CHALMERS

Manpower Establishment resource plan result and setup presentation

This thesis is aimed to analyze the current presentation of the data in three different views of crew planning system called Manpower, in order to make them easy to learn and interact for end-users

Master of Science Thesis in the program Interaction Design

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Abstract

The aim of this master thesis was to analyze the current presentation of data in the crew planning system for airlines and to give suggestions for changes and/or present new ways of representing data either in figure or in graphics. The main demand was to provide users with essential information in a comprehensible and an easy-to-use way.

This thesis was a way to enlighten the existing problems in the system and to show how these problems can be solved by considering the users' needs while keeping Interaction Design principles in mind.

In order to analyze the existing problems and to achieve the thesis goal different methods such as Documentation analysis, Interview, Cognitive Walkthrough, Morphological charts and Iterative Design and Prototyping were used.

Jeppesen develops software for airlines, ships and trains. Manpower is one of the new software which is developed by Jeppesen for managing airline crew and one of their first clients is SAS. SAS is now in production phase meaning that they are testing the system and are using it in parallel with the old system that they got. This gives them the opportunity to both get acquainted with the system and debug Manpower. Because of SAS being in acceptance phase and end-users not being located in Gothenburg, unfortunately only one visit has been paid to end-users. Most of the information has been provided by internal users at Jeppesen. After gathering the information and analyzing the results of interviews, paper prototyping was done and internal users were asked to evaluate the prototypes. In two rounds of iteration, users' suggestions were considered and the final decision was made. For the reason that all the suggestions could not be implemented in the time format of the thesis, users were asked to vote for the three most important features which needed to be implemented. The result was reviewed and the one which fitted in the time frame was picked to be programmed.

I am proud to say this work had a fruitful result and most of the design ideas were cherished by Jeppesen.

Preface

This is a master thesis report in Interaction Design, written for the Chalmers University of Technology. The master thesis was carried out by Azadeh Shirzad at Jeppesen, Gothenburg.

I would like to thank my supervisors Fang Chen at Chalmers University of Technology and Eva Bengtsson at Jeppesen for their incessant help and support during this project.

Especial thanks to Jeppesen particularly Niclas Sundelid for granting me the opportunity to work with Carmen group on this project and the chance to show what I could contribute to in the industry.

Throughout this project I have had help, ideas and feedback from number of people at Jeppesen namely people from Carmen PD group, Implementation SAS and Service Center. I would like to thank them all for all their support.

This work could not be completed without the assistance of all the above mentioned people.

Thanks!

Azadeh

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1. Introduction

"The industrial age is over. More and more businesses are utterly dependent on software. Thousands of companies of all sizes that provide products and services across the spectrum of commerce use software in every facet of their operations, management, planning, and sales. The organizational structures and management techniques that have worked so well in the past for manufacturing-based companies are failing us today in the postindustrial age." (Cooper et al., Page xxi) That is why everything is being transformed from atoms to bits or in the other word everything is becoming computerized.

"Reducing the cost of manufacturing was the essential contribution of industrialization." (Cooper et al., page xxii) but when it comes to software and post-industrial age it is not only about reducing costs but also about making a most desirable and effective product. By being desirable, I mean not only from vendors' side (less expense and more revenue) but also from end-users' perspective (easy to use and effective). Unfortunately most digital products are just designed to answer technical needs and not much attention is paid to their ease of use or ease of control. Developers are focused on resolving technical issues more than thinking about users and their comfort. Other than their desire on working on technical issues there are also three other possible reasons for this 1. They are not in contact with end-users so they do not know what the end-users want 2. There are technical limits so not everything can be implemented and 3. They have deadlines to meet thus sometimes they are forced to chose between ease of code and what users want. "They (developers) are often given incomplete, confusing, and sometimes contradictory instructions and are forced to make significant decisions about the user experience with little time or background" (Cooper et al., page 5) So all these problems and constraints result in producing software which does not respond to users' needs as it is supposed to.

Unfortunately considering the managers' ideas and meeting the deadlines are coming first in development process after that, if at all, users' need will be considered. There is also a problem in understanding users' needs. Marketers are the ones who are mostly responsible for that part and they believe in 'what people say they'll buy' (Cooper et al., page 4) which is not true. Marketers are mostly focused on dominating the market by considering list of features. They do not try to analyze people's needs but just consider what they say which is usually is not what they want. That is typically the reason why 8 out of 10 digital products fail.

This is the sign of need for change in industry. Now it is the time for many companies to begin thinking about spotlighting users' needs and considering Interaction Design while designing a digital product. It is time to replace industrial and technical design with human-oriented design. Here are three important definitions of human-oriented activities stated by Alan Cooper which are needed to be considered to avoid the burden imposed by difficult-to-use technological products.

- Understanding users' desire, needs, motivations, and contexts

- Understanding business, technical, and domain opportunities, requirements, and constraints

- Using this knowledge as a foundation for plans to create products whose form, content, and behavior is useful, usable, and desirable, as well as economically viable and technically feasible.

The focus of this thesis is on two parts of Manpower system with which end-users are experiencing difficulty to interact. Due to limited time that development group had, they were not able to put that much time on user friendliness of the system but spent more time on making the system work as accurate and efficient as possible. They have been victorious in achieving that goal and SAS is their first customer on this platform. But it should also be mentioned that people who decided to purchase the system are not the ones who are using it and as usual the buyers have different goals than the end-users. That is why the problems with system and users' interaction have now been realized and not earlier. Unfortunately this is a confirmation to what Alan Dix mentioned in his book, saying that HCI professionals complain about being called in when it is too late. They are called in when a system has been designed and users are experiencing problems. ."(Dix et al., Page 195) Or it can be this case, "In other companies usability is seen as equivalent to testing-checking whether people can use it and fixing problems, rather than making sure they can from beginning."(Dix et al., Page 195)

This thesis was done to analyze the root of the problem(s) and to recommend solution for each of them. Several methods have been used and a part of the project has been implemented. All the process will be described later but I first start with explaining the background of the project and what works are done in order to do a crew planning for an airline.

2. Background

2.1. About the company

Jeppesen is a company with 75 years of experience in aviation industry. Today they are expanding their scope of work to rail, sea and air operators as well. Jeppesen helps its customers to discover how they can improve the safety and efficiency of their transportation program in the air, on the water and on the ground.

Jeppesen has offices at nearly 50 locations around the world and it is backed by the expertise and resources of its parent, the Boeing Company. (www.jeppesen.com)

2.2. Aviation and Crew planning

This part is to explain how the process of planning crew is done and how Manpower is helpful in this process. Different steps which are taken to do the planning for an airline are named here. Each step has its setbacks but hopefully by using Manpower these problems will be reduced since the system is developed to consider all the problems in the early stage and to

provide planners with the best solution which is stable and has a low cost while maximizes the quality of life of crew. First month of my work was dedicated in understanding these processes and the work which can be done by Manpower. The PowerPoint slides which are used for teaching the new comers in Jeppesen and also the product manuals that are to present the system and its functions to end-users were the materials which helped me through this step. More information about these processes can be read in Documentation Analysis method.

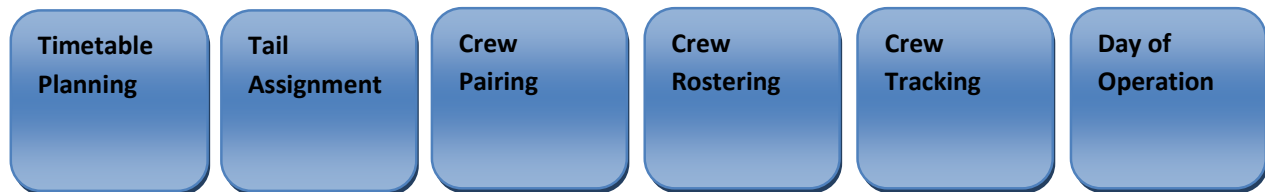The list of the steps which are taken by planners to perform the crew planning is shown in Figure 1.

Figure 1 Crew planning process

First timetables are distributed by IATA (International Air Transportation Society) then Tail Assignment is done by airlines which mean assigning aircrafts to different flights[1] according to the number of passengers. Now is the time when Manpower is used to create anonymous flights (Crew Pairing), Create detailed working plans for crew (Crew Rostering) and to maintain the plans (Crew Tracking) till the day of operation. These three processes are done in different times during Crew Planning process. The closer the day of operation (the day when rosters go live) gets, the more detailed the plan becomes.

Manpower is developed in a way to consider all the possible ways for planning the crew and then presenting the one which has the most benefit for both the airline and the crew. This is done by a function called Objective function in Manpower which guides the optimizer when it generates the solutions/plans. This function is modeled in Rave[2] and it returns a value for every solution. This function contains two parts

- Real costs (e.g. hotel costs)

- Penalties or cost for lacking quality or stability[3] (e.g. penalties for unpopular trips)

The best solution is uniquely identified as the one with the lowest value of the objective function and is presented by Manpower as the result of its work.

3. Literature Review
This part is about the articles and books which were reviewed before and during the thesis. The main focus of this thesis was to find out about existing problems in the system then make the airline planning system easy to use and understand for planners. In order to get a better

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[1] A flight is a commercial and administrative concept. A flight can consist of one or several legs.
[2] A purpose-built declarative modeling language tailored for resource management and optimization in the transportation industry (Reference: Internal wiki at Jeppesen)
[3] Stability means that the roster is not very sensitive to delays and other changes

view about UCD (User Centered Design), the design problems and the methods which can help in overcoming the problems number of articles and books were reviewed. Here a summarized version of those studies can be found.

I start with explaining the definition of user-centered design and usability then continue with the problems which can occur during design process, give explanation about methods then finish it with giving details about prototypes and ways of evaluating them.

What is user-centered design?

User-centered design (UCD) is an approach to design that grounds the process in information about the people who will use the product. UCD processes focus on users through the planning, design and development of a product. (www.upassoc.org)

This is the definition of a design which makes a system usable for its users.

What is usability?

The three main principles which usually are to support usability are Learnability, Flexibility and Robustness. A brief explanation for each of these principles can be given as below:

"Learnability: The ease with which new users can begin effective interaction and achieve maximal performance

Flexibility: The multiplicity of ways in which the user and system exchange information

Robustness: The level of support provided to the user in determining the successful achievement and assessment of goals" (Dix et al., Page 260)

These principles are general and can each be divided to the ones which are more specific such as familiarity, consistency, customizability, observability and etc. These subdivisions give more concise definition about each principle and what designers need to take into consideration. These principles should be used so that designer can achieve one of the primary goals of Interaction Design which is optimizing the experience of the user when she engages with a product. (Cooper et al., Page 151) Alan Cooper also mentions that this optimization in productive tools means "Minimizing work" for users. The categories of works which need to be diminished are Cognitive work, Memory work, Visual work and Physical work. Meaning that it should not be difficult for users to interact with system, users should not be forced to recall every detail of the system to be able to work with it, system should not exhaust users eye but should provide them with a proper way so that they can decode the layout easily and there should not be too many keystrokes or mouse movements and such involved to perform a task. (Cooper et al., Page 151)

What should a designer consider while designing a user-friendly system?

In order to be able to design a user-friendly system one needs to

- Explore the user needs and goals
- Consider users' needs and the rules of Interaction Design while designing
- Keep the users involved in the design process

A designer also must bear in mind that involving the users in the design process does not mean giving them the right to force what they want to the design of the system. As we know users do not always know what they want so it is designer's job to figure out what the real problem is and offer an acceptable design solution for overcoming it.

Does a designer need a design plan?

In order to be able to keep the design process in the right track, to avoid wasting time, effort, resource and to reach a high-quality result a designer needs to choose a right methodology for her design process. Methodology means the methods that one will use and the tasks that she will do to achieve the goal she wants. It is true that change of method might happen during the design but that happens no matter how detailed a project plan is and it should not stop a designer from choosing her design methodology in the beginning of the work.

The methods that the designer chooses should cover the different phases of the project and should provide the designer with the information she needs to help her reach the goals she have.

About methods

Fortunately in this work the methods which were chosen were all informative and provided the results which were helpful. So there was no need for considering other methods than the ones which were planned to be used. Here is the list of methods which were used in the project:

- Documentation analysis
- Interview
- Cognitive Walkthrough
- Morphological charts
- Iterative Design and Prototyping

As mentioned earlier Manpower is a system which can only be used by users with certain kind of knowledge so getting to know both the job of the airline planners and the system was the first step I needed to take. Analyzing the documentation was a wise choice for achieving this purpose.

Analyzing the documentation and getting to know the system do not offer all that is needed for discovering the problems of the system. There still is a need for getting in contact with end-users and people who are familiar with the system to get more information.

In order to be able to collect information, an analyst needs to follow certain rules or methods. Using a method stops him from going out of track and forgetting about the aim. There are two main categories when it comes to Data collection 1. Question based methods 2. Observation based methods.

Observation requires spending time with users and it cannot be summarized in one session. Due to the fact that end-users were not located in Gothenburg observing the end-users to collect information was not a choice for me.

That was why I picked one-by-one interview method to gather data. Like any other method there are positive and negative points to interviewing and they are as mentioned below

- Positive points
  - ✓ Interviewing permits clarification of questions
  - ✓ Has higher response rate than written questionnaires
- Negative points
  - ✓ The presence of interviewer can influence responses
  - ✓ Reports of events may be less complete than information gained through observations[4]

It is true that interviewing has negative points but still there is way to compensate for them and make the results as fruitful as possible. Use of "Mediating tool" in parallel with interview is one of the best choices for enhancement of the results. This tool improves the quality of the feedback which is taken during the interviews and helps in eliciting end-users' need(s) and the problems with the system. Getting in contact with end-users and trying to draw out the needed information is not a trouble-free job. This is confirmed by Pontus Engelbrektsson et al. while mentioning "Part of this problem (eliciting end-users' needs) may be attributed the way the external dialogue is run, i.e. the efficiency of the dialogue between the customers and the product development team. Hence, method is a crucial issue." (Engelbrektsson et al., Page 1)

According to this article there are three items which have effect in eliciting end-users' need(s) so it is not just limited to finding the right method. "However, efficient requirements elicitation is not only a matter of choosing *data collection method*. Methodological considerations must also include an efficient choice of context or *environment* in which data collection takes place, a choice of *participants* and a choice of stimuli or *mediating tools* in order to enhance the data collection process." (Engelbrektsson et al., Page 1)

Further this article gives a more concise description of what a mediating tool can be "In an interview situation, a typical mediating tool could be a representation of the existing or the future product. These product representations may be simple sketches, three dimensional models, or fully functional prototypes." (Engelbrektsson et al., Page2)

Although the focus of this article is on the method called Focus Group Interviews but still the findings of it can be exercised in other cases such as mine. The idea of using mediating tool to enhance the outcome of the interviews was a great help to me and provided me with detailed feedback from users and developers. More detailed information about the chosen mediating tool and the interview process is given in 4. Method section.

Evaluation is another way of getting to know a system and its problems. According to Alan Dix et al. evaluation has three main goals "to assess the extent and accessibility of the system's functionality, to assess users' experience of the interaction, and to identify any specific problems with the system." (Dix et al., Page 319)

The accessibility of functions is one of the important aspects because users should be able to find what they want easily and not be forced to dig in to the system. Besides accessibility of utilities, the level of responsiveness to the actual needs of users and the learnability of system has to be assessed as well. We may make the functions accessible but do they perform the intended task(s)? Does system target the users' aim or does it end up doing something which is not required or which is not correct? All these questions should be asked during the evaluation phase.

The evaluation should be done throughout the design process and not just once. It can be done either by involving users or without them and just by usability experts.

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[4] Methods of Interaction Analysis Course, Taught by Pontus Engelbrektsson, 2008, Chalmers University of Technology

Although users' engagement in evaluation of system is beneficial to the design, it requires a working prototype and also imposes more expense on the project. But expert analysis can be done with or without working prototype and it can be performed in any stage of the development. It is true that at any phase of development, evaluation can be done but we surely need to keep this in mind that "the later in the design process that an error is discovered, the more costly it is to put right and, therefore, the less likely it is to be rectified" (Dix et al., Page 320)

So depending on the situation and the budget of the project designer must decide which kind of evaluation can be performed.

The crucial aim of the methods which involve expert analysis is to identify the parts which cause problems because they break the usability facts or well known cognitive principles. So these kinds of methods are really helpful and they can be exercised at any stage of development. "These methods can be used at any stage of the development process from a design specification, through storyboards and prototypes, to full implementations, making them flexible evaluation approaches" (Dix et al., Page 320)

The method that I have chosen was Cognitive Walkthrough. This method is "an attempt to introduce psychological theory into the informal and subjective walkthrough technique (which is mostly used in Software Engineering for tracing code)." (Dix et al., Page 321) This technique needs the detailed review of the steps that are taken in order to accomplish a known task with the system. In this way the potential usability problems can be discovered and studied by the analyst. There are four questions which an analyst asks in each step that she takes while performing a task and they are:

- Is the effect of action the same as the user's goal at that point?
- Will users see that the action is available?
- Once users have found the correct action, will they know it is the one they need?
- After the action is taken, will users understand the feedback they get?

Everything is documented when this technique is used in the direction of keeping track of what is good and what needs to be changed. An analyst not only records the existing problems but also indicates the severity of them. The factors which play role in evaluating the severity of the problem are the frequency in which the problem occurs and its severity. "This information will help the designers to decide priorities for correcting the design, since it is not always possible to fix every problem" (Dix et al., Page 322)

After the information is gathered from interviews and evaluation, it is time to analyze the results and come up with ideas to solve the problems. There are several methods which can help a designer to look for ideas, methods such as Brainstorming, Synectics, Removing Mental Blocks and Morphological Charts. All these methods fall into a category called Divergence.

Divergence "refers to the act of extending the boundary of a design situation as to have a large enough, and fruitful enough, search space in which to seek a solution" (Jones, Page 64). This helps the analyst to think out of box and not to disregard any idea which seems to be relevant to the problem. Then these ideas will be reviewed and the parts of system which are susceptible to change in addition to the ideas and solutions for their change will be presented.

In this thesis, Morphological Charts seemed to be a good choice as it offered an easy way to help me in reprogramming my thoughts and get rid of rigid ideas.

The goal of this method can be defined as follows, "Morphological charts are intended to force divergent thinking and to safeguard against overlooking novel solutions to a design

problem" (Jones, Page 293) This method and the way it offers the designers for being creative and thinking out of box is really helpful but there are some problems when it comes to picking the suggested ideas or functions. Designers need to make sure that

- The ideas which are in a set are not the same, they cover all the aspects of existing problem and they are enough in number so that a matrix can be made out of them.
- The matrix should have an acceptable size so that it can be searched in a short time and it does not require much time for studying it. (Jones, Page 293)

Listing the different parts of the problem in a matrix then placing different and independent suggestions in front of each problem, makes it easy for the designer to rule out the options which do not worth the investigation. This results in reducing the level of uncertainty and confusion that is the main goal of methods which are in Convergence category.

The final part of methods of this kind is to present a single solution in a quick and cheap possible way. This step in Morphological charts is a vital one, and it is to select a set of functions which apply to a certain principle. This principle should first aim the design rules meaning that designers should check if the design rules are considered in the suggestions plus the ideas should fix the existing problems of the system.

We know that the aim of each interactive system is maximum usability so we need to take that in to consideration when we are choosing the solutions or ideas for fixing a system. There are design rules which have root in psychology, ergonomics, computational theory and etc. and these rules sometimes go against each other. So a designer needs to know about the theory that these rules are based on, in order to obtain a deep insight about these rules in route for choosing the one which is the most applicable to her design. (Dix et al., Page 259)

Now that all problems have been divided to sub-problems, analyzed and solutions for fixing them were listed, it is time for prototyping and iteration.

What is a prototype?

"A prototype is an original type, form, or instance of something serving as a typical example, basis, or standard for other things of the same category" (en.wikipedia.org)

What are they used for?

There are different ideas concerning the use of prototypes some think they are employed to identify requirements and needs while others believe they are means for designers, designed for discovering possibilities. "Prototypes are the means by which designers organically and evolutionary learn, discover, generate, and refine designs." (Lim and Stolterman, Page 7:2) This is the meaning which applies to the prototypes which were used in this project.

Types of prototypes

There are different types of prototypes. Generally they are divided by their fidelity: High fidelity prototype or low fidelity prototype. There are different discussions about how effective a prototype can be depending on its fidelity. Some believe that low fidelity prototypes cannot be that effective because they are not very similar to the final product (Lim and Stolterman, Page 7:4) but some believe that prototypes with low fidelity increase the willingness of the evaluators/other designers to criticize the system and lead them give suggestions.

A research to compare the computer and paper low-fidelity prototypes was done by Sefelin, Tscheligi and Giller. They wanted to see if presenting the prototype in computerized form reduces the eagerness of designers/users to give feedback on them. The result was "paper- and computer-based low fidelity prototypes lead to almost the same quantity and quality of critical user statements and subjects prefer computer prototypes." (Sefelin et al., Page 779) So they believe that there is no difference between these kinds of prototypes. They believe that one can prefer the paper prototyping to computer-based one when the available tools in system do not support the designer ideas, when the designer wants all the designers even the ones with no software skill participate in prototyping process and when lots of drawings are needed in the tests (Sefelin et al., Page 779) According to Lim and Stolterman "it is the incompleteness that makes it possible to examine an idea's qualities without building a copy of the final design" (Lim and Stolterman, Page 7:7). In all paper prototypes seem to be the better choice when one is keen on participating others in the design process.

The problems with prototyping on the management side

According to Alan Dix et al. there are several problems on the management side when it comes to prototyping: Time, Planning, Non-functional features and Contracts.
According to managers prototyping is time-consuming and if it is a throw-away prototyping then it is even considered as waste of time.
Another problem is that managers mostly are not experienced in planning prototyping phase in a sufficient way so it usually is considered as waste of money as well. In the phase of prototyping usually the non-functional parts are scarified, this can be the speed of work, the realism that the prototype provides and etc.
The last issue is Contracts; the design process is led by a contract between customer and designer. The problem is that "prototypes and implementation cannot form the basis for a legal contract, and so an iterative design process will still require documentation which serves as the binding agreement" A designer needs to find a way to bridge this gap and make it possible to translate the result of prototyping to documentation. (Dix et al., Page 243-244)

What is good about paper prototype?

Paper prototypes are easy and fast to make, change and walkthrough. This kind of prototyping gives the designer the opportunity to involve the users or stakeholders in the early stage of design and get their feedback on it. On the other hand "Software prototypes provide a greater level of realism than is normally possible with simple paper mockups" (Maguire and Bevan, Page 7). The problem with software-prototyping is that it takes more time to make and change in comparison to paper mockups and it also does not offer the stakeholder the comfort and openness in giving suggestions that paper prototypes do.
Paper prototypes give end-users the impression that the system is not finished and it is open to any kind of suggestion from your side. But a working prototype seems to be closer to a finished system and that might limit the propositions from end-users.
Paper-prototyping can even be hand sketched drawings of the interface. The main purpose of making these mockups is to involve users in the design process and walk them through the new system to figure out if designers overlooked any problem then go back, modify the system and evaluate it again. This is the same concept as Iterative Design.
The essence of iterative design is "a purposeful design process which tries to overcome the inherent problems of incomplete requirements specification by cycling through several

designs, incrementally improving upon the final product with each pass." (Dix et al., Page 241)

After evaluation of the prototypes and reaching the last design ideas, it is time to move on to the next phase which is implementation. In order for developers to be able to implement the design ideas, having only the enhanced and final prototypes is not enough. They need to be informed about the details of functionalities by the designers. With the purpose of simplifying this process, preparing the use case for each design idea is recommended.

What is a use case?

"A use case model describes the functional requirements of a software system and is used as input to several activities in a software development project" (Anda and Sjoberg, Page 127). There is no especial format or template for writing a use case so it can be done in any way which is preferred by its author. Regarding its detail, the level of details in use case differs in different projects. The more complicated a project is, the more detailed the use case needs to be.

Evaluation of use case

Use cases need to be checked with the intention of detecting defects and problems. These use cases need to be evaluated to make sure that all the needed details are given and also that developers are able to understand and later implement all the design ideas by referring to these use case models. (Anda and Sjoberg, Page 128)

There are different ways to evaluate use cases and they are ad hoc techniques, check-list techniques, review and walkthrough. Ad hoc techniques do not use a systematic way to detect defects and their results only depend on the abilities and the experience of the inspectors but in check-list techniques all evaluators are provided with a list of flaws to check against. In review, usually representatives of different stakeholders are involved to act as readers. Their job is to read the document and check for different setbacks. In walkthrough there are also different people involved but one of them, usually the author, introduces the document to the rest of the group or in other words walks them through the written use cases. (Anda and Sjoberg, Page 128) In this article it is proven that involving different stakeholders in evaluation process results in an agreement about requirements from different aspects. (Anda and Sjoberg, Page 132).

There is no definite guide to help us know which technique to pick in different project but in sum no matter how or with which technique use cases are evaluated, the last version needs to be detailed enough to give adequate information to developers to help and guide them in building the system. That is what makes a use case efficient and serviceable. That is the time when development phase can get started.

The following parts are all affected by the literatures which have been mentioned here. These articles and books have been studied in different phases and times of the project and helped me through my way till the end of this thesis.

4. Method

Interaction Design is the discipline of defining the behavior of products and systems that a user can interact with (en.wikipedia.org). Since technologies are usually complex for their end-users, Interaction Design aims to reduce this complexity and the time which is spent on learning systems while increasing usefulness and efficiency. All of these can be reached if the design process is done properly.

There are several methods that can be used in order to inspect, analyze and design a user centered system. But the important thing is choosing the one(s) which gives you the information you need and helps you to proceed. "A design method is any action one may take while designing" (Jones, Page xxv) so even one can create his own user centered design method if he does not find the existing ones helpful.

In this thesis I have utilized different kinds of methods in order to understand the existing problems, analyze them, to battle the obstacles and to boost my creativity to come up with ideas and solutions.

Most of the methods were useful and had the result that I anticipated. There was also some which did not give me the outcome I was expecting for. This is what happens in every work and research so it was not the sign of failure but it was how it supposed to be. A designer needs sometimes to jump from one method to another until she finds the one which helps her in each phase of the design process or I other words the one which can help her find her design methodology.

