

# **A new executive desk**

## **Bachelor assignment at PT. Indovickers Furnitama**

This report is written for the principals of the Industrial Design Engineering Bachelor studies  
assignment at the University of Twente  
and for the tutor of PT. Indovickers Furnitama, Jakarta, Indonesia

UT/IO-03.06-01-02-2007

University of Twente  
Faculty of Constructive Technical Sciences  
P.O. Box 217  
7500 AE Enschede  
Tel. +31 53 489 91 11

T.K.M. Thung Student # 0066893
-----------------------------------

Tutors:  
Mrs. Dr. A.H.M.E. Reinders  
Mr. J. Gandasubrata

Date of publication: 01-02-2007  
Copies 3; number of pages: 72; number of enclosures: 8

# Summary

The Industrial Design Engineering bachelor studies of the University of Twente are concluded by an individual assignment given by and preferably executed in a company.

The furniture company PT. Indovickers Furnitama in Jakarta, Indonesia, kindly granted the assignment of the design of a new executive desk.

In this report, this company is introduced by describing its profile.

At the end of August 2006, the assignment is started in the company in Jakarta.

The research phase starts with the product analysis, including the documenting of materials and production techniques.

The President – Director and the employees of the Market Division are interviewed, to determine the target group, cost demands, wishes and demands of these users.

The outcome of the questionnaires provides information about the trends and developments in the Indonesian furniture market.

Every user wants to work comfortably behind his desk and therefore the ergonomic aspects are analysed.

All of the information of the analysis is gathered, helped to determine a direction for the design.

The concept generation uses this direction and specification. This concept generation has two partitions: the orientation phase and, after the feedback of the R&D Team, the second phase.

These phases lead to two different concepts: the classical desk and the modern desk.

At the final presentation in Jakarta, these two concepts are presented to the President-Director, R&D Team and manager, and a couple of employees from the Market Division.

They give feedback and they choose the second concept, the modern designed desk, which becomes the definitive concept.

After the stay of two months in Jakarta, the work of the assignment is finished in the Netherlands.

The final concept is specified and a SolidWorks model is produced.

This SolidWorks model is used to get advice from a researcher of aluminium extrusion profiles and lecturers.

The desk has a tabletop from hardened glass. Force calculations are executed to check the strength of this tabletop and the construction.

The production costs and the selling price of the executive desk are calculated and these calculations give a good indication of the sale potential in the market.

The research in this assignment provides conclusions and recommendations, which can be used for the development of a new executive desk series.

# Table of contents

<b>Summary</b>	2
<b>Table of contents</b>	3
<b>Table of illustrations</b>	5
<b>Preface</b>	6
<b>Introduction</b>	7
<b>Formulation of the assignment</b>	8
<b>Analysis</b>	
1.1 Profile PT. Indovickers Furnitama	9
1.1.1 <i>Addresses company</i>	9
1.1.2 <i>The company</i>	10
1.1.3 <i>Company history</i>	10
1.1.4 <i>The R&amp;D Team</i>	11
1.1.5 <i>The products</i>	12
1.1.6 <i>Company's market position</i>	12
1.1.7 <i>Company's strategy</i>	12
1.1.8 <i>The factory</i>	12
1.2 Product analysis of executive desks	17
1.2.1 <i>Characteristics</i>	17
1.2.2 <i>Materials</i>	18
1.2.3 <i>Production techniques</i>	18
1.2.4 <i>Common colours</i>	21
1.3 Target group of executive desks	22
1.3.1 <i>Users</i>	22
1.3.2 <i>Showing aspects (what they want to carry out)</i>	23
1.3.3 <i>Surroundings of executive desks</i>	24
1.4 Market	26
1.4.1 <i>Competitors</i>	26
1.4.2 <i>Trends and developments</i>	26
1.5 Demands and wishes	27
1.5.1 <i>Wishes of the target group</i>	27
1.5.2 <i>Ergonomic demands</i>	27
1.5.3 <i>Cost specific demands</i>	29
1.5.4 <i>Specifications</i>	29
<b>Concept generation</b>	
2.1 Concepts	30
2.1.1 <i>Orientation phase</i>	30
2.1.2 <i>Feedback</i>	31
2.1.3 <i>Second phase</i>	31
2.2 Definitive concept	34
2.2.1 <i>Decision based on demands and wishes</i>	34
2.2.2 <i>Decision based on the final presentation</i>	34
<b>Detailed design</b>	
3.1 Detailed view of the definitive concept	35
3.1.1 <i>The definitive concept</i>	35
3.1.2 <i>Concept specification</i>	35
3.1.3 <i>The production techniques to produce the definitive concept</i>	37
3.1.4 <i>Cable management</i>	37
3.1.5 <i>Price calculation</i>	40
3.1.6 <i>Force calculation</i>	40

<b>Conclusions and recommendations</b>		41
<b>Quotation of sources</b>		42
<b>Enclosures</b>		
Enclosure A	<i>Questions and answers target group</i>	43
Enclosure B	<i>Questions and answers Market Division</i>	49
Enclosure C	<i>Process of aluminium</i>	55
Enclosure D	<i>Production of veneers</i>	55
Enclosure E	<i>Ergonomics</i>	57
Enclosure F	<i>Price calculation</i>	61
Enclosure G	<i>Force calculation</i>	62
Enclosure H	<i>Correspondence R&amp;D Team / others</i>	65
<b>Supplements</b>		
Material board		
Sketch book I: Orientation phase		
Sketch book II: Second phase		
Technical drawings - book		

## Table of illustrations

### Figures

Figure 1:	Head office Indovickers	9
Figure 2:	Hospitality chair 'Bubbles'	12
Figure 3:	Semi automatic cutting of aluminium profiles	13
Figure 4:	Chemical baths for cleaning and preprocessing metal parts	14
Figure 5:	Applying powder coating	14
Figure 6:	Sewing fabrics	14
Figure 7:	Attaching a foam layer to the seat	15
Figure 8:	Attaching the fabric to the seat	15
Figure 9:	Producing a panel of a workstation	15
Figure 10:	Assembly of pedestals	16
Figure 11:	Pedestals are checked	16
Figure 12:	Workplace for producing mockups	16
Figure 13:	Stock with finished products	16
Figure 14:	Classical executive desk	17
Figure 15:	Modern executive desk	17
Figure 16:	Edging of the tabletops	20
Figure 17:	Colours of High Pressure Laminates	21
Figure 18:	Brainstorm session 'Executive desk'	22
Figure 19:	Activities of managing directors	23
Figure 20:	Moodboard of image	23
Figure 21:	Board room	24
Figure 22:	Interiors of board rooms	24
Figure 23:	Reach envelope	28
Figure 24:	Visual-manipulative comfort zone	28
Figure 25:	Sketch view phase I; orientation	30
Figure 26:	Sketch view phase I; adding selling points	31
Figure 27:	Sketch view phase II	32
Figure 28:	Concept 1: classical desk	32
Figure 29:	Concept 2: modern desk	33
Figure 30:	Final presentation in Jakarta	34
Figure 31:	Presentational drawing	35
Figure 32:	The adjusted aluminium extrusion profile	36
Figure 33:	The connector	36
Figure 34:	Section view of the table leg	36
Figure 35:	Adjuster system	37
Figure 36:	Cables on the desk	38
Figure 37:	Cable management; Evoline series	38
Figure 38:	Cable management; V-dock	39
Figure 39:	Cable hose	39

### Tables

Table 1:	History of Indovickers	10
Table 2:	Functions of the Design Engineering Division	11
Table 3:	Used materials in the factory	13
Table 4:	Competitors of Indovickers	26
Table 5:	Specifications of the new executive desk	29
Table 6:	Force calculations of the desk	40

# Preface

A bachelor assignment in a foreign country acquires a lot of preparation, arranging and adjusting. It was impossible for me to do my assignment without the help and support of the following persons. These persons will be named and thanked for their effort.

First of all, I want to thank Camelia Bunardi, designer of the R&D Team, for enabling me to do an assignment in Indovickers in Jakarta, Indonesia. She kindly introduced me to the company, helped me with my preparation and my stay in Indonesia. During my assignment, I was offered much care and support from her. I am very grateful for everything she did for me.

Mr. Loekman, the President-Director of Indovickers, I would like to thank for inviting me to the company, and for granting me an interview and offering valuable feedback during the final presentation in Jakarta.

Mr. Gandasubrata, the manager of the R&D Team, I would like to thank for his feedback and supervision during my days in the company.

I want to thank Daniël Sudarsono, designer of the R&D Team, for his help, feedback, assistance and care.

Gilang Sundhara, graphic designer of the R&D Team, for his help, assistance, care and for involving me with his graphical tasks.

I want to say thanks to the interviewed persons of the Marketing Division, during my research phase:

Mrs. Thea, Mr. Grandy, Mr. Anton and Mr. David.

The employees of Indovickers, for their good care and accompany during my lunch and time in the company.

I would like to thank Wieteke de Kogel-Polak, Ellen van Oosterzee-Nootenboom and Angèle Reinders for their help, support and guidance during my preparation and assignment.

Thijs ter Harmsel, of the glass company VitriLine in Hengelo, the Netherlands, for his information about glass tabletops.

Gijs van Ouwkerk, researcher at the University of Twente, for his advice, regarding the design of my aluminium extrusion profile.

Olaf Grevenstuk, master student IDE, for his help with the force calculations.

At last, I would like to thank my family and friends in the Netherlands and in Indonesia for their support and care.

# Introduction

The goal of this report is to present the work of my bachelor assignment, namely to design a new executive desk. The different steps in the design process of this new executive desk will be described, as well as the motivation for the choices made.

During the two months in Jakarta, there was not enough time to execute the analysis phase extensively. The choice was made to follow, as much as possible, the whole design process. The focus lay on concept generation.

A lot of 'learning moments' occurred both in Jakarta and in the Netherlands. One of the greatest aspects was the experience of the work culture in the furniture company in Asia. The differences and similarities in work culture of Indovickers, as compared to the Netherlands, were very interesting.

The approach of this assignment was to start with a product analysis. The target group was analysed afterwards. Unfortunately, no opportunity or time was available to meet with and interview managing directors in Jakarta. The President-Director of Indovickers was the only user, which was interviewed.

By interviewing the Marketing Division of the company, more information was gathered about executive desks and their target group.

The information of the analysis is used for generating concepts. The concepts are sketched and during the research, the R&D Team offers more insight into the concepts by giving their feedback.

At the end, a couple of concepts are selected, allowing the President-Director to choose a definitive concept from.

The definitive concept is worked out in detail and a price calculation of this concept is made.

The price calculation gives an estimation of the market feasibility.

The force calculation is needed to check the strength of the executive desk.

The research, concept generation and detail phase will provide conclusions and recommendations.

The first part of the analysis phase begins with the introduction of the furniture company, PT. Indovickers Furnitama. The second part of the analysis phase contains the analysis of the product, target group, market, the demands and wishes.

During the concept generation and detailed design, the sketches and the definitive concept of the new executive desk are made.

All of the email – correspondence, relevant to the development of the executive desk, may be found in *Enclosure H*.

## **Formulation of the assignment**

The company wants to design a new system for a workstation or desk at the executive level. This means that the desk will be used by managing directors. Currently, the company has one executive desk series and they want to make a new series to fulfil recent and future demands.

The assignment will be to research and design a new concept. During the assignment, a close working relationship is established with the Research and Development Team (R&D Team) of the company to collect and synthesize information to develop a concept that is feasible to the market.

The aim of this assignment is to create a new concept of an executive desk, consisting of a final technical drawing. The mockup of the final concept will be made by the company. The mockup will be tested by the company, so the ergonomics, the aesthetics and the strength of the product can be monitored and evaluated.

The assignment is executed individually and the start of the assignment is at the end of August 2006. A part of the assignment is executed in September and October 2006, in Jakarta, Indonesia. The assignment will be finished in the Netherlands.



# Analysis

## 1.1 Profile PT. Indovickers Furnitama



Fig.1: Head office Indovickers

The bachelor assignment is executed in PT. Indovickers Furnitama, Jakarta, Indonesia. In this chapter, this furniture company is introduced.

### **1.1.1 Addresses company**

Head Office & Factory  
Jl. Cipinang Muara II no. 29  
Jakarta 13470 - Indonesia  
Tel. (62 21) 862 6385  
Fax. (62 21) 861 6165  
E-mail: [csj@indovickers.com](mailto:csj@indovickers.com)

Surabaya branch  
Jl. Pucang Anom Timur no. 52  
Surabaya 60283 - Indonesia  
Tel. (62 31) 502 8466  
Fax. (62 31) 567 8135  
E-mail: [css@indovickers.com](mailto:css@indovickers.com)

### **1.1.2 The company**

The company has 10,000 square meters of factory space within Jakarta city. They also have a number of affiliated and associated companies and factories in Indonesia, Australia and Europe. They are committed to produce furniture with highest international quality standards. Their mission is to provide a tradition of innovative, functional, and excellent quality furniture and system solutions, complimented by their professional services.

The company exports 5% of their total production and 95% is produced for the local market in Indonesia. The company is an ISO 9001:2000 contract furniture manufacturer and supplier company.

The company has over 25 years of experience dealing with hospitality, restaurant/ cafeteria, public furniture, institutional and office markets in Indonesia. They hold licenses for many of the worlds leading furniture brands, such as Wilkhahn (Germany), Haworth (USA) and Mobilex (Italy). Besides these activities, they design their own local furniture for those areas. The company maintains a total quality control, constantly monitoring against strict standards, ensuring that their products will exceed customers' expectations.

### **1.1.3 Company history**

- |      |   |
|------|---|
| 1972 | PT. Polymetal Industry incorporated. One of the first office chair manufacturers in Indonesia.                    |
| 1987 | Indovickers established as a division of Polymetal, created to produce the first workstation system in Indonesia. |
| 1989 | PT. Indovickers Furnitama is incorporated as a company with Office furniture as a main product.                   |
| 1990 | Opening of the Jakarta Barito showroom.   |
| 1993 | Opening of the Hospitality and Public area Division.  |
| 1995 | Opening of the Surabaya branch.   |
| 1998 | Expansion of its plant area to 10.000m2 with over 250 employees and 12 principals.                                |
| 1999 | Opening of the Institutional Division.  |
| 2000 | ISO 9001 certified.   |
| 2001 | Upgrading IT system to an integrated and wide operational system with 'state-of-the art' ERP software.            |
| 2003 | Upgrading Quality management system ISO 9001:1994 version to ISO 9001:2000 version.                               |
| 2005 | A new wood working manufacturing plant is acquired that expand our plant area another 10.000 m2.                  |
| 2006 | Winning the Indonesia Good Design Selection Awards.   |

Table 1: History of Indovickers

### 1.1.4 The R&D Team

The R&D Team is a new division in Indovickers and the industrial designers are part of this team. The team has three main functions in the company:

- Product development
- Research for new materials and processes
- Making product improvements

The team uses the following steps for product development:

1. Research (analytic phase)
2. Concept generation
3. Review of the concepts
4. Drawings and mockup
5. User survey to obtain feedback from the users
6. Feedback from the Marketing Division
7. Definitive model in AutoCAD or SolidWorks
8. Technical drawings
9. Price calculation; this calculation is checked by the Design Engineering Division and the R&D manager.
10. Promotion consisting of a brochure that contains an outline drawing, product code, dimensions and a product description.
11. Presentation for the marketing staff and production staff; so they can anticipate what they will produce.
12. Customers that order the product

Then this cycle will repeat in other projects. The target during one year is to develop four products. Beside this target, the team is busy with other tasks and assignments, which come from other projects. An example is to work for a big project, which is given by BCA, a big bank in Indonesia.

The manager of the R&D Team has the responsibility to direct, to help and check the R&D Team, during the design process.

The manager makes an analysis of the design and controls the product quality (QC; Quality Control). The work of the team will be presented to the President-Director of Indovickers. The President-Director has to make the final decision and gives feedback to the manager and the R&D Team.

All the data of the products will be given to the Design Engineering Division. This division has all the information of the products and closely works together with the R&D Team.

The functions of this division are divided in major and minor functions.

Major functions	Minor functions
Product development	Maintenance of a good quality of the material and product
Improvement of existing products	Research (new) processes, materials They give the R&D Team options, like two different new processes
Cost reduction	Finding better solutions for technical problems
Maintenance of a good relationship with suppliers, designers, contractors	

Table 2: Functions of the Design Engineering Division

### **1.1.5 The products**

The company produces the following products:

Office and institutional furniture

- computer desks
- executive desks
- chairs
- workstations
- office accessories

Hospitality furniture

- dance floors / stages
- tables
- trolleys
- chairs

Public area furniture

- multi purpose seating
- relax and waiting seaters
- restaurant and café furniture



Fig.2: Hospitality chair 'Bubbles'

### **1.1.6 Company's market position**

Indovickers is a middle ranked company. The company can be found in the top 5 of companies in the Indonesian market.

Their average selling price is a bit higher than the price the competitors charge. Only five percent of the total production is exported, because it is too expensive.

### **1.1.7 Company's strategy**

To maintain their market position, the company has the following strategy:

1. *After-sales customer service (for 3 years)*
2. *Improvement of the quality of the products and maintaining a stable level of quality*
3. *Variety of products*
4. *Competitive price level*
5. *Close relation with designers*

### **1.1.8 The factory**

The Cipinang factory has preparation techniques for steel and aluminium. The wooden elements are prepared in another factory, in Cileungsi, Indonesia. They do cutting, routing, calibrating, grooving and finishing. The finishing contains laminating or wood staining and edging.

Below, the description of the materials and the preparation techniques used at the Cipinang factory can be found.

The Cipinang factory uses the following materials (raw or processed material from suppliers).

