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DESIGN AUDIT IN HARJU ELETKER TELETEHNIKA RENEWAL OF TELECOMMUNICATION AND SERVER RACK CABINET

DISAINIAUDIT HARJU ELEKTER TELETEHNIKAS TELEKOMMUNIKATSIOONISEADMETE JA SERVERI KAPI UUENDUS

Speciality field - Design

Author applies for degree of Master of Technical Sciences (M.Sc.)

Tallinn 2014

Author's Declaration

I have written the Master's thesis independently.

All works and major viewpoints of the other authors, data from other sources of literature and elsewhere used for writing this paper have been referenced.

Master's thesis is completed under Martin Pärn's supervision.

"......."....................201.....   Author   Aivo Arusaar   signature

Master's thesis is in accordance with terms and requirements "……."…………………201….

Supervisor …………………………………… signature.

Accepted for defence

.... chairman of defence commission

"......."....................201… .

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Master's Thesis task

2013 /2014 academic year, 6th semester

Student: Aivo Arusaar 111357

Field of study: Design & Engineering

Supervisor: professor, Design & Engineering, Martin Pärn

Master's Thesis topic:

Design Audit in Harju Elekter Teletehnika
Renewal of Telecommunication and Server Rack Cabinet

Disainiaudit Harju Elekter Teletehnikas
Telekommunikatsiooniseadmete ja serveri kapi uuendus

Tasks and timeframe for their completion:

Nr	Task description	Completion date
1. Task 1	To establish contacts with Harju Elekter Teletehnikas informants.	30.01.2014
2. Task 2	To conduct interviews with the informants, visit Harju Elekter Teletehnika's production, get acquainted with the users.	30.03.2014
3. Task 3	To analyse collected data and conduct a design audit	30.04.2014
4. Task 4	To develop and design a new version of the rack cabinet	25.05.2014

Design and Engineering problems to be solved:

The main objectives of the thesis were to define Harju Elekter Teletehnika's shortcomings that could be improved through use of design and renewal of Teletehnika's core product with distinct design language.

Defence application submitted to deanery not later than   30.05.2014

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ABSTRACT

The objectives of this master thesis were to conduct a design audit and a renewal of the core product of a telecommunication and server rack cabinet producer called Harju Elekter Teletehnika.

The design audit was carried out in cooperation with the company and several informants who gave insight to the industry and it's specifics. The collected data was afterwards analysed and organised in a logical order to create a whole picture. The main focus of the design audit was on branding, product development and product portfolio. As a result several probems and shortcomings were identified. Most important of them were:
1. A weak brand image
2. Inconsistency in corporate visual identity
3. Lack of new product development
4. Inconsistency in product portfolio
5. No attention to design and aesthetics

The practical work dealt with the renewal on Teletehnika's core product, 19-inch telecommunication and server rack cabinet. Focus was on technical solutions, usability and product design that would be able to create a distinct brand language. Technical solutions were developed for reducing the number of components in the assembly. The usability of the product was improved through smarter joints that enable easier assembly of the cabinet. Emphasis was also placed on creating a design language that would help Teletehnika to differntiate from competitors and improve their competitivness.

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INTORDUCTION

This master thesis is carried out on the basis of Harju Elekter Teletehnika, a producer of sheet metal enclosures and cabinets for telecommunication and electrical installations. The aim of the thesis is to look for possibilities on how to make the company more competitive with the aid of design, focus is on brand image, product development and product portfolio. The Thesis is divided into two main parts – theoretical in a form of design audit and the renewal of Teletehnika's core product as practical work.

The first part of the thesis was carried out in co-operation with the company and gives an overview of the company's activities, stakeholders, competitors and products. Valuable data was collected for analysis on all of these topics through interviews, field visits and second-hand information. The analysis resulted in a set of shortcomings and problems that could be improved through use of design. The author gives some recommendations for further steps and points out the topics that need attention from the company.

The second part of the thesis is practical and deals with the renewal of Harju Elekter Teletehnikas core product - the 19-inch telecommunication and server rack cabinet. In accordance with the design audit, the author makes suggestions for improving the current telecommunication and server rack cabinet, with the emphasis on both technical solutions and creating a distinctive brand language that could unify and differentiate Teletehnika's products on the market. As a practical work, 3D model of the rack cabinet is designed and technical drawings and visualisations are produced.

1. DESIGN AUDIT

1.1. RESEARCH

This master thesis did not start with a concrete design brief. The first task was to carry out a design audit that would help to map possible opportunities and strategies for design use and result in a brief for work that is most needed for the company. A thorough research was carried out using different methods and approaches to explore, identify and give guidelines to several aspects of the company such as the brand, visual identity, product portfolio and the company's core product.

During the preliminary research the author used the basis of a framework for company evaluation and design audit, which was launched by Estonian Design Centre in Disainibuldooser project in cooperation with a British designer and strategic consultant Richard Eisermann. During the first interviews with Harju Elekter Group general topics and questions recommended in the design audit framework were used. The aim of the audit is to identify and define issues in the company that could be solved with the help of design. (Estonian Design Center,2012)

Another method that was used for structuring the research is the Double Diamond diagram which is developed by the British Design Council in 2005. It describes a design process in a simple and understandable graph. Divided into four distinct phases, it maps the divergent and convergent stages of the design process, showing the different modes of thinking that designers use. (British Design Council, 2007)

The Double Diamond diagram is divided into 5 main parts:

1. **Discover** - the discovery phase is a crucial part of a design process and also the master thesis by creating the base for the project by collecting data and to structure it in a logical order. The discovery phase incorporates company research, market research, user research and data management. This comes handy in the define phase where the collected data has to be analysed.
2. **Define** - the second quarter of the Double Diamond model is the definition stage, during which the data collected in the discovery phase is analysed. The analysis will result in a set of problems that derive from the previous research and insight, following a set of objectives that form a brief for the further work. The definition stage looks for opportunities, gives guidelines and fixes the focus of the next steps of the design process.
3. **Brief** – the mid-point of the Double Diamond is the brief which considers the problems found in previous stages and formulates them into expectations and objectives for the product development phase. These objectives are the base for further work.
4. **Develop** - during the development phase different concepts are considered according to the set of requirements and objectives set in the brief. These objectives are formed into a final concept that is used for finalizing the end design.

5. **Deliver** - the fourth segment in the Double Diamond is the delivery phase. This is where the product is finalised and launched to the market. The key activities in this stage are: final testing, approval and launch, target evaluation and feedback loops.

Each of those phases has a certain purpose that needs to be achieved before moving on to next phase. The first two stages are focused on exploring, defining problems and creating a framework for the development phase that addresses the problem(s) set in the previous stage by suggesting one or more concepts that are as close to a real end product as possible. (British Design Council, 2007)

Other important parts of the research were the interviews and discussions held with company informants from Harju Elekter Group and Harju Elekter Teletehnika. This was the easiest way to get acquainted with the industry and the company's operations. These interviews followed several guidelines from the design audit framework by Estonian Design Centre.

The approach to the interviews varied during the meetings as different methods were used. During the first meetings the interviews were more survey-like and pre-structured to cover some general topics like organisational structure, product development and innovation, communication and branding etc. Later, this turned out to be too strict and the author gave up the prepared questions and switched to a more reflexive interviewing, using just general topics and keywords for further discussions. This method is often used by ethnographers in their fieldwork and interactions. This way the informant can also structure the discussion. Ethnographers do not usually decide beforehand the exact questions they want to ask, and do not ask each interviewee precisely the same questions, though they will usually enter the interviews with a list of issues to be covered. Nor do they seek to establish a fixed sequence in which relevant topics are covered. They adopt a more flexible approach, allowing the discussion to flow in a way that seems natural. (Atkinson, Hammersley, 2007)

The author did not restrict himself to a single mode of questioning, on some occasions and at some points during the interview a more questionnaire type approach was used. This proved more efficient when talking about company's products and some specific nuances. In general, the interviews were more like a conversation than a survey and made the informants feel more comfortable and gave them opportunities to talk more freely.

In addition to the interviews other channels of communication were used. Some questions and problems were attended via email or telephone later in the process for quick discussions. Second-hand data was also collected via websites, company product catalogue, brochures and technical data sheets.

1.2. ABOUT HARJU ELEKTER GROUP

To get acquainted with the company the author had several interviews and meetings with different company informants. Information was collected from interviews, emails, secondary sources such as websites and brochures to get up to speed with the specifics of the industry.

During these meetings altogether 6 key persons of the company were interviewed (some of them more than once):

- CEO of Harju Eleter Group – Andres Allikmäe
- Director of communication in Harju Elekter Group – Moonika Vetevool
- Director of sales in Harju Elekter Teletehnika – Jan Osa
- Head of product development in Harju Eletker Elektrotehnika – Alar Ollerma
- Technical director in Harju Elekter Elektrotehnika – Andre Koit
- Head of Harju Elekter Teletehnika – Urmas Paisnik

Harju Elekter Group is one of biggest and leading electrical equipment manufacturers in the Baltic Sea region, with over 40 years of experience. Company's headquarters and main production facilities are situated in a vast industrial area in Keila, Estonia. Harju Elekter has several subsidiaries whose headquarters and manufacturing facilities are situated in Finland, Lithuania and Sweden.
The Group provides work for about 500 employees, 340 of them in Estonia, 80 in Finland and 80 in Lithuania.

Harju Elekter has been manufacturing electrical equipment for almost 5 decades. The parent company coordinates the cooperation within the Group, manages and supervises the subsidiaries' finances and investments. The Group has 5 subsidiaries:
- 100 % of Harju Elekter Elektrotehnika – produces equipment for power distribution networks (substations, cable distribution cabinets etc.), industrial control and automation systems for the energy and industrial sectors as well as for public utilities.
- 100% of Harju Elekter Teletehnika – core business is the manufacturing of sheet metal products for the data communication networks and telecommunication companies.
- 100% of Satmatic (in Finland) – produces equipment for power distribution network, industrial control and automation systems for the energy and industrial sectors.
- 90% of Harju Elekter AB – founded in Sweden for sales in Sweden and Nordic countries.
- 63% of UAB Rigas (in Lithuania) - core business is the manufacture and sale of electrical control and distribution units and the design and installation of industrial automation equipment.

In addition to that the Group has:
- 34% of Draka Keila Cables – biggest cable manufacturer in the Baltic States.
- Stores – a few electrical applieances stores also belong the the Group.

Harju Elekter is also one of the few Estonian companies that are on the stock market. The shares of Harju Elekter were noted in Tallinn Stock Exchange in 1997. (Harju Elekter, 2014)

Figure [1] Harju Elekter Group structural graph

1.3. VALUES AND BELIEFS OF HARJU ELEKTER GROUP

Harju Elekter Group has stated its values and beliefs on their website and brochures. These values and beliefs apply for all of the subsidiaries.

MISSION
To be one of the leading manufacturers of electrical equipment and materials in the Baltic sea region by responding to the clients' needs without delay with competence and quality and by offering added value and reliability to partners in co-operation projects.

GOAL
To be successful over a long period of time, to increase the company's capital and generate revenue for the owners, as well as the partners, and to provide motivating work, income and development opportunities for the employees.

VALUES
Co-operation - Together we achieve more!
Responsibility - High-quality solutions!
Growth and development - We are curious and innovative! (Harju Elekter, 2014)

Harju Elekter Group is oriented towards maintaining the leader's position in the Baltic region and expanding to new markets. Entering new markets can be quite difficult and time consuming, which is why having a strong brand and product portfolio could significantly ease the process of winning over new clients and being accepted in new environments.

New markets bring new competitors that already have a strong brand equity and position in the market. To be competitive Harju Elekter Group should conduct a thorough self-analysis in order to find the company's strength points and to communicate them better to their interest groups. Good communications and a trusthworthy brand is also crucial for a public company in order to attract and maintain their investors.

As one of the goals Harju Elekter states they wish to be successful over a long period of time, which requires keeping up with the industry and current trends. For that, Harju Elekter should also emphasise the use of new technologies and solutions and aim for well-defined development processes.

The company values also state being curious and innovative which could be further improved with the use of design together with their engineering capabilities.

