire
You cans ask complex, detailed questions	Sampling errors frequent

According to Berger, questionnaires are used as a tool to gather information of a certain group of people who can represent a much larger group if the information is embedded in the experience of those people (2000: 187 – 206). From this point of view the research method suited perfectly to the requirements of the research model. The idea

was to test if the employees of the case company agreed or disagreed with the proposed hypotheses based on their experience.

As mentioned earlier, the questionnaire was built to gather information for different measurement tools. The first section was divided into five different parts; personal information, the planning process, the allocation process, project monitoring and finally software tools. In this part mainly closed questions were asked which could be analysed with statistical standard-tools. The second section was built to analyse the data with the CFI method. Basically the same theme was covered in order to enhance the validity of the answers given in the questionnaire. Another important aspect concerning the response rate of the questionnaire was to inform the employees why the questionnaire was handed out and which benefits they have in responding to it (Berger 2000: 189). To decrease the possibility of misinterpreting the questionsasked, they were short and as clearly defined as possible (Hannan 2007). Therefore different parties were involved in testing, reversing, improving and accepting the questionnaire before it was handed out. For example, the management team of the case company was involved in proofreading and accepting the questions, several test runs had been made with randomly chosen employees and as a result, questions or possible answers were revised. The final version had been sent to the study advisor as well as to the Technical Research Centre of Finland (VTT). After the approval from the study advisor and VTT the questionnaire was handed out to 41 employees of the case company.

Within a two week period 24 questionnaires could be collected. After subtracting the employees who have been out of office during the respond period 36 employees could have answered the questionnaire. In total that leaves a respond rate of 66,66 percent.

The following two chapters will explain the applied analysing tools in more detail. Especially explaining in depth the CFI method, as it is a recently developed method, used to measure business process performances.

3.3.1. Descriptive statistics

The choice to analyse the first part of the questionnaire with descriptive statistics came from practical matters. The maximum achievable sample size (respondents) of the questionnaire was simply too small in order to apply inferential statistic tools. The subgroups of the questionnaire sometimes comprised of only a number of three possible participants and therefore the meaning of inferential statistics is almost zero. According to Hannan a sample size lower than 30 participants is from very low relevance (2007). Nevertheless the descriptive method is an appropriate tool to observe patterns within the gathered information. Descriptive statistics are used to measure the basic features of a particular research (Babbie 2010: 467). For example attributes like how many employees with a certain expertise have responded, or how high the average work experience of the respondents is, can be illustrated with simple graphs or tables. This approach was especially useful in the result report for the management of the case company. Since the company was interested in the internal process, the use of descriptive statistics gave valuable information about internal proceedings.

3.3.2. Critical Factor Index

The CFI method is basically a measurement tool used to indicate which attributes of a business process are critical and which are not, based upon the experience and expectations of the company's employees (Ranta & Takala 2007). The CFI was developed on the basis of the Gab analysis and the implementation index (IMPL). The IMPL was also invented by Josu Takala. The original idea, behind these measurement tools, was to develop a fast and reliable method for management purposes to sense and respond (to) customer satisfaction (Rautiainen & Takala 2003). The method reveals which attributes are critical within the business process and therefore gives the management the support to make decisions concerning which attributes should be improved. However, the usage of IMPL and CFI in over 50 different case studies, comprising a big variety of processes as well as business environments, showed that the

method can be used to measure basically every business process, given that the attributes are well defined.

The use of a questionnaire is one of the most efficient approaches to gather the required information. Due to the fact that each process has its own attributes the questionnaire cannot be standardized but instead has to be created individually. Typically the method consists of three phases. During the first phase the current situation is explored, tools like personnel interviews, in depth interviews and observing are used. The second phase is the most crucial part; the right attributes have to be defined in order to reveal the relevant critical factors. To serve the overall goal, proposing development needs for certain attributes, the choice for them should be in line with the company's own strategy, vision, mission and values. Therefore information from phase one is essential as well as internal information about the company's internal proceedings. In phase three all gathered information will be analysed and furthermore the CFI measurement tools will be applied (Rautiainen & Takala 2003; Ranta & Takala 2007).

However, a frequently stated weakness of the CFI indicator is the high influence of standard deviations. Antti Rajala and Josu Takala proposed in a case study, conducted in 2009, the further development of the CFI in order to increase the reliability of the findings (2009). In this paper the method will be explained in depth and furthermore the development from CFI to BCFI will be presented.

In this case study this method was used to measure the performance of the human resource allocation process. In total 20 attributes were chosen to describe the process of planning, allocating, monitoring and using software tools for the overall allocation process. The following table shows some example attributes taken from the internal questionnaire.

Table 3. Examples of attributes from the internal questionnaire.

	Expectations	Experiences	Direction of Development			Compared to past		
ATTRIBUTES	(1-10)	(1-10)	Worse	Same	Better	Worse	Same	Better
Resource planning process								
Structure and clearity of project schedules								
Reliability of time schedules								
Reliability of workload estimations								
Information flow throughout the project team								
Planning process in general								
Resource allocation process								
Communication between management and project team								
Distribution of projects								

The respondents were asked to evaluate each attribute in terms of expectations and real life experiences about it. In this case study it was also asked in which way the employees believe the attribute will develop within the next two years and how it has changed within the last two years. The scale from 1 to 10 was chosen to evaluate the different attributes. The relatively wide range makes it easier to point out inconsistencies between expectations and experiences (Ranta & Takala 2003: 316). The following figure will present all necessary formulas for calculating the CFI.

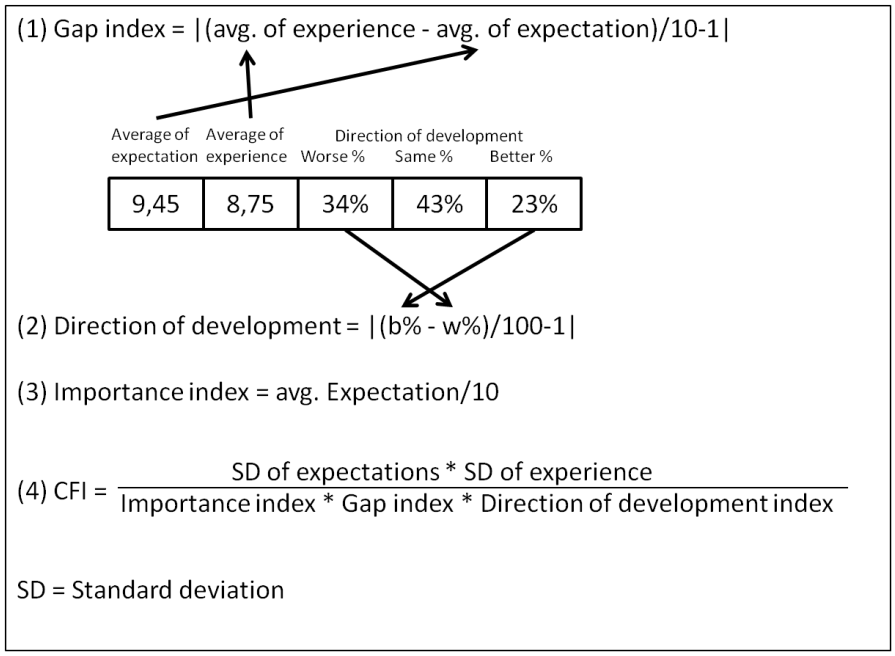

Figure 6. The CFI method.

Based on the CFI formula some changes have been made in order to lower the high influence of the SD and furthermore to raise the weight of the experience as a factor. In addition to these features the earlier SD problem, by appearance of SD = 0, was solved. The new formula is called BCFI (Balanced Critical Factor Index) and has been approved in terms of logic and functionality by the inventor of the CFI method, Professor Josu Takala and Professor of statistics at Vaasa University, Dr. Bernd Pape.

$$\text{BCFI}= \frac{\text{SD expectation index} * \text{SD experience index} * \text{Performance index}}{\text{Important index} * \text{Gap index} * \text{Direction of development index}} \quad (1)$$

$$\text{SD expectation index}= \left(\left(\frac{\text{SD of expectation}}{10}\right)+1\right) \quad (2)$$

$$\text{SD experience index}= \left(\left(\frac{\text{SD of experience}}{10}\right)+1\right) \quad (3)$$

$$\text{Performance index= Average of experience/10} \quad (4)$$

With the BCFI the critical factors can easily be identified. All attributes with a value below one are considered to be critical. The more they are going in the direction of zero the more critical they are. The value one represents an optimal attribute whereas all attributes with values above one are considered to be “high performers”. However, the expression of a high performer could lead to a misinterpretation. High performer does not necessarily mean that the attribute has a high performance it only indicates, for example, that the expectations are met by the experience and the direction of development index has a higher value than one (positive direction), or also if the experience exceed the level of expectations.

In addition to the standard formula the BCFI method offers two variables which can be emphasized. The following formulas will show how the Gap index and the Direction of development index can be modified.

Influence of Gap index increased by 0,3:

$$\text{Gap index} = |(\text{avg. of experience} - \text{avg. of expectation})*1{,}3/10-1| \quad (5)$$

Influence of Direction of development decreased by 0,1:

$$\text{Direction of development} = |(b\% - w\%)*0{,}9/100-1| \quad (6)$$

The results change accordingly to the adjustments that have been made and therefore different factors can be reflected as stronger or weaker than the others. This is important, for example, if the management feels that the employees might have a too positive attitude concerning the direction of development. In that case the management can lower the influence of this factor by reducing its weighting as stated in formula 6.

As mentioned earlier the respondents were also asked to answer in which direction an attribute has changed compared to the past. Therefore the BCFI has to be calculated with the past development index. This factor should have the reverse influence on the value of the attribute, as compared to the direction of the development index. In this case, following formula has to be applied.

$$\text{Past development index} = |(w\% - b\%)/100-1| \quad (7)$$

Otherwise the BFCI formula remains the same. Once the BFCI with the direction of development index and the BFCI with the past development index have been calculated, the development of the attributes can be monitored simply by comparing the two calculations. This approach gives valuable information about how past development efforts have been affecting the attributes.