There are different phase to a design process

1. Planning which includes getting to know the system, the existing facilities and problems
2. Research and analyze which is for focusing on users, getting to know their problems and analyzing them
3. Solution proposals based on the gathered information and implementing them (the most important ones) in prototypes
4. Iterative design and refinement of the suggestions derived from the received feedbacks

This work has been carried out in a way to cover all the mentioned phases above. The name of methods and the category they belong to are listed in the following part.

4.1. Used Methods and Design Process

The methods which were utilized during this work, the phases they belong to and the reason why they have been chosen can be found in this section.

Phase 1: Planning

Method(s): Documentation Analysis, Interviewing In-House users

To get familiar with the system, the work which it does and the functions it includes, documents which were all provided by Jeppesen were reviewed. These documents

provided me with a general understanding of the whole project. Interviews with In-house users were a complement to the gained information since all the questions could not be answered by those materials.

Phase 2: Research and Analyze

Method(s): Interviewing end-users, Cognitive walkthrough

Although in-house interviews gave me a general idea about the existing problems, the interviews with end-users were more of assistance to me. Getting to know about the users, their goals and the problems they experience while working with the system have a huge effect on essentiality of the result which cannot be provided by interviewing the coders. I had the chance to interview SAS planners and see the problems from their side by these interviews. In order to analyze the system from a professional aspect, the method called Cognitive was performed by two Interaction Designers. The result from this method was a great help to accomplish the aim of this work which was increasing the user friendliness of the system.

Phase 3: Proposals and suggestions

Method(s): Morphological charts

The main aim of this stage is to broaden the area of search for solutions to the problems which were explored via the methods in the previous phases. Morphological Charts was to choose a group of sub-solutions which go together to solve the problem in whole and to avoid overlooking new ideas and suggestions. In this phase the two different views (Establishment chart and Driver view) their problems and possible fixes were listed and studied separately and the results were taken to the next step.

Phase 4: Design

Method(s): Iterative Design and Prototyping

The final phase is design but it cannot be done right away. One needs to consider the suggested solutions, do prototypes, and evaluate them to be able to achieve the finest solution and design. The method Iterative Design and Prototyping was utilized to implement the ideas which resulted from the previous steps in order to be able to get feedback on the suggested solutions from users. Paper prototypes were made for each view and they were evaluated in two rounds by in-house users. The best solutions were chosen and documented for the future use.

This stage also includes the implementation of one of the suggested solutions. Since implementing all the ideas were not possible due to the time frame of this work, all the ideas were listed on a document. This document was sent to all the in-house users who were involved in the project -especially the ones who took part in Iterative Design and Prototyping- they were asked first to rank the problems by their severity then vote for the three of them which seem to be the most important and urgent ones to fix.

After this process a meeting with the PD (Product Development) of Manpower project as attendees en route for estimating the time for implementing each feature took place. The feature which fitted the time frame of project was picked to be implemented.

5. Requirement Gathering

The primary part of a user-centered work is to understand users, their work background and their demands. This part includes the gathered information about users, their work and goal, a description of the parts of system on which this work is focused on and finally an explanation about the existing problems. As these pieces of information have been gathered by utilizing different design methods, they are explained in different sectors titled by the name of the employed technique.

5.1. Documentation Analysis

In order to understand the system and get familiar with the procedure of planning in an airline, analyzing the documents of the system and the materials which were used for tutoring the planners was the best choice. The use of existing documentation is one of the tools which are used in Requirements Elicitation. Although documentations are considered rich sources of knowledge about the system and its functions, they have their flaws too. "Documentation analysis is a useful technique to understand the existing system, but it depends on the quality of the existing manuals and user procedures" (Sutcliffe, Page 47). Most of the time documents are out of date and they do not mention anything about the exceptions and errors of the system. (Sutcliffe, Page 47) I found this true since I experienced some problems while reviewing the manuals and the reasons for them were

1. Manpower was a new system and was in testing phase by SAS so its manual was not complete yet. Some features were not mentioned in manual due to the changes that have recently been made in Manpower to suit the end-users' needs.

2. Since manual was written by a person who was somehow familiar with the system and the procedures, some steps and guidelines were not informative enough for a first time-user like me. So there was a need for me to go and ask others to come and help me through some of the procedures

Nonetheless, those documents gave me a good picture to begin my work on the system. Below are the documents which I read in order to get familiar with Manpower and planners' job

1. Pairing Introduction (developed by Jeppesen Training for Carmen Products)

2. Rostering Introduction (developed by Jeppesen Training for Carmen Products, Version14)

3. Step by step guide, Manpower SAS, version 1.3

4. Functional Reference Manual Manpower v2.10

5. Manpower online help

Crew Pairing and Crew Rostering are parts of Crew Planning process. Some overheads are prepared by Jeppesen to tutor new employees/developers in Jeppesen and to teach them the procedures which are performed by planners. Since Jeppesen develops software which automates Crew Pairing, Crew Rostering, etc. for airlines, having knowledge about procedures of Crew Planning is considered necessary for developers. These courses are followed by some games which are to ask the course participants to use what they have learnt in order to do Pairing or Rostering for an imaginative airline. In my case no detailed knowledge was necessary. Since my work was limited to 3 views of Manpower, having complete knowledge about airline planning was not required. All I needed was to get familiar with the processes and to get a general picture of them and these slides were useful means for me to reach this goal. A general description about each process in airline crew planning is given below:[5]

1. **Time table Planning**
This is the beginning of the process and is when airlines purchase their time slots. Time slots are sold at biannual IATA conferences about1-2 years ahead of the flights.
2. **Tail assignment**
In this step by considering the time slots in timetable, aircrafts are assigned to different flights while their size is being considered. For instance larger aircrafts are assigned to flights with more passengers. In Tail assignment routing of aircraft with respect to maintenance is defined as well. A short description of the input and output of Tail assignment can be seen in the image below
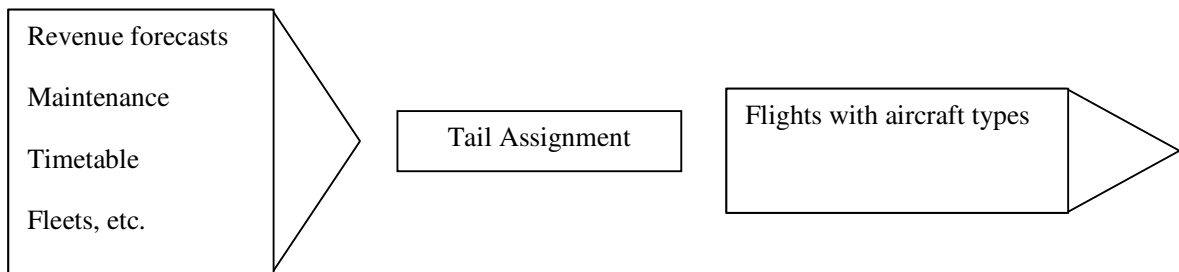

| Revenue forecasts
Maintenance
Timetable
Fleets, etc. | Tail Assignment | Flights with aircraft types |

Figure 2 Input and output of Tail assignment process

3. **Crew Pairing**
This part of process which is done between 3-8 weeks before the day of operation includes creating anonymous flight sequences with respect to flight regulations. By considering the flight regulation they mean to pay attention to rotation of crew, the number of crew which is needed per flight, stability aspects and etc. All this should be done while minimizing costs for the airline and maximizing quality of life of the crew. Although objectives like minimizing costs and improving crew's quality of life are opposite of each other, planners

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[5] Pairing Introduction Course, Provided by Jeppesen

solve this problem manually by experience, rules of thumb, etc. but it cannot be generalized since this experience differs among planners. There are some other complicating factors in Crew Pairing which are all considered in Manpower when Crew Pairing is being done. Below a list those factors can be found

- Varying crew need

- Augmentation[6]

- Multiple bases[7]

- Co-terminals[8]

- Ground transportation

- Regularity[9]

- Imitation[10]

- Etc.

4. Crew Rostering

This step is done between 1-6 weeks before the day of operation. Crew Rostering is to create detailed plans for crew, including flights, ground duties, days off, vacation, and etc. while as it was in crew pairing, fairness and satisfaction of crew plus minimization of costs need to be considered. For instance a crew member should not have more than two early starts in a trip; there should not be repetitive duties in a trip, etc.

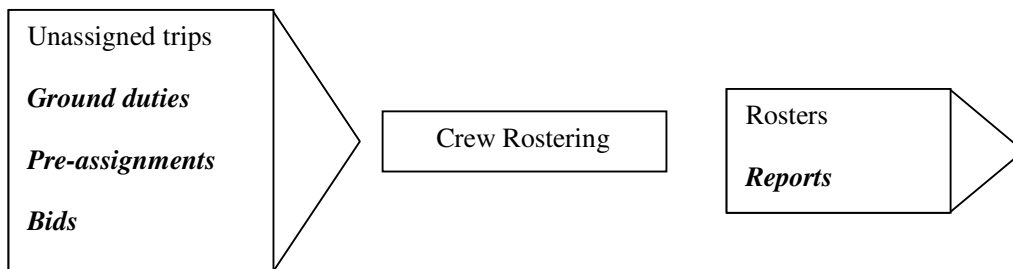Crew Rostering input and output are shown in the image below

Figure 3 Input and output of Crew Rostering process

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[6] Crew need depends on the duty. This typically arises in long-haul cockpit problems

[7] If crew is located in more than one base, trips must accommodate crew distribution

[8] Exploiting close vicinity of airports

[9] Designing trips that are more or less identical from one period to another

[10] Creating trips by imitating other trips as much as possible

5. Crew Tracking

This is to maintain Rosters after publication while minimizing the costs and the impact on published rosters and it is the final step of the crew planning process. Since Crew Rostering is done 1-6 weeks before day of operation, it is impossible to predict what is going to happen till the day of operation e.g. if someone is going to be sick and needs to be replaced, if there is technical problems and a flight needs to be cancelled, delays and etc. Crew Tracking is done from roster publication to operation and the closer to operation, the more important on-line update gets. The importance of stability of the plan is shown in this step, meaning that if the plan is stable then changing a crew member or the delay of a flight should not ruin the entire plan or impose too much cost on the airline.

After getting familiar with Pairing and Rostering, it was time to get familiar with the system and what it did. This was done by reviewing Step by step guide Manpower SAS and Functional Reference Manual Manpower.

- Step by step guide of Manpower SAS is a document which is designed to give detailed instruction on how to perform planning process at SAS airline while using Manpower.

- Functional Reference Manual Manpower is a document which includes a description of all features and details in SAS-specific Manpower application

These documents get updated whenever an update is ready to release and this is done once a year. During a year there might be some minor changes in the system but they are for fixing the issues that end-users are experiencing so there is no need for changing these documents in those cases.

The views on which this project is focused on are Establishment table, Establishment chart and Driver view. Establishment table is the one with the least problem while Driver view and Establishment chart are in need of enhancement from several aspects. A general description of these views and the way they look are included here. But the detailed information about GUI, these views and their features can be found in Specification of product document which has been prepared and used while performing Cognitive walkthrough method. (Appendix C)

- **Establishment table**

Establishment is a crew planning term. It is a resource plan that shows crew activities (demand) and number of available crew members (supply). So in this table both planned and assigned values for all activities of the airline are included.[11]

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[11] Online Help of Manpower

Figure 4 Establishment table

- **Establishment chart**

The information of the Establishment table is visualized in this chart
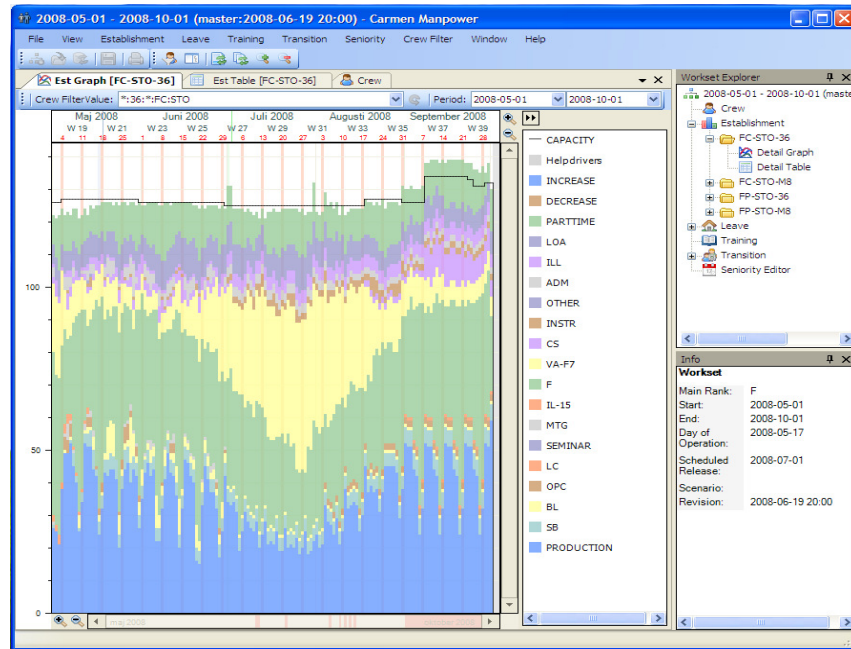
Figure 5 Establishment chart

- **Driver view**

Driver is a crew planning term as well. A driver is an algorithm that uses predefined and/or collected values to calculate the crew demand or supply on a given day, for instance to calculate free days for a crew group. [12]All the drivers in the system are listed in Driver view. So in order for users to change the drivers or check their settings, users need to open this view.
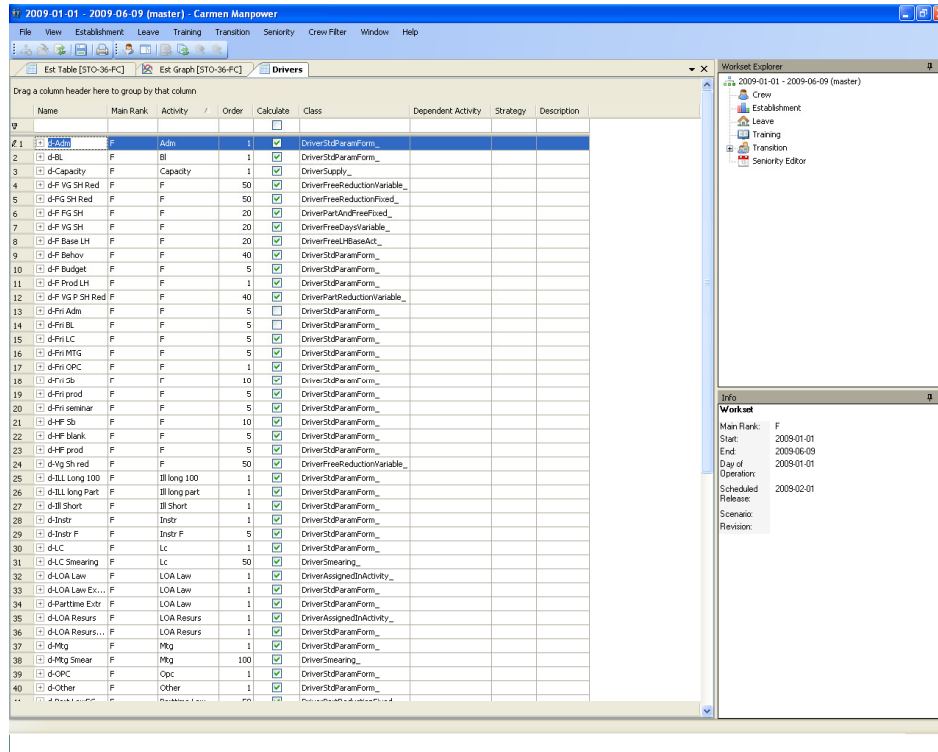
Figure 6 Driver view

After getting a general picture of the processes in the airline planning, functions and features in Manpower, it was time to get in contact with end-users and developers to get more detailed information about system and existing problems.

5.2. Interview

"Interviewing is an economic way of gathering information." (Sutcliffe, Page 45) and it is used "to elicit information that is known only to users of the product or system in question" (Jones, Page 214). That is why I have chosen this method to get more familiar with the users, the system and its problems. Interview has its advantages and disadvantages which I try to summarize the important ones in the lists below

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[12] Online Help of Manpower

Advantages:

- Being able to change the level of questions to suit the context

- Being able to look into the interesting issues as they rise in the interview

Disadvantages:

- Analyst's failure in following up on details during the interview

- Having to spend time to gain trust of the interviewees, especially the ones who do not volunteer to share their knowledge

In my point of view gaining the interviewees' trust is the most important and difficult thing to do.

- Interviewer needs to make them understand that she is there to help and not to criticize their work or their knowledge. This can be done by avoiding any kind of argument with interviewees. "Never argue with an interviewee. Even if you do not agree with the person, it is best to accept what they are saying at face value and double check it with the information from other interviews. The minute you become argumentative, it reduces the amount of information that you can get from that person." (Latino, Page 4)

- It is also necessary for her to make the interviewees sure about the exactness of recording the responses they give. They should know that their answers even the simple ones are important to her research and are being recorded as they are being described. "Allow the interviewee see what you are writing. This will set them at ease since they can see that the information they are providing is being recorded correctly" (Latino, Page 4)

Below are the interviews which were done with both developers at Jeppesen and end-users in SAS. The taken steps, the questions and answers are mentioned here but the results can be found in Result section of this report.

5.2.1. In-House Interviews

Since at the beginning, interviewing the end-users was not possible I started with interviewing the people who were part of the project. The interviewees are developers whose level of contact with end-users is different as some are core developers while others are the team who are in charge of customizing the software for a specific customer. Because of this diversity an interview guide was designed instead of a questionnaire. I believed this could keep me on track while giving me the freedom to probe to the interviewee whenever an interesting issue arises. (Dix et al., Page 348) The questions followed a top down (funnel) approach and started with asking some general questions about the interviewee himself. Since some of the interviewees were not comfortable about talking about their academic background, that question was excluded from the Interview guide.

Table1 shows the general information about them and also the level in which they are in contact with end-users.

Sex	Position	Level of contact with users in general (out of 10)
Female	Team leader , A member of course design group, Tutor	5
Female	Implementation group for SAS	9
Male	Associate System Analyst, Implementation group for SAS	9
Male	Service Manager	9
Male	Software Developer	3
Male	Software Developer	2
Female	System Tester	1

Table 1In-House Interviewees

Interview was followed by asking some general questions about users, their level of familiarity with the work which is done by Manpower, the frequency of use and also some questions about the courses which take place in Jeppesen to teach the software to users. The interview ended with getting information about the goal of the current design and getting ideas about the pros and cons of the Establishment and Driver view. In this part the screenshot of these views (in different states) were used as mediating tool. So I should say I moved from questions about facts to questions which require evaluation and reflection[13]

Although end-users have the same job in their company (they are all planners), they have different background and computer expertise. The end-users are 30 or above years old and their computer expertise is either basic or intermediate.

According to the interviewees some of the end-users have engineering background and consequently are familiar with computer but some who have been employed while ago can be said that they do not belong to the computer generation. They are mostly the ones who are not that welcoming towards the new system because of having the fear of computer, fear of trying new things and making mistake. I doubted that not being computer savvy is the only reason for end-users' avoidance and in order to figure that out I needed to gather more information.

Manpower has the ability to get all the information about crew and then make budgets, forecasts and discover problems early in the work process. This ability is provided by the complicated rules and procedures which are defined in Manpower. As unfamiliarity with a procedure can also result in avoidance of employing it by users (because they do not know

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[13] Methods of Interaction Analysis Course, Taught by Pontus Engelbrektsson, 2008, Chalmers University of Technology

what happens if they change something), I wished to know if users are able to calculate (at least part of) what Manpower is calculating now. For instance if they knew in order to calculate vacation for a crew with a specific contract what rules are needed to be considered, then they were able to check the accuracy of the provided plan by Manpower for such a crew. This could help me to understand what the source of problem is. Is it complexity of software or is it users' unfamiliarity with the rules and process?

According to the developers users are able to calculate what they want (Of course not as wide as Manpower does) so when they get a result that they did not expect they need to check the settings of Manpower to fix that and that is where the problem begins. They need to go back and look for the reason of the problem then figure a way out for resolving the issue but the complexity of Manpower makes it difficult to achieve.

Manpower is providing the users with a wide range of choice and according to one of the interviewees although this flexibility is a good feature at marketing side, it is the cause of confusion at user side. The question which rises now is what planners of that airline (in this case SAS) used to use before and to see if they were experiencing the same problem previous to Manpower. If not then that may give me a clue of what can be changed to make it easier for them to understand and resolve the problem they are experiencing.

According to the in-house interviewees the previous system included different individual software with low level of flexibility. They were mainly console applications which gave the users the numbers about the crew (the number of working hours, the number of vacation, etc.) and then planners could use those numbers to calculate what they should (e.g. vacation, leave, etc.). In addition to those applications Excel was used and as we know it is straight-forward software and does not require any special expertise (e.g. computer expertise) from user. So why did they change their system to such complicated system?

The decision for transferring to Manpower was not made because of usability problems and was absolutely not made by end-users. The reasons why the airline changed the system to Manpower were first saving money on maintenance by having all-in-one application, second to enhance the quality of life of the crew while reducing the costs for the airline. Since the people involved in the process of purchasing the software are mostly from marketing and management, they are interested in having an application which can cover all their needs and reduce the expenses. This means usability does not come first while software is being bought.

Hence users were satisfied about what they were working with because of their familiarity with the system which comes along with simplicity for them and now the flexibility of Manpower is making it a complicated system which results in end-users' confusion. But can this be changed?

Software is flexible because it is not being designed for only one user but for different users in different airlines. So it should be developed in a way that can cover all the different needs for all potential customers. It is true that an implementation team is assigned to each customer/airline by Jeppesen to customize the software for them but that is just for including the rules that they have in their airline, debugging software problems and also transferring the

system to them while making sure they know how to use the features and functions. So Manpower cannot become less flexible but can be more user-friendly to lessen users' confusion. With the intention of getting familiar with the users' problems the interview was continued by getting information about the users and their problems in the tutoring sessions.

It is usual to have problems whenever one starts to learn something but it is vital to know how long it takes them to learn it and if takes long time then what is the reason(s) for it. For the reason that Manpower is the software which users need to employ in order to do their job, it should not take long for them to gain knowledge of it. Below is the summary of the answers to the above mentioned questions which can show the level of learnability of Manpower.

- The courses are one week long and different parts are taught in different sessions.
- Different users may participate in different sessions since they do not need to learn all but just the part they work with
- Users do not manage to learn the application completely but are just introduced to it. The rest of learning process will take place while they work with it under super-users' supervision
- Their learning pace differs from one to other. The causes for it are as described below
  - Whether they were part of Testing team
  - Their educational background
  - Their willingness to learn
  - The level of fear in trying things around

So according to the interviewees, users are able to learn and perform simple tasks with Manpower after attending these courses but if they want to learn deeper then they need to put more time on it. All users are frequent users but with different responsibilities. The more advanced user you are, the more time is needed to learn the software. For instance in regard to Establishment view, users' level of duty can be divided as below which shows the complexity of the work of advanced users.

- Basic
  - Working with numbers and changing them to get a better result
- Advanced
  - Change the settings of drivers
  - Modeling stuff in new ways
  - Predictions based on firing and employing people
  - Changing the activities around (change their activity group) e.g. if you are instructor are you doing production or course activity

Establishment is presented in two ways: table and bar chart.

Bar chart is giving an overview of calculated numbers and the situation caused by them in the form of colors and nothing else. This kind of information visualization does not interest planners so they don't use this view at all. Its use is limited to managers who are not keen on looking at numbers but more are into having an overview of the information. As I am working on both table and chart, I asked if the managers participate in any course to gain knowledge of

what is presented in the chart for them. I also wished to know if that responds to what the managers desire to know from the chart. Getting the answer to the first question was easy while to get an answer to the latter, I needed a manager to talk to. It seems that managers are not the ones who are using the software so there is no need for them to participate in any course/lecture. The lack of knowledge (for instance if they do not understand what is presented in chart) is filled by a report which includes the necessary information for them.

As mentioned before the interviews ended with getting information about why these views have been designed in the way they are now. Screenshots of Establishment and Driver views have also been used as mediating tool (Mediating tools, MarieAnne Karlsson) to get the idea of the interviewees about pros and cons of the design. I also asked them to mention their idea about how the negative points can be fixed.

- The Establishment view looks like the previous software which was utilized by customer (Excel sheet). This was done to avoid mystifying end-users' work by giving a total new look to this view.
- About the driver view, since the driver is a mathematical formula and all it wants as input are parameter(s) and value(s) it was designed like a simple table with editable content. The problem with this table is that Drivers and parameters are shown in different levels and adding the new information is done in vertical form. This causes the table to be lengthy and difficult to browse/scroll. Although developers were aware of scrolling problem in that view, they did not change it because of its low priority in comparison with functional bugs consequently it was left in the way that it is now.

Considering the existing problems the question that comes in mind is if a new view is needed or if it is better to make some changes in the existing ones. The interviewees were more positive about making change rather than visualizing the information in a completely different way. One of the interviewees mentioned that he cannot say if a new data representation is needed or not since he does not know what the users want to see in such a view; according to the team leader users are satisfied with the Establishment table and the only thing that is missing is more information about the drivers.

The useful information was mostly gained from the Implementation group who were in contact with end-users. Developers and testers were not that helpful since they were not aware of users' goal(s), were mostly keen on making the functions work, and were not all familiar with Establishment and Driver views so could not criticize/evaluate them even by using the mediating tool.

Although I thought that I can treat the non-familiar developers as novice users and gain useful information from them about Establishment and Driver views, it did not become true. It was correct that they were novice but they did not know about the end-users' goal, subsequently could not say whether those views can answer their need(s) or in other words whether they are designed in a proper way. So in this case even mediating tool could not fill in the gap of knowledge.

5.2.2. SAS Interviews

This is the summary of the interviews which were carried out in Oslo with end-users of Manpower. An interview guide was prepared to keep the interview in the right track and to give the interviews a consistent base. It started with getting some information about user herself and was continued with general then detailed questions which all aimed to get understanding about users' requirements, their problem with the current views and also their feedback about the system.

