Innovation and Design Engineering
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FÖRSÄKRN

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Allt material i denna rapport som inte är vårt eget arbete har identifierats och vi försäkrar härmed att rapporten inte innehåller material som använts i en tidigare examen.

Karlstad Januari 2008

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Abstract

The project consisted of developing an office workstation specially designed to compete at the Spanish market. The assignment was received from the Daifuku Designs, a design company in Barcelona, Spain. Daifuku Designs are well experienced in various kinds of product and interior design, but has not designed office furniture earlier. The project’s purpose was to introduce the company to the branch of office furniture.

The research phase consisted in three different parts, a survey concerning office work that was handed out to Swedish and Spanish office workers and cleaning staff, studies of the world leading companies in the branch of office furniture and educational visits at different showrooms and offices.

The project resulted in a desk that is offering a flexible space dividing system and a unique cord solution. The space dividers can be put anywhere along the desktop and are easily moved by hand. All the cords and cables are hidden in the desk and computers, phones, e.g. can be installed anywhere on the desk. The desk can be used both separately and in big office landscape. Flexibility is a common sales argument and the demand of this kind of flexibility is constantly growing. The trends to hire personnel and to work in temporary project groups are two reasons to the growing demand. The office furniture needs to be able to be used in different ways when the constellation of the project group is changing. It is a big advantage if the same desks can be used for different occasions.
Sammanfattning

Researchfasen bestod av tre olika delar, en enkät om kontorsarbete som gavs ut till svenska och spanska kontorsarbetare samt städpersonal, studier av världsländade företag inom kontorsmöbelindustrin samt studiebesök på olika showrooms och kontor.

1 Introduction

1.1 Background

This report comprises a 22.5 ECTS degree project for the Faculty of Technology and Science at the Innovation and Design Engineering program. It was executed at Daifuku Designs in Barcelona Spain by three students from Karlstad University. The students are Karl Åkman, David Joelsson and Mikael Axelsson. The Assigner is Jonathan Daifuku, academic supervisor is Lennarth Wikh and examiner Monica Jakobsson

Office work is carried out all over the world and in all types of different branches. As the demands on the markets of the different branches are changing, so are the working styles in the offices. New technologies and new trends also affect the way to carry out office work. The changed working styles often bring on new demands on the office furniture. The trends to hire personnel and work in temporary project groups have increased the demands on the workstations, in terms of flexibility.

The assignment was received from Daifuku Designs, a small design company in Barcelona that is doing product and interior design work. The company is well experienced in various kinds of product design and for some time lighting design has been the most common assignment. Daifuku Designs has the desire to enter the market of office furniture. The Spanish market of office furniture has several manufactures, but quite few designers. Gabriel Teixidó and Josep Lluscà are Spain’s most productive designers, in terms of designing office furniture. According to the assigner, Daifuku Designs, a majority of all the office furniture that are designed in Spain today are designed by either Teixidó or Lluscà. The small number of active designers and the fact that office furniture has long life cycles are the main reasons that Daifuku Designs predicts a benefiting future on the Spanish market of office furniture.

1.2 Purpose

The purpose is to introduce Daifuku Designs to the branch of office furniture by designing an office workstation specially developed for the Spanish manufacturers and consumers. The project will also give the students an experience in working at a design office and an increased knowledge about the international market as well as practicing the use of foreign languages.

1.3 Aim

The aim is to develop an office workstation specially designed to compete at the Spanish market. A workstation with unique functions, that will make the everyday work easier and with a clean but still unique aesthetic expression. The workstation should be designed to be transported and assembled in the easiest possible way. Presentation materials such as sketches, 3D renderings, animations and slideshow will be produced. Both the academic presentation at Karlstad University as well as for Daifuku Designs to present the result for any manufacturers.

1.4 Limitation

The project will focus on desk and accessories and will not include an office chair or any other form of seating.
2. Method

2.1 Project planning
To define the project a project statement was written. This project statement was changed and improved several times to satisfy both the assigner, Daifuku Designs and the students. On the basis of the project statement and the aims, it was determined what kind of research that should be implemented and which sources that could be useful. All the different tasks were planned into a Gantt-schedule. The Project statements and the Gantt-schedule were written with, (Johannesson, 2004) (Landqvist, 2001) and (Österlin, 2003) as guidelines.

2.2 Research

2.2.1 Survey
A survey was made to obtain detailed information from office users. Literature were studied to gain knowledge of how to create a good survey (Trost, 2007), (Ulrich, 2000) and (Landqvist, 2001). The survey was designed to get an overview of common problems. The surveys were sent out to two specific target groups, Swedish and Spanish offices. The tool used for the survey was “Email me form”, a web based tool that allow users to make their own survey on the internet [1]. The Swedish companies were given the survey on the internet and to the Spanish company printed copies were handed out. The survey was sent to companies with different working environments to cover the whole range of different workstations that can occur in an office. The survey was written in Spanish and Swedish.

2.2.2 Market research
Competing companies were studied to gain knowledge of the market and the up-coming trends. The companies were the major Spanish manufactures Aridi, Forma 5, Levesta, Permasa and Shetug and the worlds leading actors on the office environment market Assmann, Bene, Haworth, Herman Miller, Knoll, Steelcase and Vitra.

Gabriel Teixidó and Josep Lluscà are two designers that have been very productive on the Spanish market of office furniture. Their work was also studied to find up-coming trends.

2.2.3 Educational visits
During the research phase a number of educational visits were made, most of them to showrooms at companies well established on the market of office furniture. A visit was also made at Iberconseil’s office in Barcelona. This visit was made to see an example of how an office workstation is used in reality. The showrooms visited were Bernadi, Kemen Haworth, Penta, Silka, Steelcase and Vitra, all of them located in Barcelona.
2.3 Concept phase

2.3.1 Creative methods
During the concept phase a number of creative methods (from Per Kristensens Compendiums from the course Design Theory 2006) were used to generate a very large number of ideas. M Mihalko’s Turn around, Edward de Bono’s Random input and Fishbein’s Multi Attribute Model were some of the creative methods that were used. These ideas were evaluated and the better ones were developed further through sketches and sketch-models, using (Olofsson, 2005) as guideline and inspiration. The sketching process also brought out new ideas.

2.3.2 Function analysis
At this point of the concept phase, a function analysis was designed to specify and visualise what the demands on the product were. The function analysis was made with directives from (Landqvist, 2001). All the functions that a workstation might have were listed in a function analysis. The function analysis were divided in three parts, general attributes, space dividers and cord solution. The functions was categorised as either primary function (PF), necessary function (NF) or desirable function (DF). The function analyses were used as a helping tool when ideas were developed and evaluated.

2.3.3 Cord solution
Cords are an obvious part of an office workstation today, computers, phones, printers and lamps all need cords. The project statement made clear that the final workstation should have a well designed solution for the cords. Creative methods were used to open minds and get an innovative solution. The cord solution was also given a separate part in the function analysis.

2.3.4 Space dividers
Today it is very common that numerous of office workers share one long desk or some kind of a formation of desks. To divide the desktop area into workstations, so the individual worker gets a feeling of having a personal workstation, some kind space dividing system is needed. With the knowledge gained from the research phase a space dividing system were designed. The creative methods were used and many sketching sessions were held. The space dividers were given a separate part in the function analysis to define the different demands that a client might have.

2.3.5 Aesthetic expression
To give the workstation an aesthetic expression that would help selling it, the impressions gathered from the educational visits were analysed (Monô, 1997). With knowledge of the newer trends, sketching sessions and 3D modelling in Solid Works were used to develop the aesthetics. The first idea sketches were small, but further in to the sketching process the sketches were made in full scale to get a better view of how the workstation would look in real life.
2.3.6 Concept development
The concept phase is the phase where the product is formed, which means that it is a very important phase. Therefore many meetings were held with Jonathan Daifuku from Daifuku Designs, during this phase of the project. These meetings were important because so many choices with big influence on the project were made. Every meeting had some kind of smaller concept choice. When a final concept was worked out, Francisco Torres and Enrique Marin from SILKA were invited, to give their expertise.