The following table shows the feasible values for each factor and furthermore explains the logic behind the value.

Table 2. Values and meaning of factors.

Factor	Range of value	Meaning
Standard deviation index	1 – 1,5	1= high (critical) 1,5= low (not critical)
Performance index	0,1 – 1	0,1= high (critical) 1= low (not critical)
Important index	0,1 – 1	0,1= low (not critical) 1= high (critical)
Gap index	0,1 – 1,9	0,1= low (not critical) 1,9= high (critical)
Direction of development	0 – 2	0= low (not critical) 2= high (critical)

The standard deviation, for example, indicates the agreement between the participants of a certain attribute, a low value indicates that people agree with each other and therefore this attribute is defined with a higher trustworthiness. If the value is high the significance for the attribute is decreasing as the participants have quite different opinions about it. The performance and importance index are self-explanatory and represent simply the level of performance or expectation of the attribute. If there is no gap between the expectations and experiences of an attribute the index is one, otherwise the Gap index can give positive or negative direction to the BCFI according to the relation of difference. The last index follows the same principle as the Gap index, if the direction of development is 100 percent the same (no direction) the value is one otherwise it will influence the BCFI in the same manner as the Gap index.

4. FINDINGS

As stated in the methodology section several approaches have been applied in this research, therefore the findings will be presented separately. However after all findings have been presented the thesis will be finalized by a conclusion summary which comprises all approaches and will point out the major results and the development needs.

4.1. Qualitative findings

As described in the methodology part the qualitative findings are based on six interviews which have been conducted either in group discussions or personal interviews. This section will be divided into two separate parts; the first part will give answer to the initial hypotheses and the second part will outline explorative found patterns concerning the subject of human resource allocation.

4.1.1. Findings regarding hypotheses

Hypothesis 1: According to the respondents, the roles and responsibilities in general were defined very clear. Most of the interviewed organisations have standardized project management structures and ready defined processes. Only the overall organisational structure was not always clear. One respondent answered:

"We have a functional structure! …but in a way it is working like a matrix."

In a group interview two respondents discussed:

> Respondent A: *"On higher level we have a matrix structure, but locally it is more a functional structure."*
> Respondent B: *"Maybe in some way a combination because we have these different functions like export and domestic and similar. I don't know how to describe it, it is maybe a combination."*

From these findings hypothesis 1 can be rejected. Although some respondents were not sure about the organisational structure the general resource procedure was thereby not disturbed. However, whereas the responsibilities are usually defined precisely, the inconsequent adherence could be identified as an influential factor. One interviewee for example answered:

> *"Basically the PM has to study what is needed and according to that he/she has to make the schedules and ask for resources. The lead engineers are doing the same for the engineering team, but sometimes it gets a little bit messy because the reality is often not as clear as we would like to."*

Another interviewee's words were:

> *"In some projects the PM is not doing the resource planning properly but instead is asking for people just to get a pool of employees. Later on, in meetings, the PM will start telling people what to do… that causes difficulties for the department manager, who is trying to plan how long the employees will need to be occupied."*

> *"…when we go into details, then sometimes it gets clear that the PM does not know the situation very well him/herself. In general those PMs create the problems in our resource allocation process."*

Altogether this phenomenoncould be observed in five interviewees and was stated as an influential factor which leads to disturbances in managing resources.

Hypothesis 2: The disturbances in the resource management process through external factors have been acknowledged in five cases. Three of them stated external factors as the main challenge in the planning stage of the resource process. In most cases the communication between customer and organisation is not as frequent as expected and the required information about scope and tasks are difficult to acquire. Therefore one answer of an interviewee was:

> *"The lack of information is a big problem for planning resources. If we for example are missing information for drawings from our customers then it will result in schedule changes… the internal plans should be achieved as planned if the resources are available… the main factors are coming from outside."*

Another respondent stated:

> *"The customer themselves are very different, they are working in different ways and the information is understood differently. That can lead to the situation that we do not have all the information that is required for the work."*

Furthermore some of the respondents who were in line with the assumption argued that from the resource point of view it is easier to have the management premises for the entire project then just being a part of the whole. Not only during the planning phase but also during the execution phase of a project are the external factors mentioned as one of the main factors for disturbances. One participant answered:

> *"In most of the cases the workload is increasing, when for example some tasks are taking more time … or there are some new tasks coming from the shipyard, unexpectedly, that is difficult… we had one month ago an unexpected situation at one shipyard and therefore we had to take a guy from the sales support for one month as a full time support for our project. In addition we needed some help from external employees."*

Or in other words:

> *"…the fluctuations in the project plans. Normally this does not depend on us. Mostly the customers have a delay which then influences our plans, because we have made our plans according to the dates, which the customers have been given to us."*

In general there are no standardized routines how to manage such cases and therefore they are handled individually. Especially the unexpected changes are described as fires which need to be fought. Only one respondent argued that they are not much dependent on external factors due to the internal organisation and actively communicated deadlines and freezing points.

Hypothesis 3: In four cases the limitation of expertise has been stated asa factor which has negative influence. Especially the usage of the same employees, in different projects, simultaneously is causing problems. To quote one interviewee:

> *"In many cases we cannot build the optimum team for our projects. We could easily know who would be the optimal person for a certain project, who would do a really good job, in time and thereby save our costs and achieve better profit… but this person can just be allocated to 100% to another project… we need to build the team from the available persons… often we need to accept that it is not the optimum setup, but it is good enough!"*

A similar opinion was stated as follows:

> *"The challenge is to get the right people for the project in order to really execute in a sufficient way, but we are not always able to do that."*

In one case the respondent even answered that they face a lack of capacity at all times. This is a drastically increasing phenomenon, as the projects become smaller and more

demanding, as several interviewees explained. It means more specific knowledge is needed in a growing number of projects. One participant answered:

> *"Our problem nowadays is that our business is changing a little bit. Earlier it was easier because we had very big projects, now they become smaller and smaller and they need more coordination, more work. Instead of three big projects we now have ten small ones, so the work for us and the PMs is increasing, but the turnover remains the same or is even decreasing possibly. So that is a problem."*

In all six interviews the respondents explained how the use of external resources helps them to deal with this issue and how they in turn leverage the up and downs in the overall project workload. Almost all organisations have regular frame-agreements with subcontractors and therefore can use the external resources quite efficiently. To give an example:

> *"The companies we have contracts with, are close to this geographical area. Some of them even have shared access to our databases (of course very limited). Those are handled as a kind of our own resources and been planned as the others. We have frame agreements with the sub contractors, which are agreed upon every year. We also discuss several times a year with the sub contractors about the resource capacity and availability and so far we have not had any problems."*

According to the respondents, who reported difficulties with the limited expertise level, the causes can be traced back to the ongoing changes in workloads and therefore are hard to manage. One reason is that organisations need to stay competitive and cannot afford to keep resources sitting on a bench, just waiting for a specific task or project.

Hypothesis 4: The poor visibility of the current and future workload has been acknowledged in five cases. To the question, what are the main challenges in monitoring resources during a project? Five answered, "*it is the workload"*. Whereas in

some cases the planning and scheduling tools are blamed others see their PMs responsible for the situation. The following comments are a short summary from a multitude of answers concerning the visibility of workload:

> *"I think the main challenge is that we cannot monitor the actual workload…we have not done the planning on activity-level so far."*

> *"The main challenge is to estimate where we are, how much work has been done and how much hours we still need to spend."*

> *"The main challenge is the personal workload level; this is definitely the main challenge at the moment."*

> *"I would say the most challenging task, from our local office point of view, is to know what the exact utilization rate of our employees is and what the real availability time is… so far we cannot monitor that with a clear view, we get the projects done and we do not care how long it takes."*

The next statements are a summary of causes and possible solutions:

> *"So far the PMs have to update the changes for the schedules anyway, but if they would integrate the resources in the schedules, then you would not have to keep an extra tool for the resources, it would be updated automatically."*

> *"It is essential for the project manager to understand how important and necessary it is to report and plan."*

> *"To keep the tool updated, that is manual work. One pitfall is that you cannot see how much time the employees have actually been working on a project. The hours that are assigned to one tool are not coming back to the other tool we are*

using, so that we could see the work that has been done. So you do not know what has been done and what you still need to do in the future."

"Our resource planning today is on a general level. The detailed planning will come hopefully with the implementation of the new software."

It was interesting that, without exceptions, all organisations which have difficulties in monitoring the workload have implemented reporting processes (on a functional level) on a monthly basis, whereas the only organisation which did not report difficulties on workload monitoring has the reporting sessions on weekly basis.

Hypothesis 5: The same respondents, who have been reporting difficulties in observing the workload, are also facing problems with the usage of the supporting software tools for resource management. It is common for organisations to use more than one tool in order to cope with the requirements of the multiple project environment. Often the available tools are limited to single project handling method the managers then use self developed excel sheets and in some cases even several. The overall satisfaction about tools for resource management purposes, in a multiple project environment, was very low. Only two respondents gave positive feedback about the usability of such tools. The following quotation has been a common answer:

"Yes we have one, it is not very good, but it is the best we have."

The discussion then continuous about the unique processes the different organisations or units have and that so far no suitable tool has been found. Furthermore the interviewees told about the problems with input and output feasibilities and interfaces to other programs. Here are some examples about the difficulties the participants were facing:

"We are using different excel tools, we have been using the same tool as the other units, I do not know if they are using it at the moment but we had a common tool… actually we are not using this tool at the moment… at the

moment we are using our own excel sheets… but the problem is that the different sheets have no connection and we need to update them separately and also we need to check different sheets to get an overview."

"Beside our planning tool we actually have also another excel tool which is calculating the accurate (actual) workload or utilization."

"People can only be assigned to one project in the tool…it has no interfaces… the reports are not coming automatically, they need to be done manually."

"The program is working but it takes a lot of time. For future actions we have some ideas whether or not to move to a new tool to do the planning. But let's see, I have heard both, good and bad comments about this planning tool."