1.4. ABOUT HARJU ELEKTER TELETEHNIKA

As a result of the company visits and several discussions with the CEO of the company a focus for the master thesis was defined – to redesign the core product of Teletehnika and set rules for their product portfolio . Reason for that was both the wish of the head of the company and the fact that Teletehnika has a more defined product range compared to other subsidiaries that are more focused on special and made to order products, thus giving the possibility to create more persistent values that could be more beneficial in the long run.

As the focus shifted to one selected daughter company another set of meetings and interviews were planned to investigate the telecommunication and data communication industry where Harju Elekter Teletehnika operates. Four more informants were interviewed:

- Head of Harju Elekter Teletehnika – Urmas Paisnik
- Production planner in Harju Elekter Teletehnika – Martin Härma
- Sales manager in Harju Elekter Teletehnika – Jaagup Toompuu
- Purchasing manager in Harju Elekter Teletehnika – Andres Uustalu

To identify the possibilities for design implementation the author studied and analysed Teletehnika's product portfolio, corporate visual identity (CVI) and the shared brand of Harju Elekters Group. The main focus is on their flagship product, but some guidelines and recommendations are also given about other problems and findings that will not be further investigated in the master thesis but require company's attention in future developments.

Harju Elekter Teletehnika AS is a leading producer of sheet metal enclosures and cabinets for telecommunication and electrical installations in the Baltics and has been focusing on both indoor and outdoor telecom enclosure applications for nearly 2 decades. The company has over 60 employees.

Main activities of Harju Elekter Teletehnika are:

- **Manufacture and sales of telecommunication and server cabinets** – Teletehnika produces rack cabinets for both indoor and outdoor purposes and a wide choice of accessories that go with them. These cabinets are used for cabling and stacking all kinds of electrical equipment such as servers, routers, hubs, UPS (uninterrupted power supply) units, computers and other kinds of active equipment. The cabinets are produced in-house from sheet metal.
- **Fibre optic cable assembly** – manufacturing and assembly of cables, connectors and the components according to client's needs. In addition Teletehnika offers cabinets with pre-installed cabling.
- **Electrical engineering and installation** – Teletehnika also acts as a communication service provider at the industrial park they are situated in. Teletehnika takes care of Harju KEK's communication solutions and is responsible for its maintenance.
- **Contract work** – manufacture of other sheet metal products such as mail boxes, trash bins and wardrobe closets. This, however, is not their main focus.

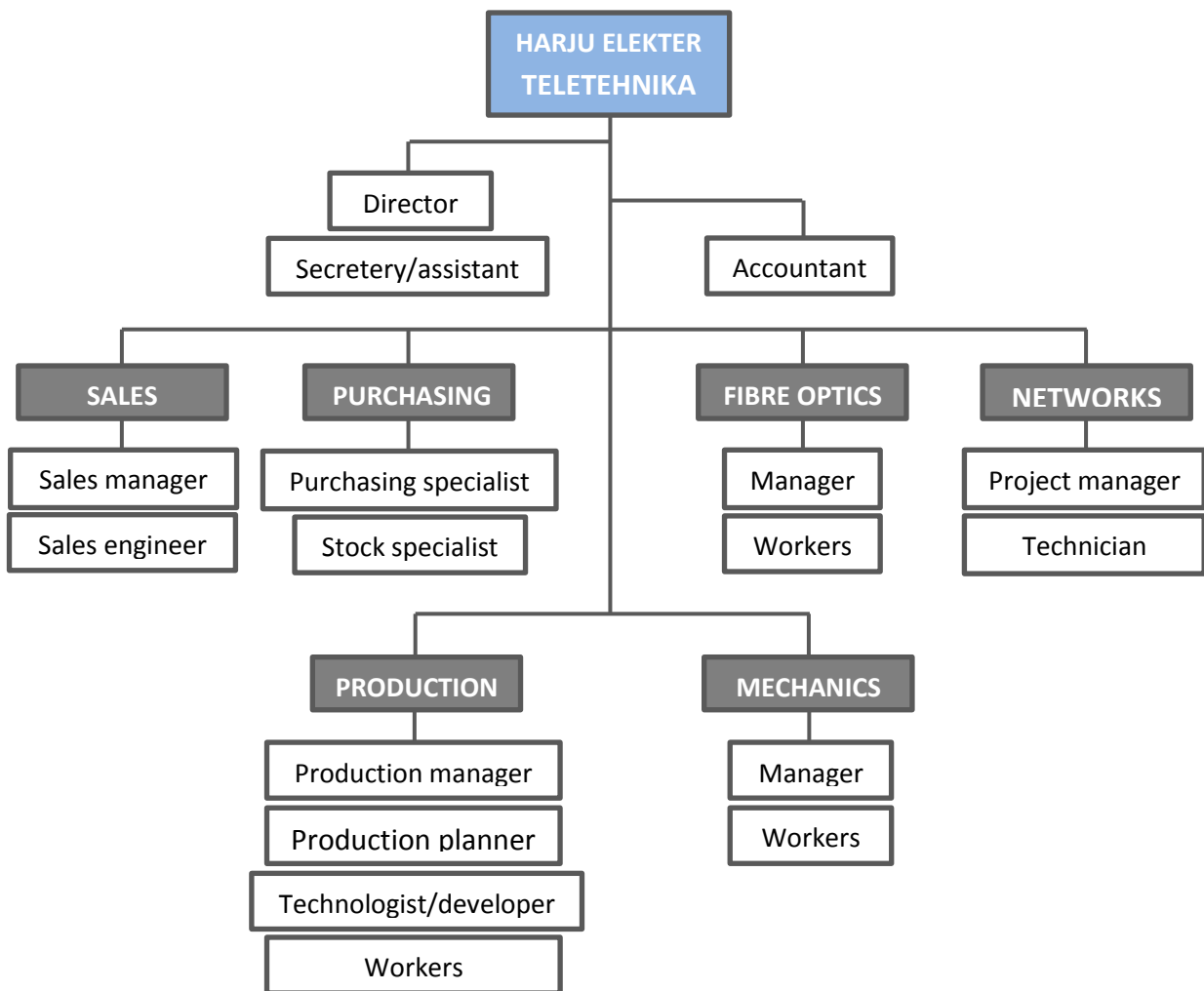Teletehnika has 6 different departments and a staff of 65 employees.

Figure [2] Teletehnika's structural graph

Harju Elekter Teletehnika operates mainly in the European market, Baltic Sea region and North-Europe. Close to 60% of all production and nearly 80% of racks and fiber-optics are exported. For the local market, Teletehnika offers mainly sub-contract and made to order works, standard and mass products are exported and sold through intermediaries. Teletehnika is also strongly oriented towards the Finnish market through their partnership with a wholesaler and distributor Elektroskandia Finland.

Teletehnika is focused on an industry that is closely related to the field IT and electronics. These industries are very design oriented which sets higher expectations for associated products and industries. Therefore, it is necessary to implement high level design in Teletehnika's operations and products. Currently, Teletehnika has no in-house or a consulting designers involved in research and development, which would be advised in order to diversify and enliven the process and create more competitive solutions. Company operates in a sector where the use of design has not been self-evident.

1.5. HARJU ELEKTER TELETEHNIKA'S FOCUS
1.5.1. DATA CENTRE

Teletehnika's products are created for use in data and telecommunication centres.
Data centre is a physical facility that gathers different IT and telecommunication operations, stores, manages and distributes the data of an organisation or multiple parties. Data centres hold the most crucial and critical systems of a network that are vital for daily operations. Because of that, the security and reliability of data centres and their data is the main priority for organizations.

Data centres can generally be classified as Internet or internal (enterprise) data centres. The Internet data centres are typically browser-based and have many anonymous users. Enterprise data centres on the other hand have less users but can host greater amount of applications that are often customized for certain purposes.

An effective data centre operation is achieved through attention to several key factors. These elements are:
- Facility – the location and "white space," or usable space, that is available for IT equipment.
- Support infrastructure :
    1. Uninterruptible power sources (UPS) – battery banks, generators, and redundant power sources
    2. Environmental control – computer room air conditioners (CRAC), heating, ventilation, and air conditioning (HVAC) systems, and exhaust systems
    3. Physical security systems – biometrics and video surveillance systems
- IT equipment – actual equipment for IT operations and storage of the organization's data. This includes servers, storage hardware, cables, and racks, as well as a variety of information security elements such as firewalls.
- Operations staff – to monitor operations and maintain IT and infrastructural equipment around the clock. (Palo Alto Networks, 2014)

The size of the data centres varies greatly. Enterprise data centres can be relatively small and can fit a living room sized space. Internet data centres however can occupy huge halls and multiple levels of a facility. The equipment is usually placed in 19 inch rack enclosures, which form a structured layout. The cabinets are placed in a line formation, side by side, creating corridors in the front and back of the cabinets. This gives access to both front and back of the rack cabinet, making them easier to service. Often the space between the backs of the two rack rows is used as ventilation and cooling tunnels.

Figure [3] Data centre isle

Figure [4] Facebook data centre in Sweden

1.5.2. 19-INCH RACK

Harju Elekter Teletehnika's main product is a 19 inch rack cabinet, which is a standard sized enclosure that is meant to facilitate a number of electronic equipment modules. 19 inch cabinets are mostly used in telecommunication industry - data centres, smaller individual server rooms, as single cabinets in office space etc. They can hold heavy servers, hubs and routers which all have standardized dimensions. This makes it easier to stack them into a single cabinet and do the cabling. These racks are also used in audio and video industries for different amplifiers, mixers and various interfaces.

There are different type of racks – open frames and closed cabinets. The open racks are often used in smaller server rooms and in dust-free conditions. They are easier to operate and give access to all sides of the equipment. For telecommunication equipment and cabling purposes the open frame is a better choice because often all the cables cannot fit a closed cabinet.

Closed cabinets are mainly used in bigger data centres where there is less need for access to the equipment. The top and bottom, sides and backs are still accessible but less comfortable to open. Closed cabinets also enable monitoring and better surveillance (door sensors, moisture and temperature sensors etc.). Closed racks are also better for more controlled cooling and airflow management. Often different companies rent or share the data centre space. In those instances closed server racks are used to keep the servers and other equipment locked for security reasons. For smaller offices there are lower cabinets or wall cabinets with smaller capacity.

Figure [5] Open frame
Figure [6] Closed cabinets

1.6. MARKET

1.6.1. CUSTOMERS AND STAKEHOLDERS

Teletehnika has a relatively wide clientele from different types of establishments and sectors. However, almost all of them are B2B (business-to-business) customers who are categorized according to the frequency of placed orders. Three priority groups have been created:

Group A – orders are placed almost weekly (delivery time in 2-3 weeks)
Group B – orders are placed once a month or once in a quarter of a year (delivery time in 4 weeks)
Group C – one time order, an occasional client (delivery as soon as possible with no certain dispatch guarantees)

Main types of customers:
- Resellers and distributors – partnership with Elektroskandia Finland, a wholesaler in Finland, who is responsible for Teletehnika's sales in Finland.
- Telecom and weak current systems developers
- IT-companies
- Various establishments with servers and server-rooms (banks, universities etc.)
- Construction contractors and developers
- Data centres
- etc.

Besides different customer groups there are other important stakeholders whose expectations and needs they have to be considered. They are divided into two groups – external (resellers and distributors, customers, end users) and internal (investor, employee).

DISTRIBUTORS AND RESELLERS
Due to operating in the international markets Teletehnika needs to pay attention to the expectations of their distributors and resellers, who are responsible for the sales and marketing on foreign markets. They are price and cost oriented for better profitability, but they also seek for other aspects that help them increase their sales, such as the brand image of the companies they represent, product design and usability. These are all great selling arguments and can increase the credibility and value of the goods they offer.

CUSTOMERS
Teletehnika has a wide variety of customers from telecom network developers to data centres. The specifics of the expectations may vary but the general values are roughly the same. Similarly to distributors and resellers, the customers focus a lot on price and delivery time. Teletehnika's goal should be to attract those clients that value a strong brand and design and are willing to pay a little extra for the goods. Another aspect that is valued among the customers is the communication and after sales support, which keeps the customers assured that help is accessible.