<p>Woods:</p> <ul style="list-style-type: none"> <li>- timber (original woods)</li> <li>- MDF (Medium Density Fibre board)</li> <li>- particle board</li> <li>- plywood or bended plywood</li> </ul>	<p>Metals:</p> <ul style="list-style-type: none"> <li>- aluminium</li> <li>- stainless steel</li> <li>- aluminium extrusions</li> </ul>
<p>Synthetic materials:</p> <ul style="list-style-type: none"> <li>- polyurethane</li> <li>- fibreglass</li> <li>- polycarbonate</li> <li>- injection foam</li> <li>- injection mould</li> </ul>	<p>Upholstery materials:</p> <ul style="list-style-type: none"> <li>- foam</li> <li>- fabric</li> <li>- vinyl</li> <li>- leather</li> </ul>

Table 3: Used materials in the factory

The aluminium extrusion profiles are delivered to the factory. The extruded profiles are cut, drilled, punched and finished, before they go to the welding place. After the welding process, the welds are honed.



Fig.3: Semi automatic cutting of aluminium profiles

The steel is prepared in a separate part of the factory. The preparation techniques are the same as the techniques for the aluminium.

The aluminium or steel elements will enter a couple of baths, filled with chemicals. These baths will clean the elements from dirt, grease and bring protective layers to the surfaces. After 30 minutes the elements have passed the baths and are ready to be powder coated. This epoxy powder is applied on the metal parts. The furnace finishes this process at 200 ° Celsius.



Fig.4: Chemical baths for cleaning and preprocessing metal parts



Fig.5: Applying powder coating

The finished elements will be gathered to be assembled. The assembly is done by using jigs. After the total assembly, the product quality is checked. During the check, the workers use gloves to prevent fingerprints from being left on the product. One single fingerprint will lead to a rejection of the entire product.

#### *Upholstery*

Besides the metals, there is a workplace for sewing fabrics. The company has a machine, which can sew double seams in the fabric parts. Most of the fabrics are sewed by a couple of employees.



Fig.6: Sewing fabrics



When the fabrics are ready, they go to the Chair Assembly Division. The wooden chair seat, made from bended plywood, will get a foam layer, which is glued to the wooden seat. The fabric will then be stapled to the seat. The edging is done by attaching a rubber band, using staples. The staples will be invisible and the seat will be finished. The seat is assembled to the chair legs and is checked and packaged. The used materials are foam, fabric, leather and vinyl.



Fig.7: Attaching a foam layer to the seat



Fig.8: Attaching the fabric to the seat

### *Panels*

The panels for the workstations are made in the Frame Unitile workplace. The boards get a fabric cover, which is attached by staples. On top of the fabric cover, a plastic cover will be attached. After this, the clamps are attached on the panels. The panels are elements of the workstations.



Fig.9: Producing a panel of a workstation

### *UMP*

The Assembly UMP area is the place where the pedestals are assembled. After the assembly, each pedestal will be checked and the approved pedestals are labeled for the 'Q.C.' guarantee certification.



Fig.10: Assembly of pedestals



Fig.11: Pedestals are checked

### *Mockup*

The R&D Team has a workplace for making mockups.



Fig.12: Workplace for producing mockups



Fig.13: Stock with finished products

### *Stock*

The finished products and the parts of all furniture are in stock in the company. They have two stocks, also known as warehouses. One stock is specially organised for metal parts, like extrusion profiles. The other warehouse contains finished products, parts, adhesive, bolts, screws and etcetera.

All the products are stacked on pallets, so the transportation goes easier.

The products, which are waiting for finishing or other parts, are kept in the 'hold area.' The ordered products are waiting in the delivery area for transportation to the customer.



## 1.2 Product analysis of executive desks

The executive desk is a desk made for a specified target group.

The target group of the executive desk includes managing directors. In the chapter Target group (1.3), the users are described in detail.

Indovickers produces their own series of executive desks, called Eclipse.

The company also produces another executive desk series, which is inspired from the brand Rosenthal. This type, the Muevo, is produced for the Asian market.

Four other executive desk series are under licence imported and sold by the company.

The brand of these series is Faram.

### 1.2.1 Characteristics

The common characteristics of the executive desk are the more exclusive looks of the desks in comparison with the 'normal' office desks, and the basic elements of a desk.

The basic elements are the tabletop and table legs. The desks often have pedestals under the table. These pedestals are moveable by using castors, so the formation is flexible.

The price of an executive desk ranges from 200 till 10,000 euros approximately.

The customer can choose and adjust the desk according to his wishes.

Many different executive desks are on the market. The executive desks can be divided in two different groups: the classic and modern designed desks.

The classic based executive desks have basic rectangular forms, and they often are symmetric. These executive desks have an expensive look and the status and show-off factor are important. Most of the time, the table legs contain storage space.



Fig.14: Classical executive desk

The modern based executive desks are more functional. The forms and formations are less restricted. The material is not limited to wood; the furniture companies use different materials, like aluminium, steel and glass.



Fig.15: Modern executive desk

### **1.2.2 Materials**

- Original woods, like nyatoh and jati, are very expensive. The popular woods are sungkai, cherry, beech and teak.
- The base is made of plywood and MDF (lower costs).
- The base material is finished by veneer or laminates in the same colours of original woods.
- During finishing, the use of veneer is 60%; the use of high pressure laminates has a share of 40%.
- The edging is made of PVC.
- Metals, like steel, iron and aluminium are used.
- The modern executive desks have glass parts, like a glass tabletop.

### **1.2.3 Production techniques**

Production techniques are the techniques to prepare wood and metals. Drilling, bending and sanding are well-known basic techniques. In this paragraph the principal techniques, with reference to the executive desk, are described.

#### *Glass*

Glass is made from quartz or silicium ( $\text{SiO}_2$ ), often gained from sand. Silicium is an acid oxide, with which water can form silica.

Glass can be cut, milled, engraved, etched, sandblasted, decorated and formed in many different shapes. During the production process of glass, the glass can be coloured by adding metals and metal oxides.

The thickness of the tabletops can vary from 4 till 20 mm, depending upon the supplier's specifications. Most of the time, the glass used for tabletops is hardened.

#### *Metals*

The metal parts of the desk can be machined. The metals can be powder metallurgy compacted (PM) or be cast. Other techniques like extruding, forging, stamping, deep drawing and forming, can be used.

Pure aluminum is a low-density, silvery-white metal, which can be found in the earth's crust. The material is light, non-toxic, non-magnetic and non-sparking.

Aluminum provides the same amount of strength for a third of the weight, as compared to steel and copper.

Aluminium can be extruded, rolled, welded and cast.

More information about processing aluminium can be found in *Enclosure C*.

The aluminium has a film of oxide on the metal surface. Anodising uses a chemical treatment to create a clear, hard and corrosion-resistant film, capable of being coloured.

The aluminium can also be powder coated. This process involves spraying the surface of the product with a mixture of finely ground particles of pigment and resin. This product will be baked inside an oven at 200° Celsius. The result is a uniform, sustainable, high quality and attractive finish.

At this moment, the polyester thermosetting powder is the most commonly used powder. Generally, powder coating is preferred to spray-painting, because it is more sustainable.

#### *Wood*

Timber can be varnished, veneered, laminated, and must be finished for sealing, beautifying and protecting the surface of the wood from dirt, humidity and ultraviolet light.

The nail holes can be filled to achieve smoother surfaces.

It is important to prepare the surface of the wood before applying a finish.

The different finishes are wax, oil, varnish, lacquer, polyurethane and paint.

Veneering is applying a thin, appealing and more luxurious piece of timber on top of a wood of less quality or beauty. This method is a less expensive way of achieving an attractive wood surface.

Veneers are available in quite large sheets, and the range in thickness is from 0.3 – 6 mm. The thin layers of veneer can be glued together and will alternate the grain directions. The amount of layers is always an odd number, which causes parallel grain directions. More information about the production of veneers can be found in *Enclosure D*.

It is important to seal the veneered parts to maintain the quality of the surface texture and the grain of the timber. Usually the veneer is finished with a transparent top coat. The edges of the veneer can be finished by edge bands or be filled and painted.

Plywood is a form of veneering and is composed of thin cross - banded veneers, which are glued together by a water-based adhesive.

Minimal three veneer layers, of 1.5 – 3.2 mm thick, are used. The grain of every next layer is perpendicularly placed to the previous layer.

Plywood is a popular option in the furniture industry and is used in the framework of upholstered pieces.

The plywood can be formed by three different sorts of presses: pre-press, cold-press and hot-press.

The pre-press assembles and presses the plywood veneers without using heat.

The cold-press is processed at room temperature. The plywood veneers are glued together and will be pressed. After the maximum pressure, the whole package will be taken out the press and dried.

Hot-pressing takes place in a hydraulic press with a couple of heated plates. The heat enables the adhesive to bond the layers together.

The plywood must be finished for protection of the surface and the methods to do this are by painting, lacquering or coating with water repellents. Another way is to overlay the plywood with veneers, phenol film, laminated plastic or impregnated paper.

Wood can also be laminated. The lamination process consists of gluing layers of timber together and forcing them into a desired shape. When the glue is dry, the object preserves his form.

The process is similar to the process of modelling a plywood part, but the difference is that the grain direction of the layers in a laminated wood component, less or more, runs parallel rather than in an alternating perpendicular configuration.

Manufactured boards, also known as Medium Density Fibreboard, are produced from wood fibres. These fibres are wood chips and saw dust. The thickness range from 3 – 50 mm. The particles are steam impregnated at temperature of around 180 °C, softening the lignin (the natural cell bonding elements in wood). Adhesives are additionally mixed in with the particles, which are then fed through a moulding machine that roughly shapes them into a mat. The board is then compressed to the requested thickness and steam-heated at temperature of around 240°C. This will be cured and hardened. After that, it is fed to the stackers, where it will be cut to size.

These MDF boards can be painted and finished as desired; with veneers, plastics and even paper.

Laminates are frequently used in applications involving countertops, wall coverings, tables, desks and furniture in general. Their purpose is parallel to that of veneer; they present a decorative surface finish. It is possible to achieve any kind of pattern, because it is simply printed on the corresponding layer. Different textural finishes are available.

Laminates are produced by taking five or six layers of craft paper in large rolls and running them through vats of resins and driers. This is cut into sheets and impregnated with phenol resins. The layers with the specified pattern are passed through melamine resins. Several layers of the resin coated craft paper are fed into a mould before the similarly coated layer with the printed pattern is placed on top. Then heat and pressure are applied to encourage the flow of these resins. These layers are cured and hardened under these conditions. For creating textures, the resin coated layers, including the pattern sheet, are placed in moulds with textured surface plates.

The laminates need no finishing and are quick and relatively easy to apply. They are highly resistant to impact, heat and cold stains and liquids. Laminates are commonly placed over plywood or manufactured board.

Generally contact cement is used in attaching laminates to other materials. The bond of the laminate and the other material is immediate, so the positioning needs to be accurate.

*Edging*

The edges of the tabletops can be finished by using edging. The edging materials can be made of wood or plastics, like PVC. The edges are extruded and rolled. The attachment of the edges can be done by adhesive.

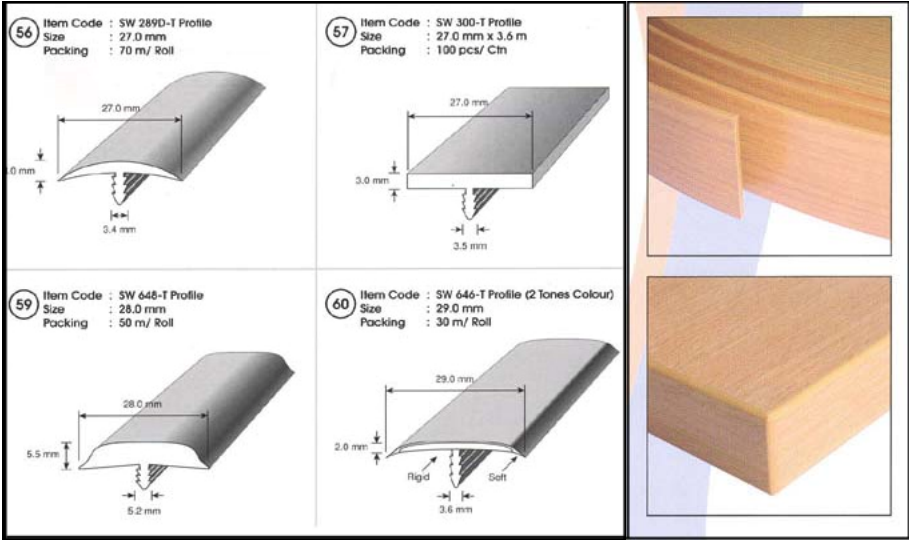


Fig.16: Edging of the tabletops

### 1.2.4 Common colours

Colours of the executive desks are dependent on the kind of wood used. The desks are often not painted, but stained or laminated, using the colour of the sort of wood. Metal parts can be powder coated in different colours. The customer can choose between many different colours and textures. The supplements contain material boards that show the different colours of the materials.



Fig.17: Colours of High Pressure Laminates

### 1.3 Target group of executive desks

The most important aspect of the design process is knowing the user of the designed product.

During the research the target group is interviewed and the Marketing Division gave information about the potential users of the new executive desk.

#### 1.3.1 Users

The users of the executive desk are directors. They have the principal position and 'seat' in the company.

The directors are working from behind the executive desk in their own room.

The President-Director of Indovickers offered information about his own board room and executive desk. The questionnaire is not used and the President-Director randomly answered the questions (*Enclosure A*).

The information of the questionnaire is used in this chapter.



Fig. 18: Brainstorm session 'Executive desk'



Executives are meeting visitors / customers, making phone calls, writing, signing documents, using the computer, reading and entertaining themselves, for example by music.

The executive desk will be produced for the Indonesian market. However, the company wishes a desk which also can be sold in Europe. The focus, however, will be on the Indonesian market.

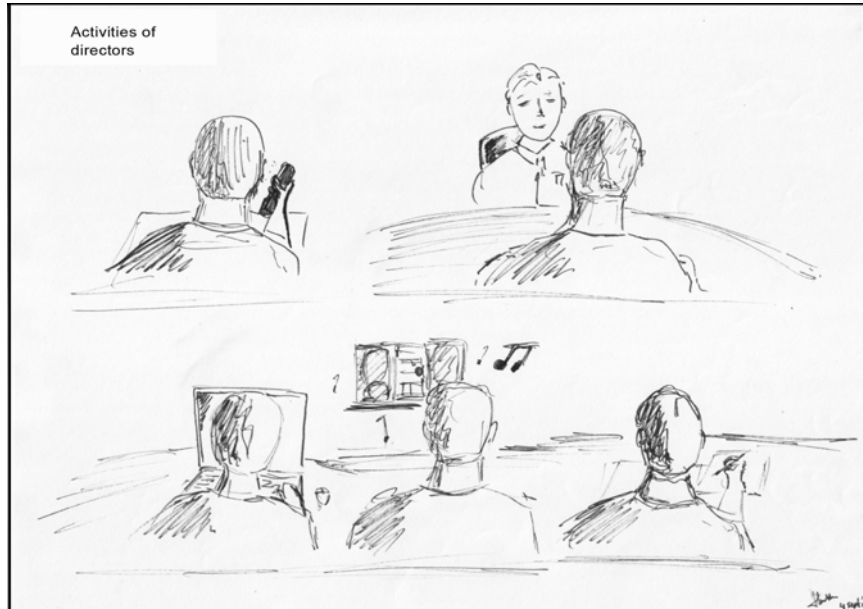


Fig.19: Activities of managing directors

### 1.3.2 Showing aspects (what they want to carry out)

Managing directors have the highest position in their company. They want to show this by their appearance and belongings, like the board room. The board room contains a lot of expensive accessories.

The principal keywords of this appearance are: professionalism, status, wealth, elegance, respect and importance.



Fig.20: Moodboard of image

### 1.3.3 Surroundings

The executive desk stands in the board room.  
The board room is often 'clean,' organized, 'empty' and has basic elements: the executive desk area, the meeting area and the lounge area.



Fig.21: Board room

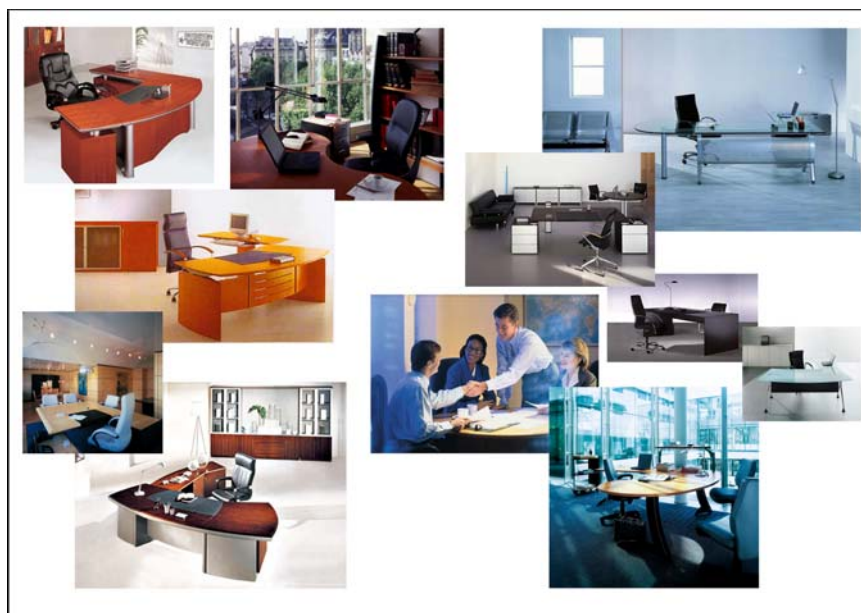


Fig.22: Interiors of board rooms



The furniture and accessories, which can be found in board rooms, are:

- the executive desk
- possibly a side desk, which is often used for a pc / laptop
- an executive chair
- a lounge area, consisting of couches and little coffee tables, for informal meetings and relaxing
- one or two visitor chairs in front of the executive desk
- cabinets or credenzas for filing, storing books and personal ownings
- a moveable pedestal under the executive desk
- possibly a showcase
- a phone
- a desk pad
- a sound system
- a cable management near and on the executive desk
- a computer (flat screen, I mac or laptop)
- a paper organizer
- a penholder
- lighting
- a wastebasket
- other accessories are possible, depending of the user

## 1.4 Market

The market in Indonesia will be taken into account. The small amount of products made for export will not be used in this research.