"We have been thinking about some tools and feasibilities in our new ERP system. Ok, we hope to get something better but at the moment we do not know what that could be."

Beside the functionality, the participants described the maintenance of such tools as rather challenging. Thereby often at times, detail complexity, WBS or workloads have been mentioned as the influential factors. How precisely the workload has to be entered, to which degree it makes sense to break down the workload, how often the tool should be or has to be updated and how much extra work that creates for the management. Also the added value of such tools was questioned several times. Only one organisation could clearly demonstrate the benefits of their human resource management tool, which had been developed over a period of two years. The interviewee outlined the importance of simplicity in nature of such a program, connectivity within the whole organisation, the visibility of entered data and the correct usage. The following quotations are from the discussion about their own developed tool:

"I think we are doing pretty well… through this new system, we in the management, we can see much more clearly where we are going. If everybody is keeping their own books, then we are not able to have a clear view."

"If we want to have reliable results, everybody has to update the tool and use it correctly. If they do not update the information or even enter false information the value of the tool goes down."

In summary, in three of the cases there are active discussions about the usage of their existing tool or if they should change to another. In two cases the implementation of a new tool is in progress and in one case the implementation phase of a new human resource management tool has recently ended.

4.1.2. Explorative findings

In addition, to the findings concerning the hypotheses, further patterns could be identified. The three most evident were related to time schedules, individual job performance and primary education. The following paragraphs will present the findings of these attributes respectively.

Time schedules: In most cases the time schedules have been an important indicator for the short-term planning process, therefore the reliability and validity has also been critically discussed. Beside the difficulties in estimating the workload, the updating process has been stressed as an important influential factor. In four cases the interviewees reported that the high level of uncertainties in time schedules were causing major difficulties in the resource planning and resource allocating process. To quote a respondent:

"The main challenge in planning the resources is to have the correct working hours from our ongoing projects. If all those numbers would be correct than I would say it would be easy for us to plan for the next projects."

Or one interviewee said:

> *"In the allocation phase, there is only one challenge and that would be to have exact schedules, this is what we need."*

Another straight forward answer was:

> *"Well, one thing that really should be improved is project scheduling."*

Further quotations, which strengthen this observation, can be found in the findings of hypothesis 1. Also the influence of changes from one project schedule to another has been stressed. So far, most of the organisations face difficulties realizing the impact of such changes and need to manage these case by case. In one case the participant answered:

> *"We are lacking in our schedules, for example, if we have changes in the scope of our projects, we do not know how to convert that from project to department level. We cannot see the influence of how changing one project will affect the schedule of other projects… that is maybe our biggest problem."*

A comparable statement from a different respondents was:

> *"Time changes in projects are maybe the biggest challenges we have. Because of these changes the project is not going as planned and our resource planning for this project is turned upside down and consequently that will affect other projects as well."*

The interviews showed that the project specific time schedules are connected to all phases of the resource management process. Additionally, the high development demands approved the importance of this attribute.

Individual job performance: A topic, widely ignored by project management literature, is individual job performance. In five out of six interviews this subject appeared without asking for it. As described by the interviewees, the main challenge is to know the employees capabilities of performing specific tasks. The following summary will show some concerns of the respondents:

> *"To estimate the workload, there is a lot of experience involved, you need to know how fast your employees can work… for some work one employee needs 80hours and another needs maybe 120hours."*

> *"The problem comes with the different working attitudes; some workers can work faster and will achieve better results than others."*

> *"Some PMs are good in planning and reporting and some are not so good."*

In addition to how fast or how good people are performing their tasks, the issue of personal workload and priorities has been discussed. In some cases the different capabilities led to preferences in the resource allocation, which then resulted in unsatisfying workload distributions. As it is a very sensitive and complex issue, which cannot be addressed very freely, the handling is considered rather complicated.

Primary education: Due to the fact that all the interviews have been conducted with companies with core competencies in the field of engineering, it was no surprise to find mainly managers with an educational background of engineering. However, it was still unexpected that even for managing positions like Line-, Unit-, Department- or Project Manager only employees with an engineering background were employed. For example, to the question, did you feel prepared for your job when you started here, the following answers were given:

> *"No, first you have to start and then you take the lessons."*

"No, you learn through the work, through actually working on projects. I had been working on projects earlier, when I started as a designer and gradually I went through different positions within the company."

Common explanations were:

"It is very important that you have a technical background because you are working with technical people (engineers), you have to understand the needs of the projects and what the people are doing. If you do not have a technical background I think you will have a very hard time to understand the projects and their needs."

Even though as some admit:

"They are line managers… they also have to manage resources, take care of the competence levels and the pool of expertise. They are so to speak not HR-personnel but are doing HR-work on operative level."

"HR-work is a very important part of the PMs… in this respect I believe, it is not always good that they have a mainly technical background."

Only one respondent mentioned:

"It could be that a person with a commercial background could learn the needed technical level but we have not tried that."

Whereas in some organisations, for example, PMs have to go through a standardized learning program for planning, scheduling and reporting, in others the educational standards are not followed so consecutively.

The following table will show the overall agreements or disagreements about the tentative hypotheses and the additionally identified patterns. If the respondents approved the hypothesis the cell is marked with a "+", if they rejected the hypothesis the cell is marked with a"-" or for a neutral opinion the cell is marked with a "o".

Table 4. Result overview.

Company	1	2	3	4	5	6	Approved	Rejected	Neutral
Hypothesis 1	-	-	-	-	-	-	0	6	0
Hypothesis 2	+	+	+	+	+	-	5	1	0
Hypothesis 3	+	-	+	+	-	+	4	2	0
Hypothesis 4	+	-	+	+	+	+	5	1	0
Hypothesis 5	+	-	+	+	+	+	5	1	0
Time schedules	+	-	+	+	+	o	4	1	1
Job performance	+	+	+	o	+	+	5	0	1
Primary education	+	+	+	+	+	+	6	0	0

4.2. Quantitative findings

The quantitative results are based on the internal questionnaire which reached a overall response rate of 66,66 percent and is compounded as follows.

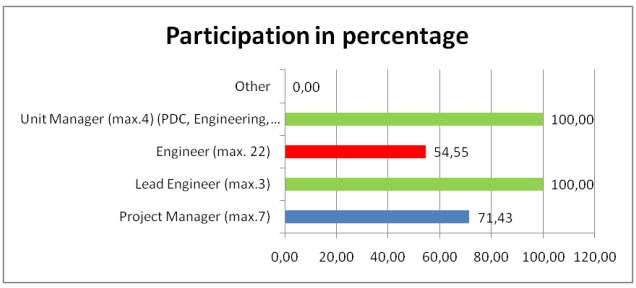

Figure 7. Participation of internal questionnaire.

4.2.1. Descriptive statistics

In this section the first part of the internal questionnaire will be analyzed and presented.The received answers are based on profound experiences. As can be seen, the work experience in general exceeded 5 years which also indicates a relatively low personnel turnover in the department. Furthermore, all of the employees have an engineering background and only a minority has also further management or business administration background.

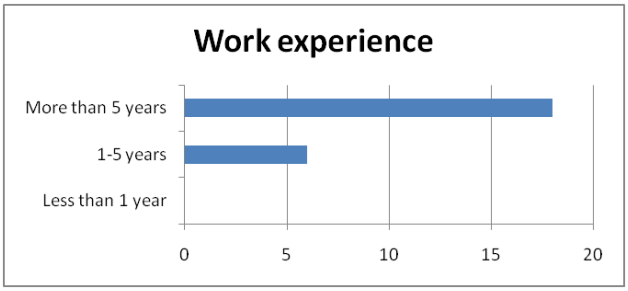

Figure 8. Work experience of respondents.

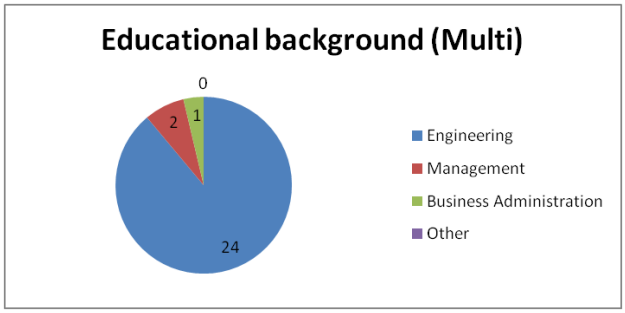

Figure 9. Educational background of respondents.

As communicated from the management the engineering background is an essential prerequisite for working in the operation's department and therefore the overall result comes with no surprise.

Hypothesis 1: The main processes in general are clearly defined in terms of structure and responsibilities, but still minor inconsistencies could be identified. The process of assigning work to employees as well as the frequency of status reports indicated weaknesses in the case company's operational sequences.

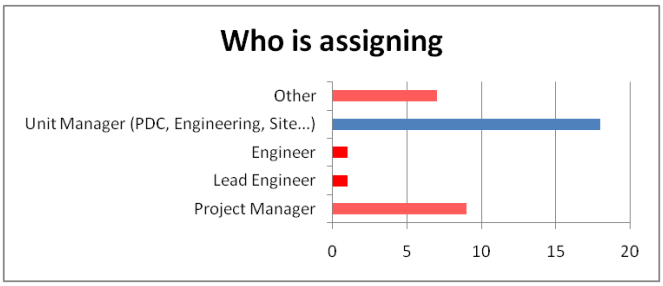

Figure 10. Distribution of workload.

The question addressed the process of the distribution of workload and allowed multiple answer choices. Therefore, the single attributes cannot be compared with each other but still the above pictured graph shows the uncertainty about the allocation procedure. In the pilot studies the management of the case company communicated a clear structure of distribution of workload, contraire to that the internal questionnaire revealed weaknesses. In the open question part some employees stated:

> *"Now too many bosses are giving work for us. There must be a clear system who is dealing work for employees."*

> *"All project assignments should be given from my boss. It is not OK that 'sales people' come direct to me saying that you should do this and this and everything should be ready yesterday."*

Furthermore the frequency of status reports differed greatly among the participants. Whereas the reporting process, in terms of to "whom" to report, is well defined and followed by the employees, the reporting process in terms of frequency reveals major

inconsistencies. The following graphs will show the frequency of reports of the different groups.