END USERS
The end user is usually a manager or operator of the network or server rooms. The customers are oriented more towards fiscal matter, the end user, however, values the functional aspects and features of the product. Most important for them is usability, but design and brand image also play an important role of the user's personal satisfaction. Having good communication between the user and the company helps them ease their work and accessible after sales help is valued.

INVESTORS
As a public company Harju Elekter Group has the responsibility to operate in the best interests of their investors and owners. Having a strong brand image and presence on the market can attract new investors. By setting themselves objectives in forms of design and marketing strategy assures the investors that the company is competitive and vital and is oriented towards progress and development.

EMPLOYEES

Employee's well-being is important to Teletehnika and building a strong brand image can increase the workers trust towards their company. Use of design diversifies the working process and helps keep the employees motivated and eager to look for new solutions and be part of the company's development. Product usability should not be considered only from the user's point of view, but also from the employees perspective regarding assembly and manufacturing logic.

INFLUENCIAL FACTORS	External stakeholders			Internal stakeholders	
	RESELLER	CUSTOMER	END USER	INVESTOR	EMPLOYEE
PRICE	✓	✓			
SHIPPING COST	✓	✓			
TIME OF DELIVERY	✓	✓			
CUSTOMER SUPPORT		✓	✓		
USABILITY	✓		✓		✓
PRODUCT DESIGN	✓	✓	✓	✓	✓
BRAND IMAGE	✓	✓	✓	✓	✓
MARKETING STRATEGY				✓	
DESIGN STRATEGY				✓	
COMMUNICATION	✓	✓	✓	✓	✓

Table [1] Influencing factors for stakeholders

TELETEHNIKA'S FOCUS

Teletehnika is mostly oriented towards their customers and the fiscal matters like deadlines and production cost and forgets other important aspects that can have strong positive influence on the sales numbers and customer satisfaction. Little focus is placed towards other "softer" interests of the stakeholders such as communication, brand image, marketing and strategic design. Teletehnika should conduct further client satisfactory surveys and a stakeholder analysis to identify the specific expectations and needs of different individuals and groups and to balance the company's activities and emphasis.

1.6.2. FIELD VISITS

Several site visits were organised for getting authentic information and feedback from the clients and end users of the telecom products. Even though they might not be able to define their needs in detail, they can still be able to give valuable insight.

„Unlike surveys of focus groups, where researchers' questions dictate the conversation, a field visit emphasises observation and inquiry about what is being observed. Researchers ask participants to talk about specific activities and things they use. Conversations are guided by simple open-ended questions. The method is a way to get acquainted with users in an unbiased fashion and frequently provides glimpses of nonobvious or surprising behaviours and insights about unmet needs. " (Kumar 2013)

This should also be one of the priorities for companies in order to better their products and get the insight for new developments. Another reason for the vistis was to see the products in use and to make sure they were functioning the way they should and were designed to. This part of the process should not be left aside and would also be reccommended to be carried out occasionally by the company's own developers.

Due to security reasons it was difficult to access bigger server rooms and data centers and insted a few smaller server rooms in Estonian Information Technology College and Tallinn University of Technology were visited. A third visit was to Zone.ee, on of the leading domain and server service providers in Estonia. The visits were accompanied by specialists who know the specifics of the rack cabinets. They introduced the current situation and talked about their own ideas and problems they have faced. The visits were also documented by taking notes and photographs for later analysis and data collection.

VISIT TO ESTONIAN INFORMATION TECHNOLOGY COLLEGE

The server room in Estonian Information Technology College is quite small. All together it facilitated 7 open floor racks. The racks used were from Teletehnikas product range and were installed in 2007-2008. In addition to the server racks the room also had a seperate cooling unit that blew cool air towards the server racks and a UPS unit. The racks were set up by a developer and the equipment was afterwards installed by local specialists. The layout of the room was simple – two rows of rack cabinets were placed in the middle of the room so they could be approached from both sides. A cooling unit was placed in the same row as the cabinets that facilitated servers and equipment with higher Watts. Cooling unit was an important purchase as the existing regular room conditioner was not sufficient enough.

VISIT TO TALLINN UNIVERSITY OF TECHNOLOGY

The second visit was to the server rooms of Tallinn University of Technology. The informant was Edgars Žigurs, the manager of the university's IT infrastructure services. As it is located at the university campus on a relatively large area there were several rooms in different buildings for network distribution. The servers however were located in one certain building. There were alltogether 8 Harju Elekter Teletehnika racks in the TUT server room. Some of them filled with servers, other with network distribution equipment. Just like at the Estonian Infotmation Technology College they had a cooling unit in the server room that blew cool air towards the servers. Another thing in common was the use of open rack cabinets. „We have open server racks due to the need for access to the equipment. It makes the work more convenient and

leaves more room for cables and connections." (Žigurs, personal interview)

In addition to the server room the author also had access to several network distribution rooms and a computing center. The computing center had a more high-end solution by Rittal. A closed aile with special cooling and a seperate door. This keeps the equipment under specific conditons.

VISIT TO ZONE.EE

The third visit was to Zone.ee, one of the leading domain and server service providers in Estonia. The informant was the CEO of the company, Riho Kurg who has had lots of experience with data centers over the years and was able to give insight as an owner of the rackcabinets, rather than a user. Due to security reasons it was not possible to access the data center itself. Zone.ee rents the space in a well-known data center called Linxdatacenter Tallinn, by Linx Telecom. It is a 600 m2 data center in a specially built facility with security and surveillance. (Linx Telecom, 2014)
This is quite a common practice and usually the data centers space is rented out and shared by several companies. The informant however showed a server rack in their office and talked about main aspects that are specific and important to a server rack.

The cabinet Zone.ee had in the office was manufactured by Fujitsu. The reason for that was that they ordered servers from Fujitsu and they offered a full solution by shipping the servers already installed in a server rack. This is a common practice that the servers are often sold with the rack for easier installation.

1.6.3. INSIGHT FROM FIELDVISITS

CABLE MANAGEMENT

ESTONIAN INFORMATION TECHNOLOGY COLLEGE
Cable management can be quite messy and reorganizing them can be an unpleasent and timeconsuming task. This can create network problems and needs to be dealt carefully. It is important to do the cable management right in the first place, because later adjustments can be quite difficult. Right components need to be chosen for the cable management.

Some of the cable routing panels could not be used due to faulty design (figure below). Some of the equipment can reach outward from the fixing rails and need appropriate clearance. The cable routing panels however could not be fitted between to pieces of equipment because the cable hooks reached out from the 1U parameters. Teletehnika's current cable routing panels have fixed that problem and fit nicely to racks.

TALLINN UNIVERSITY OF TECHNOLOGY
The informant also elaborated on the general cabling issue regarding the network distribution. The cabling is always a messy and difficult part of the work. „Often it is easier to cut the cables ends and pull it out, rather than trying to trace exactly were it goes. It is easier to just replace it with a new one". (Žigurs, personal interview)

Lots of cabling was done outside of the cabinet row which is easier and simpler to manage. The possibility to open the sides with minimal obstacles between two cabinets is important for the cabling. The informant also drew attention to this detail. „One of the cabinets we have has a partial wall that cannot be removed on the side and complicates the cabling. It has to be done in the front." (Žigurs, personal interview)
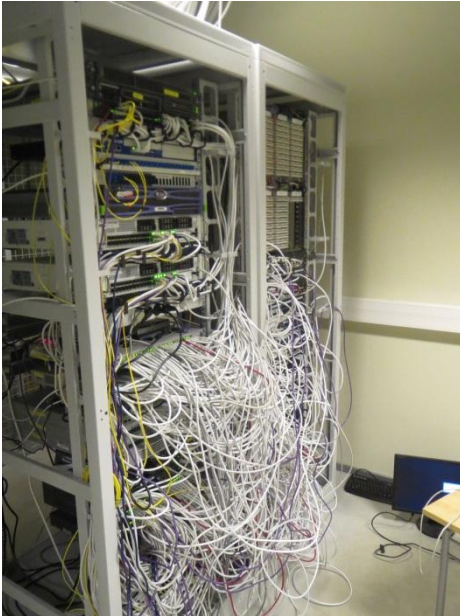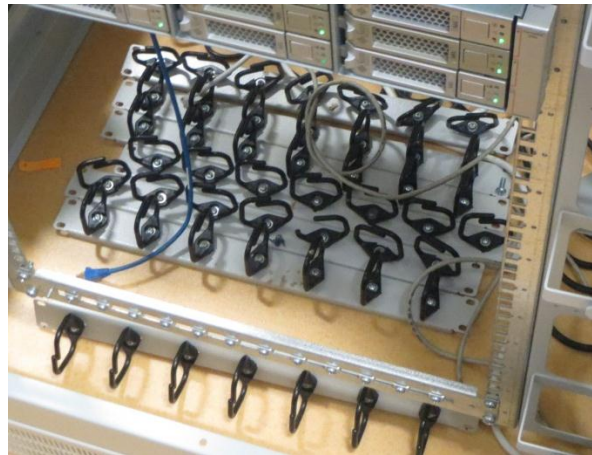

Figure [7] Messy cable management

Figure [8] Faulty design of cable guide in IT-College

COMMUNICATION

ESTONIAN INFORMATION TECHNOLOGY COLLEGE
The informant was not aware of the manufacturer of the racks and all the specifications, he was worried about load applied to the rack when installing 10 servers into a cabinet. Better communication with the users would help them manage their racks better or provide suitable solutions. This however might not be the case with bigger data centers and clients have more frequent communication with the company.

„ The rack manufacturer does not install the cabinets themselves, this is usually done by a weak current systems developer. Because of that there is no direct contact with the manufacturer. After some time, however, it might be necessery to have the manufacturer check up on the installation. There might be a need for some accessories such as shelves, cable guides etc. or to do smaller adjustments or corrections" (Kruusma, personal interview)

TALLINN UNIVERSITY OF TECHNOLOGY
One of the problems that was similar to IT College one was that the informant was not aware of the racks origin that were used for network distribution equipment.
„Usually the university sends out a request and gets offers from multiple companies. The price is usually the main argument." (Žigurs, personal interview)

The cabinets are installed by a telecommunication developing company. There is not much room for personal preferances. Accessories however are later bought off the shelf for specific purposes. There is no

certain company they turn to with a request. Keeping contact with the customers or sending out occasional offers or catalogues to related institutions would be one way to attract customers to buy the accessories from a certain manufacturer.

FUNCTIONALITY AND USABILITY

ESTONIAN INFORMATION TECHNOLOGY COLLEGE
Another issue revealed when there was a need to install a shelf in the rack that already had servers in them. The rails were already fixed to a certain position, but adding a shelf needed both of the rails to be adjusted together. This turned out to be quite complicated. The rails had to be loosened in the C-profiles and then moved. With the weight of the servers on the rails it was quite a task so slide them in the profiles. It would be good to recommend to consider positioning the rails in a position that would later make it easier to adjust or to fit the shelves.

ZONE.EE
The informan emphasized the importance of ventilation and airflow in the cabinet.
„One of the most important critearias is the airflow in the rack. The equipment produces lots of heat that needs to be directed away from the cabinet. Usually the cabinet has a perforated door, back or roof." (Kurg, personal interview)

„Even though this cabinet fulfills the functional requirements its still has lots of problems. First of all, it is not a standard height cabinet with its 46U height and creates complications when positioned next to a standard one with 42U height – creating closed ventilation tunnels is impossible. Another problem is the footprint of the cabinet. It has a protruding floor plate that might make it difficult to incorporate with other racks in a data center. In data centres the front of the cabinets is often equipped with cooling vents. This cabinet however would cover this with its foot." (Kurg, personal interview)

Figure [9] Protruding footprint of Fujitsu rack cabinet

AESTHETICS AND DESIGN

ESTONIAN INFORMATION TECHNOLOGY COLLEGE

The manager also mentioned Rittals' products regarding their aesthetics and clever solutions. The aesthetics and apprearance of a product may not be important for the purchaser who operates in numbers but they are important to the user who has to use the product on daily basis.