Manpower is a new system and SAS is the first customer so the system is now being tested by some of the planners in SAS and has not gone into production yet. Because of this situation the number of interviewees was limited to three people as they were currently the only ones working with Establishment and Driver views. The interviews were done in SAS Learning Center which is placed near Oslo Lufthavn (Airport of Oslo) and interviewees were all Norwegian.

Sex	Years of experience in planning	Role in SAS	Background	Computer Expertise
Male	3	Planner	Master degree in Economics and Logistics	Advance
Female	3	Resource Planner & Analyst	Not mentioned	Novice-Intermediate
Male	2	Manager in Resource Planning	Economical Planning & Advisor	Novice-Intermediate

Table 2 SAS Interviewees

In order to get familiar with users' requirements, users were asked to explain what makes them satisfied or unsatisfied with their job. They were also asked to clarify their objective while working with Manpower and the way they measure their success.

Their answers are grouped to two groups to give a better overview of what have been said.

Positive points:

- Challenging
- Always having something to do
- Flexibility of the job and working hours

Negative points:

- Short deadlines
- Complicated and not user-friendly systems

Having the knowledge about users' goal(s) and desires can be a great assistance in the design process. That was the reason why interviewees were asked to point out what their objectives and needs are as a planner. Below are the mentioned items:

- Design a Good –quality plan
- Having a better grip over crew
- Having the reliable numbers/figures

Previous to Manpower, users had to get the crew information from number of different of systems and this problem is now solved in Manpower since all the data is being saved and loaded from one database, as a result Manpower gives a better grip over the crew. Measuring the success of this goal is pretty easy since all one needs to do is to select the right crew filter then he will get all the needed information.

About two other goals, they cannot be measured until the flights are done. At that time a good view about how good the plan was and how consistent the provided numbers were can be seen. If a plan is good then planners are able to go back and have a look at it every time they want by using Manpower. This is one of the best features in Manpower since it gives planners the opportunity to follow the successful plan for future (if the conditions are the same).

As expected, the system seems complicated to users as they are used to work with simple systems such as Excel. Manpower considers all the rules of the airline plus their priority when provides the users with numbers in table. Although these users have a good knowledge in planning and are familiar with all the rules which are needed to be considered while designing a plan, they find working with Manpower pretty thorny. In their idea users not only need to have a good knowledge of both computer and planning but also they need to be able to think like an engineer while they work with Manpower. But is the provided information enough or is it too much for them?

Establishment table and chart include too much information but it is all needed by frequent users who are Analyzers and Planners. Given that most users are frequent users, we do not need to consider people who might rarely work with these views or to think about a fix for their problems. The focus of the work should be on planners and no one else. So what is considered vital in their job and is Manpower helping them to achieve that?

The most important duty of a planner is to make sure that the numbers which are put/set for each activity in different periods are good. There are number of factors which make a figure considered as a good one; some of those factors are listed below

- Legality
- Not having a negative effect on the Balance
- Cost efficiency
- Etc.

According to interviewees most of the needed information is provided by the table but if anyone needs to get deeper and find out for instance about how a figure has been calculated

he needs to refer to Driver view. So all information is in Manpower and no other system is needed in this matter. After Establishment table, it was time to talk about Establishment graph and its pros and cons.

Both group of interviewees (in-house and SAS) confirmed that there is no use for Establishment graph. Developers thought it is used by managers while SAS interviewees said Excel charts are used since Establishment chart does not provide a good overview. Their suggestions for improving the chart were all recorded to be used in prototyping phase.

In order to get the reflection of users on expected and unexpected behaviors while working with Manpower, they were asked to give details on the typical task in Establishment and Driver views. Also to state what they will do if something goes wrong like getting an unexpected number for an activity.

A typical task related in Establishment table or Driver view does not require changing the settings, knowing about all the existing details e.g. how a driver works, what each column means, etc. Change of settings is a one-time job which is only done by super-users who have the enough knowledge.

The same question which was asked from developers was mentioned in these interviews, and that was whether there is a need for a new data representation or if some changes are needed in the existing views. Only one of them showed interest in having the option of showing figures in different charts (like what exists in Excel), the rest were happy with the Establishment Table.

The interviews ended with asking if there is any other thing which needs to be addressed in the direction of improving the discussed views or if there is a feature which was in the previous system and they like to have in Manpower as well.

- Being able to change the figures directly in Establishment Table (at least ABS type)
- Having the option of changing the figures without affecting other people's work
- Having the possibility for exporting (copy-paste) the figures to Excel or Word
- Having the possibility to work on a table while another Establishment table (Establishment table) is being recalculated

The second item is already included in Manpower. End-users are able to create scenarios and work with them till they are satisfied with the result they have; this is done without affecting other people's work. But still end-users are not satisfied with it because of the reasons below

- Although they don't work with database, the system is still slow

- They still have to go to Driver view to be able to change the figures

In all I got good feedback from all these three interviewees. I should also mention that it was the first time that I found interviewing a bit risky since one was not willing to talk and seemed to have a negative feeling towards Manpower as well. I am not sure if the source of her insecurity towards being interviewed was her lack of knowledge about the system, her

negative feeling towards Manpower or having difficulty in talking in English. Whatever the reason was I succeeded in gaining her trust by letting her see what I am writing, not arguing with her in any matter and by showing respect and patience whenever she could not find the right word to say. Except for her all other interviews went smooth and without any problem.

5.3. Cognitive Walkthrough

This is one of the methods which use expert analysis to evaluate a system. As mentioned by Alan Dix et al. (Dix et al., Page 320) these methods are cheap because they do not need the participation of users and they can be used at any stage in the development process. "The basic intention is to identify any areas that are likely to cause difficulties because they violate known cognitive principles, or ignore accepted empirical results." (Dix et al., Page 320).

In order to be able to perform this method I asked several Interaction Design students to take part in the evaluation process. Unfortunately only one of them was able and agreed to come. His personal information can be found in table 4.

Sex	Age	Background
Male	24	Interaction Design

Table 3 Personal Information of the Participant

So the documents with necessary information were prepared and sent to him in order to make him ready for the job. Below are the prepared documents

- Description of Cognitive Walkthrough method along with an example (Dix et al., Page 321-324)
- Specification of the product plus the information about end-users and their previous system (Appendix C)
- A description of a representative task with its list of actions (Appendix D)

The document with product specification includes representation of Manpower in general in addition to detailed information of the views on which this thesis was focused.

The participant was asked to read the documents, ask his questions and let me now when he is ready. Unfortunately he did not pay attention to the demands and claimed to be ready the next day. Since in one hand I did not know for sure that he was not prepared yet and on the other hand he was the only participant I had, I could not risk doubting him or showing distrust which could make him change his decision to become involved the evaluation process. That was why I have chosen to let him perform the evaluation and check if the expected result can be deduced.

As anticipated he has not read the documents and did not have any familiarity with the system. The bigger problem was that the gap could not even be bridged by looking at Product Specification document since he did not know where to look for that particular information. The lack of knowledge, the avoidance in accepting help and not having the courtesy to accept

his lack of attempt in this matter made the evaluation process very difficult and slow. He blamed it all on the system being complicated and him not being aware of users' goal. Although I explained for him that he did not need to have a complete knowledge of the system but just to evaluate the design and interactivity of it, he did not seem to be convinced or happy about it.

He was asked to follow the task step by step and answer these four questions for each of them

1. Is the effect of the action the same as the user's goal at that point?
2. Will users see that action is available?
3. Once users have found the correct action, will they know it is the one they need?
4. After the action is taken, will users understand the feedback they get?

All answers were recorded in a Usability Problem sheet for further analysis. Beside these answers the participant was asked to point out the severity of the problem as well.

Since the first evaluation did not result as I wanted, after consulting my supervisor I have decided to do the evaluation one more time myself. I have tried to not to let my knowledge of the system and my familiarity with it affect my judgment. The same process was followed and all the answers to the questions were documented in a Usability Problem sheet.

The results from both evaluations were put together and shown in a table. This can be read in Result section of this report.

5.4. Morphological Charts

Now that the problems of the system are explored, it is time for coming up with ideas and fixes then evaluating them and choosing the ones which do not conflict with each other while resolving the discovered issues. There are different methods which can be handy in this phase such as Brain Storming, Boundary Searching, Ranking and Weighting, Morphological Charts and etc.

I found Morphological Charts most helpful since it provides a visual way for capturing the necessary product functionalities and exploring alternative ways and combinations of achieving them (www.ifm.eng.cam.ac.uk). It also forces the divergent thinking which stops the analyzer from failing to notice the new ideas and solutions. (Jones, Page 293) Since there might be various ways to solve a problem, listing the different aspects of a problem and their solutions in a table can be truly helpful in locating the finest combination of sub-solutions.

This method was used to find the answer to the explored problems via interviews and Cognitive Walkthrough with Establishment Chart and Driver view. First for each view the essential functions and at most three different solutions are presented in two separate tables, and then the ones which go together are chosen as a fix to the problem. In some cases choosing only one fix for a problem was a bit difficult and more feedback was needed for taking the decision and choosing one over another. As a result the solutions to those cases were all considered while doing the paper prototypes to assess the essentiality of each and ease the decision making process.

In all the principle of selection of solutions for both views was fulfilling users' desire and accomplishing their satisfaction with the provided information. In Results section you can read about the result of this method and the reason why other proposed solutions were not considered for the prototyping phase.

6. Results

6.1. What are the problems

Five different methods were utilized during this project and each of them played an essential role in reaching the goal of the work. This part is to present the results based on the analysis which were done by using the above mentioned methods.

Documentation analysis gave me general information about the system while the interviews with in-house interviewees and end-users plus the Cognitive walkthrough made me aware of the existing problems.

The answers to the interview questions and the end-users' frequently asked questions during courses (which were mentioned by tutors in the interviews) demonstrated that most of the FAQs and problems were about Driver view, drivers and their settings. This was also confirmed by end-users' answers during their interviews. This does not mean that there is no problem with Establishment table or chart but just emphasizes on the severity of the existing problems with Driver view.

The difficult parts/terms are as listed below:

- Driver term, its use and function
- The source of numbers in Establishment view (where do they come from)
- Tracking the numbers and correcting them

Drivers are mathematical functions in which the rules of the airline are included. In order to get familiar with drivers' functions users need to read the manual that at least has 30-line description for each driver. So after a while this problem will be solved, all is needed is spending more time on the system.

While being familiar with drivers and their functions is necessary, changing the settings for drivers is not an everyday-job and when it is done, normal users are not in charge. What concerns the everyday job of the normal users is the need of changing the figures in Establishment table and in order for them to do that, they need to have an easy access to the information below and not to be forced to go back and forth to Driver view for accessing them

- The origin of the figure (Especially when the type is PERC and more than one drivers are involved in the calculation)
- The period in which it is valid
- The crew on whom it has effect

Explaining the problem in the form of an example/scenario can help the reader to easily grasp the existing problem(s). The most common problem which involves both Establishment table and Driver view is tracking a figure in Establishment table.

Scenarios

Scenario A

The crew pairing is done with Manpower and the plan is available for planners to work on. A planner has a look over the plan for the crew filter OSL-LH-FC (meaning the captains with Oslo as base[14] or workstation and long-haul[15] flight) and the figure on February 2nd looks suspicious. She wants to check if the figure on 2nd of February with value of 1.24 has been calculated correctly

1. Planner tracks the number to the first column in left of the table to find the name of Activity Group
2. She clicks on Activity Name to reach Activities under it
3. She clicks on the required Activity to reach SUM-PLANNED and SUM-ASSIGNED
4. She clicks on SUM-PLANNED to reach the Driver
5. Now she looks for 2nd of February in the table and right-clicks on its figure
6. She chooses 'Edit Driver Parameters..' option from the context menu to enter the Driver view via the Establishment table
7. The Driver view opens. There are two types of Parameters under the Driver: Standard and Filter Parameter
8. There is nothing listed under Filter Parameter so she clicks on the Standard Parameter tab to find the origin of the figure
9. There are some crew filters listed but OSL-LH-FC is not one of them
10. She tries to locate the crew filter(s) which can be related or have effect on OSL-LH-FC. Crew filter ALL-LH-FC is listed there, so she expands ALL-LH-FC to reach its Parameter Value for 2nd of February
11. The value is set to 3 which do not match the figure (1.24) in the Establishment table. This is because filter crew OSL-LH-FC is a part of ALL-LH-FC not all of it so she needs to know what percentage of ALL-LH-FC is dedicated to OSL-LH-FC
12. She opens the Establishment table for ALL-LH-FC , checks the Capacity of 2nd of February which is 126
13. She goes to Establishment table of OSL-LH-FC and checks the Capacity of 2nd of February which is 52. So 41.26% of crew in crew filter ALL-LH-FC belongs to OSL-LH-FC
14. 41.26% * 3 = 1.24

So the calculation was OK!

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[14] A home base is the station at which a crew member resides
[15] Journeys typically made by wide-body aircraft that involves long distance and often non-stop flights

Scenario B

Here is another scenario for getting more familiar with the process of tracking a figure. In this scenario user needs to pay attention to the Calculation Order of each Parameter. User is interested in checking the figure with value 1.5 of Activity Group on 2nd of February for crew filter ALL-LH-FC (base or work station: any, Type of flight: Long-haul, Type of crew: Captains).

1. Planner tracks the number to the first column in left of the table to find the name of Activity Group OPC
2. She clicks on Activity Name to reach Activities under it
3. She clicks on the required Activity to reach SUM-PLANNED and SUM-ASSIGNED
4. She clicks on SUM-PLANNED to reach the d-OPC Driver
5. Now she looks for 2nd of February in the table and right-clicks on its figure
6. She chooses 'Edit Driver Parameters..' option from the context menu to enter the Driver view via the Establishment table
7. The Driver view opens. There are two types of Parameters under the Driver: Standard and Filter Parameter
8. There is nothing listed under Filter Parameter so she clicks on the Standard Parameter tab to find the origin of the figure
9. The crew filters which are listed under d-OPC Driver are: ALL, ALL-LH-FC and OSL-LH-FC. Their Calculation Order and Parameter Values are as listed below

OSL-LH-FC   Calc Order = 1   Parameter Value = 2
ALL-LH-FC   Calc Order = 2   Parameter Value = 3
ALL   Calc Order = 3   Parameter Value = 5

It is always recommended to give the lowest Calculation Order to the most specific Crew filter (in this case OSL-LH-FC) to get the best result in the plan.

So Crew filter OSL-LH-FC gets the value 2 and that is what will be shown in its Establishment table.

Since OSL-LH-FC is a part of ALL-LH-FC we first need to exclude that from the Crew filter ALL-LH-FC then do the calculation to check the figure on 2nd of February. (See the Figure 7 for more information about the relation among all there three Crew filters)
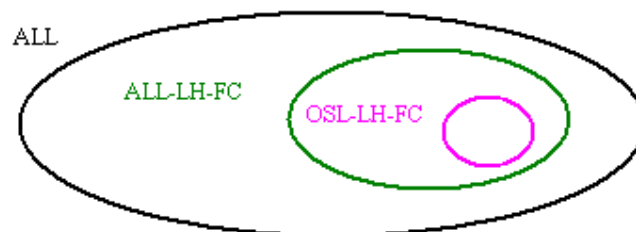

Figure 7 The relation among the Crew filters in scenario 2

10. She opens the Establishment tables of the Crew filters OSL-LH-FC and ALL-LH-FC and checks their Capacity on 2nd of February

    Capacity of OSL-LH-FC = 35

    Capacity of ALL-LH-FC = 70

    So she needs to give the Parameter Value 3 to half of the Crew filter ALL-LH-FC

11. 0.5 * 3 = 1.5

So the calculation was OK!

We can also calculate the figure on 2nd of February for Crew filter ALL (just to practice). All we need to do is to exclude the Capacity of Crew filters OSL-LH-FC and ALL-LH-FC from Capacity of Crew filter ALL.

100 -70 =30

30 * 5 = 1.5 → The figure on 2nd of February for Crew filter ALL

Note: A person is always calculated once. So if she is calculated in a filter e.g. OSL-LH-FC, she will not be included in the calculation for other filters e.g. ALL or ALL-LH-FC

The problem with this view is not only about the figure but also with interaction with Driver view. Each driver has two levels under it; one for Parameter and one for Parameter Value. Users need to use 3 scroll bars to be able to scroll up and down under a driver. The obligation for expanding three levels to reach the required information causes difficulty and confusion for users. A picture of an expanded Driver in Driver view can be seen in the Figure 8.
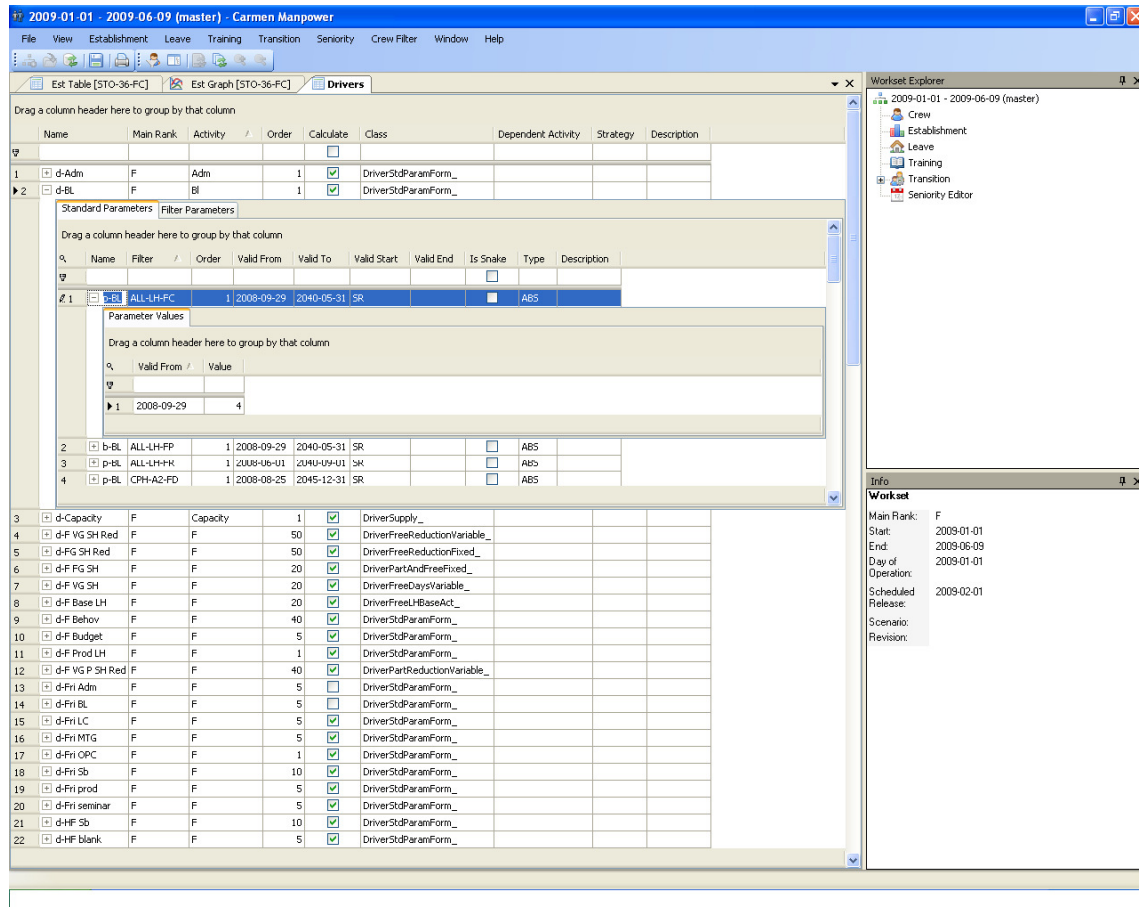

Figure 8 The Driver d-BL, some of its Parameters and Parameter Value of ALL-LH-FC

The summary of the gathered information, the problems and their cause, even the ones which do not consider normal users, in Driver view are presented in Figure 9.
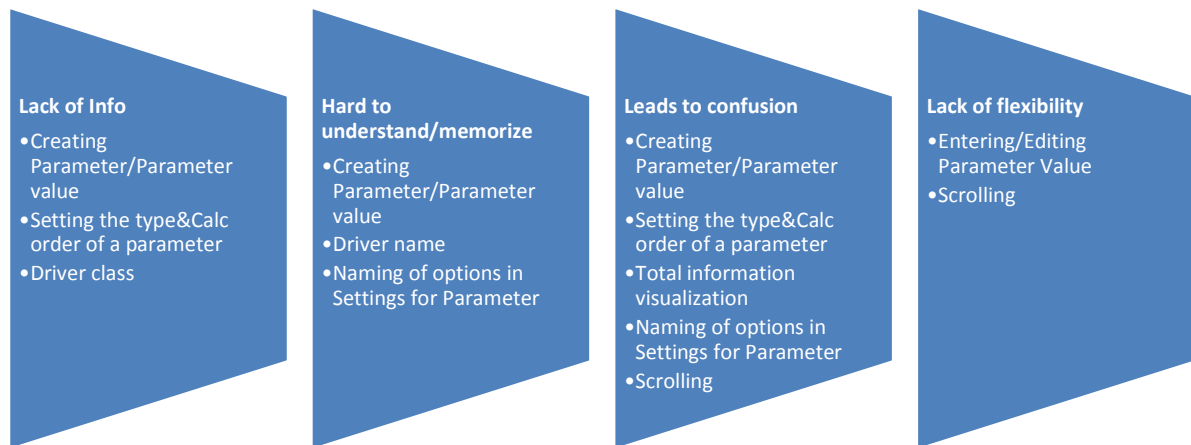
Lack of Info
- Creating Parameter/Parameter value
- Setting the type&Calc order of a parameter
- Driver class

Hard to understand/memorize
- Creating Parameter/Parameter value
- Driver name
- Naming of options in Settings for Parameter

Leads to confusion
- Creating Parameter/Parameter value
- Setting the type&Calc order of a parameter
- Total information visualization
- Naming of options in Settings for Parameter
- Scrolling

Lack of flexibility
- Entering/Editing Parameter Value
- Scrolling

Figure 9 Negative points of Driver view and their sources

In the figure above the problems are summed up and there is a need for giving more detailed information about some of the problems in the direction of clarifying them

- Setting the Type and Calc Order of a Parameter
  - ❖ The system does not warn users about not entering the same filter with the same value and Calc Order. This results to undefined problems when calculation is over
  - ❖ There is no information about how to set a Parameter with PERC (percentage) type.
    Note: An Activity with PERC parameter type is dependent on another Activity. That Activity should be chosen by user other than that Capacity is taken as the default Activity.
  - ❖ There is no information about how to consider the priority of each Parameter e.g. the necessity of giving the lowest Calc Order to the most specific Parameter
- Entering/Editing the Parameter Value
  - ❖ Users are forced to use Edit option which is hidden in context menu to be able to edit a Parameter Value
  - ❖ Users need to click on a special area to get the context menu but there is no information or guidance about where to click.

In addition to these problems there are some which do not fit in these groups such as
- The waste of space in front of the Parameter Value
- The need of resizing the original view for being able to see the Parameters or Parameter Values below a Driver.

This goes against what is indicated by Alan Cooper "Most people rather see the application take some 'good enough' first step and then adjust it to what is desired. This way, the application has moved a person closer to his goal" (Dix et al., Page 215)

- Presenting too much information in both expanded and normal view

All these problems have been documented so that they can be considered in next step when the solutions are going to be suggested.

Now is Establishment table turn, although end-users are satisfied with the provided information in Establishment table, they prefer to use Excel for their work. This is because Excel provides them with

- The possibility to edit the figures directly in the table
- The possibility of setting the functions, putting notes about why a number is set like this, etc.

Editing the figures directly in Establishment table is not possible and there is a reason behind the current design decision. Manpower is offering an advanced service which enables the users to foretell the future and plan for it; this is done automating the calculations while considering all rules and their priorities. This automation comes with the complexity in process of changing the figures of Establishment table (e.g. one needs to enter the Driver view to choose a driver, its parameter or value to reach the figure he wants in Establishment table).

It is true that Manpower has a complicated way for doing the calculations but we can bring the Excel feeling to Manpower by giving the users the opportunity to put notes in the time they are planning and setting a number for a driver. In this way they are able to understand the process better and speed up their work by decreasing the need of going back and forth to Driver view or consulting a co-worker for figuring out the source for a number.

There are also other problems with Establishment table; these problems and their source are all shown below in Figure 10.
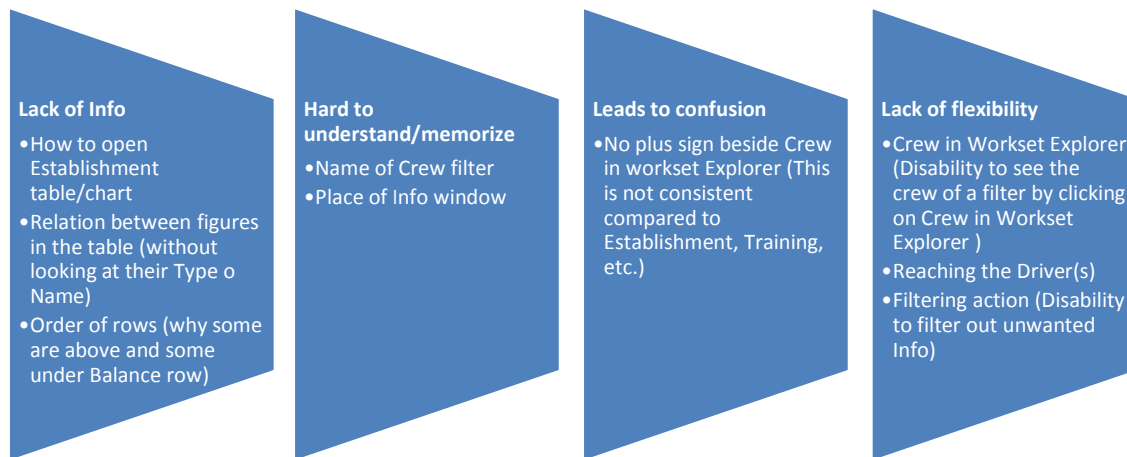
Lack of Info

- How to open Establishment table/chart
- Relation between figures in the table (without looking at their Type o Name)
- Order of rows (why some are above and some under Balance row)

Hard to understand/memorize

- Name of Crew filter
- Place of Info window

Leads to confusion

- No plus sign beside Crew in workset Explorer (This is not consistent compared to Establishment, Training, etc.)