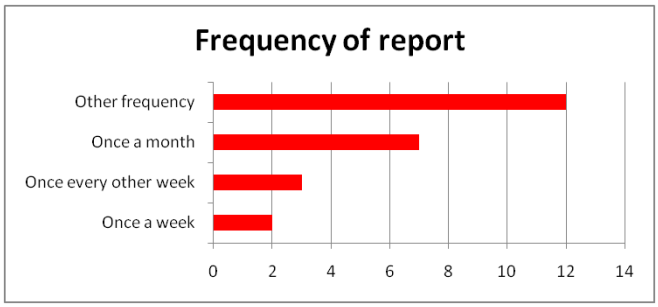

Figure 11. Frequency of status reports.

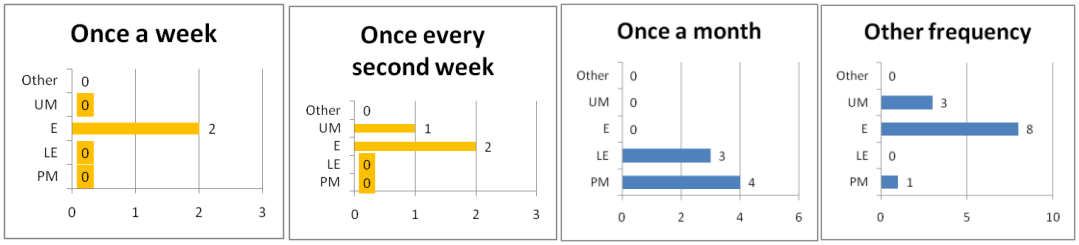

Figure 12. Frequency divided by answer choices and positions.

The case company's monthly follow up meetings can be identified in the "Once a month" answers and the distribution between LEs and PMs. However all other reporting frequencies differ enormously. The most common answers in "Other frequency" have been that it depends on the project, task, PM or similar issues. Those answers showed the uncertainty about how often the progress of the work should be reported.

Hypothesis 2: The high dependency on external factors can be monitored in several questions. However, the most obvious influence of external factors can be seen from the personal schedule changes. The question addressed the frequency of changes concerning the personal schedule. About 20 percent answered that they have to deal

with changes on daily basis, if we now accumulate the percentages to see how many employees have to deal with changes at least on weekly basis the percentage is 66.

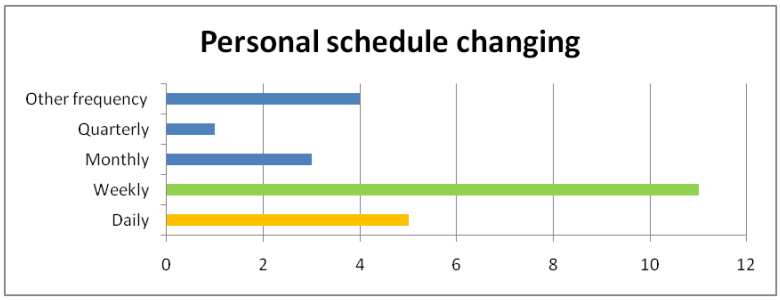

Figure 13. Personal schedule changes.

To give an example, one of the respondents answered to the question how the process could be improved:

"Teach customers to keep their schedules."

Therefore it is no surprise that over 40 percent of the respondents do not keep an own working schedule. One employee stated quite felicitously:

"It is impossible to keep an own working schedule."

One of the reasons of the high dependency on external factors is that the case company is only a minor shareholder of the main project. Most often the company's share of the overall customer's project is under ten percent. Therefore the company depends not only on the customer but also on a multitude of other suppliers.

Hypothesis 3: The limitation of expertise in numbers is evident and can be reflected by the respondent's experience about fights for personnel. The respondents were asked if they feel that there is a fight about their participation in different projects. As the following graph will show, over 40 percent reported that there is a fight about resources,

25 percent were not sure and only about 30 percent did not experience the phenomenon. The results showed that 80 percent of the participants who answered yes were engineers. In total 66 percent of the engineers answered with yes, 17 percent answered with I don't know and also 17 percent with no. The following graph will show the results in total numbers.

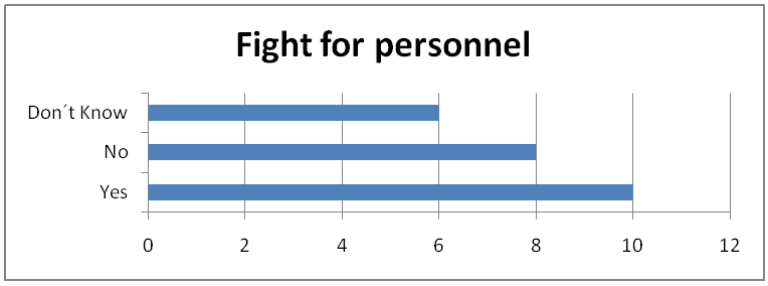

Figure 14. Fight for resources.

Hypothesis 4: The visibility of workload has many interdependencies to other factors. Therefore the reporting frequency, external factors, project duration, assignment to several projects and similar indicators has to be taken into account when evaluating the workload visibility. As already indicated for hypothesis 1 and 2, the reporting frequency as well as external factors are considered as being negatively influential. In addition the next graph represents the awareness about the personal workload in the future. As can be seen the respondents reported rather short future workload visibilities. The majority of the employees can only foresee the coming weeks up to three month.

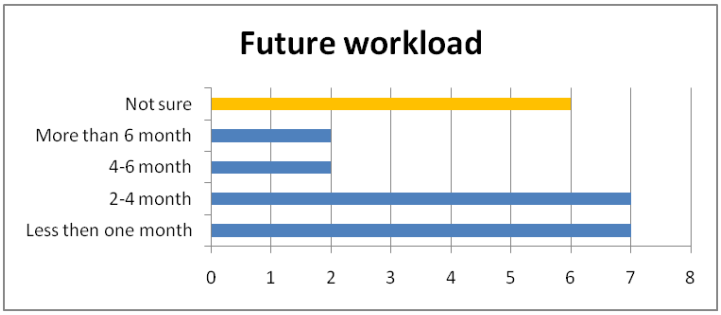

Figure 15. Future workload.

Furthermore are the workload estimations an important indicator for future workload. Thus it is very important to have reliable estimations in order to have a clear understanding about future resource needs. The following graphs will show the experience of the employees about the estimated workloads compared to the real workloads.

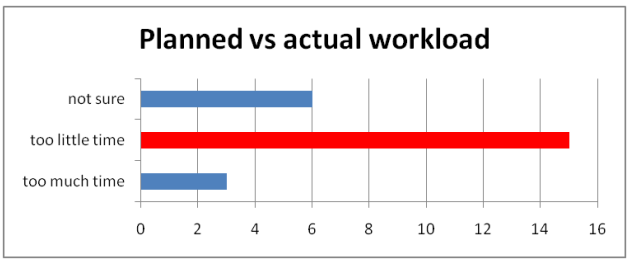

Figure 16. Planned vs. actual workload.

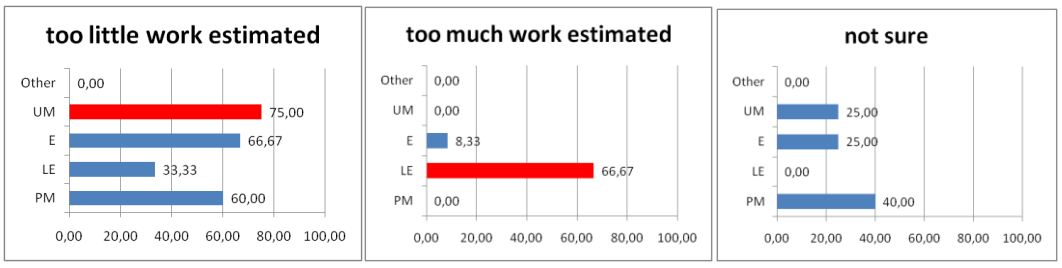

Figure 17. Workload estimations divided by answer choices and positions.

The first chart is drawn on total numbers of participants whereas the subdivisions are given in percentage. Overall agreement on “too little time planned for workload” can be monitored from the first graph. However it is noticeable in which positions the time pressure mainly occurs. As can be seen the LEs answered exceptional to all other positions.

In conclusion thevisibility of the future workload is rather poor. The information about the availability of resources as well as the future resource demand is difficult to monitor.

Hypothesis 5: Has not been tested with this method.

4.2.2. Balanced Critical Factor Index

The BCFI, as described in the methodology part, has been developed for measuring the performance of business processes based on real-life expectations and experiences of employees. The following graph will show first the overall evaluation across the whole department and later divided up by positions. After the position specific evaluations have been presented the hypotheses will be discussed.

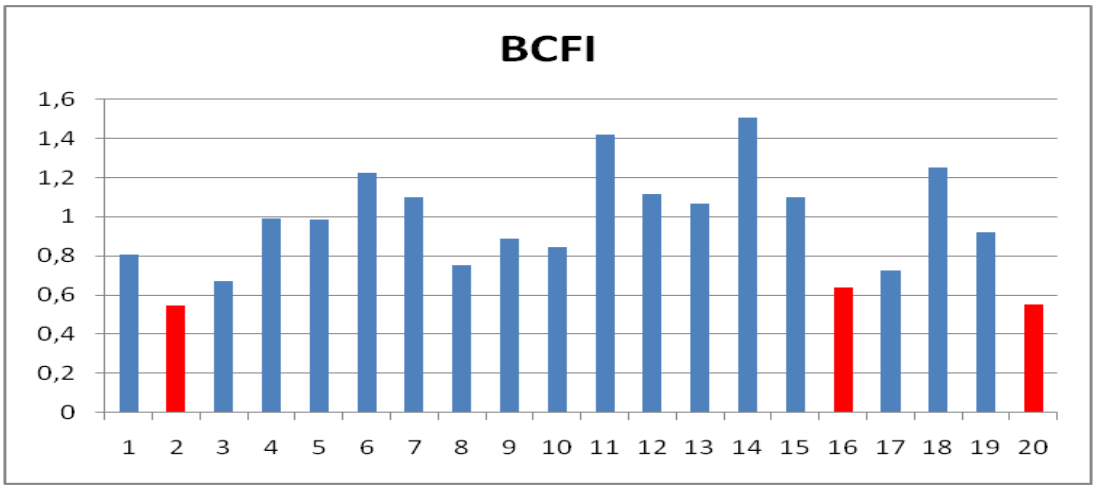

Figure 18. BCFI results of all participants.