„Sure, the functionality comes first, but the appearance and the aesthetics of the product are not less important. My opinion on this matter is that a low-priced product does not necceserily have to be less attractive than a more expensive one." (Kruusmaa, personal interview)

ZONE.EE

The importance of aesthetics was also discussed during the visit. „Aesthetics is definitely an important part of the product. Data centers need to be able to rent their space out and attract more clients. A good looking interior with nice looking cabinets is definitely a good selling argument." (Kurg, personal interview)

PRICE

ZONE.EE

The price and choice of cabinets in the data center was also discussed. The informant pointed out that the price of the cabinet is trivial compared to other expenses in the data center such as cooling and monitoring. The price of the cabinet starts to play a bigger role with bigger datacenters when the number of cabinets might reach hundreds.The cabinets offered by different producers have a relatively similar price ranges. The choice of cabinets is done by the data center owner and is often something that the tenant cannot influence.

1.6.4. COMPETITORS

Due to operating at international markets Teletehnika also has to face global competitors, a few names such as Steral, Laukama and Ojala from Finland, Scrotton from Germany and APC from USA. All of the companies have their own specialities. Some focus more on sub-contract work, some on offering a large variety of products and special solutions.

RITTAL

One of the biggest competitors and leaders in the global telecom solutions business is Rittal from Germany. Rittal has a relatively wide specialization and product range having solutions for almost any industry. As a market leader it is expected of them to provide as wide range of solutions as possible. Rittal manufactures and develops solutions in the enclosure, power distribution, IT infrastructure, software and service sectors. (Rittal, 2014)

Their products are well engineered and thought through equipped with good documentation for assembly and maintenance. As market leaders they have a big role in setting the prices for the rest of the industry. Rittal also uses local distribution-centres and brand representatives which enables fast delivery times. Rittals' brand is looked up to in the global scene and was often mentioned by the informants during the interviews.

As a market leader Rittal has all the bells and whistles that give them a great advantage before smaller competitors. They have a good consulting service for the developers and they have also developed their own planning and monitoring software and mobile applications. They are able to offer a full service, all from one place and that makes it appealing to bigger clients. Rittals brand and visual identity is also thought through and creates a unified impression. The controlled use of visual elements and imagery have a professional and trustworthy effect. Rittals products are better designed and with better aesthetics than most of its competitors and have a very wide product range with several product families. The visual and aesthetical language changes among different product families, but the general picture is neat and thought through.
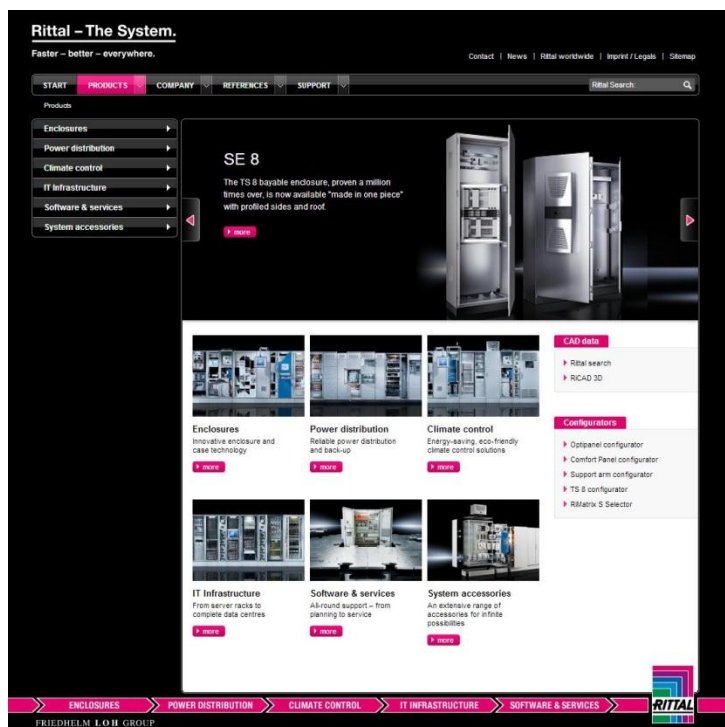

Figure [10] Rittal logo

Figure [11] Rittal website

Figure [12] Rittal rack enclosure

Figure [13] Rittal liquid cooling unit

Figure [14] Rittal monitoring unit

APC

Another well-known name in the rack bussiness is APC by Schneider Electric from USA. Even though APC is not Teletehnikas' main competitor it is still a good example to consider for comparison. APC is quite similar to Rittal regarding its products and services. They offer full solutions for home use to medium and large datacenters with clients support and consultation services. Besides the rack cabinets and wiring encosures they also offer cooling units, power distribution units, UPS (uninterruptible power supply) and monitoring software. (APC by Schneider Electric, 2014)

APC visual identity is a quite good but a little outdated and could use a facelift. Their webpage lacks a good navigational logic and is at some points hard to follow. APCs' products on the other hand are well-designed. As one of their specialities they produce UPS units which similarly to PC's are often placed to visible places and therefore need greater attention to design and aesthetics. APC's experience in this field is well transferred to their other products and create a holistic product portfolio.
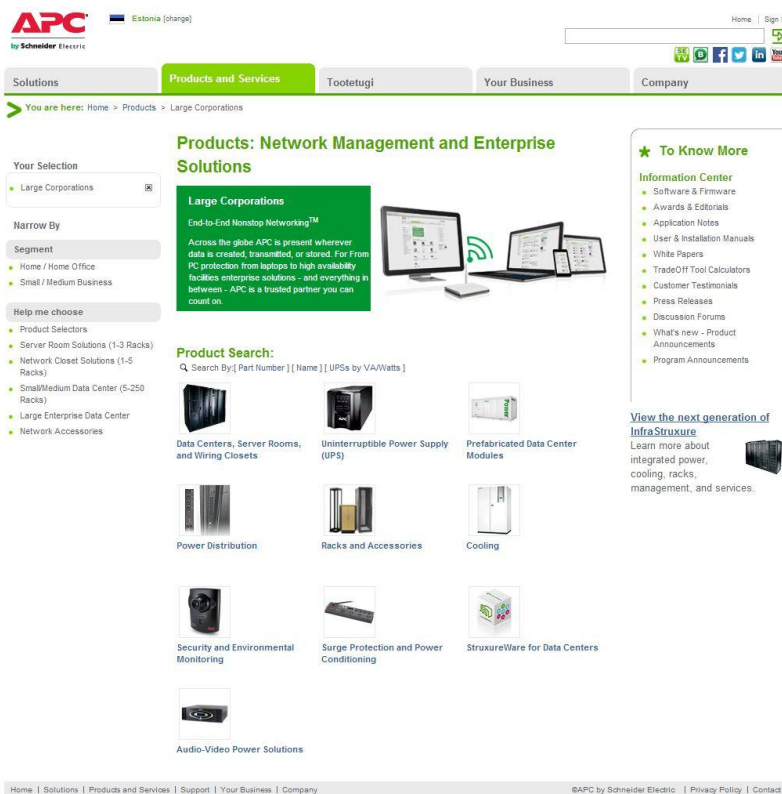
Figure [15] APC website

Figure [16] APC UPS unit

Figure [17] APC Cooling

Figure [18] APC Rack enclosures

1.7. PRODUCTION AND PRODUCT DEVELOPMENT IN TELETEHNIKA

1.7.1. PRODUCTION

Teletehnika has more than 10 years of experience in sheet metal fabrication and the telecommunication industry. Due to the specifics of the industry and various needs of the clients, the development process can be rather complicated.

The small size of Teletehnika's lets them be quite flexible and react quickly to incoming orders. It is possible to push some orders between others and offer short deadlines. This is an important advantage and brings in the orders.

Teletehnika has an impressive machine park specialised for sheet metal manufacture: guillotines, punching and laser benches, bending benches, PEMserter benches, welding, and powder coating capabilities. In addition to in-house manufactured components and parts, a lot of buy-in components such as hinges, locks, shelves, cable guides etc. are also used in production. The manufacturing facility is shared with another subsidiary in the group, Harju Elekter Elektrotehnika, who also deals with sheet metal fabrication. A lot of the machinery is identical and some parts of the production line is shared (powdercoating). Having a shared or partially shared production line and machinery could reduce the amount of investments on new equipment and tools. This is something that requires collaboration in both financing and production planning and would be recommended to consider.

1.7.2. DEVELOPMENT PROCESS

Teletehnika's product development is based on direct orders with the aim to meet various needs of different clients and operate without their own strong strategy behind it.
Teletehnika offers both standard (50% of production) and custom products (50% of production) that we sell under our own name and also brand-labels which are only sold and marketed with their owner's permission. In some cases only one parameter is changed in the whole assembly, which makes the distinction between a standard and a custom product difficult to make. (Paisnik, U., personal interview)

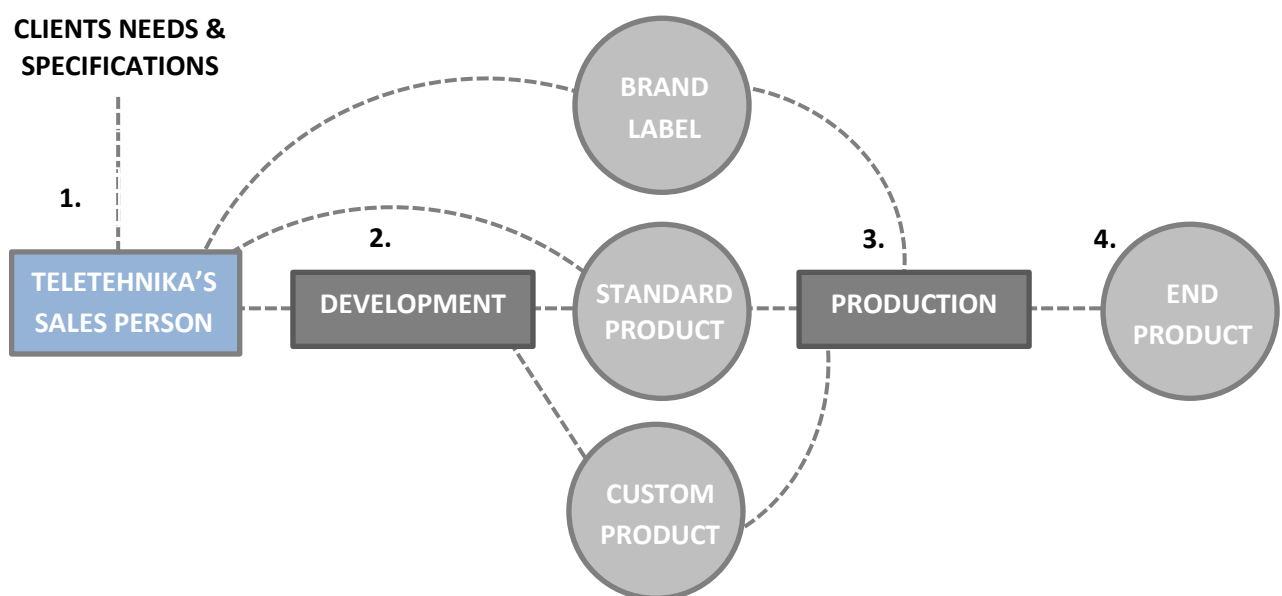**A following simplified graph shows the basics of Teletehnika's product development:**

Figure [19] Teletehnika's product development graph

1. The process starts with the input from the client which is analysed by the sales-engineer, who makes appropriate recommendations and forms the brief. The decisions made in this stage influence the end result the most, therefore they must be in accordance with the company's objectives.

2. During the development process the requirements are evaluated and it is decided whether to offer the client a standard product (often with minor changes), a custom product or a brand label product that Teletehnika itself sells and manufactures.

3. After the development phase the process continues in the production stage where necessary parts are manufactured and assemble together with buy-in components and accessories.

4. The output is the end product that is ready to be packed and shipped.

Teletehnika has no fixed processes for product development and acts mainly according to technical capabilities in hand. Usually, the solutions that seem the simplest to execute are used. However, "the simplest way out" approach is in conflict with the company's stated values of being curious and innovative. The current development process is more with the attitude of "playing it safe". Instead, there should be simultaneous research and development process that would be focused on pushing the limits of the manufacturing and looking for new ideas and solutions. Currently, the product development unit consists of 3 technologists who do all the product development and production drawings and files. Teletehnika should seriously consider giving their development process a new function by taking the leaders role and offering their own new well-developed solutions instead of adapting themselves every time for clients wishes. That needs a different design approach in the process to work for understanding clients needs before they themselves articulate it. This is something that could be carried out by an in-house design professional or by and external design consultant.