Lack of flexibility

- Crew in Workset Explorer (Disability to see the crew of a filter by clicking on Crew in Workset Explorer)
- Reaching the Driver(s)
- Filtering action (Disability to filter out unwanted Info)

Figure 10 Negative points of Establishment table and their sources

In order to complete the research on Establishment table and Driver view, I have carried out the Cognitive Walkthrough method. This was done to check over the process of tracking figures and to find out about any areas that can cause obscurity. This method was performed by me and another Interaction Design student. Its results are a complement to the results of interviews.

Problem	Severity / Priority
Activity Group, Activity, Sum Planned and Sum Assigned do not look clickable	• Severity= 3 • Priority = 2
Activity Group, Activity, Sum Planned and Sum Assigned do not show they include info	• Severity= 2 • Priority = 3
No noticeable feedback after clicking on Activity Group, Activity, Sum Planned and Sum Assigned	• Severity= 4 • Priority = 1
No sign that text can be written in filter boxes	• Severity= 2 • Priority = 3
Both Parameters are visible when they are not needed	• Severity= 2 • Priority = 3
No noticeable feedback after checking Visible in Crew Filter view	• Severity= 4 • Priority = 1
Establishment Detail Table icon does not look clickable in Workset Explorer	• Severity= 3 • Priority = 2

Figure 11 Results from Cognitive Walkthrough (The problems, their severity and priority)

The reason why Cognitive Walkthrough was not performed to evaluate Establishment chart was that both groups of interviewees confirmed there is no use for Establishment chart. Developers did not put that much effort on it and users were not keen on using it. And in fact there is no

functionality in Establishment chart which is worth getting evaluated or analyzed. In other words this view needs to be worked on from the start.

The main problem with Detail graph is that it does not provide a good and comprehensible overview of the existing information. The way the Activities are stacked on each other, the similarity of the colors, the inability to see or notice the amount of difference between different Activities or even in the same activity in different times, etc. make it useless for users. This can explain the reason why they prefer to use Excel or Word in order to get the overview in more detailed and comprehensible way for themselves or for the managers.

Since the aim of the graph is giving an overview of the plan to the user, we need to make sure that user can get that by looking at the graph. As it is mentioned by Robert Spence "visualization is solely a human cognitive activity and has nothing to do with computers."(Spence, page 5) So when it comes to data visualization, it should be done in a comprehensible way to address the users' need in a simple, fast and clear manner. "Data-in whatever form- is transformed into pictures, and the pictures are interpreted by a human being…the sight of a graphical encoding of data causes an 'Ah Ha!' reaction in the viewer in the sense that a useful discovery has been made."(Spence, page 5) and I needed to create that kind of reaction when users employ Establishment chart.

Since end-users are able to get most of the required information from Establishment table and because they did not see any use for Establishment chart, they were not able to give feedback on this part of the system. However they provided me with the features they would like to have when working with a graph in their field of work. Suggestions such as

- Being able to see the Balance in the middle of the chart
- Being able to recognize the activities by a look
- Having the ability to choose what Activity to depict in the chart
- Having the ability to change the aggregation level (as it is done in Establishment table)
- Including the figure in the chart especially when the figures are low
- Having an easy access to the figures via chart
- Having an easy access to the crew of each Activity via chart

These suggestions helped me to conclude what the problems with the chart can be. Those problems are shown below in Figure 12.
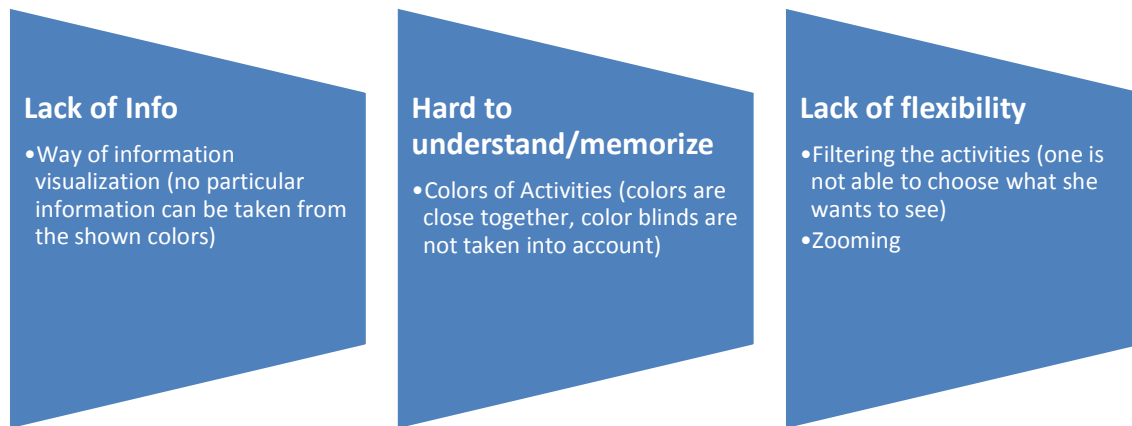
Lack of Info

•Way of information visualization (no particular information can be taken from the shown colors)

Hard to understand/memorize

•Colors of Activities (colors are close together, color blinds are not taken into account)

Lack of flexibility

•Filtering the activities (one is not able to choose what she wants to see)
•Zooming

Figure 12 Negative points of Establishment chart and their sources

There are two ways for zooming in Establishment chart: Horizontal and Vertical. Two separate magnifiers are provided on X and Y axis and each of them has one for zooming in and another for zooming out. I as a novice user had difficulty using this feature for two reasons

1. The reason for zooming in/out was obscure to me
2. I could not figure out my current situation when I zoomed in

Usually when one uses zooming feature, she needs to get more information and being aware of that requirement can help with design procedure. As mentioned earlier end-users were not that helpful in answering the chart related questions so I had to analyze this view with the help of the read articles and books within the subject of Information Visualization.

According to Robert Spence there are different kinds of zooming action; it can be geometric or semantic. Geometric zooming is more about magnification while semantic zooming is to get more detailed information. Here is how geometric zooming is defined by Robert Spence "In a conventional 'geometric' zooming action no change in the data or its representation is involved, only the activity of filtering caused by the inevitable discarding of context when zooming in." (Spence, page 117) but "with semantic zoom a new representation is involved" (Spence, page 119). And that is what is expected here by end-users of Manpower. Besides knowing the type of the zoom, an Interaction Designer needs to also know about the task, the intention and the required information by users "…the interaction designer must understand the task that is being performed and the way it is carried out to be able to effectively design the sequence of data representations that will constitute semantic zoom" (Spence, page 119). Since end-users were interested in having more information in this chart, I could provide them with that information when they zoomed in.

Currently the graph is showing the number of crew who are assigned for the tasks under each Activity plus the total number of available crew. So the information that an end-user in the time of zooming can be interested in is

- The name of the Task

- The exact number of crew for a special Task in that period

- The date of the task (e.g. 2009-01-01)

- The number of crew who are not assigned to any task for that period (the remaining number of crew in total for that period)

In addition to the items above, it is also required to inform the user about her current situation and provide her with an easy mean to be able to go back to default view. All the problems, ideas and suggestions for fixing them are gathered and analyzed by performance of Morphological chart. This method gave me the chance to list all the suggestions I had in mind for fixing the problems, compare solutions with each other and choose the ones which are compatible and also address the setbacks of the system.

6.2. What are the potential solutions

This method was utilized to list and analyze the solutions for issues in the Establishment chart and Driver view. Some of the solutions can be used for other views such as Establishment table e.g. Feedback window as well.

The first step in this method is to classify the functions that a system like the one which is being worked on, should support. By having a look at the explored problems in Establishment chart and Driver view, the functions which can help in the enhancement of those views were listed, and then the possible ways for accomplishing those aims were gathered in two separate tables. But first the essential functions

Regarding Drive view:

A. Provide understandable explanation of the functions (to avoid confusion in Establishment table)

B. Provide understandable explanation about how to set a driver, parameter Settings. (to avoid setting them in wrong way and to get the best possible result)

C. Provide easy way of entering values (to avoid disruption and confusion)

D. Fast and easy overview of the change in a driver (To speed up the process of the work)

Regarding Establishment chart

A. Consider Color blinds (to help everyone benefit from the shown information in the chart)

B. Show the difference between different number of crew in different times in precise way (To give a better overview to the user)

C. Make the chart customizable (to provide users with the view they are interested in)

D. Ability to access figures in Establishment table (To make the chart interactive, to answer the question "what if?" and to give more detailed information)

E. Access to crew who are assigned to different Activities (to bring interactivity and to speed up the work process for users)

F. Provide users with easy way for zooming

G. Give the essential information when zooming in/out (To answer to users' needs for each situation)

H. Show users their current situation (To answer the questions "Where am I " and "Where can I go from here")

Now it was the time for recommending solutions and ways to implement those functions. The suggested sub-solutions are shown in tables 5 and 6. By taking the users' requirements and principles of Interaction Design into account, the best solutions were chosen and highlighted in these tables. As mentioned earlier due to having doubt in the time of selection, there were cases in which two solutions were picked in order to get more feedback on them by evaluators of the prototypes.

Essential Functions	1	2	3
A. Explanation of driver functions	Show the essential Info	Show considered-rules by Driver	Use Super users' note as guidance
B. Guidance for setting up Driver/Parameter	-Group Crew filters by priority -Show if one is dominant or sub-collection	In case both dominant & sub-collection are both valid, show them in hierarchy -Give a warning if the Setting is not proper	-Show Driver Parameters and their Calc Order in Feedback window -Visualize the relation among the Driver Parameter and the Crew filter in Establishment table -Show the capacity percentage (compared to dominant Crew filter) beside each Crew filter
C. Simple way for entering Values	-Design a calendar which shows month, year and values for each month. -Add a button to put the calendar in Edit mode	-Put a slider which shows values for each day while the date of the day is shown above the value -Giving the option to enter the required date/period	
D. Fast preview of the made change(s)	Show the change in a chart in Driver view (use the same strategy as in Scenario to speed up)	Show the change on the Activity Group which is affected by that driver plus the balance	

Table 4 List of sub-solutions for issues in Driver view (achieved by Morphological Charts method)

Essential Functions	1	2	3
A. Consider color blinds	No use of Green, blue and red	Use of pattern, shape	
B. Show the precise difference between diverse number of crew in different times	Add figures	Add a table below the graph showing Balance	Show Balance for each day, week or month(depending on the aggregation level) in the form of bar in the graph
C. Make the chart customizable	Enable the user to choose the Activities in the graph		
D. Ability to access figures in Establishment table	Use context menu	Show tasks and their figures in the bottom of the graph	Show names of tasks of an Activity when it is clicked, and highlight the task in graph when its name is clicked
E. Ability to access the assigned-crew for different Activities	Add the Crew table below the graph	Show the percentage of crew in graphics	
F. An easy way to zoom	Use of only one magnifier to zoom in and out		
G. Provide the essential Info when zooming in/out	When zoomed in, show detailed numbers on Y axis	Show figures in graph when zoomed in	
H. Show the current situation	Show the thumbnail of view and the situation of user		
I. Easy way for going back to original view	Double clicking on the magnifier		

Table 5 List of sub-solutions for issues in Establishment chart (achieved by Morphological Charts method)

6.2.1. The reasons for acceptance/refusal of the solutions

Here the explanation for recognition or rejection of solutions is provided. The main principle of selection for solutions in both Driver view and Establishment chart is fulfilling users need while respecting Interaction Design rules. But what in particular resulted in acceptance/refusal of these suggestions is clarified in the following text.

Regarding Driver view

A. Manpower considers the rules of the airline according to their priority in the time when it is providing a cost-effective plan for airline planners. This is done by Drivers and as said earlier planners need time to get familiar with Drivers because of their complexity. Here are suggestions for making this process easy for users:

- The essentiality of each piece of information needs to be investigated. This is not a good suggestion since one piece of information may be important to one user while it is not to another or one piece of information is vital in one case but not in another one.

- Some Drivers functionality is based on one or two rules while some may consider different and complicated regulations. So demonstrating rules in those cases not only is helpful but also makes the procedure complicated and confusing plus lots of space is needed for implementing this feature.

- ✓ Super users are experienced planners who are familiar with airline rules and their priority moreover they were the ones involved in the testing process of Manpower. So they are familiar with the system as well. Their notes and guidance can be a great help to normal users. Consequently by giving the super users the chance to leave note for others we can simplify the path f users through learning the system and its Drivers.

Note: This was the reason why the suggestion for designing a new window in Manpower was given by me. In the right side of the system two windows already exist: Workset Explorer[16] and Info. But these do not provide users with the ability of entering information so a new widow with such a facility is needed. I called the window, Feedback window because of its functionality

B. In the time of adding Parameter(s) for different Drivers one needs to be attentive about setting their Calculation Order, their valid time, etc. to make the result as useful as possible and to avoid problems. Here are the proposals for assisting users in this process:

- Grouping the parameters according to their priority is not possible since each airline has its rules and preferences so a general rule cannot be considered or implemented in the system

- The same critics apply to this solution

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[16] It is used to give the user an overview of the worksets in a tree structure

✓ Visualizing the relation between the Crew filter in Establishment table and the Parameters under the aimed Driver can give a good overview to the end-user. This can assist her to take a good decision while considering the Calculation Oder for each Parameter. Since the Capacity of each Crew filter is a vital piece of information, having it beside each Parameter can be of great help.

Note: This information is shown in Info window[17]

C. Handling three different scrolls in order to reach Parameter Value makes the Driver view difficult to interact with. The suggestions below can help in enhancing the interaction between users and system:

✓ Showing the Parameter Values in a calendar simplifies the process of locating and adding/editing the Parameter Values for a certain date/period under a Driver. In case the user entered the Driver view by use of context menu in Establishment table, the target Parameter Value will be high lightened for her.

Adding an Edit button abridges the process of editing the Parameter Values. In the current system Edit is hidden in context menu and is not in sight.

More information about the look of the calendar can be found in Figure 13

Figure 13 An example of calendar-look suggested in C1

✓ Showing the Parameter Values in a horizontal line in which different dates and their Values are shown in separate cells can simplify the process of entering Parameter Values for each day/period.

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[17] The window which provides users with different kinds of information e.g. when objects as bookmarks, scenarios or worksets are selected, information about the selected object is shown there

Giving the users the option for changing the date to the one they are looking after is also another feature which is going to be considered in this view. So they can either slide to find the date or enter the date and let the system do the rest.

More detailed description of this look can be seen in Figure 14.
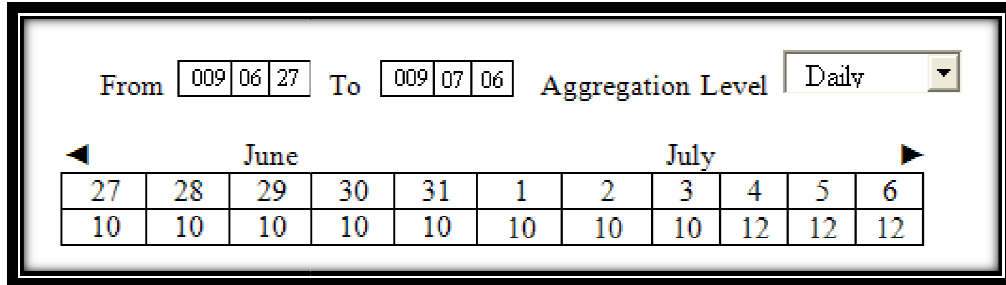
Figure 14 An example of the view suggested in C2

D. In the time when users make a change in a Driver, they would like to have a fast overview of the result. The ideas below can help the system to provide users with what they desire:

- Add a chart in Driver view to give an overview to users of the change which has been made by using the same strategy which is used in scenario[18] can be helpful to users. Although this is a good suggestion it still takes the same amount of time which is spent to go back to Establishment table to recalculate and see the change.

✓ Making a change in a Driver affects one or more Activity Groups so by showing the affected Activity Groups we can give users a hint about where to look for the result of the change. Since this change also influence the Balance (which is an important piece of information to planners), showing the Balance can be useful to users as well.

Regarding Establishment chart

A. Considering color blinds is one of the important aspects in the information visualization. Two ideas are presented in order to enhance the Establishment chart in this direction:

- Although excluding the colors green, blue and red from the chart is a good suggestion, it is not applicable in this case. The number of Activities which are shown in the chart differs from one airline to another and there are usually plenty of them. So limiting the use of the colors can cause a problem in visualizing the information.

✓ Use of pattern and/or shapes beside color can be helpful in this case

B. Being informed about the Balance for each day/period of time is important to planners and their work. To offer them the information they require the suggestions below can be helpful

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[18] An isolated workset where one can work and test things without modifying data in the database

- Adding the figure in the graph can provide users with the detailed information but it can make it messy as well. Since some times the value of the figures is not that high, the width of their color would not be that much to fit a figure in it.

✓ A table which shows the Balance for all the needed periods can be added under the Establishment chart

1. Adding bars to the existing chart to show the balance for that period can be informative but it increases the risk of confusion for users because of giving the chart a chaotic look.

C. Making the chart customizable is one of end-users' request.

✓ End-users would like to be able to choose what to see in the chart so by giving them this opportunity we can simply enhance the system for their use

D. Users are more into checking the figures to get an overview than looking at the colors in chart so if I enable them to reach the figures in table in an easy way, I can make the chart more practical. The suggestions below are all seeking that purpose:

✓ Users can reach the figures of the Activity they are interested in, by right-clicking on that color and using the context menu which has the option to enter the Establishment table. One of users' usual tasks is to make change in a plan, recalculate it and then check if they have reached a satisfactory result. If not then they change it again. By integrating a context menu to the graph we can answer the question "what if" which rises after change of plan

2. Showing the Tasks of each Activity along with their figures on the bottom of the chart can be helpful but it does not provide the user with all the needed information e.g. Balance, the result of change on other Activities, etc. so there is still a need for them to go and check the Establishment table

✓ Showing the Tasks of an Activity in the chart and highlighting them whenever they are clicked can be useful to users. This suggestion can be used as a complement to D1 since it individually does not provide any access to figures in Establishment table.

E. Having access to the names of crew who are assigned to an Activity is considered a valuable feature to planners since there might be a need for change and the need for contacting the crew in that regard. Two suggestions were given and one has been chosen

✓ Showing the crew table under the chart whenever an Activity is clicked in the chart is the easiest and most essential way to implement this feature

3. This suggestion cannot be helpful. First of all it does not provide the user the detailed information she needs, second of all sometimes there is an overflow which can be

limited to only one day, one week and not all month long. This forces us to show the percentage of the crew on daily base which is not helpful.

F. Currently there are 4 magnifiers in the Establishment chart. For each horizontal and vertical direction two magnifiers are considered. One is used to zoom in and the other is for zooming out.

✓ Offering the user one magnifier can ease this process. User can grab the magnifier and choose the area she wants to enlarge.

G. Currently no particular information is given to users when they zoom in/out. As stated before the sort of zoom here is semantic zoom so the ideas below are to convert the current zooming function to the semantic type and they were both chosen for the next phase to get more feedback from users on their efficiency

✓ Showing the numbers of Y axis in detail in the time users zoom in can give more information to users. In the current view when zoomed in and out the numbers on Y axis are 10, 50, 100 so it can be changed to 0, 1, 2, 3, …10 when users zoom in.
In order to make it easy for users to track a color to its number on Y axis, we can add a horizontal line to the top of the mouse cursor as shown in Figure 15.

Note: This line is used in both statuses zoomed in and out
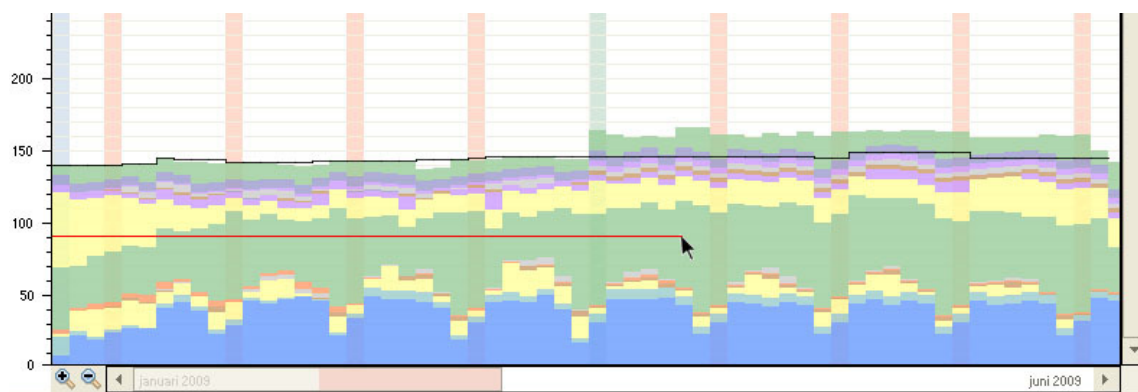
Figure 15 An example of horizontal line on top of mouse cursor

✓ In the time when users zoom in they should be able to see the figures of each Activity within their colors

H. It is required to inform users about their current situation when they zoom in. In order to achieve this, the solution below was offered

✓ A thumbnail of the chart can be a useful tool to answer the question "where I am" and "Where I can go from here" which are the questions which users should be able to answer according to Robert Spence (Spence, Page 162)

I. It should be easy for users to go back to the original view and not be forced to continuously click on magnifier-which is for zooming out- to reach that view. (As it is in the current system) One and an easy solution is the one mentioned below

- ✓ We can make it possible for users to zoom out by double clicking on the magnifier. This function is what is used by Adobe in Photoshop

7. Prototype Development

This part is to explain the prototyping process and its two rounds of iteration. As mentioned before the method "Iterative Design and Prototyping" was employed and its results were documented in order to be used for the next step.

In both rounds of evaluation all participants were asked not to consider the technical issues which may occur in implementation of the ideas but just give feedback on their usability and efficiency. The following table shows the prototyping development phase:

Prototype No.	Design material	Purpose of Development	Purpose of Testing	Test Group
1	Paper and Photoshop	To present the design suggestions regarding Establishment table and Driver view	To evaluate the efficiency of the suggestions without considering the possibility of their implementation	PD Group and Service Center Manager
2	Paper	-To present the changes resulted from the feedbacks of previous round -To present the design ideas and changes regarding Establishment chart	-To assess the effectiveness of the made changes in the first round prototype -To receive feedback on the new functions and features presented in Establishment chart without considering their possibility for implementation	PD Group, Implementation SAS and Service Center manager

Table 6 Prototyping development process and related Info

During the evaluation sessions the prototypes were shown to participants one after another while each view and the developed design ideas were being explained to them. After showing each view the feedbacks and suggestions of each participant were documented.

Prototype number one only includes Establishment table and Driver view since the Establishment chart prototypes were not ready at that time. As a result evaluation of the first prototype and finishing the prototypes of Establishment chart were done in parallel.

7.1. First prototype

The aim of this step was to implement the changes which have been decided by use of Morphological Charts method, present them to in-house users and get feedback. Two of the views of the system namely Establishment table and Driver view were modified in these prototypes. There also was a change which was not limited to any particular view and was suggested to ease end-users' working process in Manpower. This design idea was about adding a new window to the system. A window in which alleviates the communication among users in addition to simplifying the learning process of different parts of Manpower.

At the beginning some of the prototypes were implemented by Photoshop but after studying literatures and consulting my supervisor at Jeppesen we came to the decision that prototypes in Photoshop can give a feeling of finished model rather than a prototype. This might intimidate the participants of the evaluation process and decrease their willingness in giving comments instead of giving them the freedom to criticize the prepared prototypes. Consequently the prototyping material became limited to paper. Some of the paper prototypes can be seen in the Figure below.
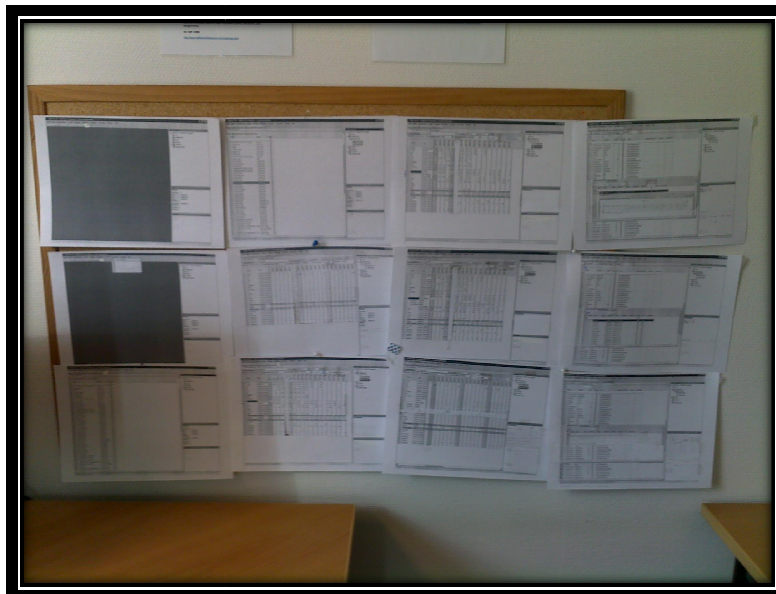
Figure 16 Some of the paper prototypes

Appendix E includes the detailed information of the design ideas and the result of first round of evaluating prototypes can be found in Appendix F. They include all the design ideas, the suggestions from evaluators, a list of ideas which were not included in the second prototype

and finally a list of the suggestions which were documented to report to Jeppesen but have not been presented in the prototypes.