2.4 Presentation material
To get a good manufacturer interested in producing a product, the concept needs to be presented in a selling, interesting way. (Hemlin, 2001) Meetings were held with Jonathan Daifuku regarding how the concept was to be presented. It was decided that the concept were to be presented verbally, with a pedagogic flash presentation as a helping tool. A full scale prototype of the foot was also made. Presentation materials for the degree project exhibition at Karlstad University were created as well.
3 Results

3.1 Project planning
All the different tasks were planned into a Gantt-schedule, which can be seen in appendix 2.

3.2 Research

3.2.1 Survey
Two different surveys were given out, one for office workers and to attack the problems from another angle one survey given out to cleaning staff. 53 office workers answered the survey, 17 from Spanish companies and 36 from Swedish companies. 7 persons answered the survey for cleaning companies. The surveys can be seen in appendices 3, 4 and 5.

Shortly after sending out the emails to the different Swedish companies, replies started to come in and kept coming for a few days. 36 replies were received from the Swedish office survey, some with really thorough answers and some less detailed. The Swedish telemarketing company Transcom, Nordea’s Vällingby office in Stockholm and the Spanish cheese importer Iberconseil were some of the companies that answered the survey. Below follows some important parts of the answers and the statistics from the survey.

The conclusion from all the other questions was that there were a few strong points that repeatedly turned up when examining the answers. The most common opinions on matters of great importance are listed here.

- Queries about better light either more daylight or better illumination in the office, 16 out of 36
- A more open office space, 7 out of 36.
- Height adjustable tables and standing tables, 17 out of 36, this seems to be one of the most important input as almost every other participant mentions it.
- Problems with disturbing noise e.g. from co-workers, 9 out of 36
- Air and temperature related problems, 5 out of 36.

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The answers from the Spanish office confirmed what was brought to light from the Swedish answers. The only different was none of the Spanish answers mentioned anything about height adjustable tables and standing table, probably because they do not even know they exist. Apart from that, the Spanish answers were similar to the Swedish.

The answers from the cleaning companies were not as many as the other one, but some answers were really comprehensive, and it could be a good idea to attack the problem from another point of view. Some points that the cleaning personal found important was:

- Flexible pieces of furniture, with wheels and height adjustable.
- Good storing possibilities to avoid the staff from putting objects on the floor.
- Cables should be bundled together and off the floor.

### Statistics Office Survey, Spanish Participants

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3.2.2 Market research

To gain knowledge of the market and the up-coming trends, competing companies and the work of the two leading Spanish office furniture designers were studied. The companies that were studied were the major Spanish manufactures and some of the worlds leading actors on the office environment market e.g. Kemen Haworth, Steelcase, Knoll and Vitra. This chapter starts with a short presentation of the two leading Spanish office furniture designers followed by an analysis of the trends and conditions on the market. Short presentations of the studied companies can be viewed in appendix 6.

Gabriel Teixidó and Josep Lluscà are two product designers with similar background. Both of them have designed office furniture for a number of Spanish companies. According to Jonathan Daifuku approximately three quarters of all offices furniture that are designed in Spain, are designs of either Teixidó or Lluscà.

Gabriel Teixidó was born in Barcelona, 1947. He was trained in the School of Applied Arts and Artistic Crafts in Barcelona and specialises in product design. His work has won numerous awards, e.g. Silver Delta Award in 1992 and 1997, Industrial Design Award of the Council of Chambers of Catalonia, Nuevo Estilo Award and SIDI Awards. [20]

Josep Llusca was born in Barcelona in 1948. He studied design at the Escuela Eina in Barcelona and set up his studio in the same city in 1972. He is a former Vice-President of ADI-FAD*, a member of the Design Council of the Generalitat de Catalunya (The Autonomous Goverment of Catalonia), a member of the Advisory Council for the Fundació BCD (Barcelona Design Center) in Barcelona. His project has been included in many permanent collections including exhibitions in museums in Amsterdam, Bangkok, Barcelona, Bremen, Mexico City, Frankfurt, Lisbon, London, Milan, Montreal, New York, Paris, Santiago de Chile, Singapore, Tokyo, Yokohama, New Dehli. [21]

* The Industrial Design for Development of Decorative Arts Association, is a non-profit making cultural institution. Its main objective is to promote and develop Industrial Design on a social, institutional and corporate level. ADI-FAD has been a member of the International Council of Societies of Industrial Design (ICSID) since 1961. It joined the Bureau of European Designers Associations (BEDA) in 1986. [22]
It is hard for a company to get established on a new market. Clients often chose a brand that is well known to them, especially when the products are as expensive as office furniture. In the same way the manufactures seem to want to choose designers that are well known on the market. Therefore it important for a newcomer to present a product that is not too different from the competing designers, but the product still needs to have something that makes it unique. It needs to have a unique and eye-catching selling point, a sales argument that the salesman can present to the clients. All the demands that the clients have on an office line can be satisfied by making good choices from already designed solutions. However, if an office line is to be selling it also needs one new eye-catching solution for a common problem like lose cords, annoying noise, etc. If it has one new solution that is satisfying, it is enough to make it sell. It would be a mistake to make to many new solutions. The office line would distinguish too much from the competing lines, which would make it harder to sell. Another advantage is that if the workstation only has one or two new solutions, the new solutions will appear even more eye-catching.

The market research made clear that organic formed desktops were a trend of the past. The newer trend, inorganic designs with straight clean lines, is also starting to become yesterday’s news. What seems to be the newest trend is strict inorganic designed desktops with more eye-catching organic formed feet. Another obvious trend is that the desktops look very thin. In most cases the desktops are quite thick in the middle to give stability and gets thinner near the edge, which make them look really thin because the thicker part is not visible. In the latest furniture lines, almost all of the studied companies have a lot of free floor space under the desks. A common sales argument seems to be that the chair is able to run freely without being interfered by the feet. Portable file cabinets are common, but when the desk is presented in a showroom or in a catalogue it is often shown without the file cabinets. Without the file cabinets the desk gives a nice, lighter expression. However, it is never used that way in real life because the client needs the file cabinet for storage.

An interesting up-coming trend is more flexible workstations, with portable space dividers and a cable solution that makes it possible to place the electrical equipment where ever the client wish to place it. A flexible workstation makes it possible for the client to change the shape for different actions, e.g. if a temporary project group needs to sit at the same table or when a consultant is employed temporary and needs a workstation. Vitra’s space dividers have a good and simple design. The dividers are easy attached to the desk with a clip-on mechanism and can be placed anywhere on the desk. The only problem that was noticed with Vitra’s space dividers was that when they are not in use, they are not easily stored. None of the studied designers and companies did have a really god solution for the storing of the space dividers.
There are two common ways to hide and control the cords. One way is to run the cords through a spine looking tube. The tube consists of a number of smaller sections, which makes it bendable (see picture 3.1). The other way is by using a clip-on piece on one of the feet and run the cords through that one. The clip-on pieces are designed as a part of the desk while the bendable tube is a standard product used by many different furniture companies. A third and not as common way to run the cords is through a fake foot in the middle of the desk. The foot is just used for running the cords and is not attached to the desk. This is for safety reasons. The desk should be able to be moved without risking that the cords are damaged. If the cords are run in a common foot all the way to the floor, it is a major risk that the cords are damaged when the desk is moved.

One interesting observation made during the market research was that it is not common, especially not in Spain, to have height adjustable tables, which make it possible to work standing up. If a desk is height adjustable it is normally just a few centimeters and is only applied when the user sits in a wheelchair.

### 3.2.3 Educational visits

During the research phase a number of educational visits were made. All the showrooms and offices are located in Barcelona. To summaries the impressions are brief presentations of each visit given below.

**Silka, 2007-02-14**

During the visit at Silka one of their salesmen, Francisco Torres gave a very detailed exposition of what the demand on an office workstation is.