### 1.4.1 Competitors

The big competitors of Indovickers in the Indonesian market are:

<b><i>Furniture, which is imported</i></b>	<b><i>Local furniture</i></b>
<i>Vivere</i>	<i>Morelli</i>
<i>Vilato</i>	<i>Vinotti</i>
<i>Fantoni</i>	<i>Datascript</i>
<i>Index (low price, no service)</i>	

Table 4: Competitors of Indovickers

They make similar products and have a big influence on the furniture market. Index, for example, can be compared to IKEA, and sells a lot of medium quality furniture at lower prices.

Big companies or institutions in Indonesia, like the BCA bank or government, prefer the higher quality furniture. They contract furniture companies, like Indovickers, for their interior projects.

### 1.4.2 Trends and developments

Executive desks become more minimalistic, futuristic and modern. A desk with a 'floating' glass tabletop and chromed legs, for example.

The use of metals and silver colours is a clear development in the market. Especially aluminium is conquering the furniture market.

An increasing amount of companies are using cheaper woods, like MDF. Original woods are becoming rare and expensive, because the rainforests are becoming 'empty'. The new materials, with their finishing, look like original woods.

The furniture for the government is classically designed. The furniture for the private market (managing directors) is slim, 'light' and minimalistic.

The government prefers the classical models, but little by little their taste is changing towards modern models.

## **1.5 Demands and wishes**

The target group have their wishes and every person have different needs. The demands and wishes are described in this chapter.

### ***1.5.1 Wishes of the target group***

The R&D Team and the Marketing Division gave their opinion about the executive desks and the board room. The managing director has the most counting opinion. Unfortunately it was not possible to collect much 'personal' information of the users.

The President-Director of Indovickers was the only person, who gave his opinion.

The wishes and requirements from the target group, marketing department and R&D Team are:

- the desk must have a minimalistic design
- modern
- not fashionable, long lasting design
- the combinational use of new materials, like aluminium, steel, glass
- a floating tabletop, which makes the desk slim and not bulky
- light colours of the woods, veneer or lamination
- mobile furniture suitable for flexible arrangement
- a solution for the cable management
- adjustable table legs to catch the irregularities of the floor
- a solution for the slippers/ sandals of the Muslim directors, who often put their sandals under the desk. They use slippers most of the time, because they pray five times a day.
- a small part of the desk can be used for small meetings
- a new design of the paper storage
- a small whiteboard
- storage for coats
- better lighting
- no ashtray built in the desk

### ***1.5.2 Ergonomic demands***

The designer must have extensive information about the user of the designed product.

Without taking account of the user, the product can be useless or even dangerous.

In case of the executive desk, physical and visual ergonomics must be taken into account.

The user is unique, and that is why designers want to use the most common dimensions of people.

The world population can be divided by three groups: the Negroid, Mongolians and Indo-Europeans. The division is very shallow, because Dutch people are different from Indonesian people.

The Asian people are also called 'sit-giants,' because they have relative short legs and a long upper part of the body.

Users of the desk want to work comfortably behind it.

Theoretically, this can be achieved by the adjustment of the table-height or the seat-height and the floor-level (using a foot rest).

However, it is not ideal to adjust the table - height, because of the difficulties with the unification of the technical and visual aspects.

The alternative is to adjust the seat-height and the floor-level.

The envelope of reach is a used model to determine the reach of the user. In the above or side view, the designer can see how the maximum reach is of the hands. The designer of the executive desk must pay attention to people with short arms and with people with long arms.

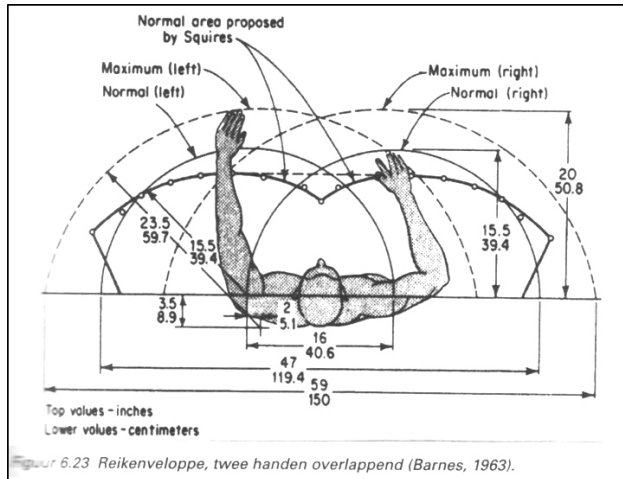


Fig.23: Reach envelope

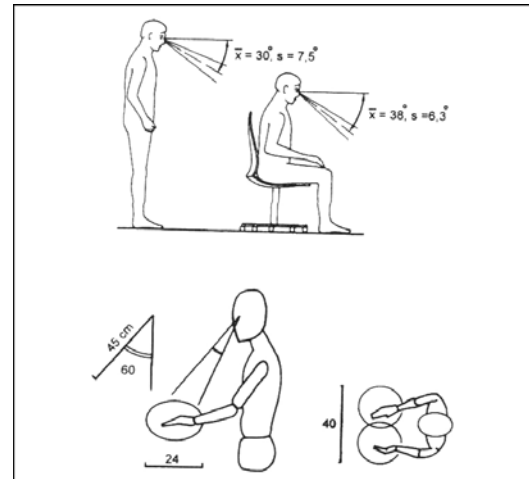


Fig.24: Visual - manipulative comfort zone

The reach envelope can be symmetrically specified, with an overlap in area where both hands can easily reach, because in many situations both arms can be used separately.

The optimal field of vision does not take into account the optimal envelope of reach of the two hands. When the user sits, he will look down with an average angle of 38 degrees under the horizontal. His looking direction will cross a table at 1.5 times the vertical distance from eye till tabletop.

The achievement to compromise the optimal vision and the comfortable hand positions is called VMC: Visual-Manipulative Comfort zone. Then the user will look down with an angle of 60 degrees under the horizontal.

The relevant ergonomic aspects are:

- A standard size for the tabletop of executive desks, of the conference type, is 180 by 90 centimetres.
- The proper height for using a computer keyboard is around 22.9 cm above the seat.
- The minimal writing space must be 61.0 cm by 40.6 cm.
- The height of writing must be from 25.4 till 30.5 cm above the seat.
- The width of the table is minimal 0.79 metres, measured from the front table leg to the back table leg.
- The common height of the desk is 76.0 centimetres.

During the design of the executive desk, there will be feedback on the ergonomic requirements.

The needed measurements are viewed in *Enclosure E*.

### 1.5.3 Cost specific demands

The executive desks cost around the 2 – 20 million IDR. The price depends on the materials and production processes used.

Low level executive desks cost 2 million IDR, middle level desks cost 4-5 million IDR and the high level desks cost between 8 – 20 million IDR.

It is expected, that the new executive desk will be positioned in the high level. The reason for this choice is to design a new exclusive executive desk, which uses new materials, and therefore the desk may be more expensive. The aim is to have a new executive desk, which is categorised in the middle level.

### 1.5.4 Specifications

Requirement	Explanation	Specification
1. The executive desk can be customised.	The customer must be able to choose options.	Three different sizes of the desk are available.  The materials can be selected by the customer.
2. The executive desk must have enough working space.	The user must be able to work comfortably. A laptop or flat screen can be settled on the desk.	The minimal writing space is 610 mm by 406 mm.  A standard executive desk, a conference type, is 1500 or 1800 mm by 900 mm. The height is between 730 mm – 780 mm.
3. The executive desk must have a strong tabletop.	Sometimes a person wants to lean or sit on the desk.	The executive desk will not break, if one person (max. 90 kg) sits on the desk.
4. The executive desk must have cable management.	To avoid chaotic cables, there must be a solution to organise the cables from and near the desk.	The cable management must have the ability to store an in bow socket or an out bow socket. Three sockets is the minimum. The data and telephone line must be separated from each other and from the electric cables.
5. The legs must cover the irregularities of the floor.	Floors are not 100 % even.	The table leg must be adjustable in a range of 40 mm.

Table 5: Specifications of the new executive desk

# Concept generation

## 2.1 Concepts

During the concept generation, many drawings and sketches were made, to visualise the ideas to the R&D Team and the manager.

The important sketches and drawings are inserted in this report. All sketches and drawings can be found in the supplements *Sketch books I & II*.

### 2.1.1 Orientation phase

In this phase, different coloured sketches were drawn, to find a clear view of the product and the differences between 'normal' and executive desks.

The following sketches are selected, which give a good image of the process during this phase.

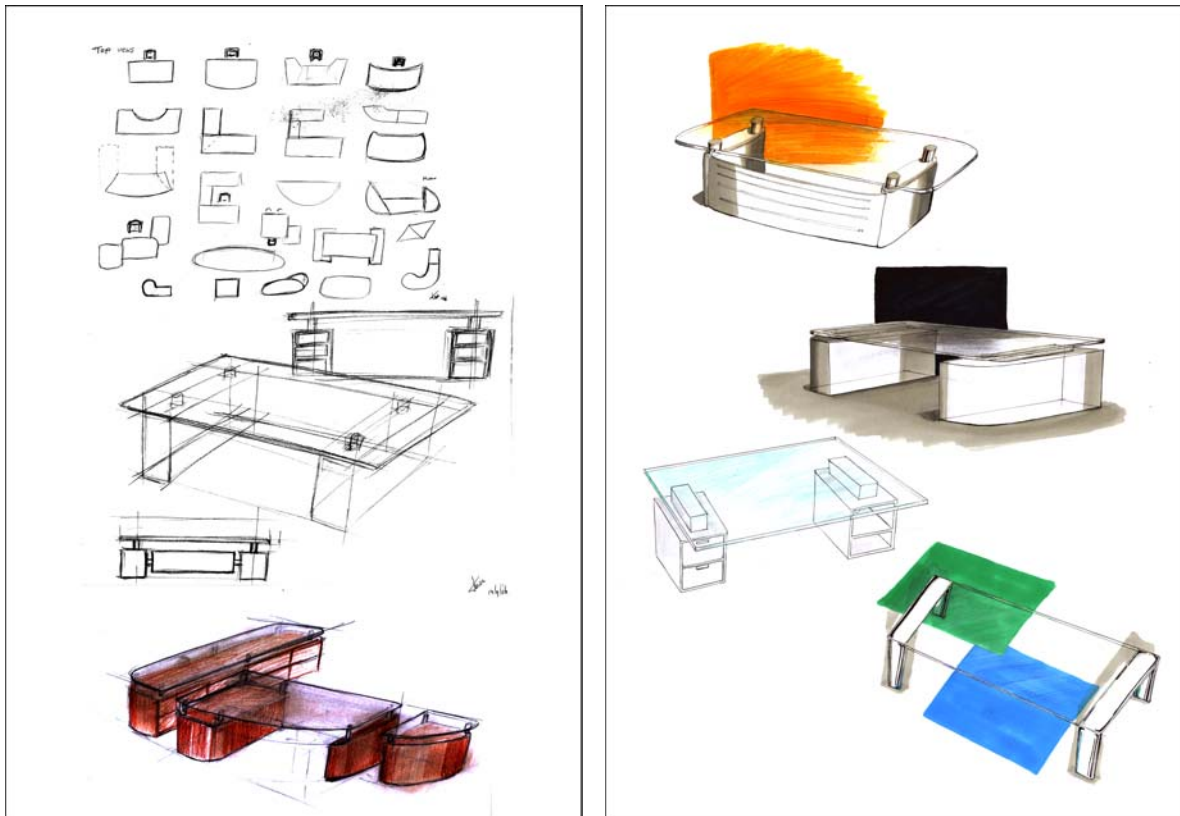


Fig.25: Sketch view phase I; orientation

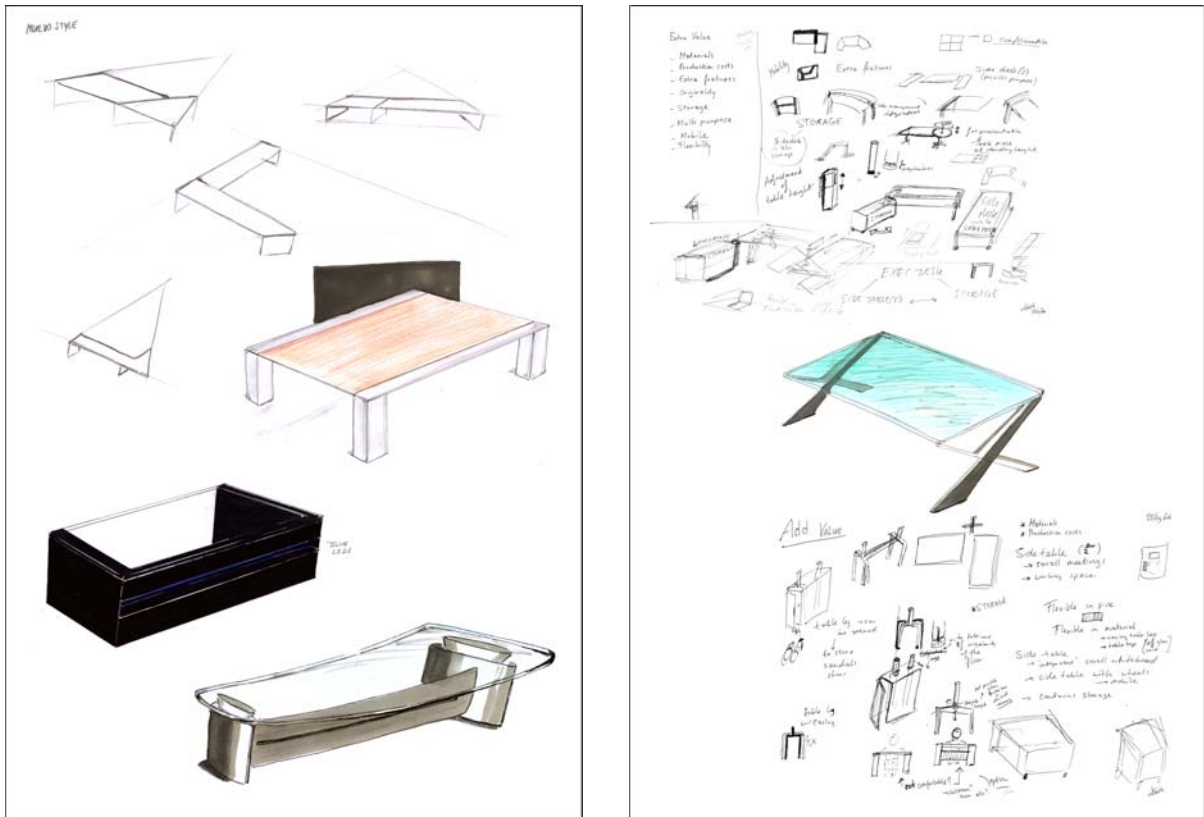


Fig.26: Sketch view phase I; adding selling points

### 2.1.2 Feedback

After the orientation phase, the R&D Team and manager gave feedback. With this feedback, and the information from the Marketing Division, the direction of the design was determined.

The feedback at the sketches:

- keep following the wishes/preferences of the Marketing Division
- the design must be minimalistic
- the floating tabletop is a nice element, but not a demand
- the glass tabletop is appealing
- combination of new materials with wood; steel, aluminium, glass
- possibly design a mobile side desk, which can be used for a small meeting
- the (side) desk for small meetings must maintain the status of the managing director(not a table, where the managing director has not an important seat and sits on a same level).

The next steps in the concept generation are given:

- add value to the design (selling points)
- design the table, configuration, storage, cable management
- specify in detail the table legs / structure

### 2.1.3 Second phase

After the feedback, new sketches were made. There is focused on adding selling points to the concepts and the details of the concepts.

The sketches and drawings, of this phase, can be found in *Sketch book II*.

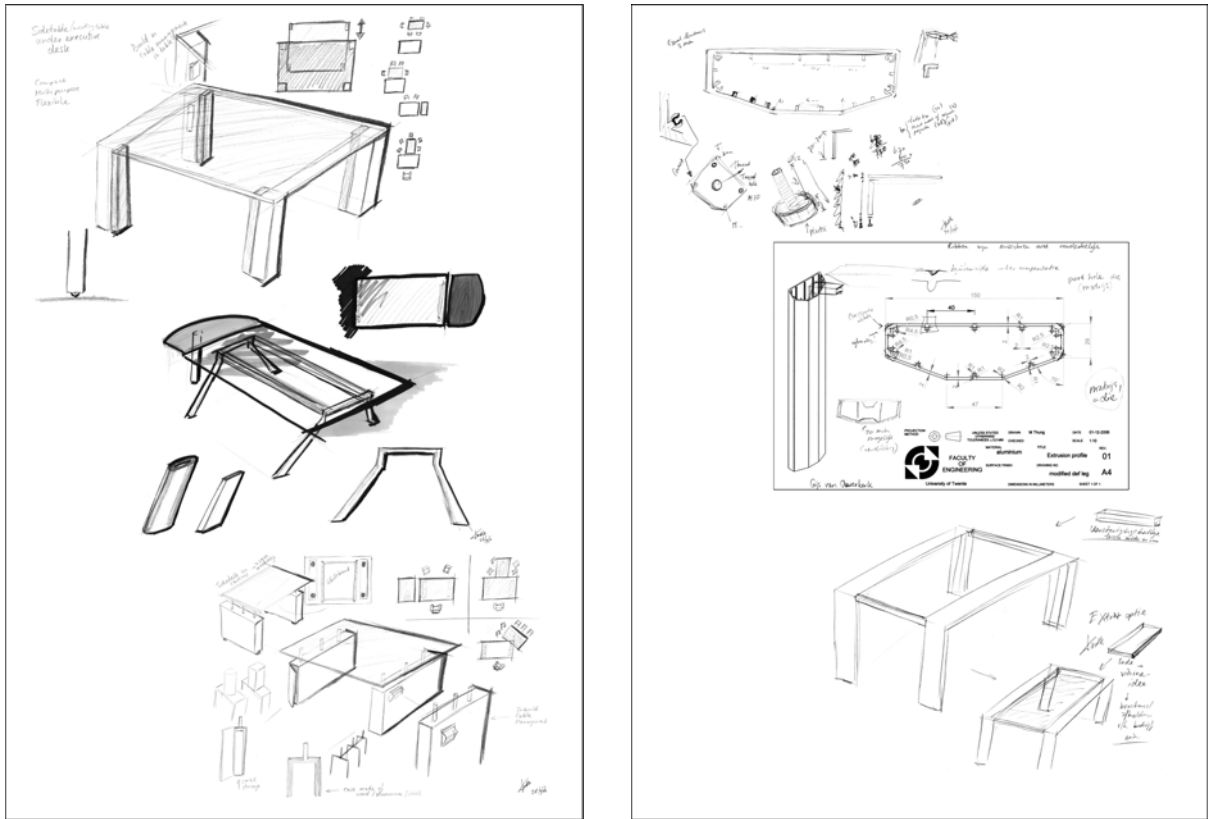


Fig.27: Sketch view phase II

*Classic design*

Concept 1 is based on a classic design. The design has simple lines and forms. The basic form is the rectangle.