1.8. HARJU ELEKTER TELETEHNIKA'S PRODUCT PORTFOLIO

Harju Elekter Teletehnika's product porftolio has 3 main types of telecommunication enclosures - floor rack cabinets and frames, wall mounted rack cabinets and frames and network enclosures for home use. (Harju Elekter, 2014)

All the rack enclosures are suitable for the 19'' standard equipment. In addition to that, Teletehnika offers a wide choice of accessories that are applicable with the racks. A more descriptive overview of the products is added to the appendix section of the master thesis.

Teletehnika's products are listed below.

19-INCH CLOSED CABINETS

The rack cabinet is the core product of Harju Elekter Teletehnika. It is used for installing various telecommunication and data management equipment and has two main widths – 600 and 800 mm. All of the dimensions can be changed according to client's needs.

For data centres Teletehnika has developed a new server rack that has greater depth and better ventilation. Servers are quite powerful and emit lots of heat which requires more attention to ventilation. This is solved with perforated doors and backs that enable better airflow. These racks also support heavier loads – up to 1400 kg.

Figure [20] Solid door 600 mm   Figure [21] Glass door 600 mm   Figure[22] Solid door 800 mm

Figure[23] Glass door 800 mm   Figure [24] Render of a server rack with perforated door
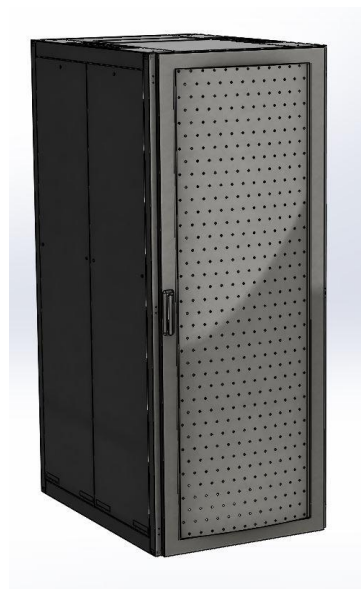
19-INCH OPEN RACKS, FRAMES, WALL CABINET AND HOME BOX

For well-conditioned and dust-free rooms, there are open floor racks which come in same sizes as the closed rack cabinets and share the same frame as the closed cabinets.

Teletehnika also offers cheaper solutions such as open floor frames and wall frames. These products also require a well –ventilated and dust-free rooms.

For less-demanding purposes the company has developed wall cabinets with smaller capacity.

The product line also offers a Home box, a data communication cabinet for home use and new housing.

Figure [25] Open floor rack	Figure [26] Open floor rack 800 mm	Figure [27] Open floor frame
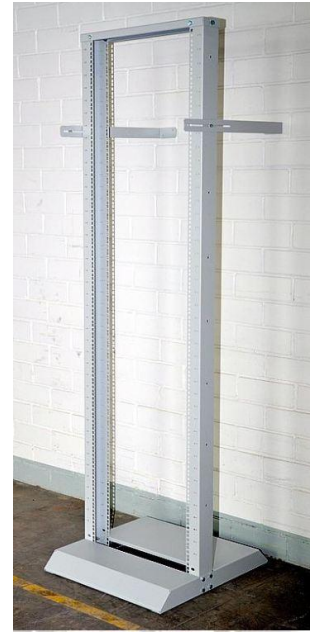
Figure [28] Open wall frame	Figure [29] Wall rack	Figure [30] Home box

OUTDOOR CONTAINERS

Teletehnika also offers outdoor telecommunication containers for data racks, power units etc. with complete electrical installation. These products are made to order and come in higher IP classes.

Figure [31] Outdoor container

ACCESSORIES

Figure [32] Recess panel (HB) Figure [33] Dummy front panels (1U, 2U)
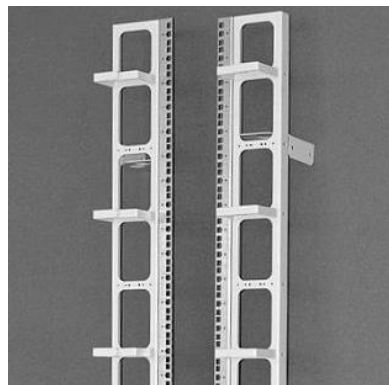
Figure [34] 19-inch rails (600 mm rack) Figure [35] 19-inch rails (800 mm rack)
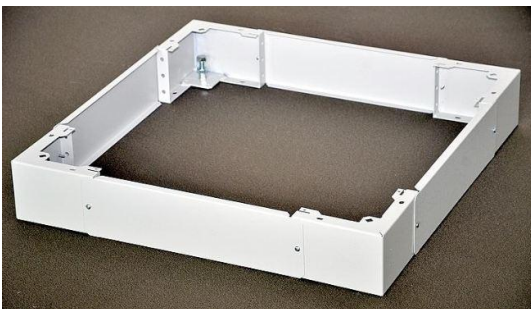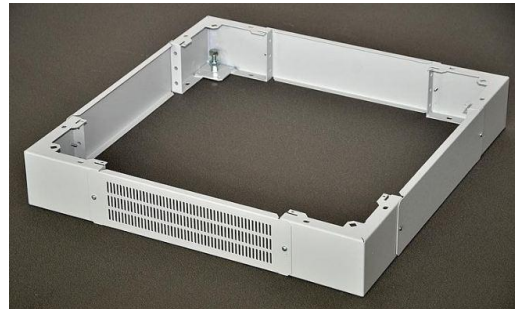
Figure [36] Solid plinth Figure [37?] Ventilated plinth

Figure [38] Roof fan panel Figure [39] 19-inch RJ45 panel

Figure [40] Fiber optics distribution panel
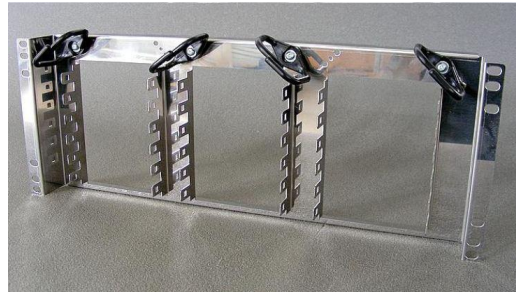
Figure [41] 19-inch back mount frames

Figure [42] 19-inch power supply
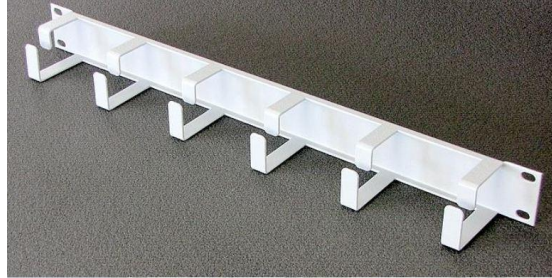
Figure [43] 19-inch cable routing panel

Figure [44] 19-inch sliding shelf

Figure [45] 19-inch stationary shelf
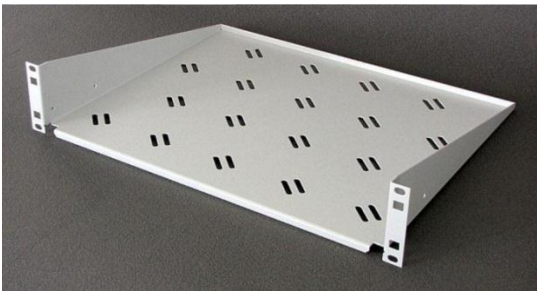
Figure [46] 19-inch shelf front fixing
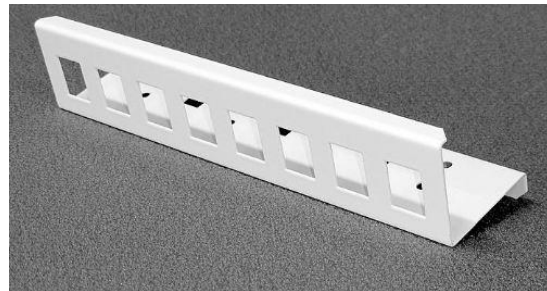
Figure [47] Cable panel (HB)

Figure [48] Levelling feet

Figure [49] Equipment fasteners

Figure [50] Sliding fastener

1.11. PRODUCT PORTFOLIO ANALYSIS

In orded to find points of improvement Harju Elekter Teletehnikas' product portfolio was analyzed. Products were looked at both individually and together as a product family. Focus was on design, general aesthetics and technical solutions.

Teletehnika is mainly focused on the 19-inch rack cabinet, one type of product that carries certain functions – a core product. Together with other complementary products and accessories they form a product family. Having only one product family as the main source of revenue requires assurance that the products in hand are able to sustain the business. For that, the product line has to be thoughtfully planned and executed. Teletehnika has so far not focused too much on aesthetical aspects and the unity of the product line, but more on fulfilling functional needs and requirements. Teletehnika's products are generic and offer same functional criteria and parameters as other producers on the market, but have nothing on product level that differentiates their products from others.

The first glimpse of the product porftolio leaves a relatively outdated and a random impression. It seems that these products act just as functional structures with no characteristic identity and come off anonymous. When looking at Teletehnikas product portfolio more in detail one can see that the products do not share any distinctive features and seem detached from others.

RACK CABINET
Teletehnika has recently developed a server rack with more attention to aesthetics. The rack shares the same frame as other cabinets. It consists of profiles that are bent from sheet metal and are joined together with simple bolt-nut connections. This however makes the assembly a bit more difficult and time consuming as there is relatively big number of elements that need to be assembled. These joints should be made more modular and easier to assemble to simplify the assembly process and reduce the number of buy-in components. The racks functional logic is justified and meets the requirements well which is obvious because of the company's long experience.

Figure [51] Frame connection

All of the rack cabinets have flat-packable frames due to the limits of the production line, but Teletehnika has managed to make this their speciality. Because of the limited size of the powdercoat oven it is not possible to produce welded rack cabinets like Rittal or other competitors. Teletehnika paints their products in multiple parts. This means that Teletehnikas products can be disassembled for shipping. This reduces the amount of „air" that is shipped and brings down the costs.

There are however some details that are still clumsy. For instance, the side panels are fixed between the frame with a flange on the bottom and bolt fixings on the top and sides. The flange however is a separate detail that is later welded into place. This adds several operations to the production process including punching, bending and welding. This function should be more thought through and made simpler if possible. Another element that seems to be added on later and is not incorporated into the assembly is the side panel fixing. It is a rivet-on solution that adds multiple unnecessary components to the assembly.
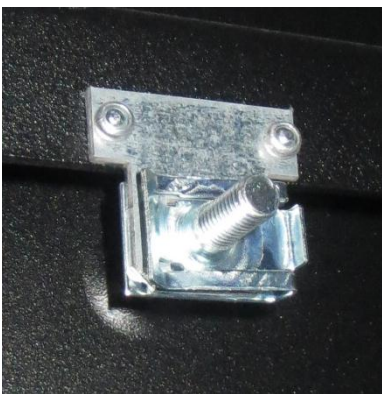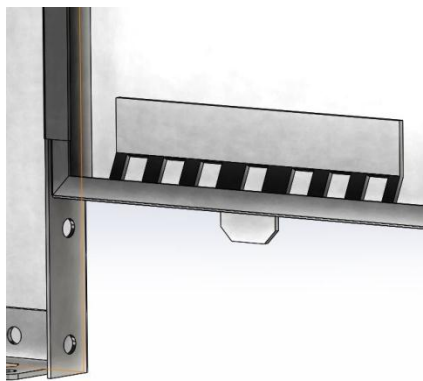
Figure [52] Side panel fixing   Figure [53] Side panel guiding flange

The back of the cabinet can either be filled with a back panel or fitted with a door. The front of the cabinet has various possibilities from solid steel, glass or perforated doors. It is also possible to choose a two-sided door. Current door solutions are flat and simple. The new server rack however has a more characteristic door with a convex perforated centre part. The doors are most visible part of the product therefore should carry the products visual characteristics and identity.