It is important to remember that the table should be designed for an office and not for someone’s home. It is not common for someone to sit at someone’s dinner table but to sit on the edge of a desk in an office is socially accepted. Therefore the table has to be able to carry the weight of one or two full grown men. It can not be assumed that the clients are going to move the table correctly. It is very common that the clients push the tables instead of lifting it, which gives an enormous stress on the foot. The table’s feet should be placed so the chair can be moved freely without obstruction.

When a desk is shown in a showroom it always looks clean because there are generally no computers and phones plugged in. In reality it is very important to have enough sockets and hide the cables and cords, to get the desk to look good. The cords and sockets can be hidden in a box under the desktop, in a panel or in a space divider. The sockets can also be visible on the desktop. If a cord box is used the cords could run from the box to the floor through a fake foot or some kind of pipe attached to one of the feet.
The organic forms and wavy lines were a trend that proceeded for 15-20 years, but the strict more clean designs that are common today has been the trend for 5 or maybe 3 years and that era is already coming to an end. What probably are going to be the next style are strict, clean desk boards and more organic and unique formed feet. (2007 Torres, Francisco) The interview with Francisco Torres is attached as appendix 7 and pictures from Silka’s showroom can be seen in appendix 10.

Bernadí, 2007-03-01
Bernadí have what they called a “live showroom”, which means that everything that the employees use in their work is components in the showroom. Desks, accessories, toilets dining room, workspaces are all parts of the showroom. The Bernadí showroom was shown by Arantxa Bernadí.

Bernadí strive to use as much standard measured products as possible to reduce the price. Some of their manufactures has stockrooms and some not, the ones with stockrooms are automatically cheaper, but then you’re not allowed to customize measures on your workstation. In the bigger projects Bernadí collaborates with the manufactures and their designers, to be able to give the best solution to the client. The latest trend seems to be white and naturally colored clean tables with lightly rounded edges. Many customers have lately requested white legs. A problem when designing desks is that the size of the new computers is extremely varied. The accessories for mounting the computers are therefore hard to dimension (2007 Bernadí, Arantxa). A more extensive summery of the visit at Bernadí can be seen in appendix 8 and pictures from the visit can be seen in appendix 11.

Kemen Haworth, 2007-02-28
The Kemen Haworth showroom consisted of two floors with products from their own assortment only. Kemen Haworth’s office system had a couple of interesting solutions. The cords and cables were hidden in an extra part attached to the foot and the height of the desk was adjustable. To adjust the height a sprint is moved from one hole to another. The maximal height adjustment was about 10 cm. Kemen Haworth has different legs to the same office line to give the client the possibility to make their own choice. This is very important according to Jordi Rodriguez at Kemen.

Vitra 2007-02-20
Vitra had a neat and tidy showroom. One of Vitra’s workstations had an interesting space dividing solution, the space divider are easily attached anywhere on the desk board. This solution is very flexible and you can move the screens for different occasions. If a meeting is held for example all the screens can be removed.

Penta 2007-02-28
Penta had small showroom, that mostly consisted of executive furniture, but it had an operative desk with a simple but interesting cord solution (see picture 3.2). The sockets are easily accessed, located on the desktop, but the aesthetic does not give an exclusive expression.
Steelcase 2007-03-02

During the visit at Steelcase their salesman Jordi Gracia explicated their office system and answered questions. According to him the latest in office furniture are shared tables with co-workers and simple space dividers. In that way a lot of space is being saved and therefore also a lot of money since offices are expensive per square meter. The communication gets better, but still the workers got their own private sections. Flexibility is important because companies are constantly evolving, new people get hired one day and fired the next. And the nature of the work changes from day to day, i.e. between meeting and individual work. The space dividers are also a place to hang accessories like small shelves, holders for cell phones, etc. (2007, Gracia, Jordi)

Some strong points, according to Gracia, are that Steelcase’s office lines have a long lifecycle, so if you need to buy more furniture after 10 years you can find the exact same line.

Like Torres at Silka, Garcia also points out the importance of a workstation having enough sockets. Normally at least 2 extra sockets are needed after installing all the basic equipment, computer, phone, etc. A more extensive summery of the visit at Steelcase can be seen in appendix 9 and pictures from the visit can be seen in appendix 12.

Iberconseil 2007-03-13

The visit to Iberconseil was made to observe the day-to-day work in a normal office environment. Iberconseil is a Spanish company in the cheese business. The visited office had approximately 20 employees with all sorts of different tasks. The office includes secretary, salesmen, marketing, advertising, executives, logistics etc. Seeing how real people in actual work gave another perspective than the showrooms. The office, designed by Daifuku, gave an overview about some normal problems, and what kind of items the people used in their work. The most apparent problem was the cables and chords, hanging and laying everywhere, and the lids for the technical boxes* in the floor could not be closed (see picture 3.3). The office did not have a separate wastepaper basket for papers, which seemed to lead to a quickly overfilled trashcan. There were a lot papers on the desks but not as much stored in cabinets or on the shelves. The owner says that they are going to take away all paperwork, and change entirely into digital handling, within a year or two. (Mari, Maryze)

* A technical box contains electrical sockets and connects to cables that are run under the floor.
A common workstation problem is that the desktop is not big enough and therefore gets filled with different items. Things that were seen at the desks in the Iberconseil office were:

- Computer screens
- Printers
- Telephones and mobile phones
- Water bottles
- Transformers
- Yogurts and snacks
- Personal interior decoration (family pictures, textile cows, etc.)
- Jackets on the back of the chairs
- Head sets
- Calculators
- Hole-punches
- Letter tray sets
- Penholders
- Calendars
- Printed papers
- Staplers
- Eyeglasses cases
- Paper clip holders

### 3.3 Concept phase

#### 3.3.1 Creative methods
Apart from the aesthetics there were three main issues that had to be considered during the concept phase, the space dividers, the cords and the storing possibilities. Creative methods were first used to generate general ideas for the whole workstation and then separately for each issue.

#### 3.3.2 Function analysis
After the use of the creative methods a function analysis were made. All functions that could be desired from a workstation were listed and categorised as primary function (PF), necessary function (NF) or desirable function (DF). The risk that the function analysis would interfere with the creative thinking was reason that the function analysis was made after and not before the sessions of creative methods. The function analysis can be seen in appendix 13.

It was early decided that the project should focus on the space dividers and the cord solution and not develop the storing ideas further. During the development of the cord solution and the space dividers a number of needs were considered. The desk needed the possibility to be used alone, but also to be used in a row with other desks along a wall or with a desk on the opposite side. The desk also needs to be strong enough to carry the weight of a full grown man, in case of someone would sit down on it.
3.3.3 Cord solution

The competing companies that were studied during the research phase had a number of different solutions for how to run the cords. Most of them solved the problem with lose cords and cables in satisfying ways, but what was remarkable was that none of the studied companies had a cord solution that was nicely integrated in the design. They all gave the expression of being add-on pieces. The plan was to make an effort in designing the desk so that the cords could be hidden without using an add-on piece. It was decided that the cords should be run through the foot. Out of safety reasons, it has to be a certain gap between the floor and the cord exit in the foot. If the gap is not big enough the cords could be damaged when the desk is moved. The cord solution was designed to give the user easy access to the sockets, which were placed in a box with hatches in the desktop (see appendix 14). The box is supposed to be made in sheet metal, so it will also give stability to the desk. The dimensions of the box were optimised to make it small enough to not interfere with the users legs and big enough to fit enough cords. To get the dimensions right a cardboard sketch model of the box were made in scale 1:1. Cords were put in the cardboard model to see if it was big enough. From the box the cords are run through the foot down to the technical box in the floor (see appendix 14). A lid on the short side of the desk is attached to the rest of the box with the attaching technique Dual lock™ (see 3.3.3), which makes it easy to remove during installation of the cords. In an ideal situation, only two electric cords are needed, one for levelled current and one regular. One network cable and a cable for the phones are also needed. However, in a real office situation the cord solution needs to be able to take more cords. It can not be assumed that the clients do not put in extra cords and cables instead of connecting them to the already existing cables and cords. Another reason to make room for more cords are that office furniture has long life cycles and it is impossible to know what the future technologies might require in terms of cords. A test was made with a pipe, with an inside diameter of 70 mm. 7 cords could be run through the pipe. (see picture 3.4)

If the computer is not placed next to the foot it would not be profiting to run the cords through the foot. It would be more convenient to run the cords directly to the box, therefore is the box designed with bottom holes. When two desks are put together cords should be able to run from one box to the other. For that reason, the box also has holes on the shorter sides and on the opposite side to the user.