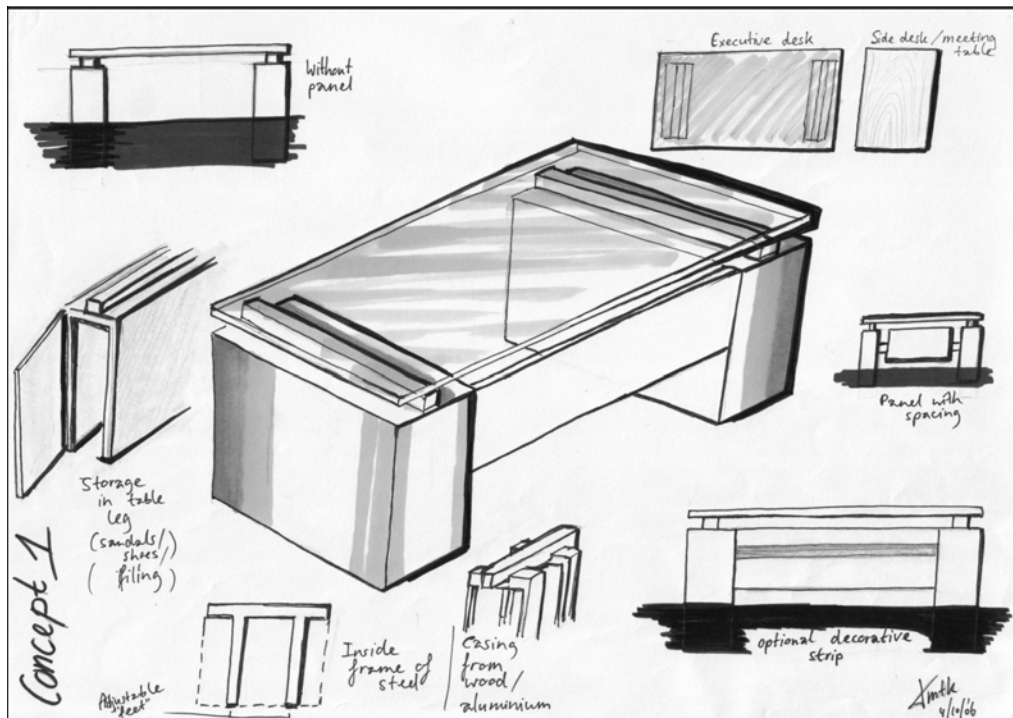


Fig.28: Concept 1: classical desk



The selling points of this design are:

- Adjusters in the table legs to cover the irregularities of the floor.
- The table legs have casings, which offer the ability to build in a drawer in the leg or for other storage possibilities. For example: to store the sandals of the managing directors (many directors are Muslim) or for magazines, CD's and office tools.
- These casings can be produced from a metal, like aluminium, or laminated multiplex. So the user has options.
- The cable management can be built in the table legs.
- The 'floating' tabletop makes the desk visually lighter.
- The tabletop can be made from glass, but a wooden tabletop is possible, too.
- The desk can fit in the most board rooms.

The frame of the table leg takes a lot of volume. Therefore, the leg is bigger than expected. Consequently, the executive desk will look more classical than modern. The R&D manager gave some feedback and the new design can be more minimalistic and modern.

This feedback is used to generate concept 2.

### *Modern design*

This second concept is based on a modern design. The design is very simple, basic and innovative. Few similar executive desks are on the Indonesian market. The selling points can be found in the innovative techniques and the use of new materials, with reference to the trends and developments in the Indonesian market.

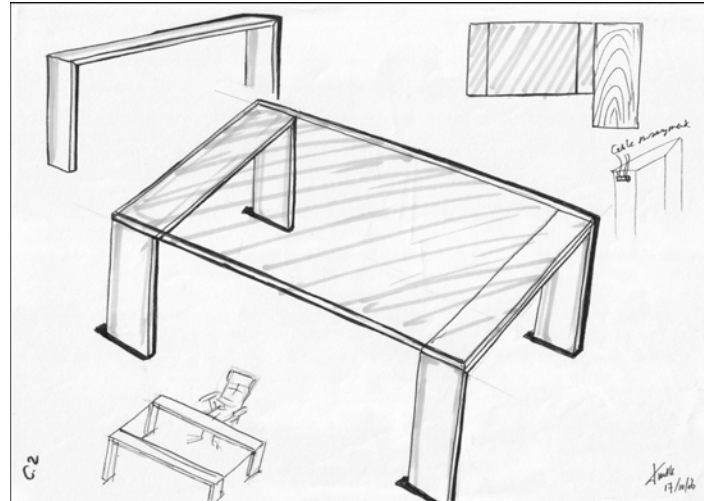


Fig.29: Concept 2: modern desk

The materials of the legs are metals, like iron and aluminium. The tabletop is made of glass, and instead of glass, the tabletop can be made of wood. The table legs and crossbars are extruded by using one mould.

## 2.2 Definitive concept

The definitive concept is selected from the two concepts. The second concept, the modern based design, is selected. This chapter describes the decision and motivation.

### 2.2.1 Decision based on demands and wishes

The important demands and wishes are used for the decision of the definitive concept. Concept 2 has a modern and a minimalistic design. The combination of materials is achieved by using aluminium and glass.

The desk does not have a floating tabletop, but a 'light' construction of the aluminium and the glass tabletop makes the desk visually light and not bulky.

The executive desk itself does not have to be mobile, because the desk will not be moved, when it is placed in the board room.

Managing the cables is not a problem in combination with this desk.

The desk has adjustable table legs to cover the irregularities of the floor.

### 2.2.2 Decision based on the final presentation

A final presentation was held at the end of the two months. This final presentation was given in front of the President-Director Loekman, Mrs. Thea (marketing), Mr. Bram (marketing), Mr. Chodery (project administrator), Mr. Janardana (head R&D), Daniël Sudarsono and Camelia Bunardi (both from the R&D Team).

During this presentation, the two concepts were viewed and described. The President-Director and the others gave feedback and they preferred the slim design of concept 2. After this presentation the decision was made. Concept 2 became the definitive concept, to be further developed.

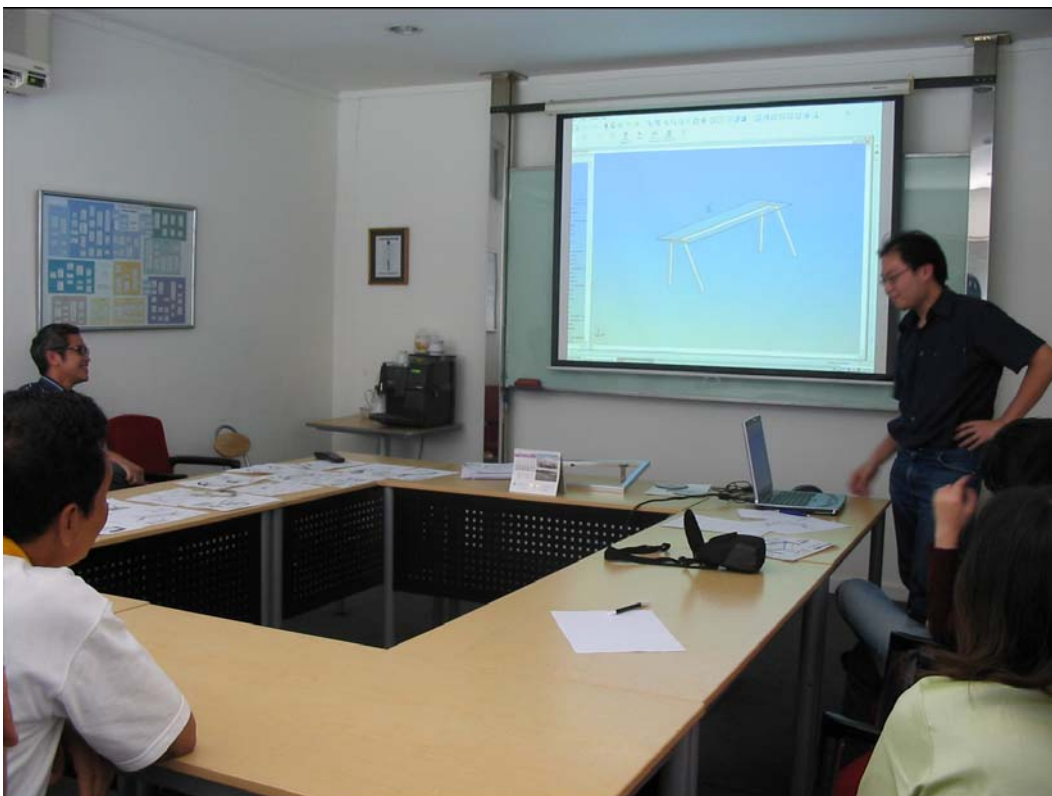


Fig.30: Final presentation in Jakarta

# Detailed design

## 3.1 Detailed view of the definitive concept

The definitive concept is concept 2, and will be viewed with the motivation of the design choices, using SolidWorks drawings.

### 3.1.1 The definitive concept

The presentational drawing of the definitive concept:



Fig.31: Presentational drawing

### 3.1.2 Concept specification

The specification of the definitive concept is described and more information about the measurements can be found in the technical drawings in the supplement *Technical drawings-book*.

The model of the definitive desk, in this report, has the size 1800 x 900 mm.

#### *Aluminium extrusion profile*

In the Netherlands, Gijs van Ouwkerk, researcher at the University of Twente, gave his opinion about the aluminium extrusion profile. He asked a Dutch aluminium extrusion company and the conclusions were:

- the mould for the aluminium extrusion profile is realisable.
- the ribs give the profile strength, but these ribs can cause very small local deformations at the outside. This deformation must be taken into account. In the definitive concept, these small deformations do not give problems to the appearance.
- if the ribs are fluently in the profile, then they will not give deformations.
- the outside corners of the profile must be thinner to achieve a constant thickness.

With these conclusions, the aluminium extrusion profile is adjusted.

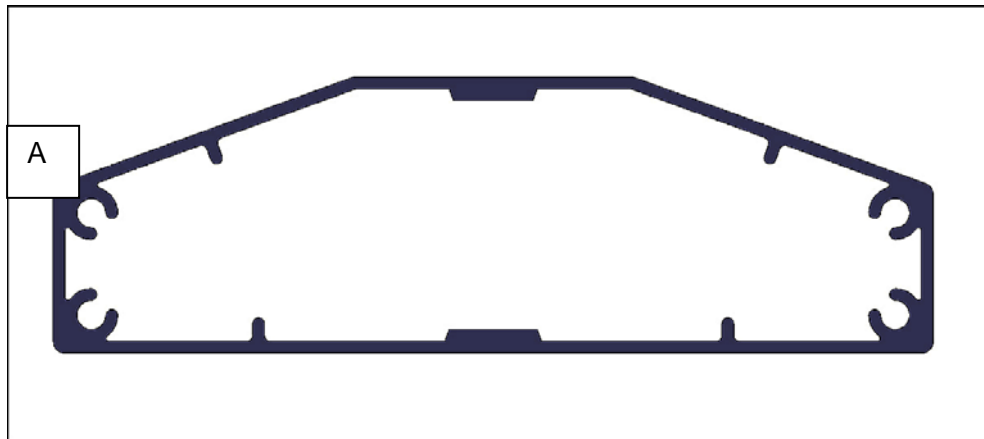


Fig.32: The adjusted aluminium extrusion profile

The four corners, one is pointed at 'A' in Figure 32, are designed for the screws of the sheet metal for the adjuster and they give strength to the construction. The screws will be tightly locked in these holes at the corners.

#### *Glass tabletop*

The tabletop can be made of wood, but for this design the tabletop is made of hardened glass. The tabletop will be glued by a 2 - component glue and is strong enough to keep the two leg assemblies at their place. The glass will break quicker than the glued connections, if there is too much force applied on the desk.

The tabletop is available in three different sizes: 1800 x 900 mm, 2000 x 900 mm, 2200 x 900 mm. These sizes are often used for executive desks. The thickness of the tabletop is 15 mm.

The surface of the glass tabletop can be modified, like being frosted, being engraved, using milk glass, and using other colours of glass. The edges of the glass tabletop are honed. The information about hardened glass comes from Vitriline, Hengelo, The Netherlands (*Enclosure H*).

#### *Connector*

The connector is a symmetrical bracket, made by iron casting. The four holes with threads and the M8 screws will lock the bracket in the table leg and crossbar.

The connector tightly fits in the ribs of the extruded profile.



Fig.33: The connector



Fig.34: Section view of the table leg

#### *Glider, adjuster and the sheet metal for the adjuster*

The glider is made of iron and is screwed into the adjuster, which is from strengthened ABS. The sheet metal is also made of iron and is attached to the table leg with M6 flat head screws.

The executive desk can cover the irregularities of the floor by this adjuster system. The range of the adjuster is 40 mm.

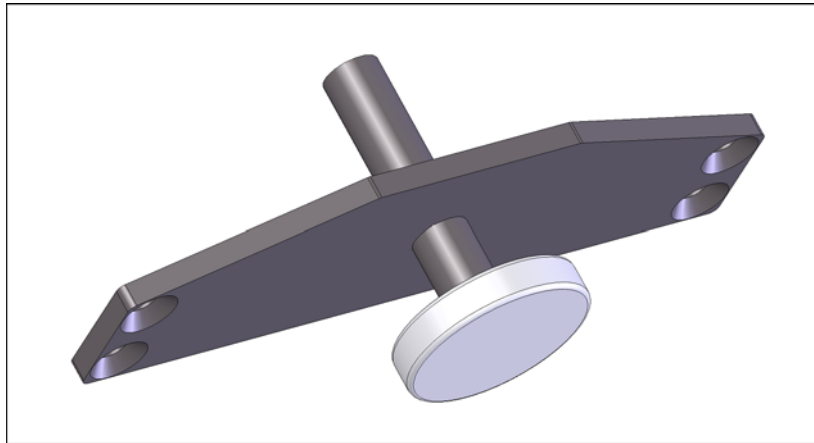


Fig.35: Adjuster system

#### *Screw cover*

The visible screw heads are not appealing and standard screw covers hide these screw heads.

### **3.1.3 The production techniques to produce the definitive concept**

The following production techniques are used in the production of the definitive concept of the executive desk.

Drilling, cutting, and honing are the basic techniques, which will be used.

The aluminium parts are produced by the extrusion of aluminium. These parts will be epoxy powder coated or polished.

The iron parts are cast.

The tabletop is glued to the leg assemblies and the plastic parts are made by injection moulding.

### **3.1.4 Cable management**

Many executive desks have a problem with the storage of cables of electronic devices.

Much electronic devices, like the PC and telephone, have cables. Without cable management, those cables cause a messy environment on and around the desk.

The photo of an executive desk provides a clear view, why it is important to have a good cable management. The executive desk has an inbuilt grommet in the tabletop, but the cables are not well organised.



Fig.36: Cables on the desk

New products can solve the problems with the cables. Figure 37 shows products of the series Evoline from Schulte Elektrotechnik. Most of these products are built in the tabletop.

The definitive concept of the executive desk has a glass tabletop. This makes a grommet or an inbuilt tower expensive and less appealing, because the part of the tower under the table will be visible by the transparent glass tabletop.

It is possible to build in cable management in the pedestal (UMP), which is placed under the executive desk. The problem is that the pedestal loses its mobility by the connection of the cables.

A total new design of a separate cable management for the definitive concept is possible, but designing this cable management will acquire a new design process. Therefore this alternative is not selected.

A good alternative is an existing unit, which can be placed on or under the desk. No perforation is needed and the design of these hubs is appealing in combination with the design of the executive desk.



Fig.37: Cable management; Evoline series



Three sockets in a hub are enough to meet the demands of the user of the desk. The data cable and the telephone line have separated lines and inputs, which are integrated in the unit. Figure 38 shows the Evoline V-dock.