ATTENTION TO DETAIL
The accessories in the product portfolio should also be attended with greater focus to detail. Even if the core product is well designed, a faulty or an inapt accessory is able to ruin the overall impression. Accessories should act as add-ons that would not only complement and fit the core product itself but also each other. Accessories are an important part of the product family that help to make the product simpler to use or to adjust it to specific needs and should be therefore treated equally. They are relatively small compared to the rack itself and even the smallest unfit details can influence the appearance of the accessory. For an example, all kinds of screws, rivets and other fixings on the facade carry a message of low quality engineering work and harm the trust of a whole product. These fixings should be hidden from sight if possible offering a smarter look and product image.

Currently there seems to be no guide-lines for product development and design. Each component seems to be designed at different time, with different logic and form language with little regard towards the whole. This includes for instance fillets and radiuses of cut-outs and edges of flanges. On some occasions chamfers are used all-together. Even though these things might not be identifiable at first, they still play an important role in the perception of the overall image and are simple changes to make the design process more systematic. Other details that need attention are all kinds of perforations. These features can be used to create distinct visual elements that help to tie different products together as a family under the same brand. Currently there are several types of perforations used – circles, squares and round cornered slots. They are also used in various sizes and are not thought through. The choice of these types of elements should be kept as low as possible and should be well defined in the design process.

BUY-IN COMPONENTS

Choice of buy-in components is another factor that can be quite influencing. For an example, Teletehnika has several cable guide solutions that do not fit together. An in-house solution is bent of sheet metal, however the buy-in components are bent wires with bends that seem strange when compared to others. Same applies to the castors and levelling feet and power supplies. These parts are less visible and are not that crucial but if possible the preferred components would have least effect on the assembly and draw any unnecessary attention.

Figure [54] Subrack with cable guides

Figure [55] Screws on products façade

More important components however are handles, locks and hinges that should be chosen more carefully. These components can create quite a distinctive look to the product because they draw a lot of attention to themselves. Ideally these components should be specially made and not an off-the-shelf product.

1.10. BRAND AND CVI ANALYSIS

BRAND

Teletehnika's brand has to be analysed together with Harju Elekter Group and Harju Elekter Elektrotehnika, because they operate under the parent company's name and share the same corporate visual identity (CVI). Harju Elekter Group's brand communicates confusing messages and ideas – company's missions and values are not in accordance with the company's activities. Claiming to offer added value and being curious and innovative is one thing, but without communicating it through the company's brand image and goods it

is merely a sentence on the company's webpage that bears no true value. Good brand management is the key factor for a company's success. (Lehari et al., 2012)

The general impression of the Harju Elekter's CVI is conservative and out-dated and does fails to communicate what it stands for or how it differs from competitors. Neither is there consistency in the use of visuals elements across the subsidiaries or the holding company, which is something that makes a brand recognizable and memorable to the customers and users. This should be extremely important for Harju Elekter Group as a parent company in stock market. Compared to some of the subsidiaries like Satmatic and Rifas, Harju Elekter Group has much weaker visuals and aesthetics. Rifas and Satmatic have put more emphasis on how they want to be perceived and the same should be done by Harju Elekter Group.

CVI

The first thing that catches the eye when skimming through the CVI of Harju Elekter Group is the mismatch between the logo and the supporting graphic elements. The logo has a sturdy, angular, and highly constructed feel. The logotype is set in an extremely wide typeface, which is an uncommon choice for a longer name because it causes difficult proportions in terms of use – wide and low. The angular design carries the popular aesthetic choices of the 1990s and therefor feels outdated as opposed to a modern long-standing aesthetics .

The graphic elements introduced in the CVI-book speak a different visual language from the logo. Opposed to the constructed, sturdy, angular feel, these elements use transparency and gradients and free flowing curves to create an airy, flowy and gentle feel. These characteristics are not represented elsewhere in the CVI.
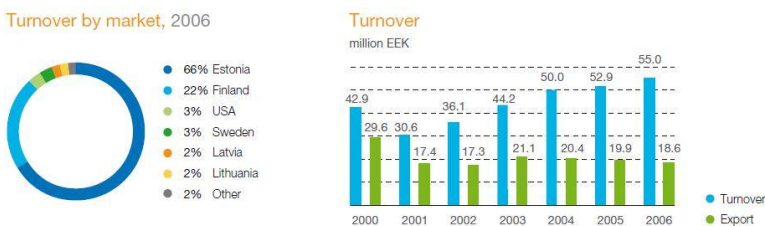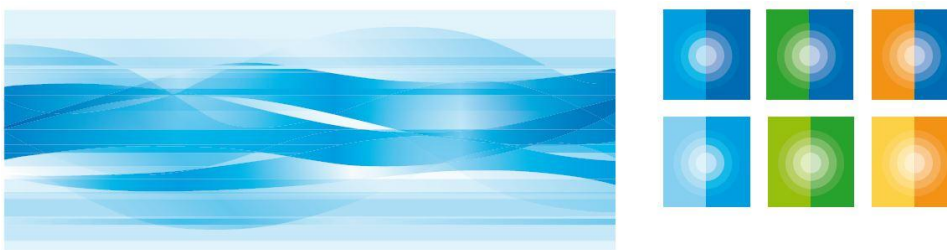
Figure [56] Graphic elements in CVI book

The CVI also fragments the visual language by introducing the faint use of imagery with lowered opacity which contradict the visual strength of the logo.

Another aspect that catches the eye is the inconsistency in typography. The CVI lists the typefaces approved for brand communication. The list includes a single serif typeface – Times New Roman as an alternative to Calibri and 4 sans-serif typefaces Helvetica Neue, DIN, Calibri and Arial.

There are big differences in the characteristics and values that these fonts carry.
Helvetica and Arial are generic typefaces that carry no certain feeling. DIN, however, gives a mechanical,
angular and highly constructed feeling. Calibri on the other hand gives a warm and soft character with
subtly rounded corners. This set of typefaces does not form a unified story. In addition to that, the website
uses a completely new typeface – Ubuntu. All this creates a strong inconsistency in the company's visual
communication across different mediums which undermines the goal of creating an easily recognisable
brand image. Harju Elekter Teletehnika's technical data sheet uses yet another typeface – Perpetua Titling
MT.

There is also some inconsistency in creating rules for the use of graphic elements. The CVI also dictates the
forbidden use examples for the logo. These rules forbid the use of outline and the use of another colour
than the specified blue in non black and white print. The CVI later goes on to contradict both these rules in
the case of diplomas.

Figure [57] Forbidden use of logo in CVI book

Figure [58] Diplomas in CVI book   Figure [59] Faint imagery in CVI book

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There is also no consistency in the layouts across the CVI. The logo can be aligned to the right on the letterhead, left on 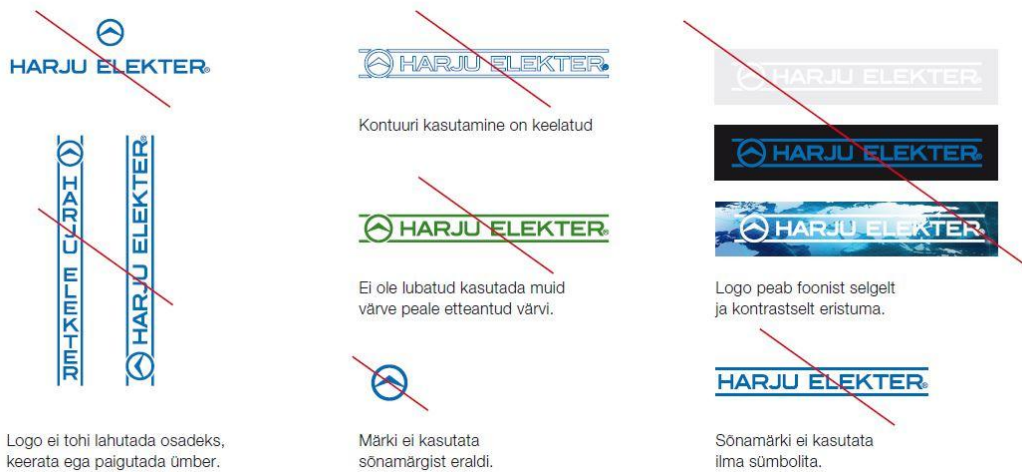the envelope, fully justified with the text on the business card, centered on the diploma and set at an angle on the flag.

The same inconsistency is also present in text justification. The CVI fails to describe the use of the different alignment ideas which makes the everyday application of the design difficult to implement and not consistent in the long run. This will hurt the continuity and therefor trustworthiness of the brand.

Harju Elekter group should cooperate with a branding and corporate graphic design specialist who can help them develop a new CVI and update Harju Elekter's logo. With the help of a designer, a set of rules are created for controlled use of visual graphics in different mediums and applications – web, printouts, catalogues, template, products etc.

1.11. CONCLUSION OF DESIGN AUDIT

1.11.1. SWOT ANALYSIS

According to the findings and insights from the design audit and research a SWOT analysis was carried out. Main keywords related to the organisational aspects were listed in each category with short explanations.

STRENGHTS
1. Flexibility of production – Teletehnika is able to meet short deadlines and move things around in the manufacturing stage. This gives them a competitive edge as time of delivery is an important sales argument.
2. Knowledge in sheet metal fabrication – more than 10 years of experience have given good knowledge of sheet metal fabrication technicalities.
3. Flat-packable solutions and lower shipping costs – Teletehnika's products can be disassembled, compact package reduces the shipping costs.
4. Leading position in the Baltic region – good existing network and partnerships.
5. Good machine park capability – all necessery sheet metal fabrication tools are present.

WEAKNESSES
1. Weak brand image – Harju Elekter Group fails to communicate its strengths and message through different mediums. There is controversy in the company's stated values and reality.
2. Out-dated visual identity – current CVI is old-fashioned and controversial to itself. There is inconsistency in the use of visual elements and imagery throughout the Group, which does not leave a trustworthy impression.
3. No new development – too little emphasis is placed on looking for new solutions and experimenting. Development process deals mainly with adapting current solutions for different orders.
4. No consistency in product portfolio – Teletehnika's products fail to give a coherent impression and seem to be developed with no regard toward others. Lack of rules in the development process leave a random and messy impression.
5. Little regard towards design and aesthetics - Teletehnika does not emphasize design enough in their product development. There is no professional designer involved in their activities.

OPPORTUNITIES

1. Attracting new customers – gaining new clients through brand image and product portfolio improvements.

2. Attracting investors – increasing appeal to new investors and raising the companies value through use of design and marketing strategies.

3. Improve their speciality – to further develop and emphasise their knowledge on flat packable solutions.

4. Improving brand image and CVI – to create a partnership with a brand consulting company that can help Teletehnika to create an appropriate and competitive image.

5. Raising machine park capability – to reduce buy-in components and materials and possibility to produce as much of the components in-house as possible. (e.g. new punching and bending tools, automatic bending bench etc.)

THREATS

1. Losing customers – customers put emphasize on design and brand more and more. There is a threat to fall behind and losing customers to other competitors who value design more.

2. Lose speciality – bigger competitor decides to develop flat packable solutions and through that reduces Teletehnika's market share.

3. Losing leading position in Baltic region – not focusing on what are their strengths and not finding or developing new ones can reduce their competitive edge. Even a single company in the Baltic region that would do things better than Teletehnika could influence their market share strongly.

1.11.2. FINDINGS AND GUIDELINES

BRAND

As a company that operates on the international markets, including the Nordic market, where the emphasis on design is crucial in order to be competitive, Harju Elekter Group should not forget the importance of having set themselves a strategic design plan. Not only is design implementation important regarding their products but also to the brand of the company. Harju Elekter has not set themselves any significant design related objetives or tried to create a consistent brand communication throughout the Group.

In order to be competitive on the international market and IT-related industry it is crucial to have a strong brand image and brand promise. The values and beliefs of the company have to be in accordance with company's operations, and vice versa. The question asked should not only be "How can we make things cheaper to produce?" and "How can we reduce delivery time?", but also "How can we attract clients that are willing to pay extra for our products?" and "How can we add value to our products?". Good communication is important and lots can be done with right marketing strategies. It is important to have a good partnership with a branding or an advertising agency. It is a small investment compared to production expenses, but just as important.

Keywords and findings from design audit:

- Weak brand image that fails to communicate the company's values and beliefs.
- Out-dated visual identity – old-fashioned aesthetics and visual elements do not leave a professional and modern impression.