The workstation needs a solution for the lose cords that can not be run through the foot. The sessions of creative methods gave one simple and really good idea, a piece of fabric with Velcro or a zip could be used to bundle the cords together. Because of the projects pressed time schedule and the fact that a separate manufacturer would be needed, it was decided that the fabric idea would not be develop further and that an already existing solution were to be integrated. The bendable tube solution mentioned in 3.2.2 was chosen.
3.3.4 Space dividers

The creative methods gave a large number of ideas on how to design the space dividers. Those ideas were discussed and evaluated together with the assigner's own ideas. During this meeting with the assigner four ideas were chosen for further development. All four ideas were well-known techniques that have not been used for the purpose of space dividing earlier. The ideas were:

- Roller blind
- Japanese rice lamp
- Fan
- Velcro

Idea sketches can be viewed in *appendix 15*.

It is very important that the space dividing system offers flexibility. The client has to be able to reorganise the workstations for different occasions, e.g. between meetings and regular working situations. The roller blind idea works as a horizontal roller blind, which is pulled out from the long side space divider in front of the user. This idea makes it possible to pull out the space divider when it is needed, and one advantage is that when not in use it does not require any storing space.

The idea based on Japanese rice lamps is basically to pull the space dividers up from the desktop, have them made in a transparent material and have light coming from a fluorescent lamp in the desktop under them. When the space dividers are not in use, they are hidden in the desktop. The fan idea has the space dividers hidden in the long side space divider in front of the user and are folded up just like fans. The fan has the same benefit as the rice lamp and roller blind ideas concerning the storing space. However, the fan has one big disadvantage, it does not really give the desired privacy. The fan has its highest point far from the user and not near, where it is needed. The idea to attach the space dividers with Velcro has a weakness compared to the other ideas. With the Velcro idea, the space dividers need to be stored somewhere when not in use. However, the Velcro idea has one big advantage. Unlike the other ideas it is making it possible to put the space dividers anywhere along the desktop. Velcro is not strong enough to hold a space divider, but the company 3M has a product that is working in a similar way as Velcro. The product is called Dual lock and has unlike Velcro two identical sides and is much stronger (*see picture 3.5*). The Velcro idea turned into the Dual lock concept and it was decided that the Dual lock concept, as a first priority, should be developed to become the number one selling point of the workstation.
The space dividing system was designed with three attaching points, one in a notch in the table edge and two on the long side space divider (see picture 3.6). The table edge consists of a trim with a notch, made in extruded aluminium. The other three ideas could all be integrated in the Dual lock concept. This and the fact that the space dividers will come in different colours and materials will give the client various options to choose from. Because of the tight time schedule it was decided that these integrations only would be presented as idea sketches. This to be able to focus on the Dual lock concept, the cord solution and the determination of the measurements of the desk.

When the space divider were designed major consideration were given to the hatches in the cord box (see 3.3.2). At first it was decided that the space dividers were to be designed with a hole, to make it possible to open the hatch. The determination of the shape of the hole brought some problems. A lot of different shapes were sketched up to get an elaborated shape, but none of the shapes gave the desired, discrete look. It was therefore decided that the space dividers were to be designed without holes. To still have easy access to the sockets, the number of hatches was increased from four to six, so that it would not be a problem if a space divider block on of the hatches.

Two other areas of use for the Dual lock™ are to attach desks to each other and to attach accessories on the space dividers and at the edge of the desk, e.g. penholders, photo frames and mouse pads (see appendix 16).

3.3.5 Aesthetic expression

In terms of the aesthetics it was decided to make the desktop really thin and give it a clean design with strict lines and make the feet in a discreet organic shape. The office line Nomos, designed by Norman Foster in 1985, and some of the work of Charles and Ray Eames were used as inspiration. With the inspiration from Foster and Eames and with clean desktop and discreet organic feet as guidelines the sketching process started. First many small sketches were made. The best of these sketched ideas were developed further. To get a better view of how the ideas would look in real life these ideas were sketched in actual size. First the very basic lines were worked out in the view of the shorter side of the desk. To get a more genuine understanding of how the foot would look in 3D, the foot was modelled in the 3D-program Solid Works. In Solid Works the cross sections of the foot were carefully designed, and different types of ovals and egg shapes were worked with until the desired shape appeared. The development of the foot resulted in a desk with two feet. Each foot consists of a standard pipe with a diameter of 80 mm, which splits into two smaller, organic formed feet. The foot was placed and dimensioned so it does not go all the way out to the tablesde because a chair needs be able to move freely.
The gap between the divided parts of the foot was given an angle of 120°. By using a 120°, the same angle can be used if a complementary table with only one foot were to be designed in the future. The foot for a one foot table would have to be divided in three with a 120° angle between the parts. The client should be able to choose from various colours, but as standard the colours white and metal were chosen.

It was decided that computer screen holders and CPU holders were not to be designed. Companies that specialises on these kinds of products were studied and the company Human Scale have a well designed screen holder. It is adjustable in all directions, so the screen can be moved to avoid reflecting sunlight and be adjusted in height to get the best ergonomic position. The screen holder also has the right aesthetics to be integrated in the workstation. It was further decided that the height leveller in the foot were not to be design. Height levellers that already existed on the market were to be integrated in the foot and during the development of the foot, the dimensions of the existing height levellers were considered.

### 3.3.6 Concept development

A meeting was held with Francisco Torres and Enrique Marín. Both of them are selling office furniture for the Spanish furniture company Silka. Torres and Marín generally liked the concept, but pointed out some parts that needed further development. The tables should share the same foot if two tables are joined together. Not only for aesthetic reasons, a shared foot will also keep the price down and free more floor space. Because of the high costs of office space in the bigger cities, the tendency today is that the desks are getting smaller. The concept that was presented at this meeting had a desk that measured 1000 x 2000 mm. According to Torres and Marín, a desk this big could be used as a complement, but not as the standard desk. The width 800 mm is god for the standard, but it is also necessary to have a smaller desk (650-700 mm) as a complement. The length should be 1600 mm or 1800 mm. The lack of space also makes it important to maximize the space under the desk to fit in file cabinets, CPU, etc. The feet should therefore be moved further to the table’s edges. If four desks are going to be joined together in a 1600 mm wide square are add-on-pieces on the shorter sides required. The add-on-pieces should be 250-300 mm wide.

Torres and Marín thought that attachable accessories were a god idea, it gives more free space on the desktop and clients usually likes the freedom to decorate the workstation them self. One problem is that the furniture manufactures do not like to make accessories, because it does not gain enough economical profit. The preferred thing to do is to locate a manufacturer that specialises in accessories and have products that fit to the aesthetics of the desks.

Because of European regulations, the pipe for the cables might have to be separated in two, one part for the levelled current cables for the computer and one for the others. That is the rule when the cables are run under the floor or in the roof and it is possible that the regulation are to be interpreted as even to concern desks.
After the meeting with Silka some changes were made to get the final concept. The dimensions of the foot were made smaller to make it fit both a desk with the width 800 mm and one with 700 mm. The smaller dimensions gave the pipe a much too heavy and robust expression and the foot had to be redesigned. The pipe was given an oval cross section, which gave the foot back its discrete expression. It was a change that increased the manufacture costs because a standard pipe no longer could be used, but the change was considered necessary. The feet were also moved further to the sides and for that reason, the 120º angle had to be changed to 180º, so the feet would not stick out from under the table (see picture 3.8). The feet are attached to the cord box with four screws and to be able to use the same holes for the screws, when two desks are sharing the same foot, the feet could not be moved all the way to the tables edge (see picture 3.9). A more detailed summery of the concept meeting with Silka can be seen in appendix 17.

As the last modification were add-on pieces designed, to be attached with the Dual lock on the shorter sides.