7.2. Second prototype

In this round, some of the suggestions for change which were given by evaluators have been considered in the prototypes. These changes were either what exactly the participants asked for or the edited version of them. Moreover the prototype of the Establishment chart was presented to get some feedback on the design ideas from the in-house users on it. One of the presented views of Establishment Graph can be seen in the figure below
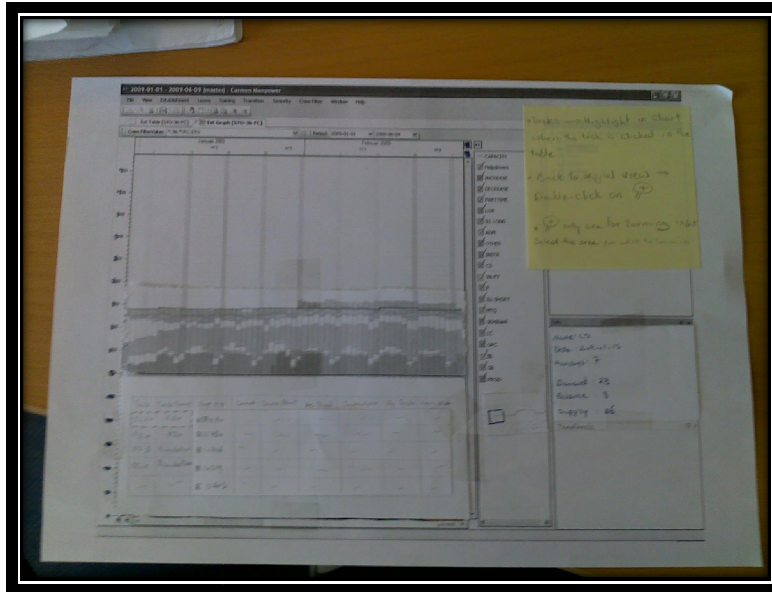
Figure 17 One of the paper prototypes of Establishment Graph

Due to the decrease of the workload in Jeppesen, more people were able to participate in this round of evaluation. The changed prototypes were shown to them one-by-one and after finishing each view, they were asked to comment on them.

The changes in the graph turned out to be satisfying. The reason for that was these design ideas give the graph a more informative look while providing the users with additional functionality without complicating the interaction with the system.

The results of this round of evaluation were documented to be used for the next step of the work. All the comments and feedbacks in this round were essential and helpful so I decided not to cross any of them out. Due to lack of time no other round of prototyping or session of evaluation was planned but still the ideas were all documented in order to use for the future work.

The detailed information about the configured views, the comments from the participants and the results can be found in Appendix G and Appendix H.

8. Ranking, Grading and Time estimation

This part is to explain about the ranking and grading of the design solutions. Since various design ideas were presented in the prototypes, ranking and grading them seemed to be a good idea for both the implementation part and for the future work of Jeppesen.

In order to rank and grade the design solutions a document with twenty one design ideas was prepared. Some design ideas were followed by pictorial example in order to overcome any kind of obscurity. Four options were given after each design proposal and they were numbered from 1 to 4 to indicate their necessity. One was to present "Definitely needed" and four was to indicate "Not required". (See Appendix I)

This document was emailed to all the in-house users. They were asked to rank the design ideas first then vote for three of the features that in comparison to others were more necessary to implement. The summarized version of the result of the votes and a figure representing the most important features plus the number of their given votes can be found in Appendix J.

The reason for grading the importance of the design proposals was more for the future work in Jeppesen. Because in this way they knew what needs to be fixed/edited in their future software update.

Now that I knew which ideas were more necessary to implement, I had to proceed to the next step. After collecting the results, a meeting with Carmen group was held in order to estimate the time which was needed for implementing each idea. This was necessary because I had to pick the one which could fit in my project timeframe. This estimation was done without considering the time which was needed for getting to know the code and the rules of the work. The result of the time estimation for all the features in total was 28 weeks for a professional developer. (Detailed information about time estimation of each design proposal can be found in Appendix J)

After estimating the time for each idea, three of the design ideas with the most votes were picked for further investigations: number 12, 7 and 8, 15. (Since number 7 and 8 were related, they were treated as one idea and one use case was prepared for them). Features 12, 7 and 8 were the ones with the most votes and the longest development time. Given that implementing them was not possible in the remainder of the time of my thesis, writing use case for each of them could provide an efficient and useful guide for the future work. In addition to them, idea number 15 (making the graph customizable) was selected for the implementation phase, so writing the use case for that was necessary as well. The time for coding this feature was estimated to one week for a professional developer and 2-3 weeks for an intermediate developer which turned out to be right.

In the following section a brief explanation about the use cases and the process of writing them can be found.

9. Use cases and Implementation

Here the processes for writing the use cases plus the coding of the customizable graph are explained. Use cases were written in pure text, meaning that no UML diagram was presented (The detailed version of the use cases can be found in Appendix K.) and coding was done in C# language.

9.1. Writing the Use case

"A use case model describes the functional requirements of a software system" (Anda and Sjoberg, page 1) and it depicts the interaction between the user and the system by explaining the interaction in a sequence of simple steps (en.wikipedia.org).

By keeping the above description in mind, the use cases for the selected design proposals were written. Different situations, various possible decisions and dissimilar steps which one might take to reach a goal was analyzed and documented. Although all the situations were considered in these use cases, still more examination was required. This is because one's view may get limited and not see the setbacks of the design solutions; so it is vital to discuss the use cases with others and get feedback on them. Unfortunately due to the lack of time and the heavy workload of Carmen group in Jeppesen this discussion and evaluation session did not take place.

As a result, these use cases were presented to Jeppesen for further examination and their future work.

9.2. Implementation

This part was fortunately done smoothly. First step was to get familiarize with the code and different parts of it especially the parts related to the Establishment graph. The second step was to start coding. This could be done in two different ways: one was to add a new class and start the code from the beginning, the other was to configure the existing code to create the design idea.

The second option was selected and the work was carried on by editing the code of the graph. This included the way of selecting the Activities and how to illustrate one Activity is selected or not in different parts of the view. By having the use cases as guide line and by keeping the principles for ease of use and interaction in mind, the coding was done.

The coding of this project provided the users with the ability to customize the graph by choosing the Activities they like to see. Of course more work can be done on the graph and its user friendliness but the essential and required change was done on the graph during the implementation phase.

This part was performed on 3 weeks which included getting to know the code and configuring the code to reach the goal.

10. Problems during the project

Every project has its own problems and dilemmas. No matter how detailed your project plan is; you still cannot foresee all the situations and problems.

During this project I experienced different sorts of problems, the most important ones are listed below

- End-users were located in cities/countries other than Gothenburg/Sweden which resulted in lack of access to them
- The need for limited type of user with certain kind of knowledge which resulted in inability to ask people other than planners or developers to participate in tests sessions
- The help and presence of in-house users was needed during the different parts of the project but because of their high workload, they were not always able to cooperate. As a result slowdown was experienced during the project

In spite of these problems still the project had a satisfactory result and the needed work was done in an acceptable period of time. The new look of Establishment chart before and after omitting an Activity from the chart can be found in Appendix L.

11. Conclusion

This master thesis shows how important the user study can be before or even after designing a system, especially a system which is designed for particular users. Although only one interview with end-users was done in this work, still the collected information made a great amount of change in efficiency of the results of the thesis. This thesis explains how a small change in a system can make a big difference in enhancing the user-computer interaction.

As a result of the performed researches and analysis the following suggestions can be proposed:

Minimize the excise

- Do not force the users to navigate from one window/view to another if all or at least the necessary amount of information can be shown in the same window/view
- Present the information in a way that not much scrolling is needed by efficient use of space
- Remember the previous work of the user e.g. save the customized table for her future use

Provide feedback

- Visual feedback is an efficient way for informing users about the result of their action(s) e.g. graying out the non-selected Activities in the chart
- Show the affordability of different parts of the system e.g. give the Establishment table and graph icon in Workset Explorer look clickable

Minimize the memory and cognitive work

- Provide users with the important and useful information to minimize their memory work e.g. after changing a Driver show what other Drivers were affected
- Offer the user a simple way for learning the system and its complicated functions e.g. let the super users leave note for normal users and explain the needed parts for them
- Use of simple and understandable names for different functions, titles and menus e.g. replacing Is snake with repetitive pattern in Driver view

Retain the consistency all over the system

- If one part can be reached in different parts of the system, give that part the same look all over the system e.g. the horizontal look of the Parameter Value level in both Establishment table and Driver view

The job of airline planners is difficult and challenging. Manpower is a system which helps these planners with performing their work as efficient as possible so there is no surprise if the system is complicated. Considering the above mentioned suggestions in the design of such a system can reduce the amount of complexity and simplify the user-computer interaction.

The pre-studies, interviews, analysis resulted in helpful design ideas for enhancement of the system. As mentioned before those ideas were implemented in the form of low fidelity prototypes then the users' critics of these prototypes were collected in two rounds of iteration. This effort somehow purified the design ideas and made the result even more helpful and efficient.

It is true that Manpower can only be used by limited users with certain kind of knowledge but still the suggestions above can be useful in designing other systems with other functionalities. But in general the results of this thesis can be employed for design of different software which is meant to help airline planners with their work.

12. Future work

It is advised to inspect the end-users' reflection on the result of the work. The best way would be evaluating the paper prototypes in which all the changes that were suggested by in-house users are implemented. In this way the setbacks can be discovered immediately.

It would also be needed to ask the end-users to vote for the feature they like to have in the system as soon as possible so that the implementation of those ideas can be prioritized by Jeppesen.

Further investigation and analyze of use cases is also considered necessary. This is because first they need to be reviewed so that any vagueness or obscurity is resolved before coding

begins, second the developers need to look at them from technical view and check if some of the actions need to be changed or omitted.

A suggestion for future work would be finding a straightforward and simple way to keep users informed about different actions, calculations and also about the rules which are considered during the computations.

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Glossary

Leg: The smallest (atomic) planning component is Leg. A leg is the operation between a departure station and the next arrival station. It has a unique combination of flight carrier, flight number and leg number per day.

Duty: Duty is a sequence of legs constituting a day's work (i.e. work between required rest periods) for a crew member

Ground duty: Ground duty is a non-flight activity at base

In-house users' Interview Guide

Interviewee:

- Who she/he is
- What she/he does
- Is she/he in contact with end-users? To what extent (level)?

General:

- Who are the users?
- What is their background?
- What range of age they usually belong to? What sex?
- Are they familiar with computer? Or is their work with computer only limited to working with Manpower? (Level: Basic, Intermediate, Professional)

Specific:

- Are they familiar with the processes which are done by Manpower? Can they do it manually? If so then how did they learn it? (E.g. can they calculate and plan for each activity?)
- What did they used to use/do before? (What was the problem there? Is it solved now or is it placed by another problem?)
- How long does it take for them to learn and understand what to do and how to work with Manpower?
- Do they manage to learn all the taught parts during one period of lectures or do they come back? What is it that they usually forget about or take them long time to learn (regarding Establishment view)?
- Do they learn in the same pace or is it needed to spend more time for some of them and teach them in a slower pace? If so which ones are they (which customers) and what is the reason for that? (Their age, experience in this field or with Manpower, their background?)
- Do they have the same responsibility when working with Manpower? (***Have in mind:*** *Are they divided to separate groups and are assigned to do different tasks while working with Manpower?*)
- If there are different groups of end users do they have different kind of lectures or tutoring sessions (e.g. if managers work with bar chart do they learn how to use it in tutoring sessions? What do they want to achieve by using the bar chart? Do they experience any problem in understanding the chart?)
- Can users be divided to frequent and non-frequent users? If so then who are the frequent users and who are the non-frequent ones? What do they want to achieve by using Manpower?

- What is the most difficult part to work with or understand when it comes to working with Establishment view (both table and bar chart)? Why is it difficult?
  Things to remember: *Consider both original Establishment view and also after recalculation*

- What is (are) the most frequent question(s) asked by end-users when it comes to learning and working with establishment view? (before and after recalculation in both table and bar chart)

Personal idea:

Developers & Tutors

- Why did you choose to depict/show the information in the way that it is now? (table and bar chart)
  Have in mind: Ease of coding, Different kind of end-users (Bar chart for managers and table for planners)

- Do you think a new data representation is needed? Why?
- Have you had any suggestion from customers about how to show information?
- If so then have you considered implementing it? If no then why? What was the problem?
- Show the pictures of system and ask:
    - What is good in this view? What is bad in this view?
    - What and where should be changed?
    - How the change should be? (Draw it if you can)

SAS Interview guide

1. Name, Years of experience in planning, Role in SAS
2. Background
3. Computer expertise
Novice   Intermediate   Advance

Interview Guide

1. What makes you satisfied with your job (planning)? (Is it speeding of the work; is it the quality of the plan and its preciseness?)

2. What makes you stressed and dissatisfied?

3. What is it that you want to achieve when using Manpower? How is the success measured?

4. How much expertise in planning is required in order to be able to work with Manpower? What about expertise in computer?

5. Who are the people who work with Establishment Establishment table and graph? Do they belong to different work groups?

6. Can users be grouped to frequent and non-frequent users?

   6.1. Who are the non frequent users?

   6.2. What information are they after when working with Establishment table/graph? Why?

7. What information do you need to have in order to make the decision about whether the plan or the number for one activity is good?

   7.1. Is the needed information provided in Establishment table or do you need to refer to another part of the system to get that information?

7.2. What about Establishment chart? Do you use it to evaluate your plan? Is the needed information included? If not then what would you like to have/see there?

8. Describe a typical task about Establishment Establishment table

   8.1. Why do you do this?

   8.2. What if this develops a fault?

9. Describe a typical task about Driver view

   9.1. Why do you do this?

   9.2. What if this develops a fault?

10. How do you check if a number in Establishment table is correct or not? *(This is to know the process that they follow to check a number, so we may be able to make it easier for them)*

11. What are the main problems which arise when trying to find out how a number in Establishment table was calculated?

    11.1. What do you think is the source of the problem?

    11.2. Do you have any proposal for resolving this issue? (*How would you like it to work?*)

12. What would you like to see when you compare two tables?(*e.g. Comparing detail table for one crew this year and Establishment table of the same crew in last year to see how efficient or exact the planned figures were this year and if you planned/predict it well*)

    12.1. Is the information provided by Manpower?

    12.2. How would you like to see the result? *(In figures or in graphics)*

13. Do you think a new data representation is needed? (Other than table and graph) If so what do you like to see and have in that view?

14. Is there any especial function/feature which is used in the previous system and you like to have it in Manpower as well?

15. What other suggestions do you have? (Anything that needs to be changed or enhanced)

Specification of Product

Table of Contents

Introduction

Carmen Manpower is a software solution for long-term planning of crew. It is used to control the balance of the crew supply and demand. Some of the main benefits are to make more precise budgets and forecasts, discover production problems early, create transition plans and integrate vacation distribution.
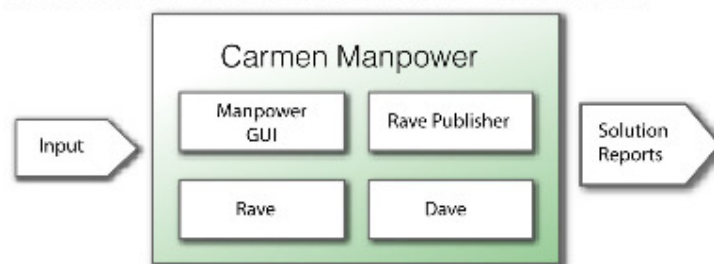
Figure 1 Simplified image of the components in Manpower

GUI is the part on which the focus of the work will be. That is why I will continue with general information about different existing views and a brief explanation about what can be

done in them by users. Then will continue with specific explanation about Driver and Establishment views which are going to be tested by using Cognitive Walkthrough method.

1. GUI

The user interface of Carmen Manpower contains several views, for example Training, Leave and Establishment. These give you a quick overview of the crew supply and demand.

In Manpower you can

- Use crew filters to show crew data
- Calculate the crew establishment on a given day
- Assign, move and edit leave
- Plan transfers of crew between crew groups
- Create courses, assign course participants and confirm and release courses
- Edit and update seniority numbers.

Below are the existing views in Manpower which give us the opportunity to do the above mentioned tasks.

- Crew view
  In this view all data regarding crew in this workset is shown. Use crew filters to show only a subset of the crew.

- Establishment view
  In Crew Establishment you see the relations between activities planned on a day and the planned or assigned crew to do a certain task.

- **Leave view**
  The Leave view consists of an overview of planned leave for a specific period. Here you can assign, move and edit leave.

- **Training view**
  In the Training view, course blocks and other activities are shown.

- **Drivers view**
  A driver uses collected values to calculate the crew establishment on a given day.

- **Transition views**
  Transition is used for flight deck crew for planning transfers of crew between crew groups.

- **Seniority Editor**
  The Seniority Editor is used for editing and updating seniority numbers.

2. Establishment view
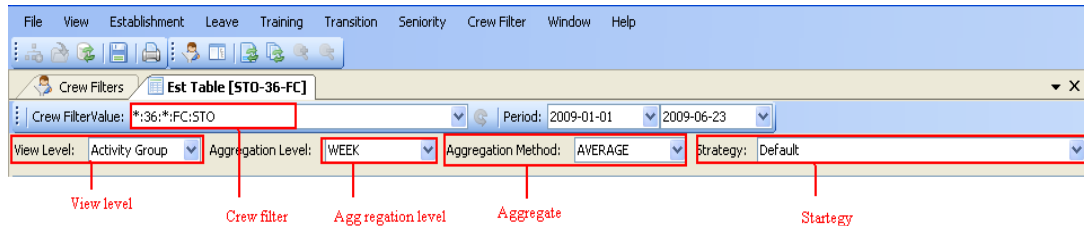
Figure 2 Different parts in the upper part of Establishment Establishment table

The image above shows the bar which can be seen above an open Establishment table

➢ **View level**
It defines the lowest level in the hierarchy that should be displayed in the table.

➢ **Crew Filter**
It is the filter that its information is shown in the table

➢ **Aggregation Level**
You can aggregate the information to get an overview of what you are interested in. You can select aggregation level DAY, WEEK or MONTH. Default aggregation is WEEK.

➢ **Aggregation method**
You are able to change aggregation level to Maximum, Average and Median

➢ **Strategy**
Different strategies can be applied for all activities in the whole period.

Different strategies are: Max, Assigned, Planned, Adjusted and Default

Figure 3 Capacity, Demand and Balance

In Figure 3 a part of table is shown in which the Name and Type of each Activity Group can be seen. The upper part of the table the activity groups which are considered as demand are displayed while in the lower part effective and gross capacity are shown. The line in the middle shows the balance which is the difference between effective supply and effective demand.

In order to get more detailed information such as activities included, tasks and drivers about each activity group you should click on the name of that activity group. You will then see something like the image shown in Figure 4.

9	F	ACTIVITY_GROUP
10	F	ACTIVITY
11	F	SUM_PLANNED
12	d-F FG SH	DRIVER
13	d-F VG SH	DRIVER
14	d-F VG SH Red	DRIVER
15	d-FG SH Red	DRIVER
▶ 16	F	SUM_ASSIGNED
17	F	TASK_GROUP
18	F3	TASK_GROUP
19	F31	TASK_GROUP
20	F34	TASK_GROUP

Figure 4 The view of an expanded Activity Group

3. Workset Explorer and Info Window

These two are placed in right part of the table.

Workset Explorer is to give you an overview of the worksets in a tree structure. You can double-click any of the items which are shown in Workset Explorer to be displayed in the workspace.
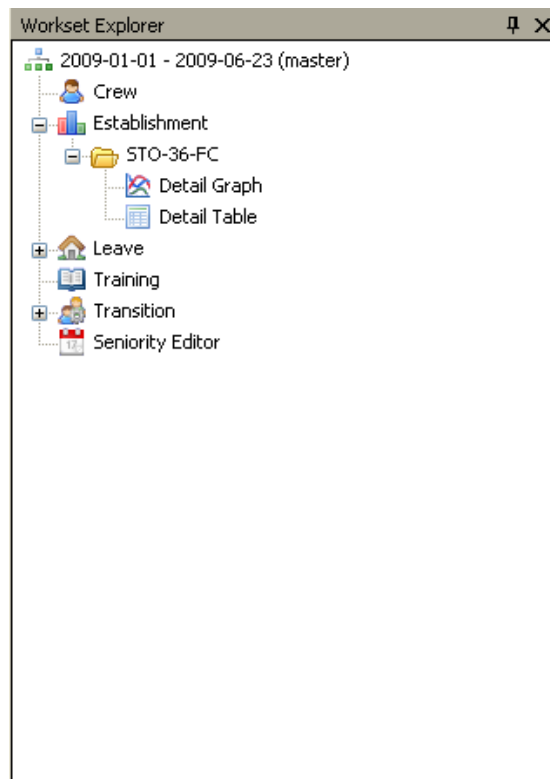
Figure 5 Workset Explorer

Information Window is placed in right corner beneath Workset Explorer. When the mouse is moved over different views, or when objects as bookmarks, scenarios or worksets are selected, information on the selected object will be displayed in the Information window.
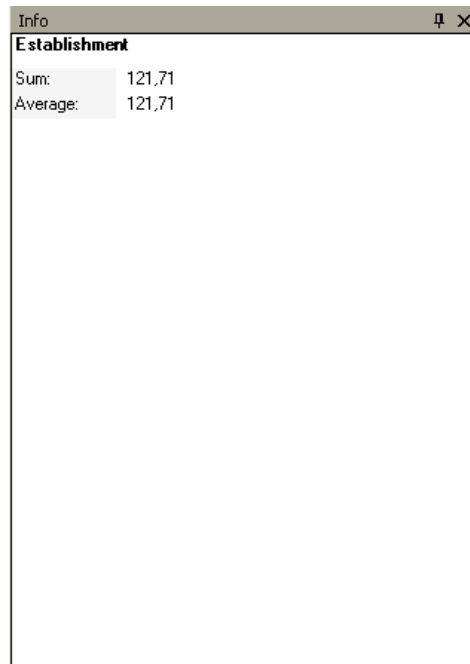
Figure 6 Information Window

Here is how the Establishment view looks like in total

Figure 7 Establishment Table

4. Driver view

In order to be able to see this view you have two options

1. Click on Establishment menu, and then click on "Show drivers" option
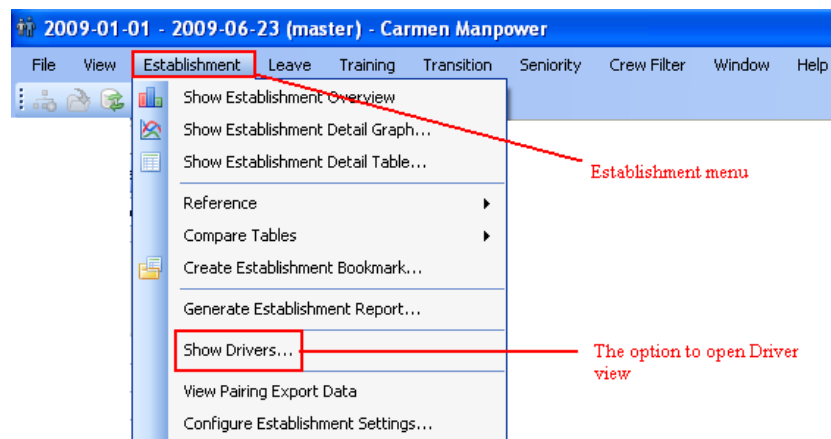
Figure 8 Establishment menu & Show Drivers option

2. Expand an activity group in Establishment table view so that you can see the drivers.

Right click on a number which is shown in front of the driver you want to see.

Choose "Edit driver parameters" from the context menu.

Figure 9 Context menu for editing a Driver Parameter(s)

In the driver view you are able to see all the existing drivers, their detailed information e.g. rank, activity they belong to, their order, if they depend on another activity and so on.

Figure 10 Driver view, Information about Drivers and Filter boxes

If you are looking for a special driver you can either scroll to find the driver or you can use the text boxes in filter, type in the name of the driver name or other information (e.g. Main Rank, Activity, etc.), then you will be able to see it.

4.1. Driver

A driver uses collected values to calculate the crew establishment on a given day. One activity can have several drivers connected to it. One needs to expand a driver in order to be able to configure it. The definition of each of the columns shown for each driver can be read below:

➢ **Name:** Name of the driver

➢ **Main Rank:** F (Flight deck crew) or C (Cabin crew)

➢ **Activity:** The activity the driver belongs to.

➢ **Order:** The calculation order within the driver.
Used if you have several drivers calculating the same crew filter. Here you decide which driver is to be calculated first. In a calculation order range, as for example 1, 2, 3, 5, 8, 13 ... 144, the driver with the lowest number (1) is calculated first and the driver with the highest number (144) last. The calculation order has impact on drivers that have a dependency on an activity. Drivers must have been calculated first to give input to the activity before another driver that depends on that activity can be calculated.

➢ **Calculate:** Defines if the driver should be calculated or not. A driver can easily be removed from the calculations without deleting the driver settings.

➢ **Class:** Type of driver, for example smearing driver or standard driver.

➢ **Dependent Activity:** For standard drivers of PERC type you can specify a dependency on other activities. Double-click and select from the list.

➢ **Strategy:** Strategy used.

➢ **Description:** Additional comment.

4.2. Parameters

Different drivers have different kinds of parameter(s). Some may use Standard parameter and some Filter parameter. It depends on the kind of the driver which is being used.

Filter parameters do not have value but Standard parameters do. So when a user is configuring a Standard parameter he needs to set a value for it as well.

Both Standard and Filter parameters have a calculation order that indicates which one (which) parameter should be calculated first. For instance if a parameter has lower calculation order in comparison with other parameter, it will be calculated first.

If a user is looking for a specific parameter he is able to either scroll to find it or can use the filtering boxes which are located under each title to type in the information about the filter they are looking for. That will filter other parameters and just shows the one user is looking for.

Figure 11 Driver Parameter and its detailed information

The description for each column shown in front of each Parameter can be read below:

➢ **Name:** Name of the parameter.

➢ **Filter:** The parameter is valid for the crew that is selected in the crew filter.

- ➢ **Order:** The calculation order within the driver.

- ➢ **Valid from:** The start of the period in which the driver is to be appplied. The interval defined by **Valid From** and **Valid To** is used if the values for **Valid Start** and **Valid End** are empty.

- ➢ **Valid to:** The end of the period in which the driver is to be applied.

- ➢ **Valid Start:** The valid start of the sliding period, given in relation to the day of operation (OD), for example OD+30 (30 days after day of operation). SR (Scheduled release) can be used in the same way as OD. Default value is OD.