- Confusing - too many elements (colours and geometrical shapes) and typefaces with no certain rules of use. Up to 7 different typefaces are used at the same time.
- Comes off as amateurish - due to little rules of use these elements are used rather randomly by different subsidiaries (Elektrotehnika and Teletehnika) and fail to give a holistic impression.
- Lack of consistency and logic - elements and examples given in the CVI-book have little to no linkage to each other. Use of imagery is not controlled (various settings and angles).
- Missing marketing strategy

PRODUCT DEVELOPMENT

Currently there is no research and development department in the company structure. This indicates a missing function that is absolutely crucial for a manufacturing business. An independent division that is focused on new solutions, technologies and experimenting can create new superior products and give competitive edge before other competitors. Product development should also follow certain rules that should be considered together with the design of the products. This can help eliminate inapt solutions and create a holistic product family in both technical and aesthetical aspects.

Keywords and findings from design audit:
- Outdated solutions - no clever solutions in structural logic or assembly. "Bolt-nut" connections and joints. A lot of "add-on" components and elements. Too little incorporated solutions.
- Technological constraints as an advantage - Teletehnika's technology park only lets them produce demountable rack cabinets (due to the dimensions of the powder-coat oven), hence they are oriented towards flat-packable product development. This should be explored more and ease of assembly should be kept in mind with these solutions.
- New tools and technologies should be experimented with. Investments to new tools should be shared with Harju Elekter Elektrotehnika if possible.

PRODUCT DESIGN

In a B2B industry where the products are often hidden from sight and not visible to public one might think that design is not important and is overlooked during the development process. It is not just the price of the product or delivery time that helps a company compete on the market. Just as important as are these factors, is the aesthetics and overall impression that a possible customer gets when looking at a certain brand, their services and products. To keep up with the current market and refresh their product portfolio it is necessary to firstly update and give a facelift to existing products but also to set long-term objectives for further developments and improvements. It is important to involve a design professional in the decision making phase when these things are discussed and later executed.

Keywords and findings from design audit:
- Product portfolio lacks completeness - some products (mostly accessories) seem random and do not fit with others. A better choice of buy-in components or a regulated design process should be considered.
- Lack of consistency - different shaped perforations and structural logic in some product categories.
- No regard towards aesthetics - there are no characteristic features in the product range that would create distinctive or recognizable visual elements and solutions.

CUSTOMER SUPPORT

The server room visits showed a need for better communication between the customer and manufacturer. Even though these are small clients and their orders make only a fracture of the business revenue it would be good to keep track of the past clients and keep them posted on developments of new products or accessories. This could include newsletters or brochures. Often client's needs change and they are not aware of all the solutions that the company can offer. Better customer support or time-to-time visits could help define clients changing needs and help them upgrade or add some new accessories. This would create better trust and a loyal client.

1.11.3. RECOMMENDATION FOR DESIGN USE

Harju Elekter Teletehnika is new to design implementation in their development. As this process can be relatively time consuming and needs a lot of determination from the company's side, this master thesis should be considered more like an introduction to this practice.

New product development needs the company's ability to see and predict the future trends and market, and be able to develop new, more innovative solutions. This has to be aligned with the company's strategy and long-term goals. In order to accomplish more than just retaining a position on the market, greater and long-term objectives should be set. For developing really new solutions it is necessary to focus on two strong aspects: the "push" that comes from the new technology and the "pull" of market needs.

New product development would have been too time-consuming task to take in the course of the master thesis, thus, the author proposes improving an existing product. Taking into consideration that Teletehnika has developed their cabinets about 5-8 years ago, a renewal of the core product is an appropriate task to solve. This is also one of the most common development activities. Over time the need for improvement may occur within the company itself or be driven by external factors like competitors or the market. This does not imply that a product has to be totally redeveloped. Partial improvements, updating and refining can extend a products lifecycle significantly. This is done by using existing technologies and targeting the current market. (Lehari et al., 2012)
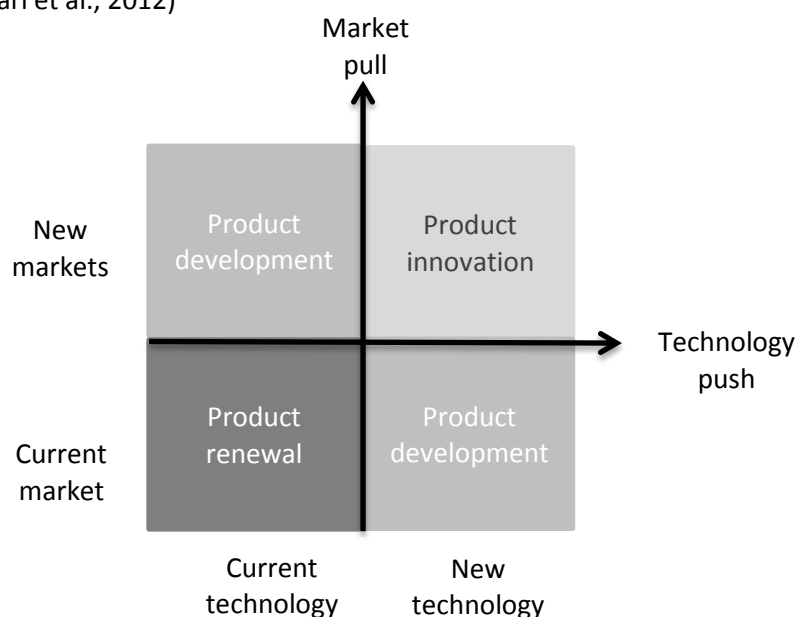

Figure [60] Matrix of opportunity areas for product planning (Cross, 2008)

2. PRODUCT RENEWAL

2.1. BRIEF

For further development a brief was formed to help to define the problems and aspects that need to be attended in the renewal of the product. These specifications were formed according to the findings and problems that came to author's attention during the research and analysis stage. This brief is built for the renewal of their core product, the 19'' telecommunication and server rack cabinet.

PRODUCT SPECIFICATION

PURPOSE
The improved product will be used for facilitating telecommunication and server equipment. The end result should be suitable for both of these uses without compromises. The product will be used in different environments and has to be adaptable from both largescale data center use to a single independent cabinet. The end result has to meet the industry standards and compatible with other products and accessories in Teletehnika's product portfolio.

FUNCTIONS
Existing functions:
- The cabinet in development has to facilitate electronic equipment for telecommunication and server system purposes
- The cabinet has to fit the 19-inch industry standard
- Ability to carry the weight of the equipment (maintain current structural logic)
- Has to function both as a frame and a closed cabinet
- Possibility to join cabinets into a row
- Cable inlet possibilities from multiple sides
- Removable sides, back, ceiling, floor panels
- Possibility to improve ventilation with perforations
- Ability to level the cabinet on cabinet rows (levelling feet)
- Cabinet has to be collapsible

Added value:
- The rack cabinet is a relatively complex product with quite many components in the assembly. The renewed cabinet should be more integrated and unified and would be easier to assemble. The assembly should consist of as small amount of components as possible.

FEATURES
Existing features:
- Sheet metal structure
- Maintain current external dimensions and parameters of the cabinet
- Maintain the possibility to change width and depth of the cabinet
- Capacity of 42 units

- Doors need to be lockable
- Possibility of various door solutions – one sided and two sided doors
- Multiple door choices – glass, perforated, solid
- RAL – paint
- Ability to install power supply panels

Added value:
In addition to these „hard" features it is important no to forget the „soft" ones that define how people perceive the product and what kind of emotions it creates in them. This is affected not only by the aesthetics, but also the usability and logic of the prodcut:

- The current cabinet needs a facelift regarding the general aesthetics. Certain keyfeatures should be chosen that could be later used in other product developments to create a holistic product portfolio. The overall look should create trust in possible clients and be up to date and not feel accidental.

POSITIONING

The renewed cabinet should create a core for the whole product portfolio. Other products in the range also need renewal and choice of buy-in components should be later done by the company in a certain harmony to the core product.
Harju Elekter Teletehnika has collapsible rack cabinets and the aim is to keep this function. This speciality compared to other competitors that have welded frames, should be embraced and used as a selling argument due to lower shipping costs.
Another characteristic to the rack would be easier assembling which would be appealing to contractors and telecom solutions providers and installers.

2.2. CONCEPT DEVELOPMENT

During the develop phase the focus is also on the aesthetics of the product. For both aesthetical design and technical solutions author seeks for ideas in different industries such as furniture, computer and electronics.

During the development phase the author uses different methods for embodiment design and visualization. Technical drawings and 3D modelling is done in SolidWorks modelling software. Another important part of the design process is sketching. Design by drawing is the easiest way to "test" primary ideas and concepts. (Cross, 2008)
In addition to that renders are made throughout the process to help visualize a more realistic view of the work.

To help define the best possible concept the author uses morphological matrix, which consists of a set of requirements and constraints for the product in development and possible solutions for each requirement. Different solutions are explored and evaluated, then matched with others in order to create the most

promising and feasible concept. (Hubka, Andreasen, Eder 1988)

Due to absence of physical tools and realistic data available to the author this master thesis only reaches a mid-point of the development phase. Prototype testing and manufacturing and economical calculations should be done by the company according to the previous work and recommendations given by the author. This, however requires lots of consideration and investment from the company into new tools and components and was no possible to execute at this point.

2.2.1. MORPHOLOGICAL MATRIX

Morphological matrix was used to consider possible solutions to some of the features and requirements set in the brief. In addition some specific details and fixings that are not specified in the brief, but caught author's attention in product portfolio analysis are evaluated in this stage. Later best of these solutions are chosen and matched with others to create a product concept that will be developed in the embodiment design stage.

FEATURES	OPTION 1	OPTION 2	OPTION 3
Frame assembly	bolted joint	punched joint + bolts	partial weld + bolts
Side panels	single piece	two pieces (current)	>2 panels
Rack rails	separate from guides	joined with guides	x
Door alignment	over-laying	offset from edges	between the frame
Side panel fixing	add-on nut-assembly	hinge + deadbolt	threaded insert
Side panel fixing guide	welded add-on	pin insert	bent from same part
Cabinet isle fixing	bolt-nut	special clamp	shared ceiling detail
C-profile fixing	bolted	punched joints	bolt + punched joint
Levelling feet plate	bent from profile	welded add-on (current)	x
Perforations	round	squared	slotted
Door locks	choose a new	black plastic	original design
Door hinges	external	choose new	original design

Table [2] Morphological matrix (selected options highlighted with orange fill, current solutions in grey)

2.2.2. CONCEPT EVALUATION

Different options and solutions that were pointed out in the morphological matrix are discussed below. The reasoning for the best solution is influenced by general logic of the product structure, aesthetics, usability and also production possibilities or complications.

FRAME ASSEMBLY
- **Option 1 -** Bolted joint (current solution) – as mentioned before in the product portfolio analysis this solution requires more effort while assembling the product. The reason why this solution is not the best is the large number of movements and operations need to be done to assemble the frame. The current two-bolt joint adds quite a large number of components to the general assembly.
- **Option 2 – CHOSEN OPTION -** Punched joint and bolts – the frame could be put together using punched tenons and later fixed with a single bolt if necessary (lifting a fully equipped cabinet). These punced tenons are able to keep the frame in place under the weight of the equipment itself. This solution requires an investment for a punch tool but reduces the amount of components in the assembly.
- **Option 3 -** Partial welds and bolts – welding the either the sides or front and back frame is not suitable for cases when only a frame is ordered. This makes the package excessively large when it could instead be taken into parts and packed into a more compact bundle. It also requires more hand work and elongates the production time.

SIDE PANELS
- **Option 1 -** Single piece – a single piece side panel would be the largest component in the assembly and increase the shipping costs that derive from the enlarged the package size of the product.
- **Option 2 – CHOSEN OPTION -** Two pieces (current solution) – two piece side panel fits into the dimensions of the cabinet door and does not influence the size of the packed product and keeps the shipping costs minimal.
- **Option 3 -** Over two pieces – having more than two side panels is not very feasible, because it adds more buy-in components to the general assembly due to panel fixings.

RACK RAILS
- **Option 1 – CHOSEN OPTION -** Cable guides, rails separately(current solution) – rails are usable for both 600mm and 800 mm cabinet. Less elements to redesign. Modular
- **Option 2 –** Joined with guides – less components in the assembly, but needs different rail for narrower cabinets. No modularity.