The final concept was given the name Neos and can be viewed in appendix 18.

3.3.7 Rejected concepts

The creative methods that were used give a big number of ideas. Only a few of these ideas are developed further, which gives many rejected concept. Some of these rejected concepts and ideas are described in this chapter.

During one of the creative sessions the common expectation that a desk should have four feet was converted. This converted expectation together with necessary function, that all cords had to be hidden, resulted in an idea of a desk with one foot. The foot was a box, big enough to give stability to the desk. All cords and cables can easily be hidden in this box. The box-foot-concept was rejected because it did not leave any free floor space.

The converted expectation that a desk should not have four feet was developed further, into the expectation of a desk not having any feet at all. This remarkable thought gave two interesting ideas, the desk could be hanging from the ceiling or be attached to the wall instead of standing on the floor. These two concepts would have the benefit of maximising the floor area under the desk, but the concepts had some weaknesses and were rejected. The fact that the material in walls and ceilings often differ in different offices was the decisive issue to the rejection. Another problem was that these concepts did not offer the right flexibility, a desk attached to the wall or the ceiling would not be easy to move to new positions for different occasions.
Another interesting concept was a workstation that combined one high and one low desk to enable the user to work both sitting down and standing up. This concept was supposed to have a flexible computer screen holder that made it possible to use the same computer when working standing up (see picture 3.10). This concept’s critical weakness was the size of the workstation. Both halves of the workstation cannot be used at the same time and the workstation uses a big floor area, which is not recommended because of the rising prices on office square meters.

One rejected concept involved an area with electric current along the sides of the desk. The idea was that computers and other electric equipment should be able to be connected everywhere along the desktop. The problem was that this kind of electric solution only works with low-voltage current, which is not enough for larger electric equipment as a computer. Another idea regarding the electricity was to place sockets on the desktop and a connection to a socket in the foot. This connection in the foot would require a new designed electric component and it was decided that our concept only were to use standard electric components. There is also a risk that the cord is damaged near the connection if the desk is moved.

### 3.4 Presentation material

The flash presentation consisted in a combination of animations and photo realistic 3D-renderings. The animations were made to in a simple, but clear way present the space dividing system, the cord solution, how the desks can be put together and also give a good view of how the desk is to be assembled. It is preferred that the presentation is seen as a presentation of a concept, which can be changed to satisfy the viewer, rather than a finished product. Therefore the animations were not made photo realistic. After the animations, the flash presentation ends by showing photo realistic examples of different space dividers and colour combinations.

A prototype of the foot was made, in scale 1:1. The prototype was made to clearly present the delicate forms of the foot and was to be used as a last convincing selling tool. The prototype was made in collaboration with Daifuku Designs and most of the work was carried out in Daifuku Designs workshop. Laser cut pieces of sheet metal were welded into a metal framework, polystyrene foam were used to bulk up the framework and a 4-5 mm layer of polyester putty was put on the polystyrene foam. The putty layer was sanded to until a nice finish appeared and then the prototype was spray painted white. Technical drawings and pictures of the prototype can be viewed in appendix 19.
4 Discussion

The Dual lock™ technique is supposed to work as the first obvious and eye-catching selling point for Neos. After the Dual lock™ technique the client can be introduced to the next sales argument, the cord solution in the foot. Neos’s cord solution deals with the cord problem just as good as the best solutions on the market, but unlike the other cord solutions it is also nice integrated in the design. The possible problem that the levelled current might have to be run in a separate pipe were carefully considered and discussed with Daifuku Designs. The pipe in the foot could have a piece that would separate the levelled current cord from the others, but then another problem would occur. To be able to install the cords, the pipe has to be wider otherwise the cords would not fit. If a wider pipe were to be used, the foot would not get the same delicate aesthetics and Daifuku Designs had the opinion that, at this point of the project, it was more important to have a nice aesthetic expression than have all the solutions perfectly designed. This opinion was based on the Daifuku Designs earlier experiences. Because this project did not have a specific client it was important to have a nice looking concept to get a client interested. When an interested client is found, meetings are always held and decisions are made together with the client to develop the concept. These types of meeting are developing the concept to fit that specific client.

The concept Neos follows today’s trends in terms of aesthetics and has all the desired functions. Neos have a flexible space dividing system and a well designed solution for hiding the cords. There are other flexible space dividing systems on the market that works just as well as the Dual lock system, but the Dual lock™ system is a very good selling point. Neos use Dual lock both for the space dividers, the accessories and to attach desks to each other and no other space dividing system use anything similar. To continuously use this unique technique will to help build up a trademark and if Neos will be produced Daifuku Designs will have great possibilities to design new accessories, that can be integrated in the Dual lock™ concept.

The survey made clear that the Swedish workers desired height adjustable desks, to be able to stand up and work. This desire was not common among the Spanish answers. The main reason is probably that height adjustable desks are not common in Spain. None of the bigger Spanish companies offer a height adjustable desk, which gives the user the possibility to work standing up. It might have been a good idea to be the first in Spain to design a desk with the possibility to work standing up. The problem was that it would be too costly to design a mechanism to make the feet height adjustable. One possibility were to integrate a height adjustable mechanism that already exists on the market, but it were discovered that none of the height adjustable mechanisms hade discrete organic aesthetics. They all gave a robust and heavy expression. It was therefore decided that Neos would not offer the possibility to work standing up. The next step, to get Neos on the market is to find a manufacturer and contact will be taken through Silka. Neos do need further development before it is introduced on the market. These developments are best done in collaboration with the manufacturer. Two obvious points that need development are the storing possibilities i.e. file cabinets and the packaging for transport. Research has been done on storing, but nothing is yet designed. The issues packaging, transport and how the workstation are to be assembled were considered during the concept phase, but it would be good to get an expert’s opinion on how the workstation should be packed during transport.
5 Conclusion

If a newcomer is to get an office workstation on the market it needs to follow today’s trends in terms of aesthetics and functions. The performed research gave reasons to predict a trend of inorganic shaped desktops with strict lines and more organic formed feet. Another trend is workstations with flexible space dividing systems that make it possible to use the workstations in different ways for different occasions.

The workstation Neos has been designed with special consideration of the sales arguments. A workstation needs an eye-catching first sales argument. For Neos is the Dual lock concept the first sales argument. The Dual lock concept has three attaching points and makes it possible to place the space dividers anywhere on the desktop. The space dividers are easily moved into any desired constellation. The Dual lock also makes it possible to have attachable accessories like penholders, photo frames, mouse pads, etc. on the space divider in front of the user or on the edge of the desk. Daifuku Designs will have great possibilities to design new accessories that can be integrated in the Dual lock concept, if the workstation Neos will be produced.

The foot is the second big sales argument for Neos. It is designed to appear as a delicate, discrete organic piece of material. The foot is also apart of the cord solution. Cords are run from the technical box in the floor, up through the foot to a sheet metal box under the desktop, where the sockets are placed. Hatches in the desktop give easy access to the sockets. The box is designed with holes, so computer cords could be run directly to box. This cord solution makes it possible to install computers, printers, phones, lamps, etc. anywhere on the desktop. The cord solution together with the Dual lock space dividing system makes Neos one of the most flexible office lines on the market today.

Picture 5.1: Neos, white
Acknowledgement

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Appendix 1: Project statement

Project statement and conditions for the study of an office furniture line

The study involves the following phases and conditions:

1. A comprehensive report on the evolution of office systems, (desks, partitions, accessories, but not seating) in particular in regards to the spatial distribution and arrangement of office space and the evolving interrelation with other co-workers. (pictures and text)
   a. Historical background starting around 1940
   b. Tendency today.
   c. In depth study of Herman Miller, Steelcase, Knoll, Vitra, Hayworth, Bene, Uniform, Samas, Assmann, ICF, etc... and Spanish based manufacturers: Aridi, Levesta, Dinamobel, Permasa, Bordonave...