- ➢ **Valid End:** The valid end of the sliding period, given in relation to the day of operation, for example OD+30 (30 days after day of operation).
  SR (Scheduled release) can be used in the same way as OD.

  The outer bounds of this sliding period are defined by the start and stop date in the **Valid From** and **Valid To** fields.

- ➢ **Is Snake:** States whether the parameter should be repeated in a pattern or not.

- ➢ **Type:**
  - ▪ ABS =Absolute value. The driver will take the specified value as output value for the day.
  - ▪ PERC = Percentage. For Standard drivers of PERC type one can specify a dependency on other activities.

- ➢ **Description:** Additional comment.

Each Standard parameter has one or some values. These values also have a date which indicates the date they can be valid from

Figure 12 Parameter Value(s) and its detailed information

4.3. Filter Parameter

Figure 13 Filter Parameter and its detailed information

Filter parameters are used to configure filter drivers and are mainly used by planners. They are used to calculate specific values on specific crew filters, for example vacation. As filter parameters use input values as for example contract information, they are less complex than implemented standard drivers.

Note: Filter parameters have no value

Figure 14 shows how the driver view looks in total

Drag a column header here to group by that column

	Name	Main Rank	Activity	Order	Calculate	Class	Dependent Activity	Strategy	Description
					☐				
1	⊞ d-Adm	F	Adm	1	☑	DriverStdParamForm_			
2	⊞ d-BL	F	Bl	1	☑	DriverStdParamForm_			
3	⊞ d-Capacity	F	Capacity	1	☑	DriverSupply_			
4	⊞ d-F VG SH Red	F	F	50	☑	DriverFreeReductionVariable_			
5	⊞ d-FG SH Red	F	F	50	☑	DriverFreeReductionFixed_			
6	⊞ d-F FG SH	F	F	20	☑	DriverPartAndFreeFixed_			
7	⊞ d-F VG SH	F	F	20	☑	DriverFreeDaysVariable_			
8	⊞ d-F Base LH	F	F	20	☑	DriverFreeLHBaseAct_			
9	⊞ d-F Behov	F	F	40	☑	DriverStdParamForm_			
10	⊞ d-F Budget	F	F	5	☑	DriverStdParamForm_			
11	⊞ d-F Prod LH	F	F	1	☑	DriverStdParamForm_			
12	⊞ d-F VG P SH Red	F	F	40	☑	DriverPartReductionVariable_			
13	⊞ d-Fri Adm	F	F	5	☐	DriverStdParamForm_			
14	⊞ d-Fri BL	F	F	5	☐	DriverStdParamForm_			
15	⊞ d-Fri LC	F	F	5	☑	DriverStdParamForm_			
16	⊞ d-Fri MTG	F	F	5	☑	DriverStdParamForm_			
17	⊞ d-Fri OPC	F	F	1	☑	DriverStdParamForm_			
18	⊞ d-Fri Sb	F	F	10	☑	DriverStdParamForm_			
19	⊞ d-Fri prod	F	F	5	☑	DriverStdParamForm_			
20	⊞ d-Fri seminar	F	F	5	☑	DriverStdParamForm_			
21	⊞ d-HF Sb	F	F	10	☑	DriverStdParamForm_			
22	⊞ d-HF blank	F	F	5	☑	DriverStdParamForm_			
23	⊞ d-HF prod	F	F	5	☑	DriverStdParamForm_			
24	⊞ d-Vg Sh red	F	F	50	☑	DriverFreeReductionVariable_			
25	⊞ d-ILL Long 100	F	Ill long 100	1	☑	DriverStdParamForm_			
26	⊞ d-ILL long Part	F	Ill long part	1	☑	DriverStdParamForm_			
27	⊞ d-Ill Short	F	Ill Short	1	☑	DriverStdParamForm_			
28	⊞ d-Instr	F	Instr	1	☑	DriverStdParamForm_			
29	⊞ d-Instr F	F	Instr F	5	☑	DriverStdParamForm_			
30	⊞ d-LC	F	Lc	1	☑	DriverStdParamForm_			
31	⊞ d-LC Smearing	F	Lc	50	☑	DriverSmearing_			
32	⊞ d-LOA Law	F	LOA Law	1	☑	DriverAssignedInActivity_			
33	⊞ d-LOA Law Ex...	F	LOA Law	1	☑	DriverStdParamForm_			
34	⊞ d-Parttime Extr	F	LOA Law	1	☑	DriverStdParamForm_			
35	⊞ d-LOA Resurs	F	LOA Resurs	1	☑	DriverAssignedInActivity_			
36	⊞ d-LOA Resurs...	F	LOA Resurs	1	☑	DriverStdParamForm_			
37	⊞ d-Mtg	F	Mtg	1	☑	DriverStdParamForm_			
38	⊞ d-Mtg Smear	F	Mtg	100	☑	DriverSmearing_			
▶ 39	⊞ d-OPC	F	Opc	1	☑	DriverStdParamForm_			
40	⊞ d-Other	F	Other	1	☑	DriverStdParamForm_			
41	⊞ d-Part Law FG	F	Parttime Law	50	☑	DriverPartReductionFixed			

Figure 14 Driver view

5. Crew Filters

Crew filters are often client-specific. They show the main information about the crew who are included in that filter, information such as Duty, Base, Rank, Station, Contract ID, etc.

Crew filters view can be opened by using the "Show Crew Filters" option under "Crew Filter" menu
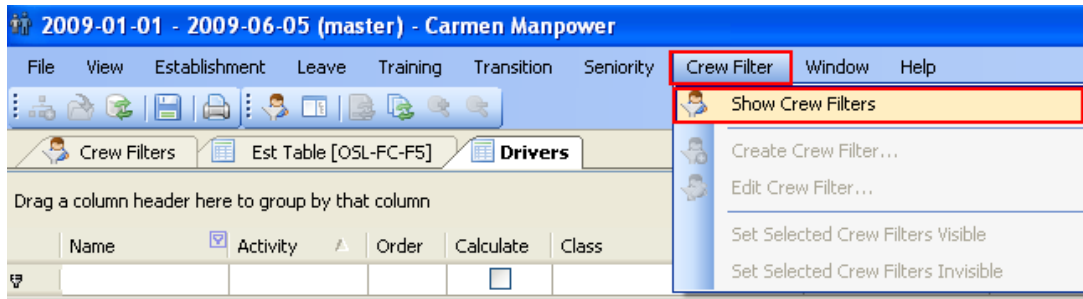
Figure 15 Crew Filter menu

In the Crew Filters view different kinds of information about each filter is shown. The description about them can be found below:

➢ **Name:** Name of the filter

➢ **Visible:** If this is checked the crew filter will be visible in Workset Explorer. Crew filters are shown as nodes under Crew Establishment and Leave in Workset Explorer. The selection is only done for the current user. (See the image below)

➢ **Filter:** Crew filter expression
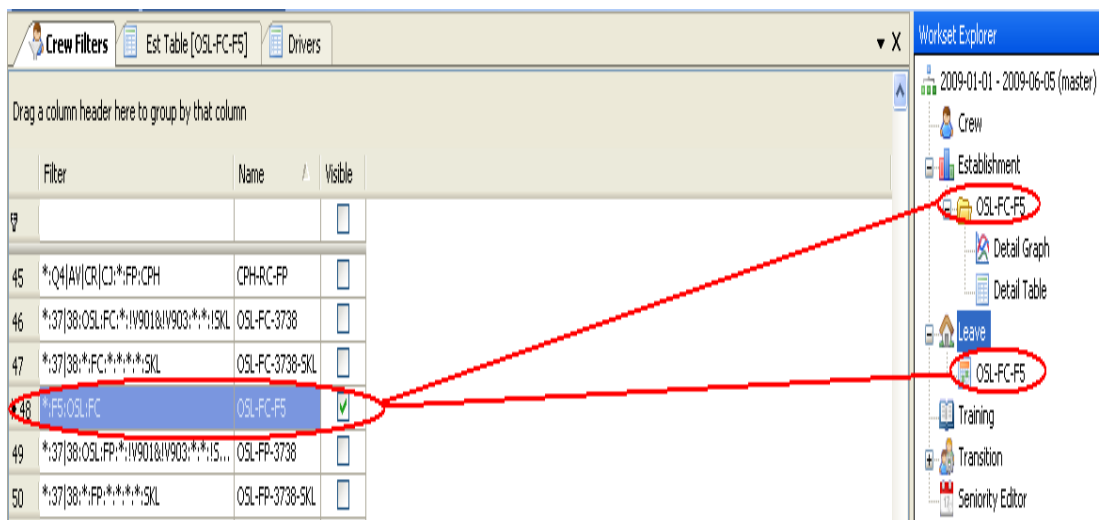
Figure 16 A visible Crew filter in Crew filter view and Workset Explorer

Below is how the Crew Filters view looks like

Figure 17 Crew Filter view

6. Who are the Users

In this part a short description about users is given.

- Users' Job and Background
- Age range

It is followed by a short explanation of the previous system used by customer

➢ **Users' Job and Background**

Users are airline planners who are in charge of planning crews for different flights.

Their background differs from one to another. The employees who have been employed for several years are not that computer savvy while the newly employed have engineering background and consequently are more familiar with computer. However that does not mean that they are professionals in this field.

> **Age range**

Their range of age is 30 years old and above. They have different responsibilities so they may use only the parts which are related to their job and not the others. For instance some are only responsible for planning the training courses and assigning them to crew while some are in charge of planning the leave and vacation.

Apparently the employees who work with Establishment are younger than the ones working with other parts which need more experience such as Leave or Transition.

6.1. Previous system

The previously used systems were as follows

- Excel beside
- Console applications

So users are not used to employ applications with GUI, complicated functions and features which are now included in Manpower. So Excel can be considered as the most modern application which was used by customers.

The reason for transferring from that system to Manpower can be summarized to

1. Cost efficiency

    Manpower provides customer with all the needed functions and information. In this way customer can avoid the high maintenance fee which needed to be paid for different applications/systems which they used to utilize before.

2. Enhancing crew's Quality of Life

    Manpower provides the planners with a plan in which the needs and requests of crew members are considered. Later planners are able to edit that plan to make it fit better to the needs of crew members. This keeps the crew happy and consequently improves the working outcome for the airline.

Task for Cognitive Walkthrough Analysis

Track a Driver (planned) number in Establishment view

UA: Click on an Activity Group

SD: Activity shows up

UA: Click on Activity

SD: Sum Planned and Sum Assigned show up

UA: Click on Sum Planned

SD: Drivers show up

Track the first number after schedule release in front of a driver

a) **First alternative**

UA: Click on Establishment menu

SD: Menu opens

UA: Click on Show Drivers

SD: Driver view opens

1) First alternative

UA: Scroll to find the driver

SD: System follows the user's action

2) Second alternative

UA: Click in Name filter box

SD: Cursor blinks

UA: Type in the information (driver name)

SD: The driver shows up

Locate the crew filter in the driver

1) First alternative

UA: Click on plus sign beside driver's name

SD: Parameters show up

UA: Click on Parameter (Standard or Filter)

SD: Parameter window shows up

UA: Scroll to find the filter

SD: System follows user's action

2) Second alternative

UA: Click on plus sign beside driver's name

SD: Parameters show up

UA: Click on Parameter (Standard or Filter)

SD: Parameter window shows up

UA: Click in filter box

SD: Cursor blinks

UA: Type in the information (e.g. Crew filter name)

SD: The crew filter shows up

Note: If the crew filter is not found refer to Exception 1

Check the Parameter value for that date (only Standard parameter)

UA: Click on plus sign beside filter

SD: The Parameter values show up

1) First alternative

UA: Scroll to find the value

SD: System follows user's action

2) Second alternative

UA: Click in filter box

SD: Cursor blinks

UA: Type in the date or/and value in the filtering box

SD: The value shows up

b) <u>Second alternative</u>

UA: Click on an Activity Group

SD: Activity shows up

UA: Click on Activity

SD: Sum Planned and Sum Assigned show up

UA: Click on Sum Planned

SD: Drivers show up

Track the first number after schedule release in front of a driver

UA: Right click on the first number after schedule release in table

SD: Context menu opens

UA: Click on "Edit Parameters"

SD: Driver view opens

Locate the crew filter in the driver

1) First alternative

UA: Click on plus sign beside driver's name

SD: Parameters show up

UA: Click on Parameter (Standard or Filter)

SD: Parameter window shows up

UA: Scroll to find the filter

SD: System follows user's action

2) Second alternative

UA: Click on plus sign beside driver's name

SD: Parameters show up

UA: Click on Parameter (Standard or Filter)

SD: Parameter window shows up

UA: Click in filter box

SD: Cursor blinks

UA: Type in the information (e.g. Crew filter name)

SD: The crew filter shows up

Exception 1: If filter is not found

I. Check for subsequent crew filter(s)

1) First alternative

UA: Click in filter box

SD: Cursor blinks

UA: Type in the information (e.g. Crew Group or Base)

SD: Crew filter(s) shows up

*In case it did not another kind of information should be typed (e.g. Rank or Station)

2) Second alternative

UA: Scroll to find the crew filter(s)

SD: System follows user's action

II. Check for a dominant filter(s)

1) First alternative

UA: Click in filter box

SD: Cursor blinks

UA: Type in a dominant filter (e.g. ALL-FC)

SD: The filter(s) shows up

*If it didn't then enter another kind of information (e.g. M8-ALL)

2) Second alternative

UA: Scroll to find the crew filter(s)

SD: System follows user's action

Check the Parameter value for that date (only Standard parameter)

UA: Click on plus sign beside filter

SD: The values show up

1) First alternative

UA: Scroll to find the value

SD: System follows user's action

2) Second alternative

UA: Click in filter box

SD: Cursor blinks

UA: Type in the date or/and value in the filtering box

SD: The value shows up

*If the value is not the same as what is shown in Establishment table

I. In case the crew filter(s) in Driver is subsequent of the crew filter shown in Establishment view

If the crew filters overlap (They have common point), check the percentage that they have in common

UA: Click on Crew Filter menu

SD: Menu shows up

UA: Click on Show Crew Filter

SD: Crew Filters view shows up

Find the crew filter

1) First alternative
UA: Click in filter box

SD: Cursor blinks

UA: Type in the Name or Filter

SD: Filter shows up

UA: Check Visible

SD: Crew filter shows up under Establishment and Leave in Workset Explorer

2) Second alternative
UA: Scroll

SD: System follows user's action

Open the Establishment view for each subsequent crew filter

UA: Click on Plus sign beside Establishment in Workset Explorer

SD: Crew filter shows up

1) First alternative

UA: Double-click on Establishment table

SD: Loading bar shows up

SD: Establishment Table shows up

2) Second alternative

UA: Right-Click on Establishment table

SD: Context menu shows up

UA: Click on "Show Establishment Establishment table"

SD: Loading bar shows up

SD: Establishment Table shows up

UA: Look at the Capacity for the day after schedule release in subsequent crew filter

UA: Click on the pane for Establishment table of the other crew filter

SD: Establishment table for dominant crew filter shows up

UA: Look at the Capacity for the day after schedule release and compare with the subsequent one

UA: Click on the pane for Drivers view

SD: Drivers view shows up

UA: If there is more than one subsequent crew filters; compare the Order of them to see how they affect the calculation of the value

Now you are able to calculate the value for the dominant filter

II. In case the Crew Filter in Establishment view is subsequent of the filter(s) listed under driver

UA: Click on Crew Filter menu

SD: Menu shows up

UA: Click on Show Crew Filter

SD: Crew Filters view shows up

3) First alternative

UA: Click in filter box

SD: Cursor blinks

UA: Type in the Name or Filter

SD: Filter shows up

UA: Check Visible

SD: Crew filter shows up under Establishment and Leave in Workset Explorer

4) Second alternative

UA: Scroll

SD: System follows user's action

Open the Establishment view for each dominant crew filter

UA: Click on Plus sign beside Establishment in Workset Explorer

SD: Crew filter shows up

1) First alternative

UA: Double-click on Establishment table

SD: Loading bar shows up

SD: Establishment Table shows up

2) Second alternative

UA: Right-Click on Establishment table

SD: Context menu shows up

UA: Click on "Show Establishment Establishment table"

SD: Loading bar shows up

SD: Establishment Table shows up

UA: Look at the Capacity for the day after schedule release (for dominant crew filter)

UA: Click on the pane for Establishment table of the subsequent crew filter

SD: Establishment table shows up

UA: Look at the Capacity for the day after schedule release and compare with the dominant one

UA: Click on the pane for Drivers view

SD: Drivers view shows up

UA: If there are more than one dominant crew filters; compare the Order of them to the order in which they effect the calculation

Now you are able to calculate the value for the subsequent filter.

Appendix E

First Prototype

The satisfaction of users towards use of Excel and its functions lead me to think about a feature which can bring that feeling to Manpower. Users are always in need of changing the figure and in order to do that they need to know how and why the current figure has been set or calculated. Below are the functionalities which are considered for this window

- o An option for each user to be able to take private notes
- o An option for super-users to leave note for normal users to help them with complicated features, functions, etc. This helps planners communicate in an efficient way while learning the system.
- o Showing an automatic help which gives revised information about the feature or function that users hover over/click
- o Guidance for users about what to do next
- o Showing the current status of user

For the reasons above a new window called Feedback was added to Manpower. (See figure below)
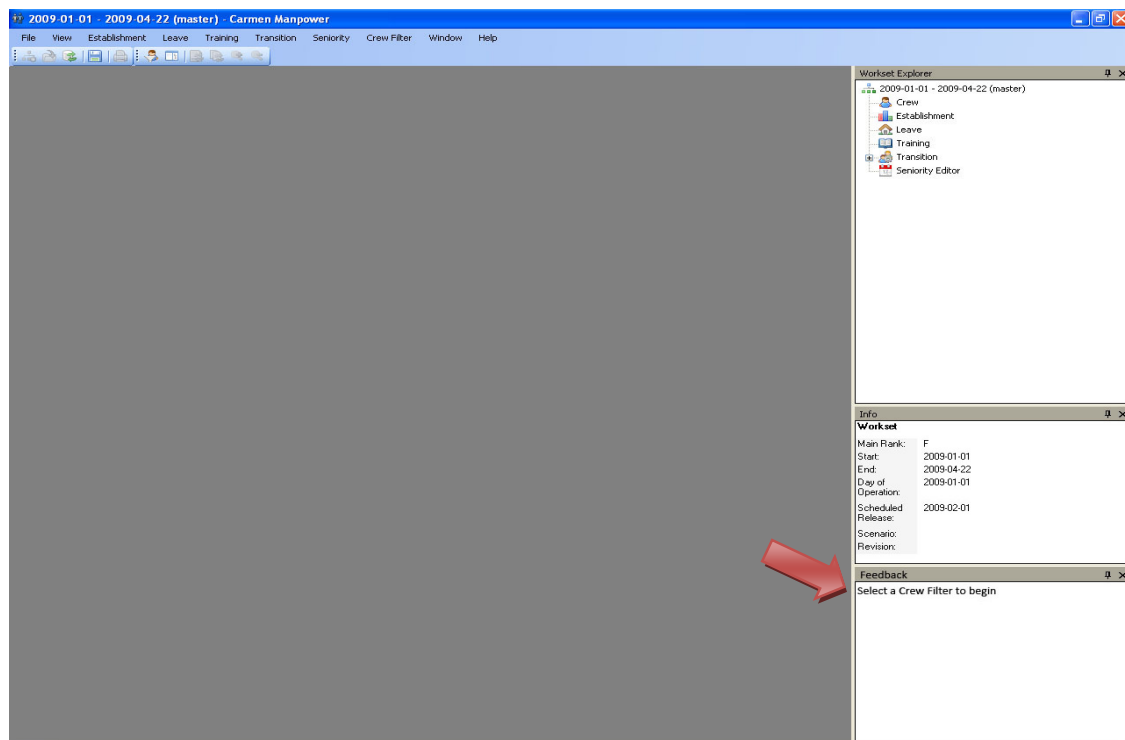
Figure 18 A Photoshop sample of Feedback window

The changes made in Establishment table and related areas of the system

Here the changes which have been prototyped in the first round in Establishment table and the related parts e.g. Workset Explorer are listed

1. To reduce excise in the time of opening the Establishment table for a Crew Filter
   a. Open the table as soon as a Crew Filter is chosen
   b. Expand the Crew Filter folder under Establishment item in Workset Explorer as soon as a Crew Filter is chosen
2. Make the Detail Graph and Establishment table icons look clickable in Workset Explorer and highlight them to show the user his current situation. E.g. if Establishment table is open and user is working with it, its icon in Workset Explorer is highlighted (See the figure below)
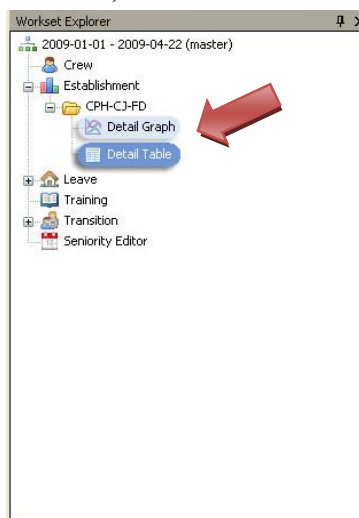
Figure 19 Photoshop sample of idea No. 2

3. Add an arrow beside Name of each Activity Group, Activity, Task, etc. in table. When that row is not expanded the arrow is horizontal (pointing to the Name of row), after expansion the arrow will point down (Changes are shown in Figure 20)
4. Add a gradient background to the cell of Parameter Value with PERC type (Refer to Figure 20)

Figure 20 Photoshop sample of ideas no. 3 and 4

5. Add Average column to table to reduce excise. (Currently users need to change the view from e.g. Daily to Weekly to be able to see the average for each week)
6. Add a drop down called Overview on top of table which gives the users the ability to choose the aggregation level of Average column. It has two options Weekly and Monthly
7. Add the Parameter Value row(s) under Driver in Establishment table
8. Coloring every other row in the Establishment table (Refer to Figure 21)
9. Add a dotted frame around an expanded row and its sub rows to show they are of one group and related. The paper prototype is shown in the figure below.

Figure 21 The dotted frame and the colored rows

10. Add a button to the main toolbar which enables the user to customize the table (see Figure 22 and Figure 23 for more information)

Steps to customize the table:

- Click the button
- A new column (named "Visible") with checkboxes beside each row appears
- Check the desired rows/Activity Groups
- Click the button to exclude unwanted rows/Activity Groups

File View Establishment Leave Training Transition Seniority Crew Filter Window Help

Crew Filters | Est Table [CPH-CJ-FD]

Crew FilterValue: *:CJ:*:FC|FP:CPH   Period: 2009-01-01 2009-05-01

View Level: Activity Group   Aggregation Level: WEEK   Aggregation Method: AVERAGE   Strategy: Default

	Name	Type	Visible	W1 01 jan-09	W2 05 jan-09	W3 12 jan-09	W4 19 jan-09	W5 26 jan-09	W6 02 feb-09	W7 09 feb-09	W8 16 feb-09	W9 23 feb-09	W10 02 mar-09	W11 09 mar-09	W12 16 mar-09	W13 23 mar-09	W14 30 mar-09	W15 06 apr-09	W16 13 apr-09	W17 20 apr-09	W18 27 apr-09
1	PROD	ACTIVITY_GROUP	✓	4,75	6,86	8,14	8,57	8,43	8,71	8,29	9,43	8,71	0,29	0	0,29	0	0	0	0	0	0
2	SB	ACTIVITY_GROUP	☐	1,25	2	0,57	1,29	0,7	1,61	1,57	1,65	2,78	0,03	0	0,32	0	0	0	0	0	0
3	BL	ACTIVITY_GROUP	☐	3,5	4	4,14	2,29	2,71	0,86	1,86	1,43	2,71	0	0	0	0	0	0	0	0	0
4	OPC	ACTIVITY_GROUP	☐	0	0,29	0,29	0	0,29	0,86	0,29	0,57	0,14	0	0	0	0	0	0	0	0	0
5	LC	ACTIVITY_GROUP	☐	0	0	0	0,57	0,43	0,29	0,14	0,14	0	0	0	0	0	0	0	0	0	0
6	SEMINAR	ACTIVITY_GROUP	☐	0	0	0	0	0	0	0	0	0,14	0	0	0	0	0	0	0	0	0
7	MTG	ACTIVITY_GROUP	☐	0,25	2,43	2,57	2,86	2,71	1,43	1,71	0,71	0,86	0	0	0	0	0	0	0	0	0
8	ILL SHORT	ACTIVITY_GROUP	✓	0,25	0,43	0,29	0	0	0,14	0	0	0	0	0	0	0	0	0	0	0	0
9	F	ACTIVITY_GROUP	☐	20,75	11,57	10,29	10	12,57	14,57	17,86	19	19,29	13,86	19,71	14	19,86	16,86	17,43	16,86	22,86	20,6
10	VA-F7	ACTIVITY_GROUP	☐	3,25	2	4	2,29	2,71	4	5,29	3,43	2,57	4	2,86	5,14	2	4,14	5,14	6,29	4	5,2
11	CS	ACTIVITY_GROUP	☐	0	4,57	3,86	0,71	1,43	3	3,71	3,29	3,86	6	8,43	13	13	11,86	9	8,29	4	3,6
12	INSTR	ACTIVITY_GROUP	☐	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	OTHER	ACTIVITY_GROUP	☐	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	ADM	ACTIVITY_GROUP	☐	0	0,14	0,29	0,14	0,29	0,86	0	0,14	0,43	0	0	0	0	0	0	0	0	0
15	Effective Demand	DEMAND	✓	34	34,29	34,43	28,71	32,27	36,33	40,71	39,79	41,49	24,17	31	32,75	34,86	32,86	31,57	31,43	30,86	29,4
16	Balance	BALANCE	✓	1	2,71	2,57	9	8,16	6,82	6	6,21	8,08	25,4	23,86	23,83	23,29	26,43	27,71	27	27,14	28,4
17	Effective Supply	SUPPLY	✓	35	37	37	37,71	40,43	43,14	46,71	46	49,57	49,57	54,86	56,57	58,14	59,29	59,29	58,43	58	57,8
18	ILL LONG	ACTIVITY_GROUP	☐	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	LOA	ACTIVITY_GROUP	☐	0	0	0	0,29	1	0,71	0	0	0	0	0,71	1	0,29	0	0	0	0	0
20	PARTTIME	ACTIVITY_GROUP	☐	0	0	0	0	0	0,14	0,29	1	1,43	1,43	1,43	2,43	1,57	0,71	0,71	1,57	2	2,2
21	DECREASE	ACTIVITY_GROUP	☐	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	INCREASE	ACTIVITY_GROUP	☐	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	CAPACITY	ACTIVITY_GROUP	✓	35	37	37	38	41,43	44	47	47	51	51	57	60	60	60	60	60	60	60
24	Helpdrivers	ACTIVITY_GROUP	☐	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 22 Photoshop sample of idea No.9: Rows selected

	Name	Type	W1 01 jan-09	W2 05 jan-09	W3 12 jan-09	W4 19 jan-09	W5 26 jan-09	W6 02 feb-09	W7 09 feb-09	W8 16 feb-09	W9 23 feb-09	W10 02 mar-09	W11 09 mar-09	W12 16 mar-09	W13 23 mar-09	W14 30 mar-09	W15 06 apr-09	W16 13 apr-09	W17 20 apr-09	W18 27 apr-09
1	PROD	ACTIVITY_GROUP	4,75	6,86	8,14	8,57	8,43	8,71	8,29	9,43	8,71	0,29	0	0,29	0	0	0	0	0	0
2	ILL SHORT	ACTIVITY_GROUP	0,25	0,43	0,29	0	0	0,14	0	0	0	0	0	0	0	0	0	0	0	0
3	Effective Demand	DEMAND	34	34,29	34,43	28,71	32,27	36,33	40,71	39,79	41,49	24,17	31	32,75	34,86	32,86	31,57	31,43	30,86	29,4
4	Balance	BALANCE	1	2,71	2,57	9	8,16	6,82	6	6,21	8,08	25,4	23,86	23,83	23,29	26,43	27,71	27	27,14	28,4
5	Effective Supply	SUPPLY	35	37	37	37,71	40,43	43,14	46,71	46	49,57	49,57	54,86	56,57	58,14	59,29	59,29	58,43	58	57,8
6	CAPACITY	ACTIVITY_GROUP	35	37	37	38	41,43	44	47	47	51	51	57	60	60	60	60	60	60	60

Figure 23 Photoshop sample of customized table

The changes made to Driver view and related areas of the system

Here is the list of the design changes in Driver view which were implemented in the prototypes.