The overall assessment of the human resource allocation process revealed that these attributes; reliability of time schedules (2), IT-systems supporting the business process (16), the usability and functionality of IT-systems (20); are considered as the most critical ones. The highest evaluations achieved the attributes number 14 (Collaboration between participants of the same project) and 11 (Reporting system for progress of projects). As described in the methodology part an optimal process is represented by the value of one. If the value of an attribute is below one it is considered as being critical, as the closer the value goes in the direction of zero the more critical it is. The following table shows the different attributes which have been evaluated.

Table 5. Attributes tested by the BCFI method.

1 Structure and clarity of project schedules	13 Visibility of remaining workload for single projects
2 Reliability of time schedules	14 Collaboration between participants of the same project
3 Reliability of workload estimations	15 Awareness of priority between different projects
4 Information flow throughout the project team	16 Information systems support the business processes
5 Planning process in general	17 Visibility of information in information systems
6 Communication between the management and project teams	18 Availability of information in information systems
7 Distribution of projects	19 Quality and reliability of information in information systems
8 Distribution of workload	20 Usability and functionality of information systems
9 Well defined responsibilities and tasks for each project	
10 Allocation process in general	
11 Reporting system for progress of projects	
12 Up to date work plans	

It is for certain that the management has focus areas when it comes to its development needs. However the BCFI results give a profound evaluation from the employees

dealing with these attributes and therefore can support such strategic decisions. The following table will show the exact values for the evaluation of these attributes.

Table 6. Evaluations of tested attributes.

ATTRIBUTES	Average of expectations	SD of expectation	Average of experience	SD of experience	Development		
					Worse	Same	Better
1	8,37	0,98	5,35	1,82	10,53	57,89	31,58
2	8,32	0,80	5,10	1,52	26,32	52,63	21,05
3	7,42	1,39	5,00	2,00	26,32	57,89	15,79
4	8,89	1,17	6,30	1,63	15,79	42,11	42,11
5	8,37	1,22	6,20	1,41	15,79	47,37	36,84
6	8,68	0,80	6,50	1,67	5,26	52,63	42,11
7	7,58	1,90	6,15	1,65	5,26	78,95	15,79
8	7,95	1,36	5,90	1,88	21,05	68,42	10,53
9	8,00	1,69	5,90	1,83	15,79	63,16	21,05
10	7,79	1,36	5,85	1,78	15,79	68,42	15,79
11	7,68	1,72	6,15	1,97	0,00	68,42	31,58
12	7,74	1,16	6,00	1,92	10,53	57,89	31,58
13	7,63	1,09	5,60	1,64	5,26	63,16	31,58
14	8,53	0,94	7,60	1,55	5,26	57,89	36,84
15	7,32	1,87	6,30	1,84	10,53	78,95	10,53
16	7,74	2,22	4,95	2,64	47,37	26,32	26,32
17	7,68	1,81	5,25	2,39	36,84	36,84	26,32
18	7,47	2,28	5,90	2,59	26,32	31,58	42,11
19	8,11	1,97	6,25	2,43	26,32	52,63	21,05
20	8,26	1,83	5,20	2,76	47,37	36,84	15,79

The primary analyses of the raw data reveals which attributes achieved the highest or lowest values from either expectations or experiences. High values for expectations (red) indicate the importance of the attribute whereas the attributes with a lower level of importance are marked green. In the section of experience the lowest values are marked red and indicate the lowest performance of all evaluated attributes. The green marked attributes on the other hand achieved the highest evaluation. In the last section, direction of development, the attributes with the most negative development forecast are marked red and the attributes with the most positive forecast are marked green.

In order to get some clearer picture how the BCFI values were evaluated from different positions the following table will show the unit manager (UM) the engineer (E) and project manager (PM) perspectives. Unfortunately only one valid evaluation could be collected from the LEs and therefore will not be analysed separately.

Table 7. BCFI values divided by positions.

ATTRIBUTES	E	PM	UM	ALL
1 Structure and clearity of project schedules	0,71	1,81	0,74	0,81
2 Reliability of time schedules	0,53	0,59	0,12	0,55
3 Reliability of workload estimations	0,87	0,81	0,57	0,67
4 Information flow throughout the project team	0,90	1,78	0,53	0,99
5 Planning process in general	0,90	1,08	1,15	0,99
6 Communication between management and project team	0,75	4,36	0,78	1,23
7 Distribution of projects	0,72	1,09	1,33	1,10
8 Distribution of worklaod	0,96	0,59	0,58	0,75
9 Well defined responsibilities and tasks for each project	0,85	1,00	0,31	0,89
10 Allocation process in general	1,15	0,71	0,53	0,84
11 Reporting system for progress of projects	1,13	1,31	0,89	1,42
12 up to date workplans	0,90	1,39	0,59	1,11
13 Visibility of remaining workload for single projects	1,33	1,07	1,17	1,07
14 Collaboration between participants of the same project	0,93	1,57	0,67	1,51
15 Awareness of priority between different projects	0,56	1,28	1,35	1,10
16 Information systems support the business processes	0,62	0,55	0,13	0,64
17 Visibility of information in information systems	0,78	0,74	0,42	0,73
18 Availability of information in information systems	1,07	0,84	0,94	1,25
19 Quality & reliability of information in information systems	0,73	0,57	0,22	0,92
20 Usability and functionality of information systems	0,68	0,50	0,14	0,55

The answers represent 3 responses for UM (=75% of possible respondents), 10 responses for E (=45,5%) and 5 responses for PM (=71,4%) plus one additional from a LE in the last section (=33,3%). Although the total number of 19 responses (=52,8%) cannot be considered as high, the percentage gives a more reliable figure in which to evaluate the answers. All in all the participants represent a respective number and therefore validate the method. From the table above one can see that different attributes were considered as the most critical among the different positions. All attributes with a BCFI value below 0,6 has been identified as very critical (only in the overall evaluation attribute 16 with a BCFI value above 0,6 has also been marked as very critical). Whereas it is quite difficult to decide which attribute should get the highest attention

when looking at the position specific evaluations, the overall result shows a quite clear picture. Nevertheless, the breakdown into subgroups allows the management to see which attributes are difficult for the different groups. For example are supporting information systems are considered especially critical from PMs and Ums points of view, whereas engineers are facing more difficulties with time schedules and project priorities. Furthermore it can be observed that the overall evaluation differ drastically between for example the PMs and UMs. The following chart shows the different evaluation in direct comparison to all other considered perspectives.

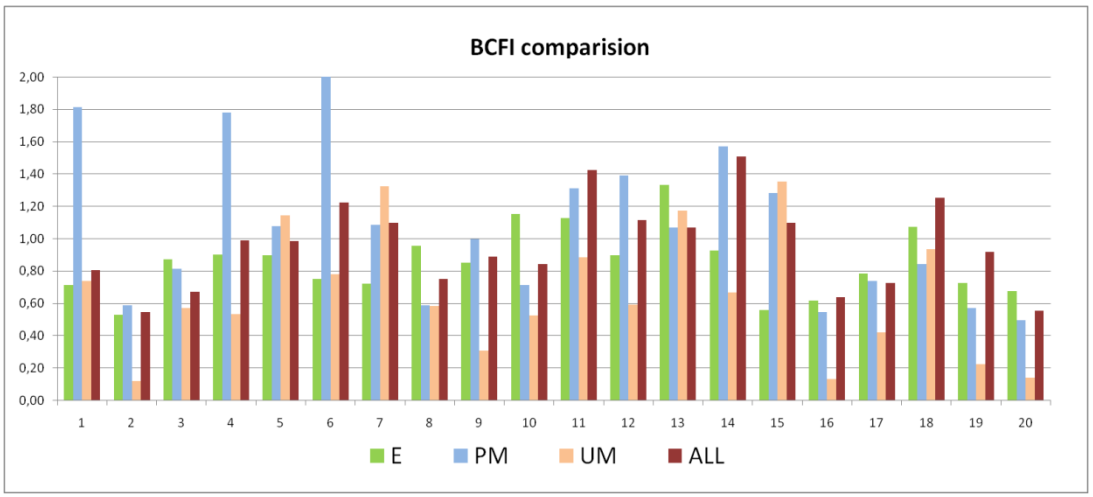

Figure 19. BCFI values comparison.

(The chart has been cut at the maximum value of 2 in order to give a good perspective for the deviation among the positions;the exact values can be monitored in the protrusive table.)

Among all subgroups the unit mangers have been evaluating the attributes the most critical. According to their evaluation the following attributes are especially critical; the reliability of time schedules, well defined responsibilities and tasks for each project and the general usage of supporting information systems. Furthermore the attributes number 3, 4, 8, 10 and 12 have reached a critical value, accumulated that makes 11 out of 20 attributes very critical. The following chart shows the BCFI values for unit managers.