2. In depth study of technical solutions employed by the world’s leading companies, in particular in terms of solving the following issues:
   a. Ease of transport and assembly on the site of the products.
   b. Innovative solutions to the problem of cabling the work surface; in particular ease of access for change and maintenance, solutions for hiding cables, flexibility.
   c. In depth study of office accessories as related to work surfaces, computers, secondary storage, and space dividers.
      (web site work, catalogues, but most interestingly: actual visits to the showrooms when possible)

3. Series of brainstorming sessions with Daifuku Designs to determine the essence of 2 office system proposals, a mid-market proposal and an up market proposal, aimed at major Spanish furniture companies with some degree of international projection. As the project progresses a number of such sessions will be held on different aspects of the project whether it be the overall aspects or technical details. It is understood that all valid opinions are carefully considered and weighed, but that in the case of disagreement Daifuku Designs has the final say as to what direction should be taken.

4. Determination of the components of the project. The idea here is to determine the strong points of he proposals and decide what ways would be most appropriate to express these to a future client. (3 d render, animation, technical drawings in 2 or 3, layouts, real models, etc...)

5. Establish a flow chart/diagram/origanigram of the different components of the project to be worked on, decide the division of tasks within the work group.

6. Realization of the technical/graphic/representational aspects of the project.

7. Realization of a written concept statement for the project. It is understood that the written statement that the students might require and that required by Daifuku Designs may differ.
8. Printing and binding of 3 office copies of the project, 3 copies, one for each student participant and two copies for Karlstad University. Cost of the printing and binding will be borne by Daifuku Designs.

9. Daifuku Designs bear the costs of the material for the presentation of the project at the Karlstad University degree project exhibition.

10. It is understood that the student participants relinquish all property rights on the project, and that except for school purposes the work done in collaboration with Daifuku Designs is of confidential nature while the project proceeds. The final project report will be public and available at the university library (if Daifuku Designs finds it necessary, Karlstad University can make the results confidential). Daifuku Designs will provide the appropriate office space for the 3 participants and bear the cost of utilities and printing, including the eventual use of the office model shop, but will not provide the corresponding computers.

11. The proposed collaboration carries no financial support on the part of Daifuku Designs.

12. The office requires that the participating students carry personal insurance (accident insurance) either provided by the school, private coverage, or as part of the EU social security system.

13. The participating students are expected to attend regular office hours, as to be convened between the parties.

Karlstad, 5 December 2006

Mikael Axelsson          David Joelsson          Karl Åkman

Barcelona,

Jonathan Daifuku
Appendix 2: Gantt-schedule
Appendix 3: Office survey (Swedish)

Enkät

Denna enkät är en del av ett examensarbete, i vilket vi i samarbete med det spanska designkontoret Daifuku Designs undersöker kontorsmöblers utformning. Målet med undersökningen är att definiera vardagsproblems och förbättringsområden med anknytning till skrivbord och kompletterande förvaringsutrymmen.

Med ordet "arbetsplats" menas i följande frågor skrivbord och liknande arbetsytor samt tillhörande förvaringsutrymmen.

1. Hur ser din arbetsplats ut idag?
   Eget rum
   Rum delat med 1-3 kollegor
   Rum delat med 4-7 kollegor
   Större kontorslandskap

2. Exponeras din arbetsplats för era kunder?

3. Upplever du några brister gällande din arbetsplats?

4. Vad upplever du som positivt med din arbetsplats?

5. Är det något som utmarker din arbetsplats från andra arbetsplatser?

6. Hur påverkar din arbetsplats din kreativitet och produktivitet?
   (Motivera ditt svar)

Tack för att du medverkar i denna undersökning och därigenom hjälper oss att utveckla framtidens kontor.
Appendix 4: Office Survey (Spanish)

Cuestionario

Este cuestionario hace parte de un estudio de proyecto de diseño de mobiliario de oficina a la vez que es un proyecto de fin de curso. La meta del cuestionario es el estudio de los problemas cotidianos que se puede encontrar en el trabajo con el fin de definir mejores soluciones para mesas, accesorios e iluminación en el entorno del trabajo.

En los párrafos sucesivos la palabra “puesto de trabajo” (workstation) se refiere a mesa y los elementos anexos como accesorios e iluminación.

Sexo  Hembra □
       Macho □

1. Profesión/tarea que desarrolla generalmente en el despacho.

   Que tipo de disposición tiene su zona de trabajo? □
   Despacho propio □
   Despacho compartido con 1-3 colaboradores □
   Despacho compartido con 4-7 colaboradores □
   Espacio grande compartido □
   Otro □

Si has contestado “otro” ruego que especifiques de que se trata

2. ¿Desde su puesto de trabajo recibe clientes?

3. ¿Que encuentra de positivo y negativo referente a su puesto de trabajo?

4. ¿Como influye su puesto de trabajo en su creatividad y efectividad?

5. ¿Que tipos de equipos/aparatos/elementos utiliza en su puesto de trabajo?

6. ¿Qué tipos de elementos personales guardas en tu puesto de trabajo?

7. ¿Cuántos y que tipo de enchufes utilizas para su puesto de trabajo?

8. ¿Con que frecuencia te ausentes de tu puesto de trabajo, y por que motivo?

9. ¿Qué otros tipos de zonas de trabajo utilizas?

10. ¿Utilizas almacenamiento físico (no virtual)? ¿Dónde esta ubicado? ¿en que tipo de mueble? Gracias por su ayuda.
    David Joelsson, Karl Åkman, Mikael Axelsson
    Karlstads University, Sweden
Appendix 5: Cleaning company survey

Denna enkät är en del av vårt examensarbete, i vilket vi undersöker och utvecklar framtidens kontorsmöbler. Då ni dagligen är i kontakt med kontorsmiljöer av olika slag skulle det vara väldigt givande för oss att få er syn på möblernas utformning. Hur påverkar utformningen ert arbete?

Vad finns det för komplikationer när det gäller städning av kontorsmiljöer?
Sladdar, svårtillgängliga utrymmen, mycket papper osv.

Hur skiljer sig kontoren från varandra när det gäller tillgänglighet för ert arbete?

Vilka förändringar önskar du i de kontorsmiljöer ni städar idag?

Vad är det första positiva du kommer att tänka på vad gäller städning av just kontorsmiljöer?

Vad är det första negativa du kommer att tänka på vad gäller städning av just kontorsmiljöer?

Övriga synpunkter:

Tack för att ni hjälper oss att utveckla framtidens kontorsinredningar.

Mikael Axelsson, David Joelsson, Karl Åkman
Innovations och designenjörsprogrammet, Karlstads universitet.
Appendix 6: Presentation of studied companies

Kemen Haworth
Kemen Haworth was created as a result of the merger between Kemen Mobiliario y Organización de Oficinas and Haworth España, when Kemen was purchased by Haworth in 1999. Kemen was founded in 1962 as a manufacturer of automobile components. A few years later, the company began to concentrate its efforts on the new opportunities offered by the furniture market, on which it has focused its attention since then. [2] Haworth is one of the world’s biggest companies in the workspace solutions industry. The company was founded in 1948 by G.W. Haworth as Modern Products. Back then Modern Product were selling a variety of wood products. It was in 1954 that the focus of Modern Products first shifted toward office environments. Today Haworth, Inc. with its headquarters in Michigan operates in more than 120 countries and employs nearly 8,000 members. [3] Haworth España, was founded in 1987 as Seldex Ibérica, and became Haworth in 1994. The company's distribution network is coordinated from its offices in Madrid and Barcelona. [2]

Herman Miller
Herman Miller is an American company that began in 1923 as a manufacturer of traditional residential furniture. During the 1950s Herman Miller developed lasting ties with skilled industrial designers who led the company in a new direction. The company was established at the office furniture market in the 1960s with its first panel system. During the 1970s, 1980s, and 1990s Herman Millers worked a lot with inventing ergonomic seating. Today Herman Miller is one of the world’s largest office furniture company with customers and locations around the world. [4]

Steelcase
Steelcase began in 1912 as The Metal Office Furniture Company in Grand Rapids, Michigan. They received their first patent in 1914 for a steel wastebasket. In 1954 the name was changed to Steelcase. [5] Today Steelcase is an international company with approximately 13,000 employees worldwide, manufacturing facilities in over 30 locations and more than 800 dealer locations around the world. [6] According to the Steelcase website there are three core elements to consider when designing office environments: interior architecture, furniture and technology. [5]