1. Change the appearance of "Drag a column to group by that column" from plain text to text box. Figure 24 shows the current look of this feature

Figure 24 The current look of grouping feature

2. Hide the filter boxes above Driver table and add a Filter button. Filters will appear whenever the button is clicked
3. Warn users about the repetitive Parameter in the time of adding the Parameter
4. Gray out the type of Parameter which is not used by the Driver
5. Gray out the period for which no Parameter Value has been considered
6. If the context menu was used to enter the Driver view from Establishment table, filter out the Parameters which are not related to the Crew Filter in the table
   Note: Users have the option to see the non-related Parameters whenever they want
7. Visualize the relation between the Crew Filters which are listed as Parameter and the Crew Filter in the Establishment table. An example can be found in figure below.
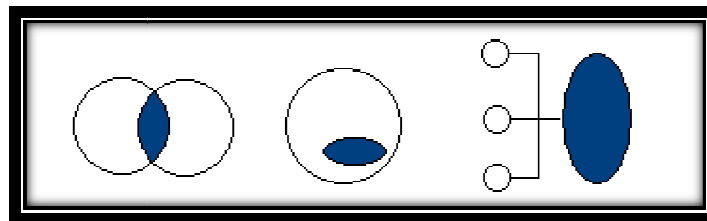
Figure 25 A sample of the relation visualization between Parameters and the Crew Filter in Establishment table

8. Change the look of Parameter Value level (Please refer to Figure 13 and Figure 14 for more information)
   a. Show the Parameter Value of each day in separate cells in a horizontal row
   b. Show the Parameter Values in a calendar
9. Add two text boxes above Parameter Value which indicates the period in which the Parameter Value is valid
10. If the context menu was used to enter the Driver view from Establishment table, frame or highlight the Parameter Value and the period during which it is valid in the Driver view
11. Change the name of "Is Snake" option to Repetitive pattern
12. After a change in a Driver, show the result of the change on the Activity in a small chart in Info window

Appendix F

Results from first Prototype

This part includes the feedbacks I got during the first round of evaluation of the prototypes. Although evaluators were asked not to think about the possible technical obstacles which might arise in implementing the design ideas, they still could not follow the rule. Nevertheless most of the ideas were valued by the participants especially the idea of adding the Feedback Window turned out to be the popular one among all the suggestions.

Here I just mention the suggestions and ideas they had concerning different views and will not state the parts they cherished. Then a list of the ideas which have not been considered in second prototype followed by the list of the ones which were documented to be reported to Jeppesen can be found.

Establishment table

1. It is not wise to open a table as soon as a Crew Filter is selected since users may not need to work with Establishment table but with some other view e.g. Leave
2. Currently users are able to select the cells of an Activity Group and see the average of those cells in Info window. Having the Average column in table will interfere in this calculation and result in wrong answer in Info window (if user is not attentive)
3. After change of Parameter Value show both old value and new one in Establishment table
4. If the Crew Filter in Establishment table is not included under a driver and its figures are affected by a larger Crew Filter which is listed as Parameter under that Driver, show what percent of the dominant Crew Filter belongs to the Crew Filter in Establishment table
5. In the customized table show some Activities have been filtered out and give the user the option to go back to default Establishment table
6. Provide the Save option in table to enable users to save the customized table

Driver view

7. If during a period the Parameter Value is the same then collapse that period and just show its value in its cell
8. Give the user the ability to choose the aggregation level for seeing the Parameter Values since showing them only in Daily format will make it difficult for user if they want to give one Parameter Value to e.g. three months in a row
9. In case of use of context menu in Establishment table to enter Driver view, inform the user know to which Crew Filter the Driver(s), Parameter(s) and Parameter Value(s) belong to. This is mostly helpful when different tables for different Crew Filters are open and being analyzed.
10. Clicking the title of each column (in Driver view) puts that column in order. So the idea of giving explanation about e.g. what a title of a column means in Feedback window by clicking on the title, does not work here

11. When a repetitive Parameter is being created all the needed information needs to be filled and also OK button needs to be clicked. Other than that no warning can be given

12. Showing the effect of a change in a Driver for an Activity in a small Graph is not enough or useful for a user. Since changing a value for a Driver may affect other Drivers e.g. Smearing Driver, showing the affected Activities will be more helpful to users

13. Show if a part of the crew has not been assigned to any Activity

14. There is no situation in which no Parameter Value is considered since when a user assigns a Value for e.g. 1st of April and nothing more, that Value will be assigned to all days since 1st of April

15. Filter boxes should not be hidden but they should be more noticeable to users (In this way consistency will be preserved)

16. The calendar look (Figure 13) does not show the days (e.g. Monday) but only shows the dates which is not convenient for users

17. It is better to use the suggestion from Figure 14 since it retains the consistency between the look of Parameter Value row in Establishment table and Driver view

18. Give the user the ability to copy-paste the values from Excel sheets

Feedback Window

19. This window should only be dedicated to the both private and public notes of users
The information which is provided by system e.g. explanation about different features, the current status of the user or the relation between different Crew Filters, they should be shown in Info window not Feedback window. This is because Info window already provides some kind of information so the new information can be included there as well.

20. The information/notes in Feedback window should be context dependant. This is to avoid confusing the users by showing non-related notes for the view on which they are working. For instance if a user is working with Driver view, the notes which are related to Drivers should only be shown.

21. Public notes should be updated when a change is made and there should be a history so that users can see what have been changed and by whom

22. Giving the users suggestion about what to do next is not possible because there are various choices that one can make depending on what her purpose in working with system is.

- The changes which were not considered in the second prototype are

Number 3: There already is large amount of information in the table. Keeping the old figures brings nothing but messiness.

Number 13: Leaving out a part of a crew rarely happens. Since after assigning activity to each part of crew, planners consider and assign an activity to the rest.

Number 20: Since showing the related notes to a figure or feature can easily be done by clicking or hovering over them, there is no need for organizing them in any order

- The changes which were considered helpful and were documented to report to Jeppesen but has not been implemented in second prototype

Number 18: The ability for copy-pasting figures from Excel sheets is what is needed by end-users.

Number 21: A useful suggestion since sometimes there is a need to contact the person who made a change to get more information about the reason for the change of plan

Appendix G

Second Prototype

Here are the changes which were made to the prototypes of Establishment table and Driver view. These changes are either the reflection of what exactly the participants asked for or the edited version of them. The reason for editing the suggestions was to make the changes user-friendly, to make them close to what end-users asked during their interviewees and not to make them easy to implement for the developers.

⬥ The changes made in Establishment table and related areas of the system

1. Feedback window will not show help or guidance. Its use is only limited to saving the notes which are entered by end-users.
2. The current status is shown to user in the bottom of the page not in Feedback window.
3. The aggregation level of Average column can be chosen by users (it can be set to show Daily or Monthly average or not to be there at all)
4. Hiding the Average column when user expands a Driver in Establishment table. This is because average has no meaning when it comes to Driver level.
5. Change of the place of the Customize button from main toolbar to the top of table. This was done because the Customized button belongs only to table so there is no need for having it in the main toolbar.
6. Show that some Activities have been filtered out and make them users able to bring them back if they want

⬥ The changes made in Driver view and related areas of the system

1. Add the name of the crew filter to the tab of Drivers (if context menu was used to enter the Driver view)

2. In case the settings or any part of a Driver is edited, show the name of the affected Drivers in Info window instead of showing a small graph

3. Add a drop down which gives the user the ability to choose the Aggregation Level of the selected Parameter Value (e.g. Having the ability to choose to see the values in Daily, Weekly or Monthly base)

4. In case a Driver is edited, show the name of the affected Drivers in the Feedback window. (This a helpful piece of information to users and it can speed up the users' working process)

5. Add an arrow beside the filter icon to put more emphasis on filter boxes and inform the users about the existence of these filter boxes

The changes made in Establishment graph and related areas of the system

1. When an Activity is clicked in the chart or in the panel in the right side of the chart (See Figure 26)

   a. The figures of Demand, Balance and Supply for that period are shown in Info window

   b. A table which includes the Tasks of that Activity plus the crew of each Task is shown under the graph

2. Add a checkbox beside the names of each Activity (which is shown in the panel on the right side of the graph, see Figure 26) to give the user the opportunity to customize the graph by checking the required Activities and un-checking the non-required ones.
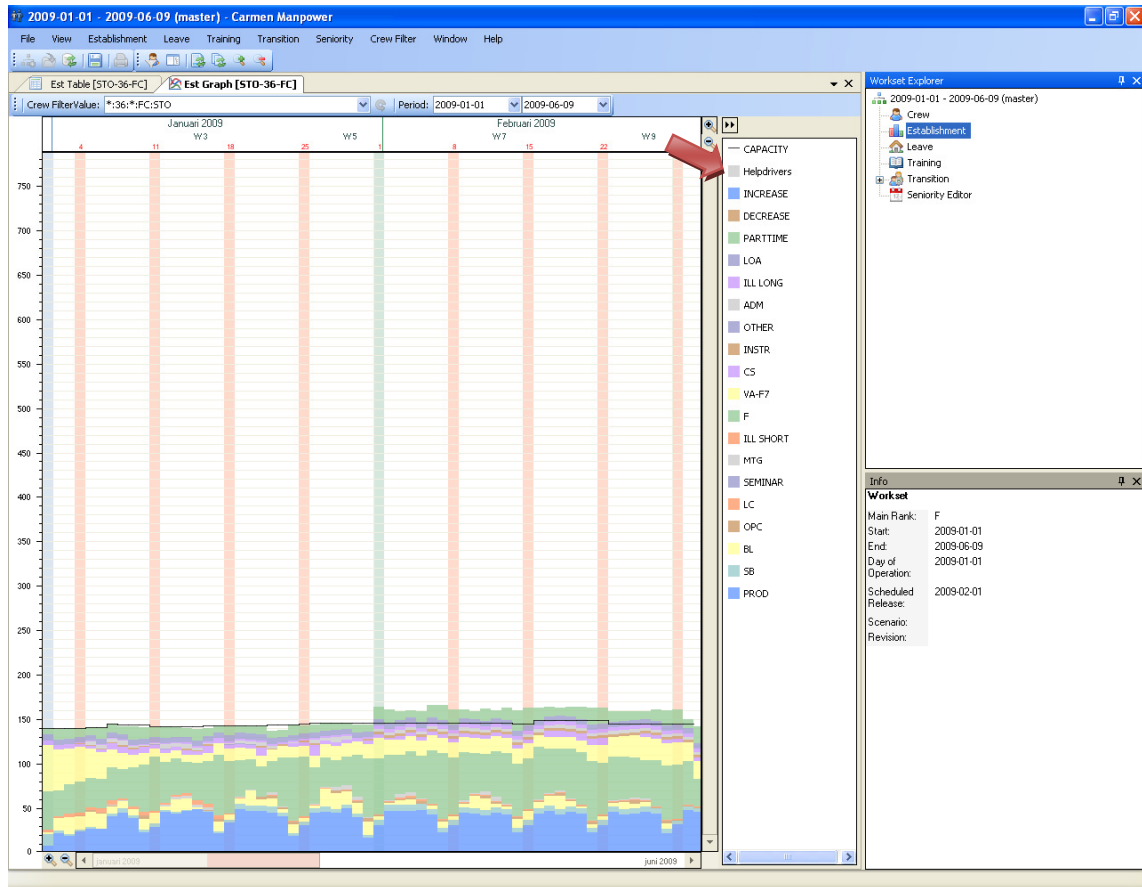
Figure 26 The panel with the name of all Activities in Establishment graph

3. Filter out the unchecked Activities in the graph
4. Add a context menu to the graph which provides the users with the possibility to go to Establishment table when they right-click in the chart on the Activity they want.
5. Add a line on top of the mouse cursor to make the tracking of the numbers easy for the users (see Figure 15)
6. The number of magnifiers is reduced to one.
7. Users are able to grab the magnifier and choose the area they want to magnify
8. To zoom out, grab the magnifier and hold Ctrl then keep clicking till you reach the desirable view
9. In order to go back to the original view (when zoomed in), users need to double-click on the magnifier icon
10. When zoomed in
    a. The figures of the selected Activity can be seen within the color of the Activity in the chart
    b. The numbers on Y axis are shown in detail (0, 1, 2, etc. instead of 0, 50, 100, etc.)
11. Add a thumbnail of the graph in the panel on the right side of the graph where Activities are listed

12. While zoomed in, the area is marked in the thumbnail to inform the user about her current situation. This is exactly like the Navigator which is used in Photoshop in which the area which is zoomed in is presented in a red rectangle (see the figure below)
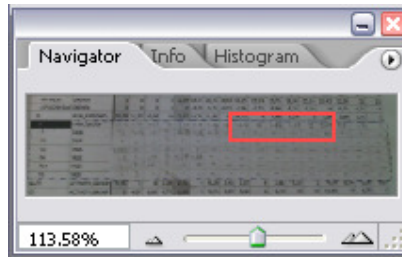
Figure 27 The Navigator in Photoshop

Results from second Prototype

Here the comments of the participants in the second round of evaluation can be found. This part includes only the suggestions for improving the design ideas and not the affirmation of the design proposals. Although the participants were asked not to think about technical issues, some of the critics are technical. Below you can find the critics about changes in Establishment table, Establishment graph and Driver view

Establishment table

1. Add the "No overview" option to the Overview drop down in case users do not want to have Average column in the Establishment table
2. Give the Average column a different look to illustrate its difference for users
3. Users should be lead to Parameter Value level in the time when they use the context menu in Establishment table to enter Driver view

Establishment graph

1. In the time of customizing the chart, do not filter out the unchecked Activities. Instead gray them out and move them to the top of the chart. This keeps the users informed about their effect on the plan.
2. Two opposite comments about the place of thumbnail window
   a. Use a floating window for thumbnail of the graph so that users can move it to the place they are most comfortable with
   b. Fix the place of thumbnail window so that users know where to look for it whenever needed
3. Do not use double-clicking on the magnifier icon as a tool for going back to the default view

4. Keep the X and Y magnifiers because sometimes users want to zoom in horizontally and not vertically or vice versa. E.g. a user may be looking at weeks 4 and 5 and she wants to zoom in vertically to see the number of crew in those weeks. So they don't need to zoom in horizontally at that time.

5. Enable users to zoom in by clicking on X or Y axis instead of grabbing the magnifier(s)

6. Give the users "zoom to fit" option. In this way they can choose the area they want to magnify and be directly lead to it without the need of using magnifier and continuous mouse-clicking

Driver view

1. In Parameter Value level if the Aggregation level is et to Monthly but the days of that month have different values, make the appearance of that cell different from others. This will inform the users about this situation

2. Do not change the appearance of "Drag a column to group by that column" (see Figure 24) to textbox since textbox does not show the drag & drop affordability either

Technical issues

3. The appearance of "Drag a column to group by that column" cannot be changed since it is one of the features which is provided by the table and cannot be customized

4. After a change in a Driver listing all the affected Drivers is not possible since the connection among some Drivers is a bit complicated. This is because their connection is defined in code and not by users

In view of the fact that all the feedbacks in this round were helpful, I did not cross any of them out. Even the two opposite suggestions which were given for the place of thumbnail window were kept and documented.

Ranking Questionnaire

1. **Adding the Feedback Window under Info Window and providing users with the possibility of writing private and public notes.**

   ☐ 1 (Definitely)   ☐ 2   ☐ 3   ☐ 4(Not required)

2. **Showing the current situation of the user in the bottom of the page/screen**

   ☐ 1 (Definitely)   ☐ 2   ☐ 3   ☐ 4(Not required)

3. **Adding an arrow beside each row in Establishment table so when a row has not been expanded the arrow points to right and when the row is expanded the arrow points down (See the example below)**

   ☐ 1 (Definitely)   ☐ 2   ☐ 3   ☐ 4(Not required)
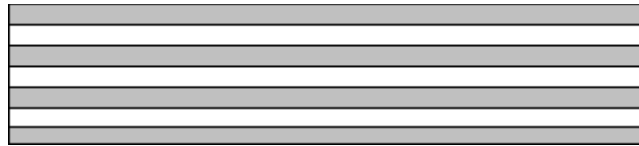
►F	Activity Group
►CS	Activity Group

   ↓

▼F	Activity Group
►F	Activity
►CS	Activity Group

4. **Showing the relation between rows by using different color for each row. For instance when F Task Group is expanded the rows below (e.g. F Task, F1,F2, etc.) look like the way shown below**

☐ 1 (Definitely)   ☐ 2   ☐ 3   ☐ 4(Not required)

5. **Providing the users with the ability to customize the Establishment table (To be able to select the rows one likes to see)**

☐ 1 (Definitely)   ☐ 2   ☐ 3   ☐ 4(Not required)

6. **Providing users with the option of adding an Overview column to the Establishment table e.g. if users are in Daily view they can choose to have a column which shows the overview of the month in the Establishment table (The figures in the Overview column will follow the selected Aggregation Method)**

☐ 1 (Definitely)   ☐ 2   ☐ 3   ☐ 4(Not required)

7. **Showing the values under Driver level in Establishment table and giving the users the ability to change values directly in Establishment table**

☐ 1 (Definitely)   ☐ 2   ☐ 3   ☐ 4(Not required)

8. **If the crew filter of the Establishment table is not listed under a driver, then in value level show the crew filters which are affecting the figures of the crew filter in Establishment table**
For instance you open the Establishment table for crew filter CPH-CJ-FD then you go to value level of the driver d-F FG SH but CPH-CJ-FD is not listed there. Instead you have crew filters ALL and ALL-CJ-FD and these are the ones which have effect on figures in CPH-CJ-FD

☐ 1 (Definitely)   ☐ 2   ☐ 3   ☐ 4(Not required)

9. **Showing the essential information of crew filters (e.g. filters ALL and ALL-CJ-FD in the example above) which affect the crew filter of Establishment table.**

Information such as their calculation order, Percentage of the capacity e.g. if CPH-CJ-FD is 30% of filter ALL-CJ-FD

☐ 1 (Definitely)   ☐ 2   ☐ 3   ☐ 4(Not required)

10. **Showing the relation between the crew filter in Establishment table and crew filters which are listed under a driver in the form of picture in Info window.**

☐ 1 (Definitely)   ☐ 2   ☐ 3   ☐ 4(Not required)

11. **Showing the crew filter name beside "Drivers" in the tab of Driver view, if a user uses context menu to enter the Drivers view (See the image below)**

☐ 1 (Definitely)   ☐ 2   ☐ 3   ☐ 4(Not required)
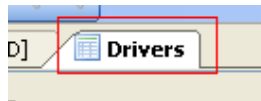
12. **Changing the way values are added under drivers in Driver view from vertical to horizontal**

☐ 1 (Definitely)   ☐ 2   ☐ 3   ☐ 4(Not required)

13. **Providing users with an option which shows them a list of connected/dependant drivers in Driver view. For instance users can right click on d-OPC and choose to see drivers which have effect on d-OPC or the drivers which are affected by d-OPC**

☐ 1 (Definitely)   ☐ 2   ☐ 3   ☐ 4(Not required)

14. **Giving a warning to users in case they are creating a Parameter which already exists**

☐ 1 (Definitely)　　　☐ 2　　　　　☐ 3　　　　　☐ 4(Not required)

15. Providing the users with the ability to customize the Detail Graph by giving them the option to select Activities they want

☐ 1 (Definitely)　　　☐ 2　　　　　☐ 3　　　　　☐ 4(Not required)

16. Separating each day by drawing vertical line in Detail Graph

☐ 1 (Definitely)　　　☐ 2　　　　　☐ 3　　　　　☐ 4(Not required)

17. Providing the users with the crew list when an Activity is clicked in Detail Graph

☐ 1 (Definitely)　　　☐ 2　　　　　☐ 3　　　　　☐ 4(Not required)

18. Showing Demand, Balance and Supply in the Info window when an Activity is clicked in Detail Graph

☐ 1 (Definitely)　　　☐ 2　　　　　☐ 3　　　　　☐ 4(Not required)

19. Showing thumbnail of Detail Graph in Detail Graph view in the time when one zooms in

☐ 1 (Definitely)　　　☐ 2　　　　　☐ 3　　　　　☐ 4(Not required)

20. Being able to take the magnifier and choose the area one wants to zoom in.

☐ 1 (Definitely)　　　☐ 2　　　　　☐ 3　　　　　☐ 4(Not required)

21. Being able to see Mandays' figures for a selected activity in Detail Graph when one zooms in

☐ 1 (Definitely)　　　☐ 2　　　　　☐ 3　　　　　☐ 4(Not required)

The summarized results of the votes

	Keyword	1	2	3	4
1	Feedback window	3	3		
2	Current situation		3	3	
3	Arrow beside row name	2	3	1	
4	Show the relation between rows	3	2	1	
5	Customizable Establishment table	3	2	1	
6	Overview column		3	3	
7	Value level in table	5	1		
8	Show needed/related filters in value level	3	2	1	
9	Crew filter's information in Info window	2	3	1	
10	Pictorial relation between crew filters		1	5	
11	Adding the name of the crew filter to Driver tab	1	2	1	2
12	Changing the value look from vertical to horizontal	5	1		
13	Showing dependent Drivers in Driver view	3	1	2	
14	Warning while creating a repetitive Parameter	2	3		
15	Customizable graph	4	2		
16	Separating days in graph	1	1	2	2
17	Crew list in graph		2	2	2
18	Demand, Balance and Supply in graph		1	3	2
19	Thumbnail of Graph			4	2
20	Selecting the zooming area		3	2	1
21	Showing Manday's figures in graph		2	4	

Table 8 The resumed version of the results of votes

The feature which were voted to be the most important ones in the list
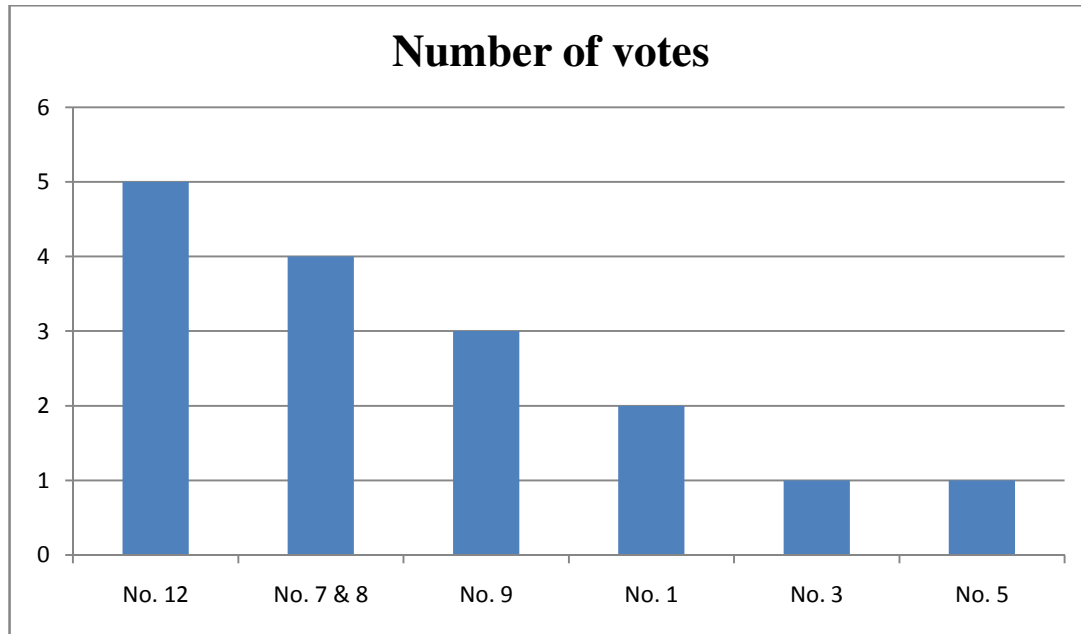
Figure 28 The important features and their number of votes