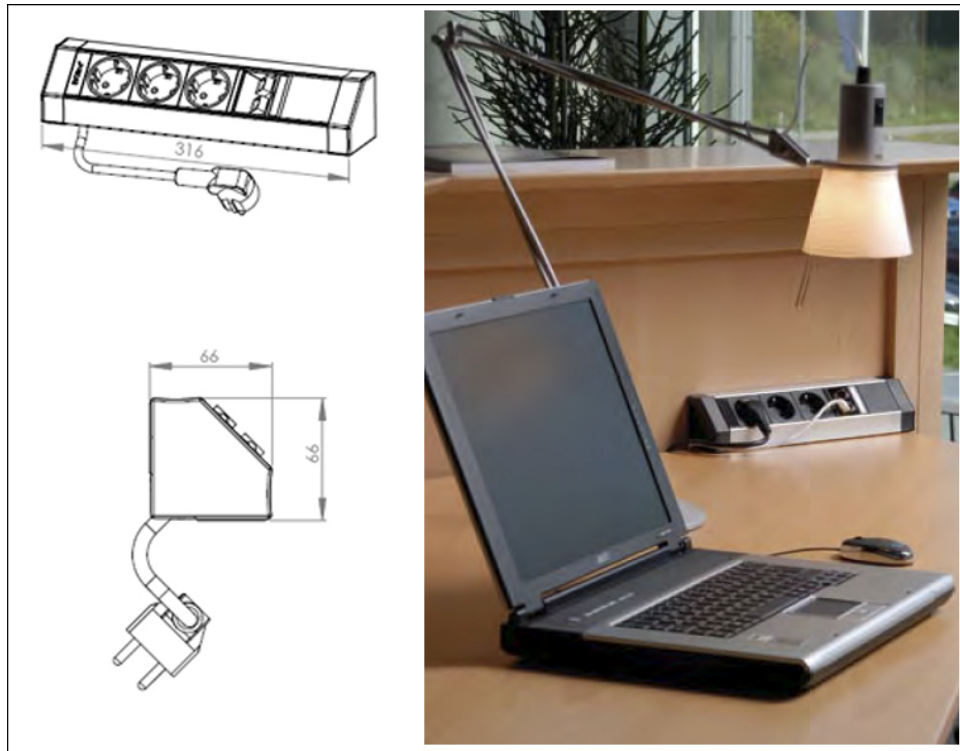


Fig.38: Cable management; V – dock

The V-dock is selected for the definitive concept of the executive desk, because the dock has enough sockets, and the data cable and phone line can be connected.

The cables, which are leaving the dock in the back, will be put in a cable hose. This cable hose is flexible and leads the cables from the dock to the floor.

The definitive executive desk has a silver coloured cable hose. The colour can be adjusted, depending on the colour of the table legs.



Fig.39: Cable hose

### 3.1.5 Price calculation

The price calculation is an important aspect for determining the market feasibility of the executive desk, and can be found in *Enclosure F*.

The complete price calculation is an estimation and an indication of the selling price.

During the calculation it is assumed, that 1 euro is 10,000 IDR (Indonesian Rupiah).

The total production costs are 1,894,504 IDR, the labor and factory overhead costs are 20% of the total production costs.

The selling price of this executive desk is calculated by using a profit margin of 50% of the total costs of the desk. This means that the selling price is 4,546,809 IDR.

### 3.1.6 Force calculation

The executive desk is designed in such a way, that the glass tabletop must support a great amount of load. The force calculations are used to check the bending and stresses of the construction.

The table legs are infinitely rigid and the legs in the support points can only rotate.

The bending has a greater influence on the construction than the torsion.

The load is 150 kg, so the force is 1472 Newton.

The force calculations can be found in *Enclosure G*.

The conclusions of the force calculations are:

<i>Calculation no. and description</i>	<i>Conclusion</i>
I: The bending of the glass tabletop and aluminium crossbar. The force is on the outside of the crossbar, and therefore a half of the total load.	The bending, during a load of 150 kg, is -0.3 mm.
II: The bending of the glass tabletop only.	The glass tabletop will bend for -0.6 mm.
III: Bending a part of the tabletop – surface. This is a realistic situation, where the load is applied on a part of the surface.	The bending of the surface is -1.3 mm.
IV: The stress is calculated for the glass and aluminium parts of the construction.	The maximum $\sigma$ (sigma) of the aluminium construction is 3.3 MPa. This is much lower than the average value of 310 MPa.  The maximum $\sigma$ of the glass tabletop is 9.9 MPa and is much lower than the average value of 70 MPa (ordinary glass). The value for hardened glass is even higher, 280 MPa.

Table 6: Force calculations of the desk

It can be said, that a maximum load of 525 kg can be put on the executive desk, without breaking the glass tabletop.

With the load is 150 kg, the minimum glass width is 130 mm, by a thickness of 15 mm, at 70 MPa. So it is possible to focus the load on this glass width, without breaking the glass. The executive desk is strong enough without using an extra crossbar between the two leg assemblies. The design of the desk can be kept simple, minimalistic, strong and safe for the users.



## Conclusions and recommendations

With the research and concept generation, a new executive desk is developed, with sale potential in the Indonesian market.

The analysis phase is not extensively executed, but the direction for a new design was clear and well used during the design process.

The design of the new executive desk is modern, simple, minimalistic, innovative and has already received positive feedback from lecturers and other fellow students.

In this assignment, the focus was on the concept generation of the design process.

Unfortunately there was not enough time and opportunity to design a completely new executive desk series with an accompanying credenza and side desk. Usually the designer of a new executive desk has to design the desk, the credenza and other accompanying pieces of furniture at the same time. Designing these pieces of furniture in the same style is important to the company and potential users.

The executive desk seems strong enough to cope with a load of 525 kg; therefore no extra crossbar is needed between the two leg assemblies. The purpose of these force calculations is only for a roughly check of the strength of the desk.

The R&D Team of Indovickers uses an external company to calculate these forces and it is recommended to execute such 'professional' force calculations.

The cost calculation gives an indication for the feasibility of the new executive desk in the Indonesian market. It was expected, that the new desk became expensive, but the cost calculation gave a lower selling price.

The price can be categorised in the middle level of executive desks, and stays competitive on the market.

Angèle Reinders and Jacques Stevens gave feedback on the design of the definitive concept, which may improve the desk. One good example is to look at the table leg construction, which can be made from wood with aluminium strips as accents.

The glass tabletop can fulfil a showcase function. The use of LEDs in the table construction can increase the appeal of the desk.

The technical drawings allow for building a mockup. This mockup might be built in Jakarta. Later on, it can be tested on ergonomic aspects in a user test.

The important ergonomic aspects are covered in the design of the definitive concept.

The conclusions and recommendations can be used in the research for the new executive desk series for Indovickers.

## Quotation of sources

- Book Verschuren, P. & Doorewaard, H. (2000), *Het ontwerpen van een onderzoek*, 3rd edition, Lemma bv, Utrecht, ISBN 90-5189-886-X
- Book Eger, A.O. (1996), *Succesvolle productonwikkeling*, 1st edition, Kluwer BedrijfsInformatie, ISBN 90-267-2465-9
- Book Dirken, J.M. (2001), *Productergonomie: Ontwerpen voor gebruikers*, 3<sup>rd</sup> edition, DUP Blue Print, Delft, ISBN 90-407-1464-9
- Book Jensen, C.H.; Helsel, J.D. (1996), *Engineering drawing and design*, 5<sup>th</sup> edition, Glencoe/McGraw-Hill, U.S.A., ISBN 0-02-801795-1
- Book Panero, J.; Zelnik, M. (1979), *Human Dimension & Interior Space*, 1<sup>st</sup> edition, Whitney Library of Design, U.S.A., ISBN 0-8230-7271-1
- Book Woodson, W.E. (1981), *Human factors: Design handbook*, 1<sup>st</sup> edition, McGraw-Hill, U.S.A., ISBN 0-07-071765-6
- Book Hibbeler, R.C.; translated by J.L. Rietdijk (1997), *Sterkteleer voor technici*, 1st edition, Academic Service, Schoonhoven, ISBN 90-395-0537-3
- Duplicated lecture notes Siang, O.W; Lim, V. (unknown), *Manufacturing Technology 6: Wood Technology*, 1<sup>st</sup> edition, Swinburne University Technology, Australia
- Duplicated lecture notes Hatters, A. (unknown), *Manufacturing Technology 6: Aluminium & Alloys*, 1<sup>st</sup> edition, Swinburne University Technology, Australia
- Internet <http://www.indovickers.com/>  
(The company, many visits)
- Internet <http://www.hpva.org/products/prodinfo/veneer%20cuts.asp>  
(Veneer slicing, 4 September 2006)
- Internet <http://www.vtindustries.com/graphics/SlipMatch.jpg>  
(Veneer matching, 4 September 2006)
- Internet [http://www.polyrey.com/index.asp?id\\_lingue=2&id\\_marche=2](http://www.polyrey.com/index.asp?id_lingue=2&id_marche=2)  
(PVC edging, 13 September 2006)
- Internet <http://www.donworth.ie/Interiors/CableManagement/Index.htm>  
(Cable management, 3 October 2006)
- Internet <http://www.schulte.com/>  
(Cable management, 3 October 2006)

# Enclosures

## Enclosure A      Questions and answers target group

### *Questionnaire target group*

This questionnaire is formulated to collect information for the target group analysis.  
At this moment I am working at my bachelor assignment. My assignment is to design a new executive desk series. The target group includes directors.  
I want to thank you in advance for answering the questions.

Name:.....

Occupation:.....

*More answers are possible*

1. What are your activities in the director room, during working days?
  - a. Meeting visitors
  - b. Making phone calls
  - c. Using the computer
  - d. Writing
  - e. Reading
  - f. ....
  
2. What is your behaviour like, when you are working?
  - a. Be concentrated
  - b. Be relaxed
  - c. Be formal
  - d. Be informal
  - e. ....
  
3. What is your behaviour like, when you are relaxing?
  - a. I do sports
  - b. I watch TV
  - c. I read
  - d. I listen to music
  - e. I sleep
  - f. ....
  
4. What do you want to carry out towards employees and visitors, according to your executive desk?
  - a. Status, prestige
  - b. Professionalism
  - c. Elegancy
  - d. Simplicity
  - e. ....

5. What do you think about the personal storage, according the capacity?
  - a. The personal storage is too small
  - b. The personal storage has a good size
  - c. The personal storage is too big
  - d. I want to have storage for my hobbies (sport gear, collector items)
  - e. ....
  
6. What do you think about the personal storage, according the appearance?
  - a. The personal storage must be more safe
  - b. The personal storage must be out of sight
  - c. The personal storage is placed too far from me
  - d. The personal storage can be re-designed
  - e. ....
  
7. What do you think about the book storage, according the capacity?
  - a. The book storage is too small
  - b. The book storage has a good size
  - c. The book storage is too big
  - d. ....
  
8. What do you think about the book storage, according appearance?
  - a. The book storage must be redesigned
  - b. The book storage takes too much space in the room
  - c. The book storage has a bad interior
  - d. The design of the book storage is not important to me
  - e. ....
  
9. What do you think about the paper storage, according the capacity?
  - a. The paper storage is too small
  - b. The paper storage has a good size
  - c. The paper storage is too big
  - d. ....
  
10. What do you think about the paper storage, according the appearance?
  - a. The paper storage on my desk bothers me
  - b. The paper storage is placed too far from me
  - c. The paper storage has a standard design
  - d. The paper storage must be integrated in the executive desk
  - e. ....
  
11. What do you think about the cable management?
  - a. The cables are hanging /lying chaotically
  - b. The cables are well ordered
  - c. The cables must be hidden away
  - d. The cable management must be re-designed
  - e. ....
  
12. What do you think about the lighting facilities?
  - a. There is not enough light for lighting the desk
  - b. I do not prefer to have a desk lamp
  - c. I want to have ambiance lighting in my room
  - d. The design of the lighting must be in the style of the desk
  - e. ....

13. What are the positive aspects of your executive desk?
  - a. There's enough working space on the tabletop
  - b. There is enough space for my legs and feet
  - c. The design of the executive desk is satisfying
  - d. The executive desk lead to comfortable working
  - e. ....
  
14. What do you like to be changed from your executive desk?
  - a. The design can be renewed
  - b. The colours can be changed
  - c. The charisma of the desk is not present
  - d. There must be more working space
  - e. The desk can be smaller
  - f. The desk can become more efficient
  - g. ....
  
15. What do you prefer to have: a classic or a modern inspired designed executive desk (see pictures below)?
  - a. A classic inspired design
  - b. A modern inspired design
  - c. A combination of classic and modern



*Classic versus modern*

16. Which materials do you like to see in a new executive desk?
  - a. Wood
  - b. Stainless steel
  - c. Aluminium
  - d. Glass
  - e. Plastics
  - f. Stone
  - g. ....
  
17. What do you think about the costs of a new executive desk? Are you willing to buy an expensive executive desk?
  - a. Maximal of 2500 euros / maximal 29 million IDR
  - b. Between 1500 euros and 2000 euros / between 17 – 23 million IDR
  - c. Between 1000 and 1500 euros / between 12 – 17 million IDR
  - d. Under 1000 euros / under 12 million IDR
  - e. ....

18. Which executive desks do you prefer mostly? (choose your top 3 of the preferable executive desks, shown under)

TOP 3

1:

2:

3:



a



b



c



d



e



f



g



h



i



j



k



l



m

## ***Answers Questionnaire Target Group***

Interview 1

Name: Mr. Loekman, President – Director Indovickers

Date: 13 September 2006

The questionnaire is hardly used. The President – Director gave his opinion about executive desks, requirements and wishes.

The main activities of a managing director are:

- calling
- paperwork processing
- meeting visitors
- using laptop

It is important to have a good cable management.

A hanger for coats and suits are convenient to have.

The desk must be available in 2 or 3 different sizes.

The executive desks will be sold in small amounts, but it will influence the image of the company positively.

The (wooden) desk may have some leather, but not too much, or else it will look like home furniture.

The design of the desk must be modern, not fashionable. So it must be a long lasting design.

During the assignment you have the freedom in shapes. At the start you can use the rectangle as base.

In case of cabins, you have to be aware that the A4 maps and ordners can fit.

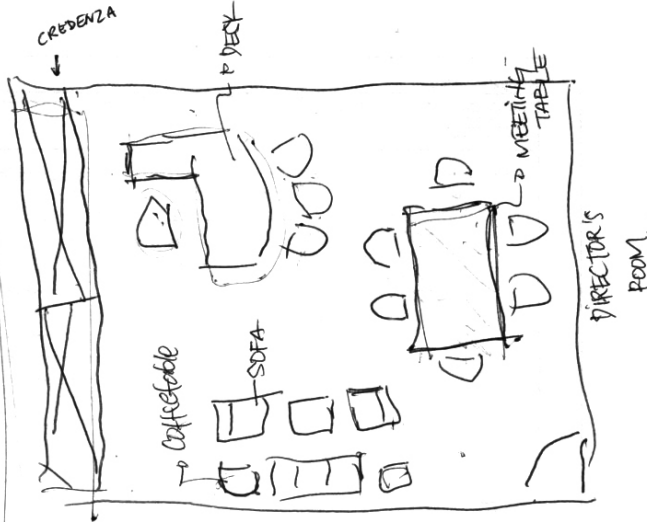
There must be a possibility to adjust the table legs.

The selling price of the executive desk is around 8 -10 till 30 million IDR.

Note: unfortunately I had little time, because Mr. Loekman had a meeting after this questionnaire. He gave me notes of the requirements and wishes.

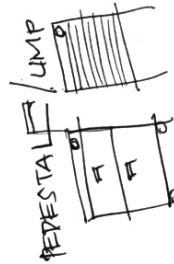
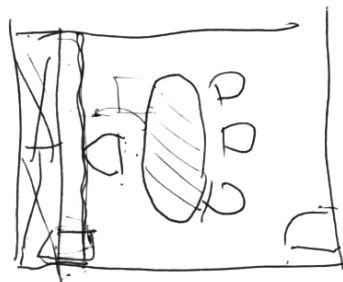
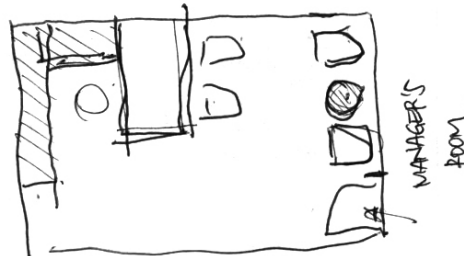
# Notes of the President-Director

- 1) MAIN TABLE 2 or 3 sizes. / shape
- 2) SIDE TABLE
- 3) CREDENZA <sup>2 access</sup> <sub>PLASTIC</sub>
- 4) CUPBOARDS / Glass doors <sub>cust (green) alum frame door</sub>
- 5) LOUNGE CHAIR
- 6) coffee table
- 7) End table
- 8) Visitor's chair
- 9) Server (opt)
- 10) planter's box.
- 11) Coat hanger
- 12) Pin Board / white board
- 13) Table lamp / light box (opt)



## CRITERIA :

- 1) Cable management / elec, phone, data outlet.
- 2) HPL / Veneer top / Glass. (TABLE TOP)
- 3) Wood / Metal frames / Aluminium.
- 4) knockdown (packaging)
- 5) Modern but not fashionable.
- 6) legs must have adjuster.





## **Enclosure B            Questions and answers Market Division**

### ***Questionnaire Marketing Division***

This questionnaire is formulated to collect information for the market analysis. At this moment I am working at my bachelor assignment. My assignment is to design a new executive desk series. The target group includes managing directors.  
I want to thank you in advance for answering the questions.

Michael Thung  
(Trainee at the R&D department)

#### Questions:

1. What is the position of Indovickers in the Indonesian market\*?
2. What is Indovickers' strategy to maintain its position in the market?
3. What are the competitors of Indovickers, according to executive desks?
4. What are the materials that Indovickers use and buy?
5. What are the most common woods, which are used for executive desks?
6. What are the most common veneers and laminates, which are used for executive desks?
7. What are the trends and developments in the market?
8. What is the range of the selling price of executive desks?
9. What are the costs for producing one executive desk, like the one from the Eclipse series?
10. Which aspects of the desks do you like, shown on page 2?

*\* In the domain of furniture*



a



b



c



d



e



f



g



h



i



j



k



l



m

## **Answers questionnaire Marketing Division**

Interview 1

Name: Mrs. Thea Miranda

Date: 8 September 2006

Question 1: What is the position of Indovickers in the Indonesian market (In the domain of furniture)?

Answer 1: *In Indonesia is Indovickers the number 3 or 2.*

Q 2: What is Indovickers' strategy to maintain its position in the market?

A 2: *The strategy has two aspects. The first aspect is to develop new products, and not only existing products. The second aspect is the service of the company. They maintain a good relationship with customers, designers and consultants.*

Q 3: What are the competitors of Indovickers, according to executive desks?