Knoll
Knoll was founded in 1938 and has headquarters located in East Greenville, Pennsylvania. The company makes and sells office systems, seating, files and storage, tables and desks, wood casegoods, textiles and accessories and serves clients in North America through a network of more than 300 Knoll dealerships and 100 showrooms and regional offices. In Europe, Knoll has showrooms and is represented by dealers in most major cities. Throughout Asia and Latin America, independently owned dealers serve the company’s clients. Knoll has three manufacturers in the US, one manufacture in Canada and also two plants in Italy. [7] Knoll has products exhibited in major art museums worldwide, with more than 40 pieces in the permanent Design Collection of The Museum of Modern Art in New York. [8]
VITRA
The international company Vitra is headquartered in Switzerland and operates with its own companies in 14 countries. It was founded as a family-run business in 1950 in Weil am Rhein, in Germany near the borders to France and Switzerland. [9]
In 1958 Herman Miller transferred the rights to Vitra to produce and distribute furniture designed by the American designers Charles & Ray Eames and George Nelson for Europe. Vitra has produced a lot of classics e.g. the Paton chair by Verner Paton and Wire chair by Charles and Ray Eames. [10]

Bene
Bene was founded in 1790 in Austria and started to manufacture office furniture on an industrial level in 1951. Since the early 1970's Bene has been a market leader in Austria and now holds a share of 25% in the Austrian market and since the 1980's Bene has embarked on an international strategy of growth. When opening offices in London and Moscow in 1988, Bene took the first step towards successful expansion of its sales network on an international scale. Today Bene is a major European player with a sizeable number of subsidiaries. [11] With a new outlet in Dubai, the company is now also represented in the Middle East. 2004 was again marked by international growth: A cooperation agreement was signed with the Japanese office furniture manufacturer KOKUYO CO., LTD, in a first step to open up the Asian market. [12]

Assmann
1968 Dieter Ahsmann joins the company as manager, the company also moves to its current location at Heinrich-Assmann-Straße 11 D-49324 Melle. In 1989 when the 100-million DEM turnover mark was exceeded, Assmann rises to take its place among the leading German office furniture manufacture. [13] All their products are made in Germany but they have a wide market in whole Europe. [14]

Grupo Permasa
The Grupo Permasa consists of two companies; Permasa, which was founded in Barcelona, in 1971 and Formas Nuevas, which was founded in 1975, in Madrid. Permasa’s production is specialised in low/high pressure laminate for system furniture and Formas Nuevas manufactures wood veneer products, for middle and high management furniture. Today Grupo Permasa owns more than 25,000 m², dedicated to the manufacturing of office furniture and exports to more than 20 countries. [15]

Shetug
The Spanish company Shetug was founded in 1964 as Construcciones Metalicas Shetug, SA, which was a factory for the production of steel furniture and safes. Fourteen years later, in 1978, the company Industrial Shetug, S.A. was established and in continuation the decision is made to amplify the current product range for furniture and office installations. In the early '80, when developing a product line, Shetug started working with the product designer Gabriel Teixidó. Today is Teixidó one of Spain’s most productive office furniture designers. [16]
Forma 5
Forma 5 is a Spanish based company located in Sevilla, that produces more than 15 integral programmes for offices solutions, more than 30 complete ranges of office chairs, more than 26 different cabinet solutions. Forma 5 produce chairs for 300.000 persons per year and 120 kilometres of cabinets. All questions concerning production are leaded by a team of designers and technicians within the company, but to create the products Forma 5 also uses external help by using consultants. [17]

Levesta
Levesta founded their first furniture fabric in 1969. 1972 they decided to produce only office furniture. The concept with only office furniture worked out well and does still today. Levesta is one of Spain’s biggest furniture manufactures. [18]

Aridi
Aridi was founded in 1979 and has its current facilities in Girona, Spain. In 1992 Aridi presented Track, the first of many series Gabriel Teixidó designed for Aridi. The latest Aridi lines are called Aire and Eria. Also these lines are designed by Gabriel Teixidó. [19]
Appendix 7: Visit at SILKA´s showroom, 2007-02-14

Participants:
Mikael Axelsson Karlstad University
David Joelsson Karlstad University
Karl Åkman Karlstad University
Jonathan Daifuku Daifuku Designs
Fransisco Torres SILKA -Disseny en mobles d’oficina

The conversation was in Spanish and translated to Mikael, David and Karl by Jonathan. The summary starts with Fransisco Torres answer to what he says is the most common question from the clients and further there is a number of point of interest for our project. Every point is from Fransisco Torres point of view.

When you meet a customer the first question that you are going to need to answer is; Why is it so expensive?

To make a table you need a good designer that should design the table not only to be a nice looking and functional in all possible ways, but also to enable transport and assemble. If that is done wrong the product often gets damaged during transport. Add to that the costs assembler, who is paid by the hour and the fact that the table comes with a guarantee of 45 years. Another cost is to have a good salesman that really knows the products and there benefits, so he can present the product that are best suited for a certain company. Everything costs money...

- The foot is very important; the chair should be able to be moved freely without obstruction from the foot. The foot is also a nice place to hide the cables and cords. Often the client chose tables by the look of the foot.
- It is important to remember that the table should be designed for an office and not for someone’s home. It is not common for someone to sit at someone’s dinner table but to sit on the edge of a desk in an office is social accepted. Therefore the table has to carry the weight of one or two full grown men. You can not be sure that the clients are going to move the table correctly. It is very common that the clients push the tables instead of lifting it, which gives an enormous stress on the foot. A solution to this problem is to put wheels on two of the feet, so you can tilt the table and roll it.
- When a desk is shown in a showroom it always looks clean because there are generally no computers and phones plugged in. In reality it is very important to have enough sockets and hide the cables and cords, to get the desk to look good. The cords and sockets can be hidden in a box under the desktop, in a panel or in a space divider. The sockets can also be visible on the desktop. If a cord box is used the cords could run from the box to the floor through a fake foot or some kind of pipe attached to one of the feet.
- The tables should be able to be aligned and it is to be preferred if the clients want to have them aligned from the beginning, otherwise the clients often move the furniture around until the office get all messed up.
- Adjustable height is important if the user uses a wheelchair, but the “standard user” almost never changes from standard height, probably because the chairs are adjustable.
• A thing to think about is that you have to deliver a larger “executive-desk” in the same style as your standard; otherwise the companies might not buy it.
• The organic forms and wavy lines were a trend that proceeded for 15-20 years, but the strict more clean designs that we are seeing today has been the trend for 5 or maybe 3 years and we are already starting to see the end of that era. What probably are going to be the next style are strict, clean desk boards and more organic and unique formed feet.
• There is a tendency that designers not only designs a table or a desk but also lighting and other accessories that suite the desk.
• It is important to combine the colours into nice combinations.
• The panel shall be able to function standing by it self or attached to the table. Heavy panels rest at the floor and the light is attached to the table. Always think about the acoustics when you are designing a panel.
Appendix 8: Visit at Bernadí’s showroom, 2007-03-01

This is a summery from the visit at the Bernadi showroom at Passeig de Sant Joan, 118-120 Barcelona, 2007-03-01.
The showroom is what they call a “live showroom”, which means that everything that the employees uses in their work are a component of the entire showroom, desks, accessories, toilets dining room, workspaces everything.

Participants: Mr Bernadi
Arantxa Bernadi
Jonathan Daifuku
Mikael Axelsson
David Joelsson
Karl Åkman

Bernadi is a family-owned company that has distributed office furniture since it was founded back in 1965. Ten years ago Bernadí made a decision to focus on five manufactures: the Spanish companies Permasa, Akaba, Vilagrasa and Franch and the German company Wilkhahn.

A tendency on the market today is that more companies buy their office furniture directly from the manufactures.

In the bigger projects Bernadí collaborates with the manufactures and their designers, to be able to give the best solution to the client. These kinds of projects are very important to Bernadí.