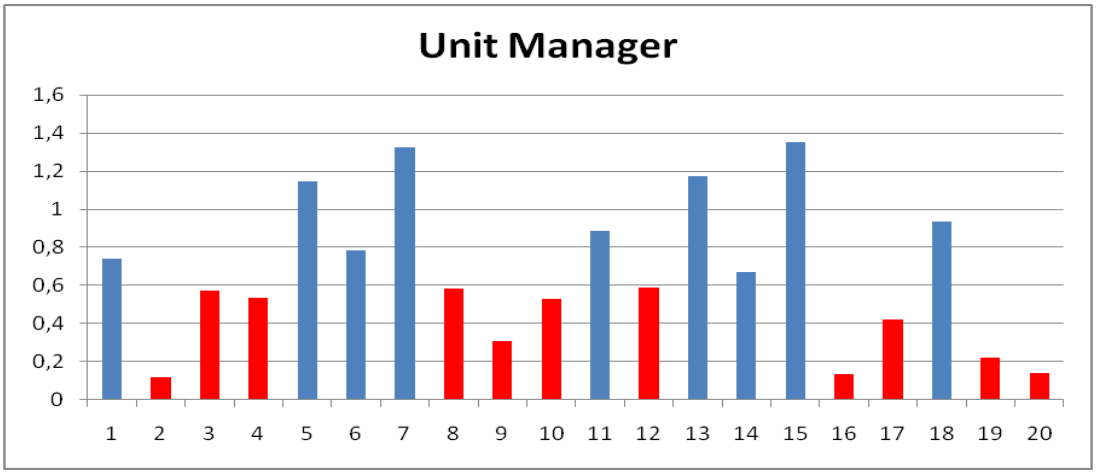

Figure 20. BCFI values of UMs.

The evaluation of the engineers on the other hand is more “in balance”. One reason for this distribution might be that the engineers are not involved in the actual allocation process in terms of responsibilities or tasks. However they still face the resulting difficulties and are an essential part of the overall process, therefore their answers are vital for the evaluation of it. As can be seen from the graph below, the reliability of time schedules as well as the awareness of priorities between different projects are considered as the most critical attributes. Those results can also be monitored in the section of descriptive statistics of the quantitative findings, in which for example 50 percent of engineers answered that there are no priorities between different projects or considered priorities as not important. It isremarkable that the remaining workload for a single project received the highest evaluation.

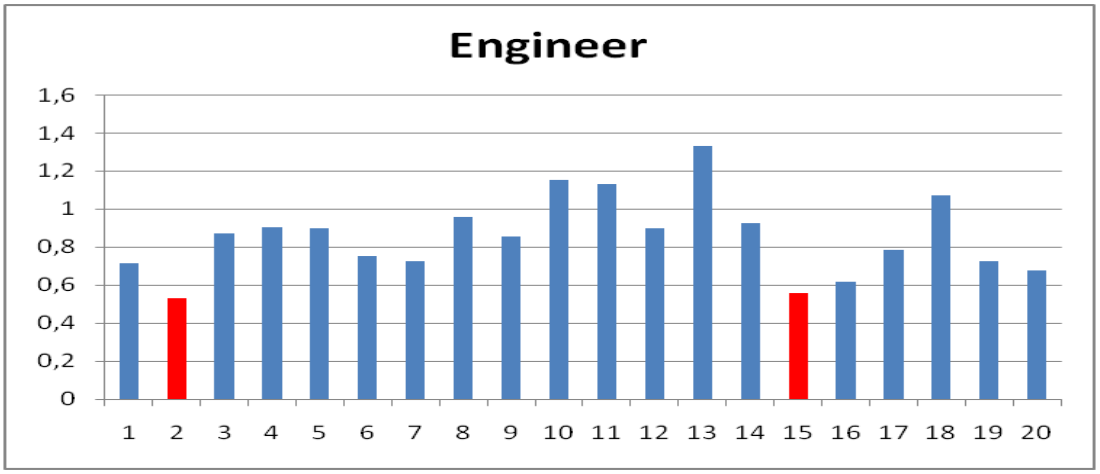

Figure 21. BCFI values of engineers.

In general,the project managershave given the most positive evaluation. Especially in terms of own responsibilities the answers were commonly quite positive. For example the attributes number 1, 4 and 6 have been evaluated exceptionally good. The main difficulties, project managers are facing, are the reliability of time schedules, the distribution of workload, and similar to the unit managers, the overall usage of information systems.

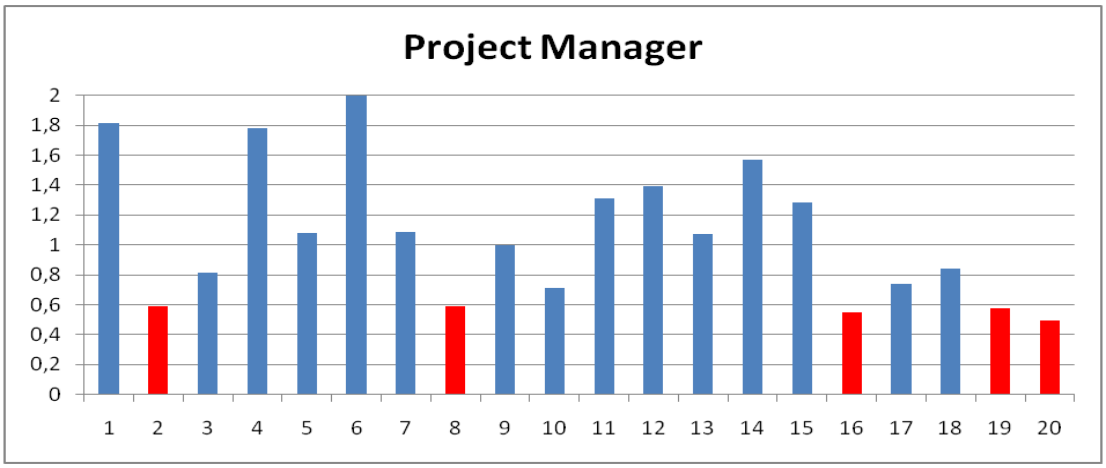

Figure 22. BCFI values of PMs.

(The chart has been cut at the maximum value of two in order to provide a good visible comparison to the other subgroups.)

As the BCFI is a method to evaluate processes rather than test implications the results will only support or not support the tentative hypothesis. The BCFI method was mainly applied for revealing internal development needs for the case company.

Hypothesis 1: The overall evaluation of attribute 9 indicates that there is a weak support for lack of clear responsibilities and tasks within projects. By looking at the position specific evaluation high deviation can be monitored especially between PMs and Ums.

Hypothesis 2: As the first part of the questionnaire identified the high influence of external factors on time changes, the evaluation of the time schedules from the BCFI supports the hypothesis. As can be seen from table 6 the reliability of time schedules has been the only attribute which has been evaluated as very critical (below the value of 0,6) among all positions. Furthermore the primary analyses (see table 5) already stated that the attribute is among the 3 worst evaluated attributes, in terms of experience.

Hypothesis 3: Has not been tested with the BCFI approach.

Hypothesis 4: Contraire to the findings from the first part of the questionnaire the visibility of workload (attribute 13) has not been evaluated as being critical. Not only the overall evaluation has been above the value one (optimal performance) but also in all position specific evaluations it exceeded the value of one. To recall the dependencies, stated in the analyses of the first part of the internal questionnaire, the evaluation of the reliability of time schedules and workload estimations are evaluated as being critical and therefore already indicate the negative influence on the visibility of workload. It seems as the attribute 13 has not been defined carefully enough and therefore is not a suitable indicator for hypothesis 4.

Hypothesis 5: The difficulties that the case company is facing with the available HR-tools are evident. The overall evaluation of the tool section has been rather negative with the exception of attribute 18. However, attribute 16 and 20 have been evaluated as being very critical. Especially the UMs and PMs stated the difficulties that they are

facing. As the engineers are less confronted with the usage of such tools the evaluation has been not as critical as from the other positions.

In addition to the critical factors, the developments over the last two years can be monitored. This feature is especially interesting if a company had development efforts over the period in question.As the development direction of both BCFI values (standard and past) are based on expectations and experiences, the reliability of the difference is greatly influenced by recent events and impressions, therefore this comparison should only give a rough idea in which direction one attribute has developed. For continuous analyses the past development index can be left out after the first investigation and be replaced by the BCFI of the previous survey. The following figure will show the findings of this case study.

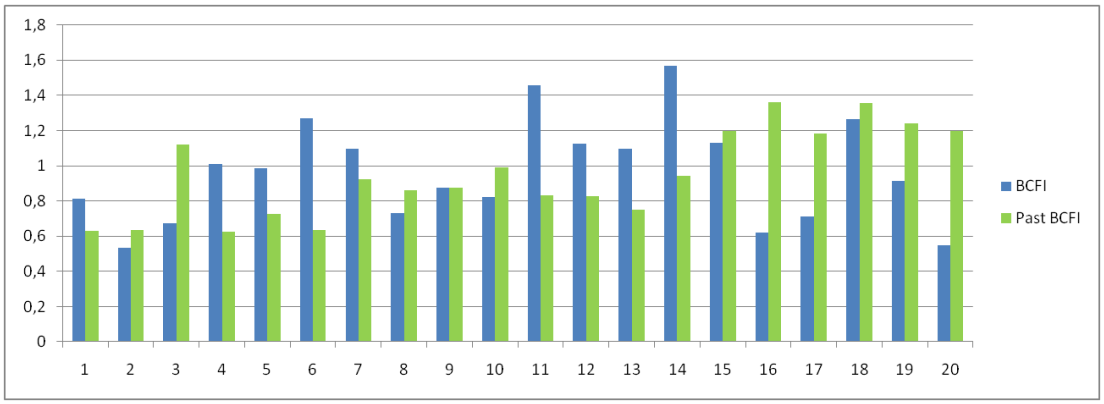

Figure 23. BCFI compared to past BCFI.

It can be monitored that the overall tool section has a quite negative development with the exception of the availability of information in information systems. The evaluation of attribute 18 can be the result of the recently development efforts of the internal portal. The most positive development can be found within the attributes number 6, 11 and 14. Whereas the evaluation of attribute number 6 and 14 can also be verified by the findings of the descriptive analyses, attribute number 11 remains a big question mark. The answers can be partly found within the project follow up meetings which are clearly

defined andconsequently followed, however the overall difficulties about the frequency of reports cannot be identified from these results. One possible reason for that is that the attribute itself should have been defined more carefully and maybe even divided into two separate attributes.