A 3:

<b>Furniture, which is imported</b>	<b>Local furniture</b>
<i>Vivere</i>	<i>Morelli</i>
<i>Vilato</i>	<i>Vinotti</i>
<i>Fantoni</i>	<i>Datascript</i>
<i>Index (low price, no service)</i>	

Q 4: What are the materials that Indovickers use and buy?

A 4: *The company buy and use glass tabletops (10 mm thick), steel, aluminium and wood.*

Q 5: What are the most common woods, which are used for executive desks?

A 5: *For executive desks they use often plywood and MDF.*

Q 6: What are the most common veneers and laminates, which are used for executive desks?

A 6: *This is dependent from the colours of the veneer of the cabinets/furniture of the customer. The colours and style must fit in the surroundings of the room.*

Q 7: What are the trends and developments in the market?

A 7: *Consultants like the use of tabletops, which are made from glass (like the desks g and k, standing on the second page of the Questionnaire Marketing Dept.)*

*There is much use of aluminium, for example the aluminium modesty panel. The minimalistic design is a clear development in the market.*

Q 8: What is the range of the selling price of executive desks?

A 8: *The executive desks cost between 5 and 10 million IDR (Indonesian Rupiah).*

Q 9: What are the costs for producing one executive desk, like the one from the Eclipse series?

Q 9: *The production costs for one executive desk is around 50% of the selling price.*

Q 10: Which aspects of the desks do you like, shown on page 2?

A 10: -

Interview 2

Name: Mr. Grandy

Date: 11 September 2006

Q 1: What is the position of Indovickers in the Indonesian market?

A 1: *In Indonesia, Indovickers is in the top 5.*

Q 2: What is Indovickers' strategy to maintain its position in the market?

A 2:

<i>1. Improve products (following the trends of the market)</i>
<i>2. After sell - service</i>
<i>3. Open branches / agencies (at Sumatra and other islands)</i>
<i>4. Follow up the designers</i>

Q 3: What are the competitors of Indovickers, according to executive desks?

A 3: *In the Indonesian market, the competitors, who make similar products, are: Vinotti, Vivere, Vilato and IBU.*

Q 4: What are the materials that Indovickers use and buy?

A 4: *Acrylics (instead of glass), fabrics, steel, aluminium, MDF.*

Q 5: What are the most common woods, which are used for executive desks?

A 5: *Indovickers uses MDF with a plastic veneer. For mass production it is easier to use laminating. Other companies may use original wood with finishing.*

Q 6: What are the most common veneers and laminates, which are used for executive desks?

A 6: *Popular veneers are made from local woods, like sungkai, cherry, teak and beech. The laminates have the same colours of the original woods.*

Q 7: What are the trends and developments in the market?

A 7: *Minimalistic designs, like the desks a, b, m, g. The use of metals and silver colours is a development in the market.*

Q 8: What is the range of the selling price of executive desks?

A 8: *The desk costs around 7 – 10 million IDR.*

Q 9: What are the costs for producing one executive desk, like the one from the Eclipse series?

A 9: *The production price is 60% of the selling price.*

Q 10: Which aspects of the desks do you like, shown on page 2?

A 10: *Desk i and j are ok. Desk k is a bit old fashioned.*

### Interview 3

Name: Mr. Anton

Date: 11 September 2006

Q 1: What is the position of Indovickers in the Indonesian market?

A 1: *In the top 5.*

Q 2: What is Indovickers' strategy to maintain its position in the market?

A 2: *1. Good and stable quality of the products  
2. Service  
3. Price (competitive level: not too high / low)*

Q 3: What are the competitors of Indovickers, according to executive desks?

A 3: *Vivere, Vinott, Decorus.*

Q 4: What are the materials that Indovickers use and buy?

A 4: *Wood, aluminium, steel.*

Q 5: What are the most common woods, which are used for executive desks?

A 5: *The base is MDF and the finish is done using veneer of laminate.*

Q 6: What are the most common veneers and laminates, which are used for executive desks?

Q 6: *In the market the customers prefer veneer (60% chooses for veneer and the 40% chooses laminate).*

Q 7: What are the trends and developments in the market?

A 7: *The furniture for the government is classical designed. The furniture for the private market (managing directors) is slim, 'light' and minimalistic. The government prefers the classic models, but little by little their taste is changing towards modern models.*

*More furniture companies are using cheaper materials, like MDF. Original woods are becoming rare and expensive, because the rainforests are 'empty'. The new materials look like original woods.*

Q 8: What is the range of the selling price of executive desks?

A 8: *The executive desks from a low level cost 2 million IDR, from a middle level cost 4-5 million IDR and the desks from a high level cost between 8 – 10 million IDR.*

Q 9: What are the costs for producing one executive desk, like the one from the Eclipse series?

A 9: *-*

Q 10: Which aspects of the desks do you like, shown on page 2?

A 10: *Mr. Anton gave his ideas and opinion. The floating table - top makes the desk visual lighter and slim. He likes the desk k, because the mix of 'light' and 'heavy.' Dark colours will make the desk look bulky and heavy. Mr. Anton prefers desk g, k, f, i. Desk c is too general and desk j is not for the director/ top level.*

#### Interview 4

Name: Mr. David

Date: 12 September 2006

Q 1: What is the position of Indovickers in the Indonesian market?

A 1: *Indovickers is a middle ranked company. The price is a bit higher than the competitors. Only 10 percent of the total production is for export.*

Q 2: What is Indovickers' strategy to maintain its position in the market?

A 2: *1. Maintenance of the customer service (for 3 years)  
2. Improvement of the quality of the products  
3. Variety of products  
4. Close relation with the designers*

Q 3: What are the competitors of Indovickers, according to executive desks?

A 3: *Vivere, Vinott, IBN, Datascript, Bostinco.*

Q 4: What are the materials that Indovickers use and buy?

A 4: *For desks: particle boards (28 mm thick), PVC edging, High Pressure Laminate (HPL), aluminium, steel for table legs and panels. The wooden panels are made from MDF.*

Q 5: What are the most common woods, which are used for executive desks?

A 5: *The original woods, especially Nyatoh. Jati is very expensive. But nowadays the companies use plywood which is veneered.*

Q 6: What are the most common veneers and laminates, which are used for executive desks?

Q 6: *Teak wood veneer is very popular.*

Q 7: What are the trends and developments in the market?

A7: *The workstations are minimalistic. The panel must be thin and 'clean' to provide the cable management.  
The executive desks become more futuristic, modern, with a glass tabletop, chromed legs and the tabletop is 'floating.'*

Q 8: What is the range of the selling price of executive desks?

A 8: *The executive desks cost around the 8 – 20 million IDR. The price is dependent from the used materials.*

Q 9: What are the costs for producing one executive desk, like the one from the Eclipse series?

A 9: -

Q 10: Which aspects of the desks do you like, shown on page 2?

A 10: *He likes desk k; the table legs are made from metals. Desk h is more appealing for the home office.  
He gives some aspects to think of:  
Having a mobile side table for small meetings or functioned as a sidedesk.  
Office systems are becoming more mobile.  
The interior of board rooms are often white, not with bright shouting colours and have much glass.*

## **Enclosure C            Process of aluminium**

Five stages are involved in the processing of aluminium; they are bauxite (aluminium ore) mining, alumina refining, aluminium melting, the final processing, and then recycling. The process of aluminium asks a lot of energy, so they often use inexpensive energy, such as hydro-electric energy.

Bauxite is mined from surface deposits that are loosened into manageable pieces. For the hard parts of bauxite they use explosions. Once collected, clay is removed and the bauxite is ready for production.

The process of alumina refining is turning the bauxite into pure alumina, a fine white powder. The bauxite is washed, ground and dissolved in caustic soda at high pressure and temperature. This will result in a sodium aluminate solution. The undissolved bauxite sinks to the bottom of the tank and will be removed. The clear sodium aluminate solution is pumped into a tank, called the precipitator. There the solution cools and alumina particles sink to the bottom of the tank. These particles are removed and washed at 1100 ° Celsius, and will become pure alumina.

To melt alumina, a high electric current is required to turn the white powder alumina into molten aluminum metal. The current needed is 150,000 Amperes that flow through an electrolytic bath of molten cryolite (Na<sub>3</sub>AlF<sub>6</sub>, sodium aluminum fluoride), dissolving the alumina and leaving molten aluminum at the bottom of the tank. Then the molten aluminum will be taken to the furnace, where it can be blended to an alloy. The alloy will be cleaned and generally cast.

The recycling of aluminium begins with separate other materials from the aluminium. The scrap aluminium will be completely melted in a furnace. This molten metal is then cast or processed.

## **Enclosure D            Production of veneers**

The veneers are obtained from different segments of a tree:

- The crotch: where the trunk forks into two or more branches.
- The burl: where wood has grown over a damaged area.
- The stump: lower segment of the tree and also the major branches of the roots.
- The long wood or trunk: the long and straight segment of the tree.

The six methods of producing veneer are:

1: Rotary - Rotary veneer is produced by centring the log in a bench and turning it against a stationary cutting knife which is set into the log at a slight angle.

Rotary cut veneer can be sufficiently wide to provide full sheet (one piece) faces.

2: Plain Slicing (Flat Cut) - Plain sliced veneer is veneer sliced parallel to the centre of the log to achieve flat-cut veneer. During this process, the half log is placed against a stationary knife in an up-and-down movement.

3: Half-Round Slicing - Half-round slicing is cutting on an arc roughly parallel to the centre of the log to achieve flat-cut veneer. Segments of the log are mounted off centre against the blade of the knife, which will result in a cut slightly across the annular growth rings.

4: Quarter Slicing - Quarter slicing achieves a straight grain appearance by slicing perpendicular to the annual growth rings. This method is more costly and is often used when the material is Mahogany, oak, teak and walnut.

5: Lengthwise Slicing - A board of flat sawn lumber is passed flat over a stationary knife. As it passes, a sheet of veneer is sliced from the bottom of the board. This produces a multicoloured figure.

6: Rift-Cut - Rift-cut veneer is produced from the various species of oak. Oak has medullary ray cells which radiate from the centre of the log like the curved spokes of a wheel. This method is not popular and more expensive.

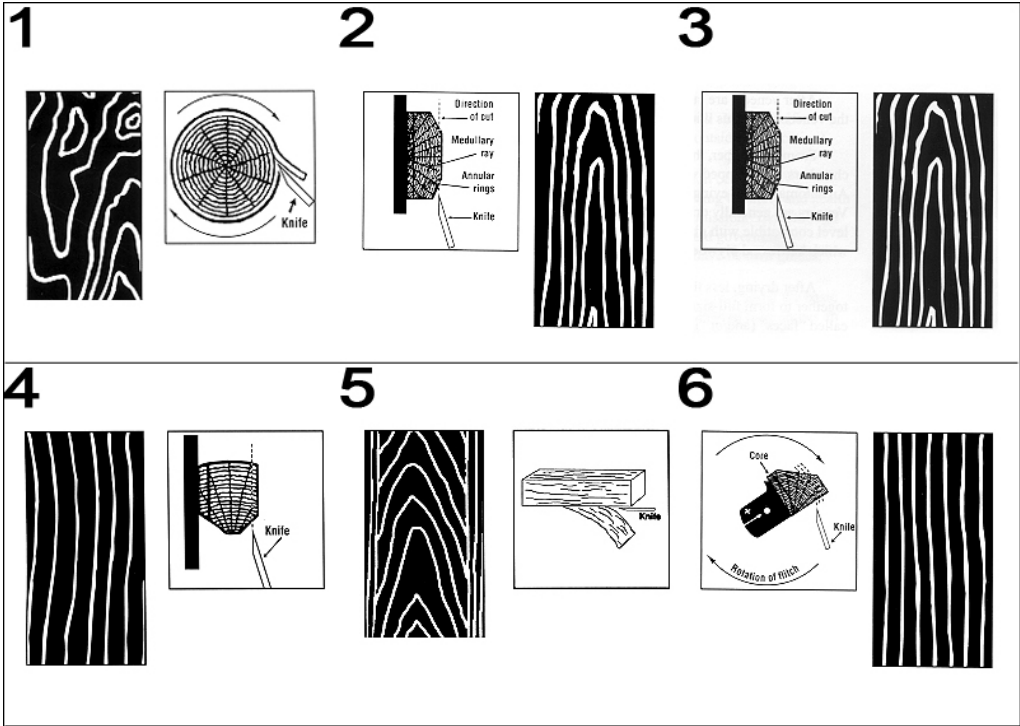


Figure: Slicing veneers

The veneer can be matched by diverse ways. The common ways for executive desks are book matching, centre matching and slip matching.

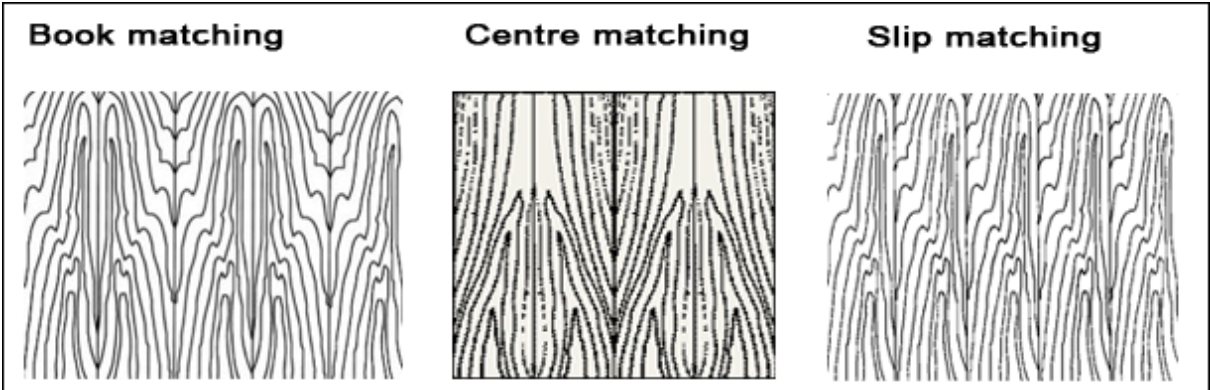
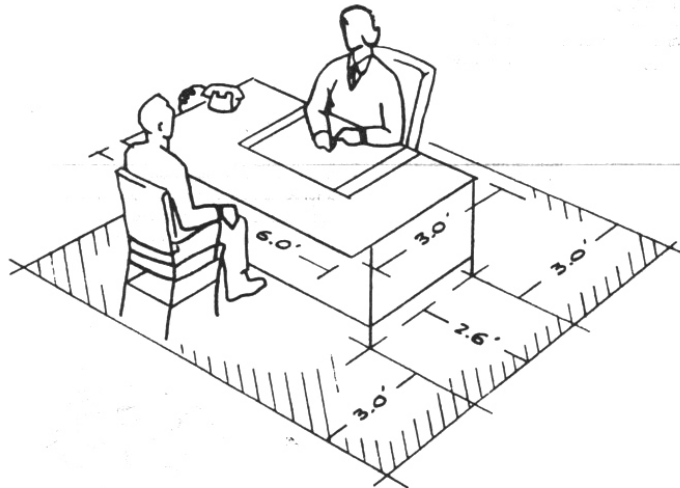