The time estimation for development process for each feature on weekly base can be seen in the figure below
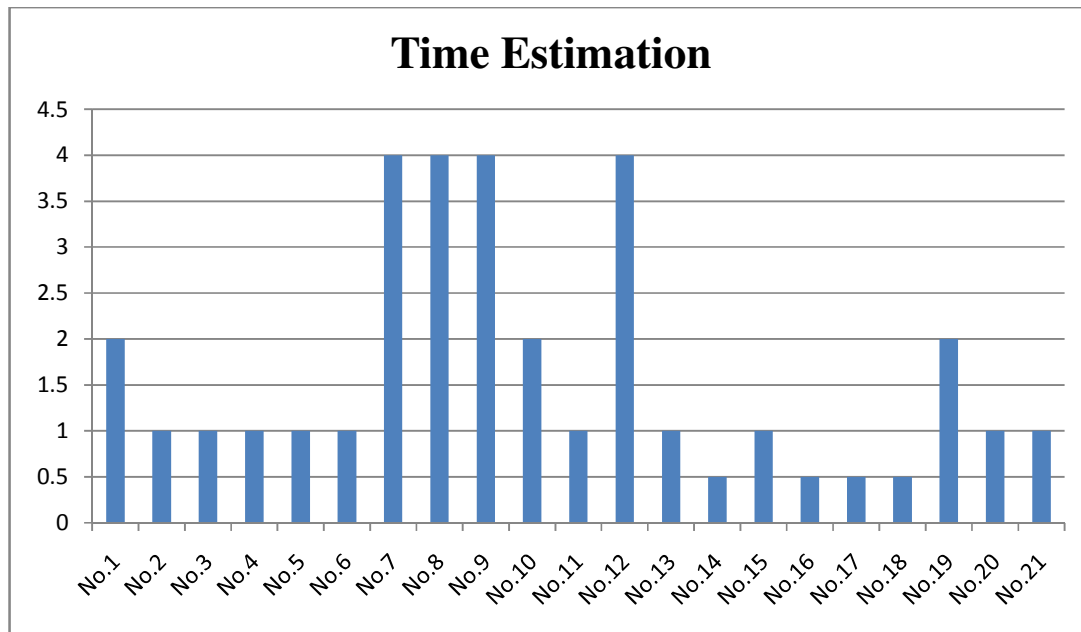
Figure 29 Time estimation of development process for all the design ideas

Use cases

1. Changing the way Value level looks from vertical to horizontal
<u>Case1:</u> Find and edit a Value under a certain driver (crew filter is listed under the driver)

1. Open Driver view
2. Find the driver
   a) Scroll (vertical)
   b) Use filter
3. Open the driver
4. Find the Parameter
   a) Scroll (vertical)
   b) Use filter
5. Open the Parameter
6. Values show up in horizontal cells with the dates which are shown on top of them (The default view is Daily)

From `009 06 27` To `009 07 06` Aggregation Level | Daily ▾ |

◄   June   July   ►

27	28	29	30	31	1	2	3	4	5	6
10	10	10	10	10	10	10	10	12	12	12

7. Go to the date or period you want to see
   a) Scroll (horizontal) by using the arrows/scrolls above the Values
   b) Enter the dates in 'From' and 'To'
   c) Use 'Aggregation Level' drop down. This drop down has three options: Daily, Weekly and Monthly
8. Click on the Value (This will select the Value inside the cell)
9. Enter a new Value

<u>Notes:</u>

a) In case you delete the value and do not enter a new one, the previous value will be chosen as the replacement automatically

b) In case you change a value e.g. the value on 1st of July from 10 to 13 then the values for 2nd and 3rd of July will be changed to 13 as well, in case you do not enter another value for them

c) In case the driver is invalid on a day, the cell of that day will be an empty cell which is grayed out

d) In case the value cannot be shown because the user is not in the right Aggregation Level, the cell of that value will be a grayed-out cell which has a value in it. For instance, user is in Monthly Aggregation Level and he needs to change to Weekly Aggregation Level to be able to see the Values for that month. The cell of that month is a grayed-out cell which has the value of the first week of the month in it.

Exception(s):

Weekly Aggregation Level

❖ If Aggregation Level is set to Weekly and values for a week are different from day to day then the look of that week is different from other weeks. It will be a grayed-out cell which contains the value of the first day of the week
a) If the user wants to check or change a value on a certain day

1. Right-click on that Value
2. A context menu which has three options (Daily, Weekly and Monthly) will show up and only the Daily option is active (enabled).
3. Click on Daily
4. The Aggregation Level will change from Weekly to Daily
5. Locate the Value you want
   a) Scroll (horizontally) by using the arrows/scrolls above the Values

   b) Enter the dates in 'From' and 'To'

6. Click on the Value you want to change (This will select the Value inside the cell)
7. Enter a new Value

b) If the user wants to edit the value for a week which has different values for different days

1. Click on the cell of that week (This will select the Value inside the cell)

2. Enter a new value

3. All the values of the days on that week will be changed

Monthly Aggregation Level

❖ If Aggregation Level is set to Monthly and we have different Value for days (not weeks) on that month then the cell of that month will be grayed-out cell with the value of the first day of the month in it.

a) If the user wants to check or change a value on a certain day

1. Right-click on that Value

2. A context menu which has three options (Daily, Weekly and Monthly) will show up and only the Daily option is active (enabled).

3. Click on Daily

4. The Aggregation Level will change from Weekly to Daily

5. Locate the Value of the day you want
   a) Scroll (horizontally) by using the arrows/scrolls above the Values

   b) Enter the dates in 'From' and 'To'

6. Click on the Value you want to change (This will select the Value inside the cell)

7. Enter a new Value

8. Recalculate the Establishment table to see the effect of the change

b) If the user wants to edit the value for a month which has different values for different days

1. Click on the cell of that month (This will select the Value inside the cell)

2. Enter a new value (All the values of the days on that month will be changed)

❖ If Aggregation Level is set to Monthly and we have different Value for weeks of that month then that cell is grayed out and the value for the first week of the month is shown inside the cell

   a) If the user wants to check or change a value for a certain week

   1. Right-click on that Value
   2. A context menu which has three options (Daily, Weekly and Monthly) will show up and only the Weekly option is active.
   3. Click on Weekly
   4. The Aggregation Level will change from Monthly to Weekly
   5. Locate the Value of the day you want
      a) Scroll (horizontally) by using the arrows/scrolls above the Values

      b) Enter the dates in 'From' and 'To'

   6. Click on the Value you want to change (This will select the value inside the cell)
   7. Enter a new Value

b) If the user wants to edit the value for a month which has different values for different weeks

1. Click on the cell of that month (This will select the Value inside the cell)

2. Enter a new value (All the values of the weeks on that month will be changed)

Case2: Find and edit a Value under a certain driver by using context menu in Establishment table

1. Find the Parameter
     a) Scroll (vertical)

     b) Use filter

2. Open the Parameter
3. Values show up in horizontal cells with the dates which are shown on top of them (The default view is Daily)
4. Go to the date or period you want to see
     a) Scroll (horizontal) by using the arrows/scrolls above the Values
     b) Enter the dates in 'From' and 'To'
     c) Use 'Aggregation Level' drop down. This drop down has three options: Daily, Weekly and Monthly
5. Click on the Value (This will select the Value inside the cell)
6. Enter a new Value

Notes:

a) In case you delete the value and do not enter a new one, the previous value will be chosen as the replacement automatically

b) In case you change a value e.g. the value on 1st of July from 10 to 13 then the values for 2nd and 3rd of July will be changed to 13 as well, in case you do not enter another value for them

c) In case the driver is invalid on a day, the cell of that day will be an empty cell which is grayed out

d) In case the value cannot be shown because the user is not in the right Aggregation Level, the cell of that value will be a grayed-out cell which has a value in it. For instance, user is in Monthly Aggregation Level and he needs to change to Weekly Aggregation Level to be able to see the Values for that month. The cell of that month is a grayed-out cell which has the value of the first week of the month in it.

Exception(s):

Weekly Aggregation Level

> ❖ If Aggregation Level is set to Weekly and values for a week are different from day to day then the look of that week is different from other weeks. It will be a grayed-out cell which contains the value of the first day of the week

> **a)** If the user wants to check the values or changes a value on a certain day

>> 1. Right-click on that Value
>> 2. A context menu which has three options (Daily, Weekly and Monthly) will show up and only the Daily option is active.
>> 3. Click on Daily
>> 4. The Aggregation Level will change from Weekly to Daily
>> 5. Locate the value you want
>>> a) Scroll (horizontally) by using the arrows/scrolls above the Values
>>>
>>> b) Enter the dates in 'From' and 'To'

>> 6. Click on the Value you want to change (This will select the value inside the cell)
>> 7. Enter a new Value

> **b)** If the user wants to edit the value for a week which has different values for different days

>> 1. Click on the cell of that week (This will select the value of the cell)
>>
>> 2. Enter a new Value (All the values of the days on that week will be changed)

Monthly Aggregation Level

> ❖ If Aggregation Level is set to Monthly and we have different Value for days (not weeks) on that month. Then the cell of that month will be grayed-out cell with the value of the first day of the month in it.

>> **a)** If the user wants to check or change a value on a certain day

>> 1. Right-click on that Value

>> 2. A context menu which has three options (Daily, Weekly and Monthly) will show up and only the Daily option is active.

>> 3. Click on Daily

>> 4. The Aggregation Level will change from Weekly to Daily

5. Locate the Value of the day you want

   a) Scroll (horizontally) by using the arrows/scrolls above the Values

   b) Enter the dates in 'From' and 'To'

6. Click on the Value you want to change (This will select the value of the cell)

7. Enter a new Value

b) If the user wants to edit the value for a month which has different values for different days

1. Click on the cell of that month

2. Edit the value

3. All the values of the days on that month will be changed

❖ If Aggregation Level is set to Monthly and we have different Value for weeks of that month. Then the cell of that month will be a grayed-out cell with the value of the first week of the month in it.

   a) If the user wants to check the values or changes a value for a certain week

   1. Right-click on that Value
   2. A context menu which has three options (Daily, Weekly and Monthly) will show up and only the Weekly option is active.
   3. Click on Weekly
   4. The Aggregation Level will change from Monthly to Weekly
   5. Locate the Value of the day you want
      a) Scroll (horizontally) by using the arrows/scrolls above the Values

      b) Enter the dates in 'From' and 'To'

   6. Click on the Value you want to change (This will select the value of the cell)
   7. Enter a new Value

b) If the user wants to edit the value for a month which has different values for different weeks

1. Click on the cell of that month (This will select the value of the cell)

2. Enter a new value (All the values of the weeks on that month will be changed)

Case3: Add a parameter under a certain driver and give it a value(s)

1. Open Driver view
2. Find the driver
   a) Scroll (vertical)
   b) Use filter
3. Right-click on Standard Parameter area and choose "Create Standard parameter"
4. Enter the specification of the parameter and click OK
5. Since Parameter is new, it does not have any value at the beginning. So the look of Value Level would be horizontal cells with value zero and the dates on top of them. The default view is Daily view and it begins from the date when the Parameter is valid from.

From | 009 | 06 | 27 | To | 009 | 07 | 06 | Aggregation Level | Daily ▾ |

◀   June   July   ▶

27	28	29	30	31	1	2	3	4	5	6
0	0	0	0	0	0	0	0	0	0	0

6. Locate the date or period for entering Value
   a) Scroll (horizontal) by using the arrows/scrolls above the Values
   b) Enter the dates in 'From' and 'To'
   c) Use 'Aggregation Level' drop down. This drop down has three options: Daily, Weekly and Monthly

7. Click on the cell you want (The zero in the cell will be selected)
8. Enter the new value (This value will be continued for all days until the user enters another value for a different day or until the day when the Parameter becomes invalid)

Case4: Add a parameter under a certain driver and give it a value(s) (Enter Driver view by using context menu in Establishment table)

1. Right-click on Standard Parameter area and choose "Create Standard parameter"

2. Enter the specification of the parameter and click OK
3. Since Parameter is new, it does not have any value at the beginning. So the look of Value Level would be horizontal cells with value zero and the dates on top of them. The default view is Daily view and it begins from the date when the Parameter is valid from.

From | 009 | 06 | 27 | To | 009 | 07 | 06 | Aggregation Level | Daily ▾ |

◄		June					July			►
27	28	29	30	31	1	2	3	4	5	6
0	0	0	0	0	0	0	0	0	0	0

4. Locate the date or period for entering Value
   a) Scroll (horizontal) by using the arrows/scrolls above the Values
   b) Enter the dates in 'From' and 'To'
   c) Use 'Aggregation Level' drop down. This drop down has three options: Daily, Weekly and Monthly

5. Click on the cell you want (The zero in the cell will be selected)

6. Enter the value (This value will be continued for all days until the user enters another value for a different day or until the day when the Parameter becomes invalid)

2. **Add Value Level in Establishment table and only show the related/needed Parameters in that level**

<u>Case1:</u> Check and edit the Value(s) directly in Establishment table

   a. Expand an Activity Group and go to Driver level
   b. Expand the driver you want
   c. All needed Parameters of that driver are shown under it in Establishment table. Note that the way Values are shown is according to the selected Aggregation Level in Establishment table.

<u>Daily Aggregation Level</u>

   1. Scroll (horizontally) to find the Value of the day you want. (For this users use the scrolls which are already in Establishment table so no extra scroll is considered here.)

2. Click on the Value (This will select the value in the cell)
3. Enter the new Value
4. Recalculate the Establishment table to see the effect of the change

Weekly Aggregation Level

1. Locate the Value of the week you want (Use the horizontal scroll which already exists in Establishment table to scroll. No extra scroll is considered here)
2. Click on the Value (This will select the value of that cell)
3. Enter the new Value
4. Recalculate the Establishment table to see the effect of the change

Exception(s):

❖ If Aggregation Level is set to Weekly and values for a week are different from day to day then the look of that week is different from other weeks. It will be a grayed-out cell which contains the value of the first day of the week

a) If the user wants to check the values or changes a value on a certain day

1. Right-click on that Value
2. A context menu which has three options (Daily, Weekly and Monthly) will show up and only the Daily option is active.
3. Click on Daily
4. The Aggregation Level will change from Weekly to Daily
5. Click on the Value you want to change
6. Edit the Value

b) If the user wants to edit the value for a week which has different values for different days

1. Click on the cell of that week

2. Edit the value

3. All the values of the days on that week will be changed

Monthly Aggregation Level

1. Locate the Value of the month you want (Use the horizontal scroll which already exists in Establishment table to scroll. No extra scroll is considered here)

2. Click on the Value (This will select the value of that cell)
3. Enter a new Value
4. Recalculate the Establishment table to see the effect of the change

Exception(s):

❖ If Aggregation Level is set to Monthly and we have different Value for days (not weeks) on that month

   a) If the user wants to check or change a value on a certain day

   1. Right-click on that Value

   2. A context menu which has three options (Daily, Weekly and Monthly) will show up and only the Daily option is active.

   3. Click on Daily

   4. The Aggregation Level will change from Weekly to Daily

   5. Locate the Value of the day you want (Use the horizontal scroll which already exists in Establishment table to scroll. No extra scroll is considered here)

   6. Click on the Value you want to change (This will select the value in that cell)

   7. Enter a new Value

   8. Recalculate the Establishment table to see the effect of the change

   b) If the user wants to edit the value for a month which has different values for different days

   1. Click on the cell of that month (This will select the value in that cell)

   2. Enter a new value (All the values of the days on that month will be changed)

❖ If Aggregation Level is set to Monthly and we have different Value for weeks of that month

a) If the user wants to check or change a value for a certain week

1. Right-click on that Value
2. A context menu which has three options (Daily, Weekly and Monthly) will show up and only the Weekly option is active (enabled).
3. Click on Weekly
4. The Aggregation Level will change from Monthly to Weekly
Locate the Value of the day you want. (Use the horizontal scroll which already exists in Establishment table to scroll. No extra scroll is considered here)

5. Click on the Value you want to change (This will select the value in that cell)
6. Edit the Value
8. Recalculate the Establishment table to see the effect of the change

b) If the user wants to edit the value for a month which has different values for different weeks

1. Click on the cell of that month (This will select the value in that cell)

2. Edit the value (All the values of the weeks on that month will be changed)

Notes:

a) In case you delete a value and do not enter a new one, the previous value will be chosen as the replacement automatically
b) In case you change a value e.g. the value on 1st of July from 10 to 13 then the values for 2nd and 3rd of July will be changed to 13 as well in case you do not enter another value for them

<div align="center">1July</div>

V ALL-CJ-FD	10	10	10	10	10	10	10	10	12	12	12
V ALL	3	3	3	5	5	5	5	5	5	5	5

3. Customize the Detail Graph

Case1: Exclude Activities from the Detail Graph

1. Open a Detail Graph

Detail Graph which includes all the Activities will be shown and there is a check   box beside the name of each activity in Activity List

Note: Activities are all checked by default.

2. Uncheck the Activities (in Activity List) you do not want to see in the Detail Graph. The unchecked Activities will be grayed out and stacked all on top of the selected Activities

Note: This view will be saved. Meaning that if the end-user opens any other Establishment table; he/she will get the same customized view for those graphs.

Case 2: Add Activities to the Detail Graph

The default view in Detail Graph includes all Activities but if this default view was customized by an end-user before then next time when the end-user opens a Detail Graph he/she gets to see the customized view for any Detail Graph he/she opens. In this case if he/she wants to add some/all Activities back to the Detail Graph, he/she needs to follow the steps below

1. Open Detail Graph

2. Check the check box beside the Activities he/she wants to see

This will turn that Activity back in color, remove it from the gray stack and will put it in the place it was before (by default)

Note: This view will be saved. Meaning that if the end-user opens any other Establishment table; he/she will get the same customized view for those graphs.

Appendix L

New look of Establishment chart

Below you can see the default view of the Establishment chart in which all of the Activities are selected. The colors of the Activities are in the same order as their names in the panel on the right side of the page. The difference between this view and the old one is that each Activity is framed (on the right side of the image) by a rectangle to give user feedback about the current situation of the Activities.
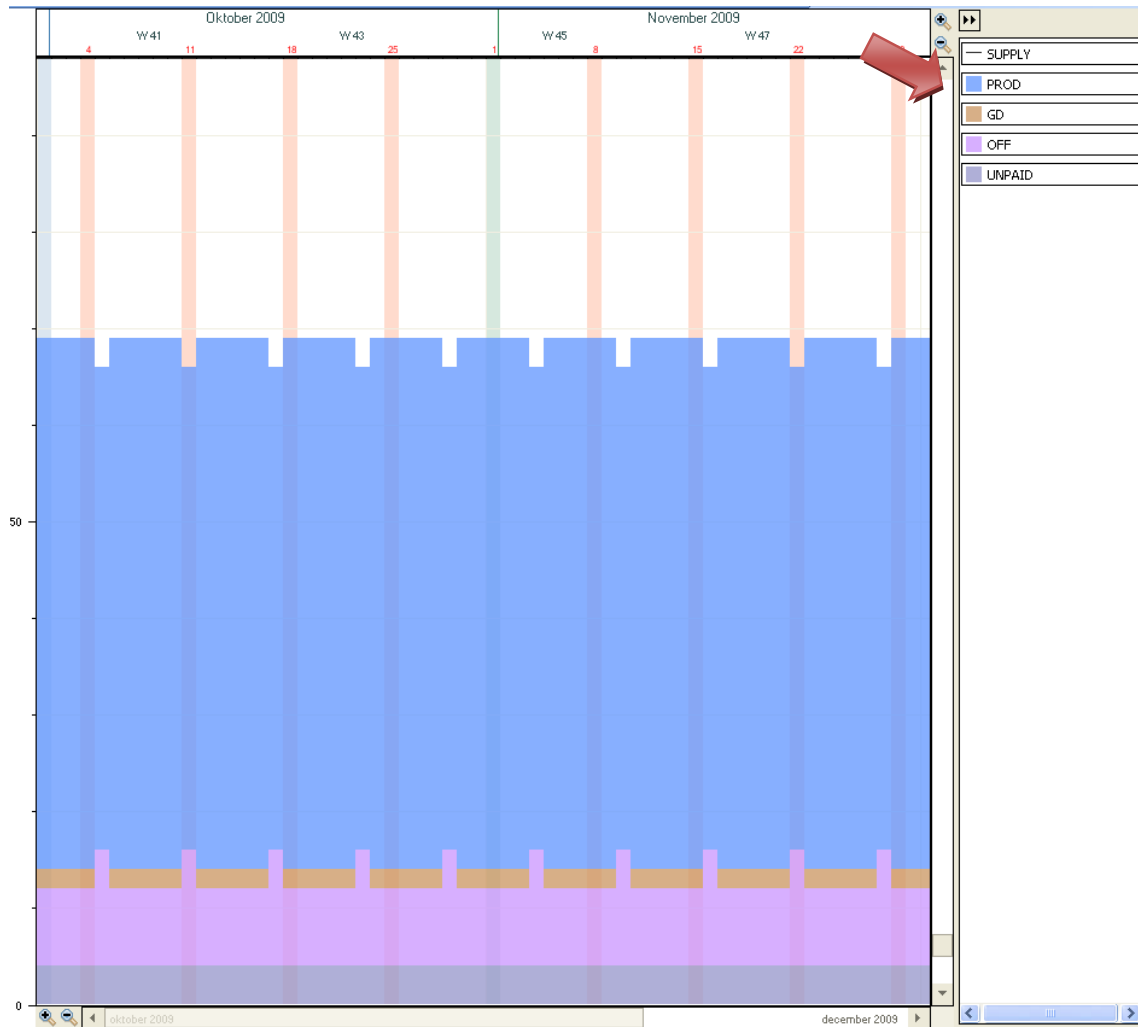

Figure 30 Default view of Establishment chart

The figure below shows the Establishment chart after one of the Activities (in this case Unpaid) was deselected by a user. It is vital for users to have the effect of all Activities in the chart even if they are not selected. That is why the unchecked-Activity is not being omitted

from the chart but is just moved to the top of the chart while its color is changed to gray to persist on its inactivity.
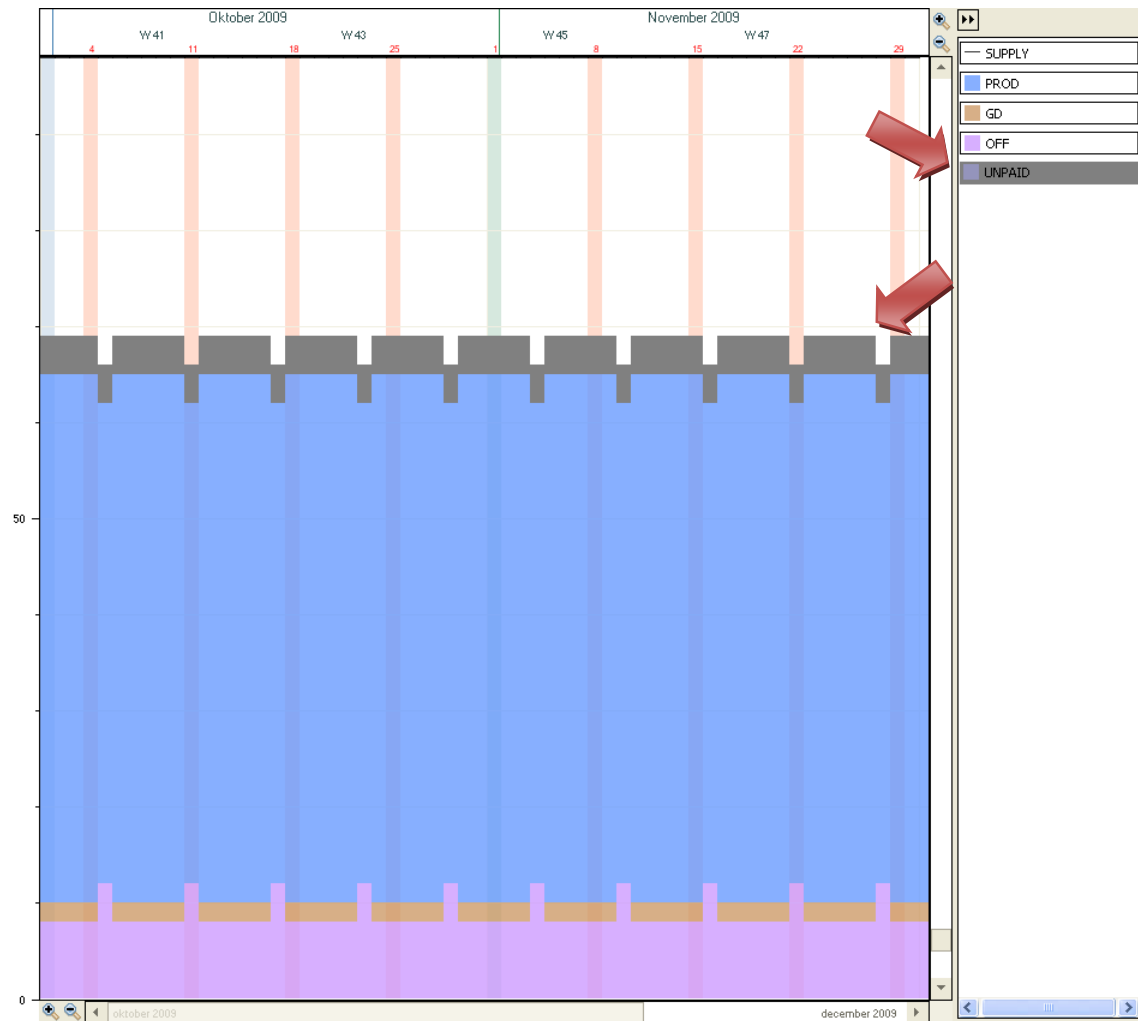

Figure 31 Establishment chart after un-checking an Activity

As shown above, the color of the background of the name of the un-checked Activity in the panel also changes to gray to give feedback to user about the status of that Activity. But it is still at the same place as before and it does not change like it does in the chart.

In this way users know if they check/enable e.g. Unpaid again, its color can be found e.g. on bottom of the chart. So it maintains the consistency, decreases the level of error and does not ask for too much mental effort from user side.