5. CONCLUSIONS

This section will start with a comparison of the different approaches and the findings concerning the hypotheses. In addition the approach specific findings will be discussed with the focus on importance and influence on the human resource management process. Although the hypotheses have been created in accordance to the main impediments of the case company the conclusion can still be generalized for managing human resources in a multiple project environment for engineering organisations. As the external interview guide in appendix 1 will show, no direct hypotheses-questions have been asked but instead very detailed questionsabout internal procedures, in order to reveal the organisations individual main challenges. However, as the study showed four out of five hypotheses were among the main challenges in almost every organisation which has been interviewed and therefore validate the generalization.

5.1. Conclusions based on comparison of findings

As the hypotheses have been tested with different approaches, the following table will give an overview about the results.

Table 8. Results comparison among all research methods.

Approach	**External interviews**	**Internal quest. part 1**	**Internal quest. part 2**
Hypothesis 1 *"Responsibilities or structures"*	Rejected	Approved	Supported (weak)
Hypothesis 2			

"External dependencies"	Approved	Approved	Supported
Hypothesis 3 *"Limited expertise"*	Approved	Approved	Not tested
Hypothesis 4 *"Visibility of workload"*	Approved	Approved	Not supported
Hypothesis 5 *"HR-software tools"*	Approved	Not tested	Supported

From a quantitative perspective the internal questionnaire (part 1 and 2) has to be considered as one entity when evaluating the hypotheses and therefore has just a minor influence on the overall conclusions. However, as this case study addressed the organisation's specific HR-management procedures the findings will still be discussed in detail.

Whereas hypothesis 1 has been rejected in all conducted interviews, minor inconsistencies could be found in the internal procedures. From the findings of the descriptive statistics one can see that the assignment of workload, the frequency of reports and project priorities are not clearly defined for all employees within the department. In the BCFI approach attribute number 9, which addressed the hypothesis, received the value of 0,89. Therefore the BCFI only gives a weak indication for actual development needs. Considering the overall evaluation the hypothesis has to be rejected as it only could be testified very weakly and within the case company internal research.

Hypothesis 2 has been testified in all three approaches. The respondents of the interviews reported in 5 cases strong influence on the internal procedures like planning and allocating resources and therefore acknowledged the external factors as a high

influential factor in managing human resources. Also the internal findings revealed the high uncertainty factors in terms of reliability of time schedules and future workload visibility. Whereas the first part of the questionnaire showed quite clearly the drawbacks of external interferences the second part only testified the poor reliability of time schedules.

The 3rd hypothesis has only been tested with two approaches but has been approved from both. The internal study showed that fights for personnel can be recognized even on a personal level. Furthermore the management of the case company already indicated such a phenomenon in the start-up interviews. Also in four external interviews,a lack of expertise has been mentioned as an influential factor while forming project teams. In general, external employees are an essential asset to deal with such shortcomings. Although hypothesis number 3 has been approved, it can be considered less influential as standard procedures were implemented in almost all organisations which took part in the survey.

The poor visibility of current and future workload has been testified by two approaches and can cause major difficulties in planning and allocating employees to projects. Whereas the respondents of the interviews mainly concentrated on their evaluation of reporting procedures and supporting software tools, the internal survey in part 1 revealed the constant changes in schedules and visibility of future workload as critical. Only the BCFI approach has been contraire to the findings of the other methods. One reason for this result is the poorly defined attribute in the method as only the visibility ofworkload for single projects has been tested. Furthermore the attribute should have been divided into current and future workloads. In summary the hypothesis 4 is a crucial factor in the HR-management process and can highly influence the success or failure not only of one but all projects which have interdependencies, especially on HR-level.

Hypothesis 5 has been tested by external interviews and the BCFI method of the internal questionnaire. In both cases the result clearly testified the hypothesis. As outlined in the section of qualitative findings, in five out of the six cases the respondent

reported difficulties about the usage and functionality of their existing HR-software tools. Similar results can be found from the internal evaluation of the BCFI attributes. Four out of five attributes which addressed the IS tools were considered as critical. The support of the business process, usability and functionality of the IS tools in use have even been considered as very critical. Furthermore the indication of high development needs for HR-tools, from the respondents of the interviews, account for the validity of the hypothesis.

5.2. Conclusions based on explorative findings

The conducted interviews did not only contribute to test the hypothesis they furthermore revealed additional patterns within the HR-management process for the multiple project environment. As presented in the findings the time schedules, individual job performance and educational background were the most commonly found patterns among the participants.

Around the discussions about the high dependencies on external factors and the poor visibility of current and future workloads the reliability of time schedules moved more and more into focus. Time schedules of projects have many connections to the overall management process of human resources. Due to the fact that time schedules are regularly used for short term planning, they demand a high degree of reliability and validity. Furthermore they provide essential information about the utility rate of employees and indicate high and low peaks (critical phases) during the project life cycle. By providing reliable and up to date time schedules an organisation can greatly improve the process of planning and allocating employees to projects. A missing link between time schedules from different projects has been identified; the information about the impact of time changes in one project to the others is strongly to be desired.

The individual job performance factor increases the work for the human resource manager. In addition to availability and ability (needed competences) the results show

that it is also important to take the individual job performance into consideration when planning the schedules for new projects. As indicated earlier this issue is very complex and difficult to handle. First of all the managers need to know the capabilities of their employees well, secondly this issue is difficult to discuss in team meetings. However the fact that this issue has never been addressed specifically and still appeared in five out of six cases, approves the common problem.

In all organisations it could be monitored that in most cases the career of mangers started as an engineer. Over 95 percent of managers interviewed or referred too, their educational background has been engineering. Especially in organisations without standardized training programs for managers the question, *why do you only employ engineers for managerial tasks?*, rises naturally. Although the arguments about being capable of understanding the technical aspects of a project are valid, the obvious deficits in planning, scheduling, communicating or handling resources should be evaluated in future researches.

The internal research detected the workload estimations, the assignment for work, the reporting process and schedule changes as influential attributes. Furthermore the BCFI indicated the reliability of time schedules and the overall usage of supporting tools as very critical. Whereas the time schedules and supporting software tools have already been discussed, the other attributes will now be addressed.

The workload estimations are crucial for the project performance as they define its scope. If estimations deviate too much from the actual workload, the project is doomed to fail from the start. Therefore it is important that estimations are as close as possible to the reality of the situation. Reliable estimations improve the planning and allocation process, can save time for PM’s negotiating changes to customers and prevent the organisation from paying deadline penalties.

In order to lower the time changes or disturbances during the execution phase of a project, it is important that the distribution of workload is clearly defined. These

findings were also confirmed in some cases of the interviews in which employees who faced the problem of getting additional input from different directions had a decrease in their effectiveness. It led to an uncontrolled increase of their workload and caused disturbances in some of the projects they were assigned too. Furthermore the visibility of actual workload has been negatively influenced.

The reporting process is a central activity throughout the entire project life cycle and will keep the project alive. The report frequency can be seen like a heartbeat which ensures that the information is kept on moving throughout the channels (veins) of the project team (body) and the management (head). As in life a low heartbeat indicates slow movements, being tired or powerless while having a high heartbeat stands for being active, excited and full of energy. However, it is important to keep the frequency in balance in order to keep the project active and not exhaust the team with reports. A well defined reporting process can enhance the visibility of workloads, will increase the reliability and validity of time schedules and therefore can greatly improve the overall planning and allocating process of human resources.

Now to respond to the initial research question the study has shown that for allocating resources in a multiple project environment the reliability and validity of time schedules as well as the supporting HR-software tools are major influence factors. As stated in the conclusions, the time schedules have a central function in the planning and allocating phase of human resources for a project and therefore are from high importance. Furthermore are workload estimations and the high dependency on external factors two critical attributes especially for the planning phase of human resources. The reporting process and the visibility of workload had been revealed to be the two main challenges for monitoring human resources in the multiple project environment.

In summary the most influential attributes, for the overall human resource management process in a multiple project environment, were the reliability and validity of time schedules, the poor visibility of current and future workloads, the high dependency on external factors and the supporting software tools.

5.3. Further research

As this research helped to find and understand major influence factors within the subject of human resource allocation in a multiple project environment, the need for further research, especially in terms of how to respond to such influence factors, are evident.

A good start would be to examine the interdependencies of the identified major influence factors. Do the influence factors have interdependencies and if, how are they interdependent? In addition how does the change of one factor influence other factors? These questions could answer if organisations could create frameworks with key improvement factors in order to subsequently develop the allocation process in general.

Furthermore, this research proved the high dependency on external factors as strongly influential for managing human resources. Therefore it would be from great interest to study how an organisation,dealing with such circumstances, could organise the internal resource allocation processes, in order to respond quickly to constant changes in scope and schedules.

As indicated in the findings as well as in the conclusion section, the use of engineers as managers is a very common approach in engineering organisations. Therefore it would be very interesting to see if PMs with a managerial background differ in performance from PMs with an engineering background. What are the strengths and weaknesses of both? Do PMs with a managerial background increase or decrease the organisational productivity? Such study could guide department managers for future decisions, regarding filling open positions.

Last but not least are the supporting software tools far from satisfying the needs of organisations dealing with simultaneous multiple projects. Especially the organisations individual procedures are challenging for program developers. As there are no standard processes how to organize the human resources in such environment, software tools differ greatly within this application. A profound research about availability and

comparison of existing applications for this matter could help organisations to find the right tool for their needs.

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APPENDICES

APPENDIX 1. External Interview Guide

Dear interviewee,
the main objective of this interview is to gather information about external experiences on the subject of human resource allocation in a multiple project environment. The process of how the allocation is planned, executed and monitored will be in the centre of the interview. Additional to the main objective we are trying to monitor which kind of supporting tools are in use and how they can cope with the required tasks in such an environment. We would like to thank you in advance for your participation and your valuable time you are giving to us.