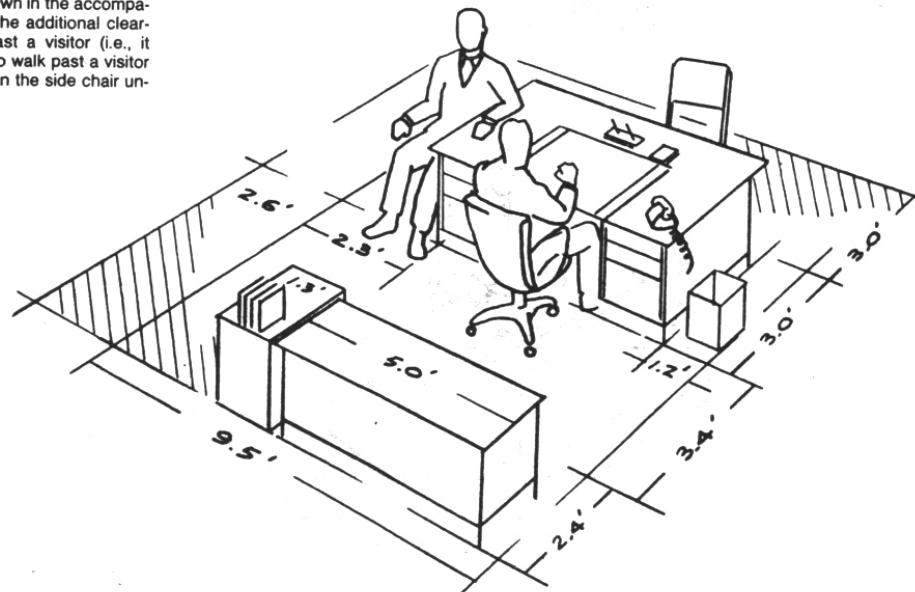
Figure: Veneer matching

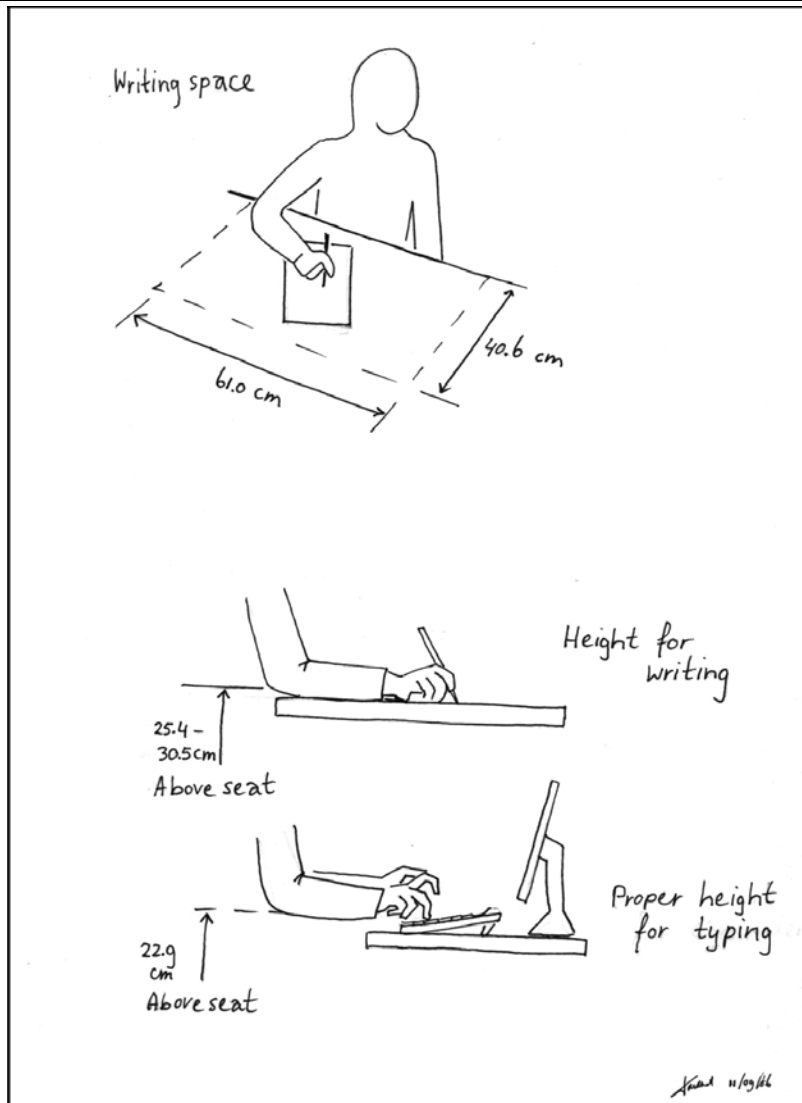
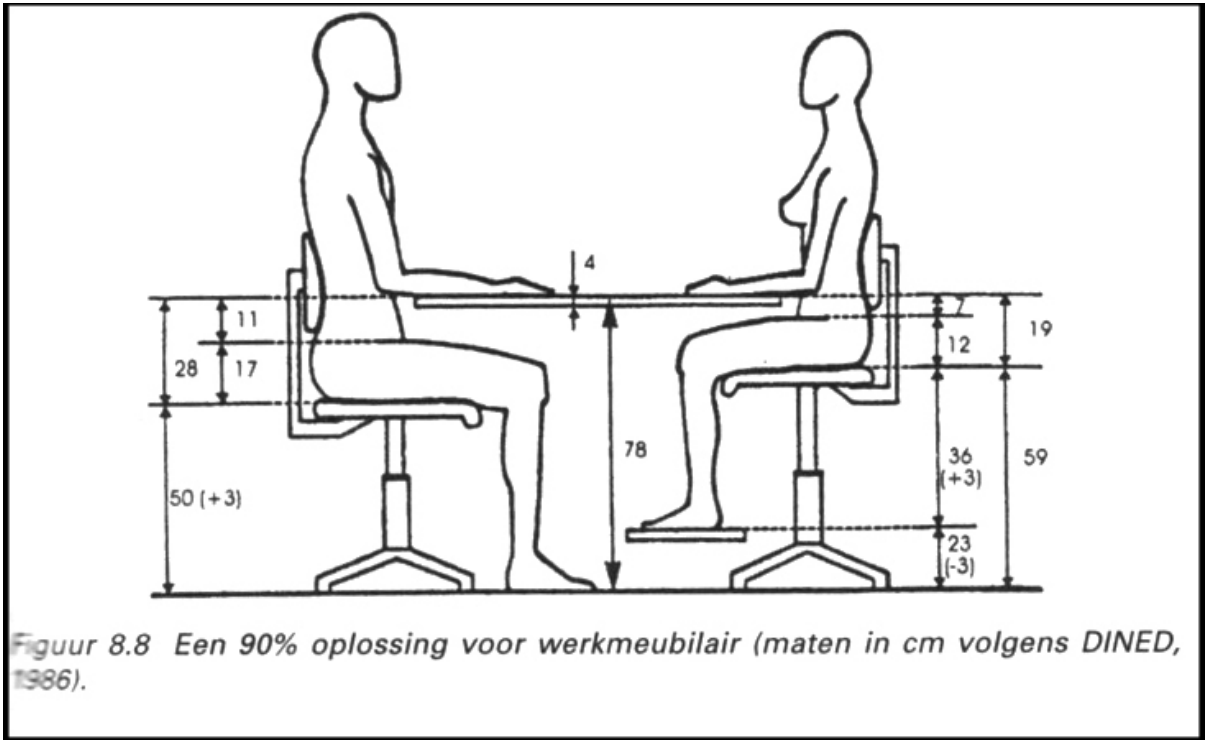


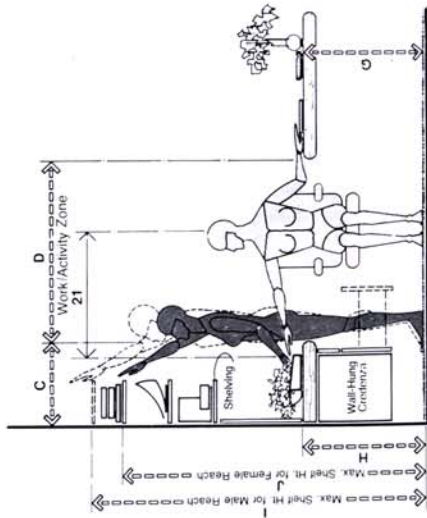
4. The more appropriate standard executive desk (conference type) is  $6 \times 3$  ft ( $1.8 \times 0.9$  m), as shown in the first sketch. The minimum working floor space (which includes room to move away from and around the desk, plus space for one or two visitors sitting opposite the primary occupant) is indicated in the accompanying sketch. This area should be considered minimum for such activities as counseling clients and discussing sales, but it is too small for extensive work that may require adjacent storage of reference materials.



5. A preferred working space for the executive who not only meets a few clients or advisees but also does a considerable amount of work requiring additional file storage space is shown in the accompanying sketch. Note the additional clearance for walking past a visitor (i.e., it should be possible to walk past a visitor while he or she sits in the side chair undisturbed).

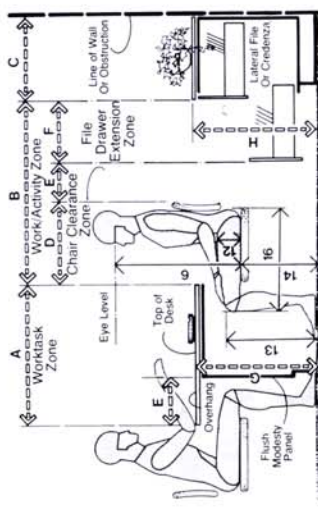




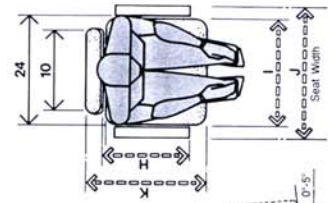


**EXECUTIVE DESK/  
CREDENZA CONSIDERATIONS**

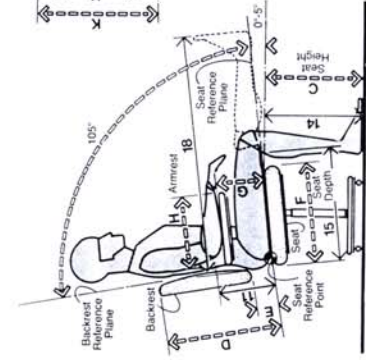
	in	cm
A	30-45	76.2-114.3
B	42 min.	106.7 min.
C	18-24	45.7-61.0
D	23-29	58.4-73.7
E	5-12	12.7-30.5
F	14-22	35.6-55.9
G	29-30	73.7-76.2
H	28-30	71.1-76.2
I	72 max.	182.9 max.
J	69 max.	175.3 max.



**EXECUTIVE DESK / BASIC CLEARANCES**



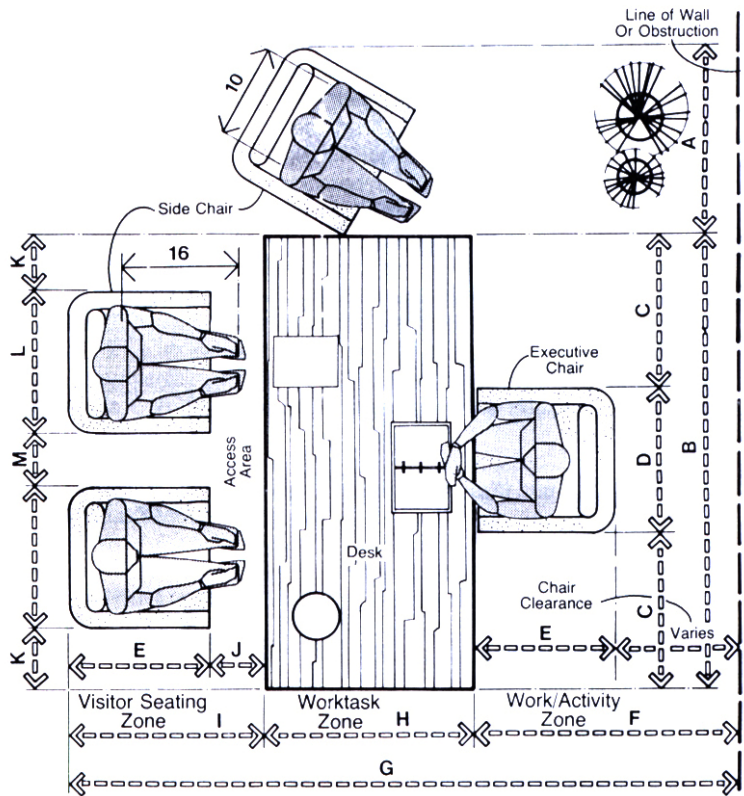
**PLAN VIEW**



**SIDE VIEW  
EXECUTIVE CHAIR**

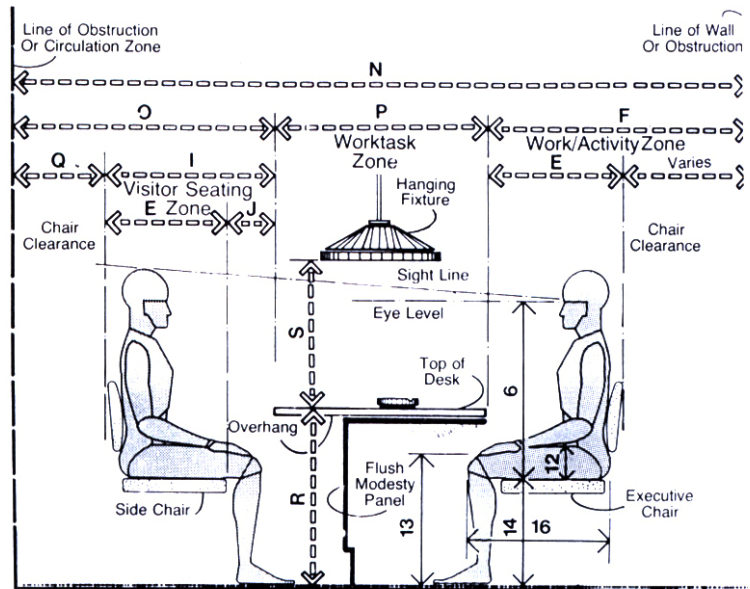
	in	cm
A	31-33	78.7-83.8
B	15.5-16	39.4-40.6
C	16-17	40.6-43.2
D	17-24	43.2-61.0
E	0-6	0.0-15.2
F	15.5-18	39.4-45.7
G	8-10	20.3-25.4
H	12	30.5
I	18-20	45.7-50.8
J	24-28	61.0-71.1
K	23-29	58.4-73.7

128 INTERIOR SPACE/DESIGN STANDARDS



**EXECUTIVE DESK / VISITOR SEATING**

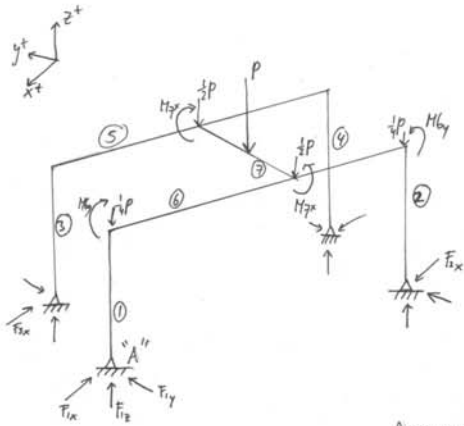
	in	cm
A	30-39	76.2-99.1
B	66-84	167.6-213.4
C	21-28	53.3-71.1
D	24-28	61.0-71.1
E	23-29	58.4-73.7
F	42 min.	106.7 min.
G	105-130	266.7-330.2
H	30-45	76.2-114.3
I	33-43	83.8-109.2
J	10-14	25.4-35.6
K	6-16	15.2-40.6
L	20-26	50.8-66.0
M	12-15	30.5-38.1
N	117-148	297.2-375.9
O	45-61	114.3-154.9
P	30-45	76.2-114.3
Q	12-18	30.5-45.7
R	29-30	73.7-76.2
S	22-32	55.9-81.3



**EXECUTIVE DESK / BASIC CLEARANCES**

NO	ITEM NAME	QTY/UNIT	PRICE UNIT	PRICE TOTAL
1	Table Leg Extrusion 732mm 2.60 kg/m	2,928 /m	Rp 84.500	Rp 247.416
2	Crossbar Extrusion 1800mm 2.60 kg/m	3,6 /m	Rp 84.500	Rp 304.200
3	Bracket (iron casting) / 3.17kg	4 /pcs	Rp 47.550	Rp 190.200
4	Sheet Metal for Adjuster / 0.22 kg	4 /pcs	Rp 3.300	Rp 13.200
5	Adjuster	4 /pcs	Rp 251	Rp 1.003
6	Glider (iron casting) / 0.05 kg	4 /pcs	Rp 750	Rp 3.000
7	Top Table Glass 1800x900x15mm (approximately)	1 /pc	Rp 1.000.000	Rp 1.000.000
8	Glue (approximately)	1 /pc	Rp 50.000	Rp 50.000
9	Allen Screw Flat Head M6 X 30	16 /pcs	Rp 1.250	Rp 20.000
10	Allen Screw Socket Head M8 X 15	16 /pcs	Rp 500	Rp 8.000
11	Cover for screw	16 /pcs	Rp 50	Rp 800
12	Powder Coating	1,07972 /kg	Rp 52.500	Rp 56.685
Total Material Cost				Rp 1.894.504
Labour+Factory Over Head 20%				Rp 2.273.405
Profit Margin 50%				Rp 4.546.809
Price				<b>Rp 4.546.809</b>

Force calculation Executive desk



$$L_1 = 0,8 \text{ m } (=0,76 \text{ m})$$

$$L_6 = 1,8 \text{ m}$$

$$L_7 = 0,9 \text{ m}$$

$$M_{6y} = \frac{1}{2} L_6 \cdot \frac{1}{4} P$$

$$M_{7x} = \frac{1}{2} L_7 \cdot \frac{1}{2} P$$

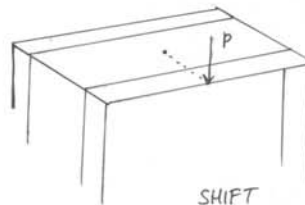
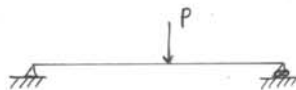
Assume:

- the table legs are infinitely rigid.
- these legs in the support points (like "A") can only rotate.
- bending has a bigger contribution than the torsion.