They strive to use as much standard measured products as possible to reduce the price. Some of their manufactures has stockrooms and some not, the ones with stockrooms are automatically cheaper, but then you’re not allowed to customize measures on your workstation.

Mr Bernadí also mentions that the ergonomic aspects are very important. He tells us a short describing story about bars and their uncomfortably sit places concerning the legs. He also mentions that it is really important to tryout the workstation a longer period before purchase it. Your spending more time in your chair at the office then your do in your own car, so why not be as careful when you buy office furniture as you are when you’re buying a car.

The latest trend seams to be white and natural coloured clean tables with easy rounded edges. Many customers have lately requested white legs.

They had a big variety of screens for hiding ugly things at the office, they also used stickers on glass walls for screen offs.

One problem that they had with the new desks was that the size of the new computers is extremely varied. The accessories for mounting the computers are therefore hard to dimension.
Appendix 9: Visit at Steelcase’s showroom, 2007-03-02

Steelcase
Cartagena 181
E-08013 Barcelona

Participants:
Karl Åkman Karlstads university
Mikael Axelsson Karlstads university
Jordi Gracia Steelcase

The latest in office furniture are shared tables with co-workers and simple screening, you save a lot of space and therefore also a lot of money.
Better communications, but still got your own private section. There are also accessories like small shelves and holders for cell phones.

The screens ("butterfly") can be moved to rearrange places or protect from direct sunlight.
Normally at least 2 extra electrical slots are needed after installing all the basic equipment (computer, phone etc).
The cables run through the middle legs.

Flexibility is important because companies are constantly evolving; new people get hired one day and fired the next. And the nature of the work changes from day to day, i.e. between meeting and individual work.

Some strong points according to Steelcase are that their lines have a long lifecycle, so if you need to by more furniture after 10 years you can find the exact same line that will suite.

When it comes to the lines for directors they normally want big flashy Italian design style.
Generally there are no trends, the needs is the deciding factor how to compose the office.
Steelcase divides the office into different areas.
Meeting area - larger areas where meetings with clients are held.
In between – areas where workers can meet briefly or have a coffee, with higher bar-like tables and small ones, with uncomfortable chairs so the workers don’t stay to long.
The working area – where the operative works, stable tables

Steelcase’s tables are only height adjustable during assembly, and cannot be instantly adjusted.

Steelcase have 3 families of product and you can build your own configuration.

Steelcase is a “global solution provider” and do all the work when building an office. Design, manufacturing, transportation and installation as well as finding the office area.
Appendix 10: Pictures from SILKA’s showroom
Appendix 11: Pictures from Bernadí’s showroom
Appendix 12: Pictures from Steelcase’s showroom
Appendix 13: Function Analysis

(PF) Primary function, (N) Necessary function, (D) Desirable function.

**General attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Requirement</th>
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</thead>
<tbody>
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<td>Allow office work</td>
<td>PF</td>
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<tr>
<td>Ease assembly</td>
<td>D</td>
</tr>
<tr>
<td>Ease transport</td>
<td>D</td>
</tr>
<tr>
<td>Allow storing</td>
<td>N</td>
</tr>
<tr>
<td>Offer space dividing</td>
<td>N</td>
</tr>
<tr>
<td>Offer cord solution</td>
<td>N</td>
</tr>
<tr>
<td>Maximize space for legs</td>
<td>D</td>
</tr>
<tr>
<td>Allow flexibility</td>
<td>D</td>
</tr>
<tr>
<td>Maximize stability</td>
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</tr>
<tr>
<td>Carry the weight of a person</td>
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<tr>
<td>Offer accessories</td>
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<tr>
<td>Ease cleaning process</td>
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**Visual attributes**

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<th>Attribute</th>
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<tr>
<td>Show uniqueness</td>
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<tr>
<td>Proper semantic appearance</td>
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<tr>
<td>Express high-quality</td>
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<tr>
<td>Satisfy target group</td>
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<tr>
<td>Express usability</td>
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</tr>
<tr>
<td>Conceal cords and cables</td>
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</tr>
<tr>
<td>Follow today’s trends</td>
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**Space dividers**

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<td>Divide desktop area</td>
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<tr>
<td>Reduce disturbing sound</td>
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</tr>
<tr>
<td>Increase privacy</td>
<td>N</td>
</tr>
<tr>
<td>Offer usability</td>
<td>N</td>
</tr>
<tr>
<td>Offer hiding options</td>
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</tr>
<tr>
<td>Offer flexibility</td>
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</table>

**Cord solution**

<table>
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<th>Attribute</th>
<th>Requirement</th>
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<tbody>
<tr>
<td>Offer phone and electric installation</td>
<td>PF</td>
</tr>
<tr>
<td>Ease cord and cable installation</td>
<td>N</td>
</tr>
<tr>
<td>Offer safe electricity installation</td>
<td>N</td>
</tr>
<tr>
<td>Integrated in the design</td>
<td>D</td>
</tr>
</tbody>
</table>

Notes:
- No disturbing table feet
- Able to move space dividers and accessories
- Penholder, notice board, etc
- Concealed when not in use
- Can be used anywhere on the desk
- Enough sockets. Mobile phone, etc
Appendix 14: Cord solution

The picture to the right is showing the cord box. The box is cords made in sheet metal to give stability to the desk. The shorter of the box are easily removed, to facilitate the installation of cords.

The picture below shows how the cords are run through the foot and how the sockets are accessed through the hatch in the desktop.
Appendix 15: Space divider ideas

- Rice Lamp Idea
- Roller Blind Idea
- Fan Idea
Appendix 16: Accessories

Examples of accessories, attached with Dual lock.
Appendix 17: Concept meeting with SILKA 2007-04-03

Participants:
Jonathan Daifuku Daifuku Designs
Mikael Axelsson Karlstads University
David Joelsson Karlstads University
Karl Åkman Karlstads University
Francisco Torres SILKA
Enrique Marin SILKA

Enrique Marín and Francisco Torres from the furniture company SILKA were invited to give feedback on the project so far. These points of interest are a summery of the feedback from SILKA.

- The tables should share the same foot if two tables are joined together, both of aesthetic reasons and to keep the price down.
- The tendency today is that the desks are getting smaller, because of the high costs of office space in the bigger cities. The width 800 mm is god, but it is necessary to have a smaller desk (650-700 mm) as a complement. The lack of space also makes it important to maximize the space under the desk to fit in file cabinets, CPU, etc. the feet should therefore be moved further to the table’s edges.
- Because of European regulations, the pipe for the cables has to be separated in two, one part for the cables for the computer and one for the others.
- The Dual Lock-concept is a good idea. However, the cleaning process of the Dual Lock has to be tested.
- Attachable accessories is a god idea, it gives more free space on the desktop and clients usually likes the freedom to decorate the workstation them self. One problem is that the furniture manufactures do not like to make accessories, because it does not bring in that much money. The best thing to do is probably to locate a manufacturer that specialises in accessories and have products that fit to the aesthetics of our desks.
- File cabinets usually come in a width of 430 mm, but it is good to also have a smaller version, about half the width. The smaller version can be used when the client do not have enough floor space for the bigger one. It is also good to have a version were the file cabinet, instead of being placed under the desk, is placed beside the user, in a 90°-angle to the desk. In that way the drawers can be reached easier.
- The file cabinet can work as a replacement to a foot if the height is the same, which can be benefiting both economical and aesthetically.
- Flat screens are getting more and more common. Laptops are still not that common.
- White is a good choice of colour.
- If the four desks are going to be joined together in a 1600 mm wide square, add-on-pieces on the shorter sides are required. The add-on-pieces should be 250-300 mm wide.
Appendix 18: Final concept

Solo table in three different material combinations

Four tables joined together showing different screening solutions

A group of four tables in office environment showing the riselamp concept
Appendix 19: Model production

Determine different cross sections in 3Dmodell to use as reference in 2D drawings for laser cutting.

Drawings that were sent to laser cut manufacturer.
Assembly of laser cut pieces.

Model making by David.

Laser cut pieces welded together.

Final model of foot.