A. Personal information

1. What is your role (tasks) in the company?
2. How long have you been working in your current position?
3. How long have you been working in the HRM / PM environment?
4. What is your educational background?

B. Company information

1. How many projects are handled by the company at the same time? (average)
2. What types of projects do you typically have in your company? (small / medium / big)
3. How many employees are involved in the projects? (average per project size)
4. What is the proportion of work and materials in a typical project? Are there big differences between projects?
5. How long is the project process? (average in month / weeks per project size)
6. What is the company organisational structure? (Functional / Divisional / Matrix … structure)

7. On which level are, the project related, human resources managed? (Project Manger / Team Leader / HR Manager / Department Manger…)
8. Do the employees who manage HR for projects have other responsibilities? (If so, how much time is used for the HRM activities? (in percentage))
9. How many employees are managed by a single PM/HR-manger? (average)

C. HRM-Process information

I. Resource planning information:

1. On how many levels are you planning resources? (Long-, medium, short-term base)
2. To which extend the different levels are planned? (Explicit times, explicit employees, explicit tasks)
3. To which degree the resource planning is done? (Personal months, weeks, hours…)
4. How often the resource planning is done, by whom? (Long- medium, short term – quarterly, monthly, weekly…)
5. How often the short-term planning needs to be changed prior the actual start of a project?
6. What are the main challenges in planning the resources in a project environment?
7. What are the main challenges in distributing resources?
8. Ideas for improving the resource planning process?

II. Resource allocation information:

1. Who is assigning employees to starting projects? (Project Manger / Team Leader / HR Manager / Department Manger…)
2. When are resources allocated to starting projects? (Time prior start)
3. How are resources allocated to starting projects? (process / tools)
4. When using the same pool of employees who gets the critical resources? (Skill related prioritizingsystems?)

5. Does it often lead to complications during the allocation process because of prioritizing?
6. What are the main challenges in allocating resources in the starting phase of a project?
7. Ideas for improving the allocation process in the starting phase?

III. Resource monitoring information:

1. On which level can you monitor the actual workload status? (Department-, unit-, personal-, expertise level)
2. On which level can you monitor the future workload status?
3. How often the workload status is updated or checked?
4. If the workload is increasing/decreasing (unexpected) during a project how fast resources are reallocated? (Can projects get new resources or give resources to other projects?)
5. How time changes during a project are managed? (late start, brakes in between, early finish, late finish…)
6. How changes in general are managed? (Scope, tasks, resources)
7. How work-intensive are those changes?
8. Who is interested in the actual workload information of employees?
9. What are the main challenges in monitoring resources during a project?
10. Ideas for improving the monitoring process?

D. HRM-Tools information:

1. What HRM tools is your company using for managing resources for projects?
2. Who has access to these tools (roles)?
3. What actions they (roles) perform with these tools?
4. What data can be saved within the tool
    - Employee records (what kind of personal information)
    - Project records (what kind of project records)
    - Any other information?
5. What kind of searches can be performed with these tools?

6. What kind of views these tools offer?
7. Does the system have interfaces to other systems?
8. What are the most useful features of these tools?
9. What are the main challenges with these tools?
10. Ideas for improvement?
    - Which kind of tool could best fulfil your requirements in HRM?
    - Who should have access to the HRM tool (roles)?
    - What tasks/actions the Tool should support?
    - How often these tasks should be performed and by whom?
    - How important are those tasks?
    - What data and what kind of views the tool should offer?
    - What project information should be included?
    - Should any other data be available?
    - Tool interfaces?
    - Reporting features?
    - Output?
    - Any other ideas?

APPENDIX 2. Internal Questionnaire

Dear participant,

the main objective of this questionnaire is to gather information about internal experiences on the subject of human resource allocation in a multiple project environment. The process of how the allocation is planned, executed and monitored will be in the centre of the questionnaire. We would like to thank you in advance for your participation.

A. General questions:

1. Please define your role within the operation department:

- ☐ Project Manager
- ☐ Lead Engineer
- ☐ Engineer
- ☐ Unit Manager (Site, PDC, Engineering...)
- ☐ Other: _____

2. Work experience within the operation department:

- ☐ Less than 1 year
- ☐ 1 – 5 years
- ☐ More than 5 years

3. Educational Background (Multiple answers possible):

- ☐ Engineering
- ☐ Management
- ☐ Business Administration
- ☐ Other: _____

4. Further training for working in a project environment (Already taken) (Multiple answers possible):

- ☐ Team building

- ☐ Working on multiple projects
- ☐ Project scheduling
- ☐ Other: _____

B. Planning process:

1. How long in advance do you get notice that you will be working on a project? (In average)

- ☐ Less than one week
- ☐ 1 – 2 weeks
- ☐ 2 – 4 weeks
- ☐ More than 4 weeks
- ☐ Not sure: _____

2. For how many months do you know your own working schedule (approximately)? (In future)

- ☐ One month
- ☐ 2 – 4 months
- ☐ 4 – 6 months
- ☐ More than 6 months
- ☐ Not sure: _____

3. Does the estimated workload in general correspond with your actual workload?

- ☐ Mostly to much time planned for task
- ☐ Mostly to little time planned for task
- ☐ Not sure: _____

4. How often is your assignment to a project changing before the start of it? (In average)

- ☐ Never
- ☐ 1 – 2 times
- ☐ 2 – 5 times

☐ More than 5 times

5. What could (should) be improved in the planning process? (For answer you can also use backside)

_____
_____
_____
_____
_____
_____

C. Allocation process:

1. Who is assigning you to a project? (Multiple answers possible)

☐ Project Manager
☐ Lead Engineer
☐ Engineer
☐ Unit Manager (Site, PDC, Engineering...)
☐ Other: _____

2. How do you get noticed about your assignment to a project? (In General)

☐ Meeting
☐ Casual visit
☐ Email
☐ Phone Call
☐ Other: _____

3. Do you have the feeling that different projects are fighting for your participation on it?

☐ Yes
☐ No
☐ Don’t know

4. To how many projects are you assigned at the same time? (Usually)

- ☐ 1 – 3
- ☐ 4 – 6
- ☐ More than 6
- ☐ Don’t know

5. Is there a priority hierarchy between projects? (Most important project, second most important...)

- ☐ Yes
- ☐ No
- ☐ Not important

6. What could (should) be improved in the allocation process? (For answer you can also use backside)

_____

_____

_____

_____

_____

_____

D. Project progress:

1. To whom are you reporting the progress of your task within a project? (Multiple answers possible)

- ☐ Project Manager
- ☐ Lead Engineer
- ☐ Engineer
- ☐ Unit Manager (Site, PDC, Engineering...)
- ☐ Other: _____

2. How often do you report the status of your remaining work for a specific project?

- ☐ Once a week
- ☐ Once every second week
- ☐ Once a month
- ☐ Other frequency: _____

3. Who is interested in the progress of your task within a project? (Multiple answers possible)

- ☐ Project Manager
- ☐ Lead Engineer
- ☐ Engineer
- ☐ Unit Manager (Site, PDC, Engineering...)
- ☐ Other: _____

4. How often do you leave a project "unfinished" due to new projects (of higher priority)?

- ☐ 1 out of 3
- ☐ 1 out of 5
- ☐ Other frequency: _____

5. How often is your personal working schedule changing? (In average)

- ☐ Daily
- ☐ Weekly
- ☐ Monthly
- ☐ Quarterly (every three month)
- ☐ Other frequency: _____

6. Do you keep an own work schedule?

- ☐ Yes
- ☐ No

7. What could (should) be improved in the project progress process? (For answer you can also use backside)

_____

_____

_____

_____

_____

_____

E. Software tools:

1. Have you been using following HRM softwares/tools? (Multiple answers possible)

- ☐ Microsoft Project
- ☐ SAP
- ☐ AC resource Excel
- ☐ Own Excel sheet
- ☐ Others: _____

2. What kind of features, for a new software tool, are important to you? (Interfaces, input, output...)

_____

_____

_____

_____

_____

_____

F. Process performance evaluation

The Sense and Respond method is a tool to measure the performance of a specific process. Therefore the employee's practical experience and general expectations about certain attributes are crucial. Please fill in the following questionnaire like the following example:

ATTRIBUTES	Expectations (1-10)	Experiences (1-10)	Direction of Development			Compared to past		
			Worse	Same	Better	Worse	Same	Better
Personal processes								
Coffee brakes are essential business meetings	2	8			X		X	
Winter working hours should be paid double	10	5		X		X		

Scale: 1 is lowest (worst performance) – 10 is highest (best performance)

SENSE AND RESPOND QUESTIONNAIRE								
This questionnaire measures organization's opinions about business performance of the company								
EXPLANATIONS: ***The questionnaire must be filled in completely***								
Expectations = What is the level of expectations for an attribute in a scale of 1-10								
Experiences = What is the level of experiences for an attribute in a scale of 1-10								
Direction of development = Direction of development in future (within the next 1-2 years)								
Compared to past = Direction of development compared to the situation 1-2 years before this questionnaire								
ATTRIBUTES	Expectations (1-10)	Experiences (1-10)	Direction of Development			Compared to past		
			Worse	Same	Better	Worse	Same	Better
Resource planning process								
Structure and clarity of project schedules								

Reliability of time schedules								
Reliability of workload estimations								
Information flow throughout the project team								
Planning process in general								
Resource allocation process								
Communication between management and project team								
Distribution of projects								
Distribution of workload								
Well defined responsibilities and tasks for each project								
Allocation process in general								
Project progress								
Reporting process for progress of projects								
Up to date project work plans								
Visibility of remaining workload for single projects								
Collaboration between participants of the same project								
Awareness of priority between different projects								
Information systems (software tools: Excel, SAP, MS Project)								
Information systems support the business processes								
Visibility of information in information systems								
Availability of information in information systems								
Reliability of information in information systems								
Usability of information systems								

Kiitos paljon!