Ⓡ

Calculation I Bending glass table top and aluminium crossbar

Force P is on the outside of the crossbar



SHIFT  
 $I^* = I + A \cdot d^2$

$$V_{\max} = \frac{-PL^3}{48EI}$$

$$E_{\text{Alu}} = E_{\text{Glass}} = 69 \text{ GPa}$$

$$I_{\text{CROSSBAR}}^* = I_{\text{CROSSBAR}} + A \cdot d^2 \Rightarrow 2,8 \cdot 10^{-6} + (9,4 \cdot 10^{-4}) \cdot (1,9 \cdot 10^{-2})^2 = 2,8 \cdot 10^{-6} \text{ m}^4$$

$$I_{\text{GLASS}} = \frac{1}{12} \cdot b \cdot h^3 = \frac{1}{12} \cdot 1,8 \cdot (0,015^3) \approx 5,1 \cdot 10^{-7} \text{ m}^4$$

$$I_{\text{GLASS}}^* = 5,1 \cdot 10^{-7} + (27 \cdot 10^{-3}) \cdot (0,0075^2) = 2,0 \cdot 10^{-6} \text{ m}^4$$

Combination of glass and aluminium  $\Rightarrow V_{\max} = \frac{-PL^3}{48 \cdot E \cdot I_{\text{tot}}^*}$

Ⓡ

$$V_{\max} = \frac{-PL^3}{48EI_{\text{tot}}}$$

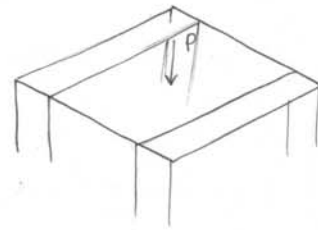
$$P_{\max} = 150 \text{ kg} \quad (150 \cdot 9,81)$$

$$I_{\text{GLASS}}^* + I_{\text{CROSSBAR}}^* = I_{\text{tot}}^* \Rightarrow 2,0 \cdot 10^{-6} + 2,8 \cdot 10^{-6} = 4,8 \cdot 10^{-6} \text{ m}^4$$

$$\text{In calculation I : } V_{\max} = \frac{-\frac{1}{2}P \cdot L^3}{48 \cdot E \cdot I_{\text{tot}}^*} = \frac{-(75 \cdot 9,81)(1,8^3)}{48 \cdot (69 \cdot 10^9) \cdot (4,8 \cdot 10^{-6})} \approx -2,7 \cdot 10^{-4} \text{ m} \\ \approx -0,3 \text{ mm}$$

Calculation II Bending glass table top only

$$V_{\max} = \frac{-P \cdot L^3}{48 \cdot E_{\text{GLASS}} \cdot I_{\text{GLASS}}} = \frac{-150 \cdot 9,81 \cdot (0,9^3)}{48 \cdot (69 \cdot 10^9) \cdot (5,1 \cdot 10^{-7})} \\ \approx -6 \cdot 10^{-4} \text{ m} \\ \approx -0,6 \text{ mm}$$

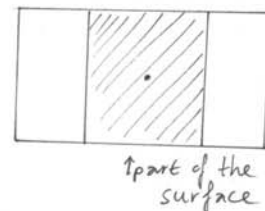


III

Calculation III Bending a part of the glass table top-surface

$$I_{\text{GLASS}} = \frac{1}{12} \cdot 0,9 \cdot 0,015^3 = 2,5 \cdot 10^{-7} \text{ m}^4 = 0,25 \cdot 10^6 \text{ mm}^4$$

$$E_{\text{GLASS}} = 69 \cdot 10^9 \text{ N/m}^2$$



$$V_{\text{III max}} = \frac{-P \cdot L^3}{48 \cdot E \cdot I_{\text{GLASS}}} = \frac{-150 \cdot 9,81 \cdot 0,9^3}{48 \cdot (69 \cdot 10^9) \cdot (2,5 \cdot 10^{-7})} \approx -1,3 \cdot 10^{-3} \text{ m} \approx -1,3 \text{ mm}$$

IV

### Calculation IV Stress

$$\sigma_{\max \text{ ALU}} = 310 \text{ MPa (Alloy 6016, T6)}$$

$$\sigma_{\max \text{ GLASS}} = 70 \text{ MPa (plate glass)}$$

$$\sigma_{\max \text{ HARDENED GLASS}} = 280 \text{ MPa}$$

$$\sigma = \frac{M \cdot y}{I}$$

$$P_{\max} = 150 \text{ kg}$$

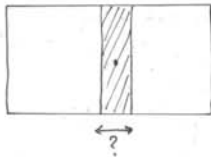
$$\sigma_{\max \text{ ALU}} = \frac{\frac{1}{2} \cdot L_6 \cdot \frac{1}{4} P \cdot y_A}{2,8 \cdot 10^{-6}} = \frac{\frac{1}{2} \cdot 1,8 \left( \frac{1}{4} \cdot 150 \cdot 9,81 \cdot (28 \cdot 10^{-3}) \right)}{2,8 \cdot 10^{-6}} \approx 3310875 \text{ Pa} \quad \begin{array}{l} y_A = 7,5 \cdot 10^{-3} \text{ m} \\ y_A = 28 \cdot 10^{-3} \text{ m} \end{array}$$

$$\approx 3,3 \text{ MPa}$$

$$\sigma_{\max \text{ GLASS}} = \frac{\frac{1}{2} \cdot L_7 \cdot \frac{1}{2} P \cdot y_G}{2,5 \cdot 10^{-7}} = \frac{\frac{1}{2} \cdot 0,9 \cdot \left( \frac{1}{2} \cdot 150 \cdot 9,81 \right) \cdot 7,5 \cdot 10^{-3}}{2,5 \cdot 10^{-7}} \approx 9932625 \text{ Pa} \approx 9,9 \text{ MPa}$$

$$P_{\max \text{ GLASS}} = \frac{\sigma_{\max \text{ GLASS}} \cdot I}{y_G \cdot \frac{1}{2} L_7} = \frac{70 \cdot 10^6 \cdot (2,5 \cdot 10^{-7})}{(7,5 \cdot 10^{-3}) \cdot (0,95)} = 5185 \text{ N} (\approx 525 \text{ kg})$$

Ⓟ



$$I_{\min \text{ GLASS}} = \frac{1}{12} \cdot b_{\min} \cdot h^3$$

$$\sigma_{\max \text{ GLASS}} = \frac{\frac{1}{2} \cdot L_7 \cdot \frac{1}{2} \cdot P \cdot y_G}{I_{\min \text{ GLASS}}} = \frac{\frac{1}{2} \cdot L_7 \cdot \frac{1}{2} \cdot P \cdot y_G}{\frac{1}{12} \cdot b_{\min} \cdot h^3}$$

$$b_{\min} = \frac{\frac{1}{2} \cdot L_7 \cdot \frac{1}{2} \cdot P \cdot y}{\frac{1}{12} \cdot \sigma_{\max \text{ GLASS}} \cdot h^3} = \frac{12 \cdot 0,45 \cdot (75 \cdot 9,81) \cdot 7,5}{70 \cdot 10^6 \cdot (0,015)^3} = 0,13 \text{ m} \approx 13 \text{ cm}$$

When the load is 150 kg, then the minimal glass width is 13 cm, by thickness of 15 mm, at 70 MPa.

Ⓟ



**Correspondence R&D Team, Jakarta**

**Questions part 1**

Date: 29 – 11 - 2006

Dear Camelia and Daniël,

Last week, I had finally a meeting with my tutor in Holland. She was on a congress in Brazil. Well, now I have a more clear view of the finishing of my bachelor assignment.

I need to finish the following aspects:

- The connector between the leg and crossbar
- An extra crossbar between the front and back leg-assemblies (not through the middle of the table, coz I have info about hardened glass tabletops, which are strong enough, thickness 15 mm).
- The cable management (which can be integrated in the extra crossbar)
- The technical drawings
- UV glue to attach the tabletop to the leg-assemblies (I already have contacted a glass company and get some information about the glue and tabletop)
- Costs of producing the desk (? I don't know if my tutor wants this too. I have a second meeting with her tomorrow)
- My report

The last time I spoke with my tutor, she was very positive about the design of the modern concept ☺ . During my meeting, there came a man inside. He is a teacher and owner of an industrial design company. He was also very positive, and gave me also some aspects to think about. Like wooden table legs with aluminium accents. I will use their opinion and make some proposals about the concept.

Qua aluminium extrusion profiles, I have a question: are there standard profiles (from a supplier), which look like the shape of my profile? So I can use those profiles, which are cheaper (instead of using a new mould = expensive desk).

Well, hopefully you can see my meaning with the attached scanned files. I do hope you may want to give me some feedback. So I can use the information to finish my Solidworks model.

For my report I need some information about the ergonomics. I made pictures of the pages of the ergonomics book in Indonesia. But, these files are not good enough for my report. So: Please could you scan and mail me the following pages from the book 'Human Dimension & interior space' from Panero, J.; Zelnik, M. (1979)?

These are the pages: 128, 172, 173, 174, 182, 192, 193. Thank you in advance!!

Thank you for everything!!

My best regards,  
Michael

## Answers part 1

Date: 4 – 12 - 2006

Dear Michael,

Here are scan documents of human dimensions..the rest daniel will give you an email as soon as possible

How is everything hope everything going well with your study?

Have a nice day ya! Send my regards for family luv u!!

## Questions part 2

Date: 1 December 2006

Dear Camelia and Daniël,

At this moment I am busy with talking to other teachers and a researcher of aluminium extrusion profiles. Maybe it's not nessecay to use an extra crossbar between the back and front leg-assemblies.

What I need to know is how you test your models/prototypes qua strenght. What is the maximum allowable external force on a desk (1000 Newton?) (like a man of 100 kg will stand on the middle of the desk). What kind of amount of this force are you using to test the desks?

Hopefully you can help me with this. Thank you in advance!!

My deadline of all the aspects, which I must finish is 24 December 2006. I hope I can make it on time.

Please send my regards to Gilang and the others.

Bye,  
Michael

## Answers part 2

Date: 4 – 12 - 2006

hi Michael ... how r u?hope u`re all ok

herein i attach solid drawing of your project, based on your previous mail, as following :

1. the connector between leg and crossbar is using bracket, made from die cast aluminum or iron gravity casting (for tight budget). the bracket itself is tapped with m8 thread (for detail you can learn from the solid drawing)

2. the cable channel, you can use the profile of the leg as cable channel ( as shown on the drawing). you can see the aluminum profile with " Y " shape, it`s actually a segregation between power and data cable.

3. for the cable socket / outlet, you can use " evoline " by schulte ( check on internet ) it`s a nice product from german. you can use this outlet because executive desk only using not so many outlet.

3. for alternative finishing, i divide the profile of leg into 2 profiles. first is main leg and the second is cover, which you can pull the cover for maintenance of cable management and you can change / choose between aluminum or wooden cover ( see " assy leg wood" )

4. unfortunately there`s no profile that similar to your design. but it`s okay, because the mould itself is not too expensive ( cost appr. 8.000.000 IDR), and per kg for about 32.500 IDR

5. for the production cost you can calculate based on material`s weight. with formula as i have given to you.

for a larger details, check these following solid drawing  
(i don`t draw the glide)

best regards,

Daniel

---

Date: 4 – 12 – 2006

sorry i forget to write you `bout force thing:

usually after draw the concept into solid drawing, we invite the vendor to discuss technical details of the design, including strength and so on  
so usually the vendor will make the calculation for us. and of course based on our experience on buliding and designing previous products  
of course it`s not ideal for design process, but we have lack of testing devices in indonesia, for example : i have to pay 200 USD to test the strength of nixie office chair (only for the seat), and the company itself is franchise from france, so can you imagine it? hahaha....

i hope it would be helpful information for you

best regards

Daniel

### **Questions part 3**

Date: 6 -12 - 2006

Hey Daniël,

Terima kasih!

I have again a question about the force. For example the executive desk Eclips: how much force can this tabletop handle? Are there some quantities known (after the results of testing by the vendor)? So I can reference my calculation a little bit. I will calculate the strength of the glass tabletop and the construction. Can I think about a force of 1000 Newton (around 100 kilograms), which is placed in the middle of the tabletop? Or is 800 Newton the maximum?

Have you an idea about a quantity, which I can use in my calculation?

Thank you in advance!

My best regards,  
Michael

### Answers part 3

Date: 6 – 12 – 2006

hi mike...about d force of eclipse table for example...unfortunately we haven` t done any research yet, regarding to the strength of the table  
but we are very sure about its strength because the structure consist of rigid and strong crossbar & leg...in fact i bet the table can support people who`s standing on top of the table as many as possible...hahaha...  
so consider if the table with dimension 1500x750 mm enough for 6 peoples to stand on top of the table, if each people 70kg weight, so the table apprximately can hold up to  $70 \times 6 = 420 \text{kg}$ ...yeah..that`s a raw estimation about the force  
instead of calculating the force of the table, u can calculate the requirement of its strength...u can calculate how many kg the table has to support..  
example : the table should support : computer (...kg), stationery (...kg), the weight of people who`s leaning on the side of the table (...kg), perhaps the weight of secretary & director at once (if they`re tryin` to mess the whole table...hahaha...)...and then u`ll have the approximate number of weight that a table should support  
after that u can ask to the glass vendor if the glass could support the amount of the approximate weight (and of course show your table structure design)  
how about that? hope it`s helpful for u  
may the force be with you....hahaha...

Daniel

### Questions part 4

Date: 13 – 12 - 2006

Dear Daniël and Camelia,

Apa kabar?

Sekarang saya sakit, tapi kerja terus. I will be ok!

I am busy with the technical drawings, and I came to new questions.  
I hope you want to answer them, thank you in advance!

The glider, sheet metal for under the table leg, and adjuster are made from which material?  
Can I use Fe 360 (steel) or can I use iron? (what type of iron?).

The leg and crossbar will be made from aluminium : do you know what kind of type alu will be used?

The bracket (connector) will be made from iron (according to ur previous email).

Furthermore something about the production costs of the executive desk:

-how much labour costs are there, during the production of one executive desk? (how manu hours of labour and how much is the average amount of the salary per hour?)

- how much the machinery costs are? Please could you give me an indication of these costs?

- What's the price of M8 and M12 bolts in Indonesia?

Thank you in advance!!!!

Please send my regards to Gilang and the others @ Indovickers.

Salam,  
Michael

## Answers part 4

Date: 18 – 12 – 2006

wah sakit?hope u`ll be fine soon....sorry reply so late...you know lah...it was a kind of hectic last week

so...for the glide u can use white iron, this is a type of iron that produced by a process called chilling, which prevents graphite carbon from precipitating out.

type of the aluminum (not aluminium!) is alloy 6063, aluminum-magnesium, silicon alloy (AlMgSiO)

it is a heat-treatable aluminum alloy having good combination of extrudability and mechanical properties, also well responding to polishing, anodising, chemical brightening & dyeing.

about the production cost, i`m afraid we can`t give u all u ask..cause u know, it`s confidential, but i`ll give u components of product cost,

u can calculate the price as followed :

1. material cost
  2. direct labor (may vary, according to the company policy), approximately 10%-30%
  3. profit margin (also vary, according to the company policy), approximately 20%-50%
- so if u figure out the material cost (with formula i have given to u) + 10-30% direct labor + 20-50% profit margin = product price

price of the bolts in IDR/pc

1. bolt allen screw flat head M8x15 : 1500
2. bolt allen screw flat head M8x35 : 2990
3. bolt allen screw flat head M10x20 : 750
4. bolt allen screw flat head M10x70 : 5200

- 5.allen screw socket head M8x20 :600
- 6.allen screw socket head M8x40 :780
- 7.allen screw socket head M8x60 :785
- 8.allen screw socket head M8x35 :730

- 9.allen screw socket head M10x80 :1498
- 10.allen screw socket head M10x70 :1250
- 11.allen screw socket head M10x35 :313

12. bolt hexagon head m8x20 : 125
13. bolt hexagon head m8x30 : 173
14. bolt hexagon head m8x45 : 240
15. bolt hexagon head m8x80 + nut : 340
16. bolt hexagon head m8x70 : 376

## Questions part 5

Date: 8 January 2007

Dear Daniël and Camelia,

Apa kabar?

Waduh, at this moment I am writing my concept-report, which must be given to the tutor at Monday 15 January!

I am busy with the price calculation.

Please, could you check the amounts? I use your formula's, and hopefully the prices are ok.

The price of UV glue is hard to find, so i estimate the price around 1 million IDR. Do you have any clue about the price of the glue?

Thank you in advance for your reply!

Greetings,  
Michael

## Answers part 5

Date: 15 January 2007

michael so sorry that we reply u so late...

but here i attach pricelist that i made, according to your pricelist & drawing that u sent

i include powder coating price. the formula

surface area of products (in m square) / 5

because 1 kg of powder coating for 5 m square of product surface

hopefully it can be usefull for u

best regards,

daniel

## ***Correspondence with Vitriline, Hengelo***

### **Questions part 1**

Date: 14 – 11 - 2006

Beste heer/mevrouw,

Momenteel ben ik bezig met mijn bacheloropdracht aan de Universiteit Twente en heb ik een aantal vragen over een glazen tafelblad.

Ik heb vorig jaar (november 2005) samen met andere Industrieel Ontwerpen – studenten uw bedrijf bezocht. Vandaar dat ik u graag wil vragen of u of een medewerker mij zou willen helpen met het beantwoorden van een paar vragen.

Voor mijn bacheloropdracht heb ik een directiebureau moeten ontwerpen. Ik heb gekozen om een glazen tafelblad te nemen, dat bevestigd wordt op aluminium tafelpoten.

Ik vraag me af welke verschillende glazen tafelbladen in uw bedrijf geproduceerd worden (zoals een tafelblad bestaande uit 2 glazen platen en folie ertussen etc.).

Ik heb vorig jaar gezien, dat een man makkelijk op een glazen tafelblad kon zitten en dat het tafelblad niet brak.

Het tafelblad wordt 1800 mm x 900 mm groot en heeft een dikte van 15 of 20 mm. Ik weet niet hoeveel kilogram een glazen tafelblad met deze afmetingen weegt. Zou u mij een indicatie kunnen geven?

De verbinding tussen aluminium en het glas kan via UV-lijm tot stand komen, maar hoe doen jullie dat in het bedrijf? Wat is de beste optie om metalen en glas te verbinden?

Zou u of een medewerker mij willen helpen met deze vragen?

Bij voorbaat dank!

U kunt mij bereiken via mijn mailadres: [t.k.m.thung@student.utwente.nl](mailto:t.k.m.thung@student.utwente.nl)

Met vriendelijke groeten,  
Michael Thung

(student aan de Universiteit Twente)

---

### **Answers part 1**

Date 17 – 11 – 2006

Beste Michael,

Hier even snel een paar antwoorden voor jou:

Voor tafelbladen gebruiken wij eigenlijk alleen maar bladen van 15 mm dikte. Je kunt hiervoor geen 20 mm hanteren, omdat er dan hardingspixels zullen ontstaan in het geharde glas. Er komt dus geen folie aan te pas.

Om het gewicht van glas te bepalen, gebruikt men in de glaswereld altijd de volgende regel: 2,5 kilo per mm (dikte) per m<sup>2</sup>.

De beste manier om metalen en glas met elkaar te verbinden is via UV-verlijmen. Dit proces is als volgt te beschrijven: Je brengt capillaire lijm aan op het glas en plakt de 2 oppervlakten tegen elkaar waardoor de lijm zich over het oppervlak verspreid. Het wordt daarna gehard door er een UV-lamp onder te zetten.

Hopelijk heb ik je hiermee wat verder geholpen.

Met vriendelijke groet,

Thijs ter Harmsel

---

## **Questions part 2**

Date 17 november 2006

Beste Thijs,

Bij deze wil ik u van harte bedanken voor uw email. Uw informatie kan ik goed gebruiken voor mijn opdracht.

Ik had nog wel een vraagje: zou u een (globale) prijs-indicatie kunnen geven voor een glazen tafelblad met aan de bovenkant chamfered / afgeronde randen (bijv. in euro per kg)? Dit in verband met mijn kostenberekening.

Dank u wel!

Met vriendelijke groeten,  
Michael Thung

## **Answers part 2**

Date 17 – 11 – 2006

Hoi Michael,

De prijs per m<sup>2</sup> voor een glazen tafelblad is als volgt: 258,20 Euro en daarbij komt nog de prijs voor rondom slijpen en dat is 90 Euro. Dit alles is excl. BTW (19%)

Met vriendelijke groet,

Thijs ter Harmsel