DOOR ALIGNMENT
- **Option 1 -** Overlaying – provides a clean façade, less "noise" on the products viewable side. Vulnerable to malicious opening. Leaves the frame with hinge holes when used without doors.
- **Option 2 –** Offset from edges (current solution) – more "noise" on the facade as the frame is still visible. Vulnerable to malicious opening. Leaves the frame with hinge holes when used without doors.
- **Option 3 – CHOSEN OPTION –** Between the frame – more "noise" on the façade. Less vulnerable to malicious opening and leaves the frame without hinge holes. Easier to develop into soundproof cabinets in the future.

SIDE PANEL FIXING
- **Option 1 –** add-on nut assembly (current solution) – an awkward connection that adds multiple unnecessary components to the assembly.
- **Option 2 –** Hinge with deadbolt – too complicated and not necessary as the side panels are not removed that often to justify that expensive solution.

- **Option 3 – CHOSEN OPTION -** Threaded insert – simple, no additional operations needed, keeps the assembly minimal. PEMserter tools are already used for other operations.

SIDE PANEL FIXING GUIDE
- **Option 1 –** welded add-on (current solution) – an awkward component that adds unnecessary operations to the manufacturing process like welding, bending, punching.
- **Option 2 – CHOSEN OPTION -** Pin insert – simple solution that uses existing PEMserter tooling. Keeps operations minimal.
- **Option 3 –** Bent from same part – simple and elegant, however troublesome to manufacture due to bend tool positioning.

CABINET ISLE FIXING
- **Option 1 – CHOSEN SOLUTION -** Bolt-nut – a basic, simple solution.
- **Option 2 –** Special clamp – requires sheet metal fabrication and nuts and bolts.
- **Option 3 –** Shared ceiling detail – extra accessory in the product portfolio, not usable on a single cabinet.

C-PROFILE FIXING
- **Option 1 –** Bolt-nut (current solution) – simple, uses buy-in components.
- **Option 2 – CHOSEN OPTION -** Punched joints – simple, uses no buy in components. Can be installed to a loaded rack easily
- **Option 3 –** Bolt and punched joint – too many components and duplicating functions.

LEVELLING FEET PLATE
- **Option 1 –** Bent from profile – integrated solution that still needs welding, needs a thicker profile.
- **Option 2 – CHOSEN OPTION -** Welded add-on (current solution) – extra detail that can be made of thicker sheet metal to carry racks load.

PERFORATIONS
- **Option 1 –** Round – most used, leaves a jagged ending line
- **Option 2 –** Squared – too technical, leaves straight ending line
- **Option 3 – CHOSEN OPTION -** Slotted – has a modern feel, jagged ending line can be finished with round perforations.

DOOR LOCK
- **Option 1 – CHOSEN OPTION -** Choose a new – a new handle that is more suitable with renewed product
- **Option 2 –** Black plastic(current solution) – a convenient solution, needs no further looking.
- **Option 3 –** Original design – adds a neat detail that characterizes the product, a time consuming and an expensive solution.

DOOR HINGES
- **Option 1 –** External (current solution – convenient solution, but is not suitable with a door that sits between the frame.
- **Option 2 – CHOSEN OPTION -** Choose new – internal hinges that fit new door solution.

- **Option 3** – Original design – adds a neat detail that characterizes the product, a time consuming and an expensive solution.

2.2.3. FINAL CONCEPT

The final concept was developed through evaluating different solutions for the requirements set in the design brief. These solutions take into consideration the findings in design audit and focus is placed on constructional logic, incorporated solutions and design.

The characteristics for the final concept are:

1. An easy to assemble frame that uses smart connections in the form of punched joints for fixing the construction and emphasising the flat packable feature.
2. Removable side and back panels for access to the equipment and better serviceability. The dimensions and number of side panels is kept minimal for smaller dimensions of the packed product.
3. Use of same rack rails and structural logic creates a reliable product that has been tested and developed over time.
4. A new door solution that sits between the rack frame and is less vulnerable to malicious activities and leaves the frame surfaces clean from drill holes for "open frame" use. Choice of different door solutions provides wider range of use – solid, perforated, glass and two-sided doors.
5. Use of threaded inserts as side panel fixings. A more incorporated solution that exploits the machine parks capabilities and reduces amount of components in the product assembly.
6. Use of pin inserts for side panel fixing guides. Exploits the machine parks capabilities and reduces amount of operations in manufacturing.
7. Cabinets can be fixed to each other from inside the cabinets and through side profiles in order to create a cabinet isle. A simple nut-bolt connection is used for that.
8. The C-profile fixings are matched with the frame punched joints and emphasises the flat packable feature of the product. This solution also exploits the use of a new tool that is needed for the frame production.
9. The levelling feet fixings are kept the same for structural rigidity and reliability.
10. A slotted perforation type for more characteristic look and to unify different products and accessories in the product portfolio (same perforations should be used throughout the whole product range.
11. New door locks that suit the new cabinet and door design and give a nice touch to the cabinets look.
12. New welded door hinges that suit the new door solution and leave no holes in the rack frame.

2.3. PRODUCT VALUE

2.3.1. VALUE TO CUSTOMER AND USER

The main value for the users and customers in the renewed rack cabinet lies in the usability and design. The new cabinet should be more appealing and create a sense of satisfaction in the users who have to work around these products on daily basis. Product design is also an important factor for a data centre's owner who depend on the appearance of the server rooms and racks as a selling argument for attracting new clients and asking for higher rent.

The cabinet should also maintain its lower shipping costs compared to competitor's products, which is important for customers and resellers who are sensitive to additional costs. Due to the flat pack feature the cabinet would also use less of the valuable space in the distributors stock.

Another important aspect to the customer is the ease of assembly of the product which should be considered in the product renewal. The new solution should be more integrated using less components in the assembly, making it easier to put together.

2.3.2. VALUE TO BUSINESS

The renewal should improve the core product of Teletehnika and create a possibility for developing a distinctive design language for renewal of other products and accessories in the portfolio, thus reaching a holistic product range. Attention to product design attracts new customers, increases Teletehnika's competitiveness on the market and helps to target the data centres owners and increase the sales of server rack cabinets which, at the moment, is relatively low compared to telecom cabinets.

Solutions used in the final concept should be more explorative and in better accordance with the company's stated values. It should also seeks for new possibilities and encourages the development process to be more explorative.

2.4. EMBODIMENT DESIGN

2.4.1. INSPIRATION AND SKETCHING

The author looked at different products and solutions in various industries such as furniture, electronics and home appliances to gather inspiration and generate ideas for technical possibilities and design of the cabinet. Main focus was on the frame and door of the cabinet.

The author also drew and sketched simultaneously with the research to test interesting ideas and to later implement them in the modelling stage.

FRAME CONSTRUCTION

The author looked for smart and easy to assemble and disassemble solutions for the frame construction. Ikea is famous for it and a steel cabinet's joints were analysed. It came evident that the connections have to be "slip-in" or "slide-in" and afterwards fixed with additional components if necessary. This makes the assembly easier without the need of holding the components in place.
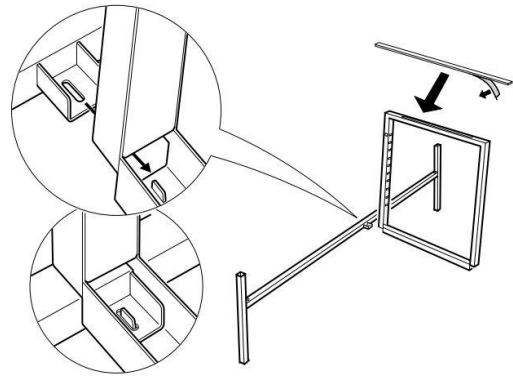
Figure [61] Ikea PS steel cabinet

Figure [62] Ikea PS steel cabinet joint

Another good example was from a Spanish company called Mecalux. They offer warehouse automation solutions and shelving. (Mecalux, 2014) They also produce metal lockers that could be assembled without any nuts and bolts. The construction of the cabinet uses punched joints.

Figure [63] Mecalux metal locker
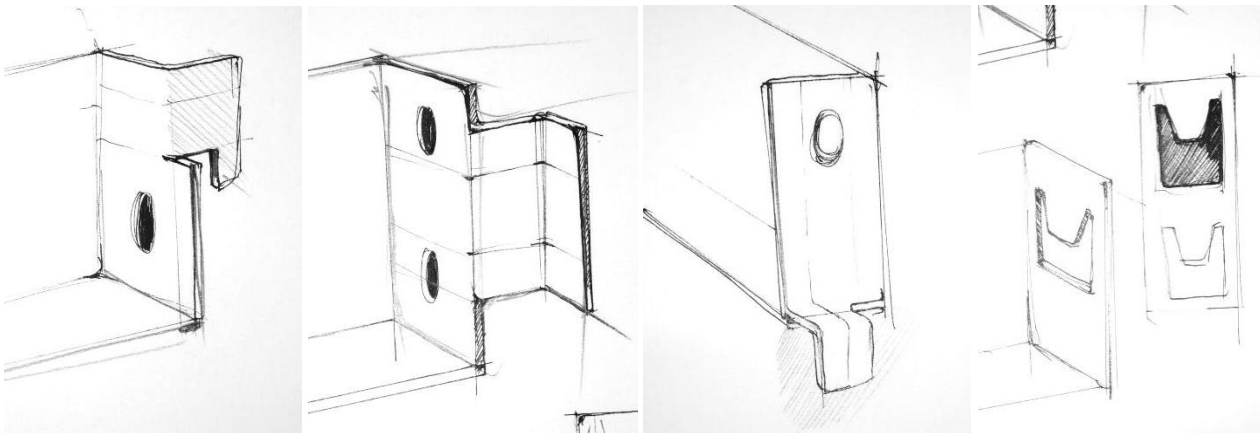

Figure [64] Mecalux locker joints

Figure [65-68] Frame joint sketches

DOOR DESIGN

The author looked for different door solutions in order to decide which approach would be best to go with. Examples were drawn from computer, home-appliance and furniture design. A door that would cover the rack frame creates a clean front to the cabinet and can create a nice flow to the cabinet isle. However, a door that sits between the rack's frame is more secure.

German furniture producer Müller has a steel cabinet with timeless and classic design with a door between the frame. Attention is put more on details such as hinges and handles that "pop" out from rest of the cabinet. This is also a suitable approach for the design of Teletehnika's product.

Samsung's refrigerator and Dell's computer have a more spatial design with lots of faces and edgy aesthetics. These elements require special presses and are not very suitable for Teletehnika's product range due to the made-to-order nature of the business.
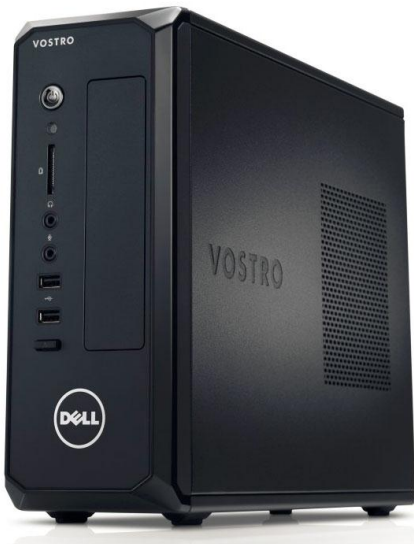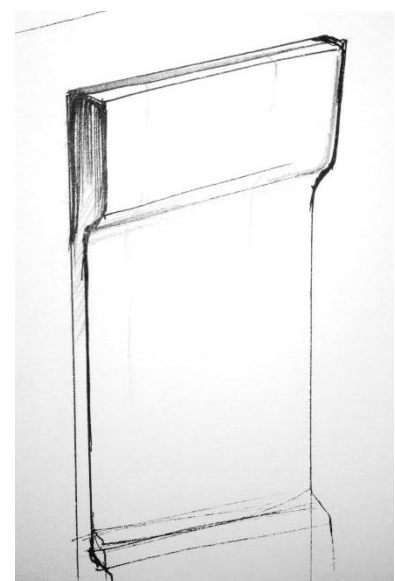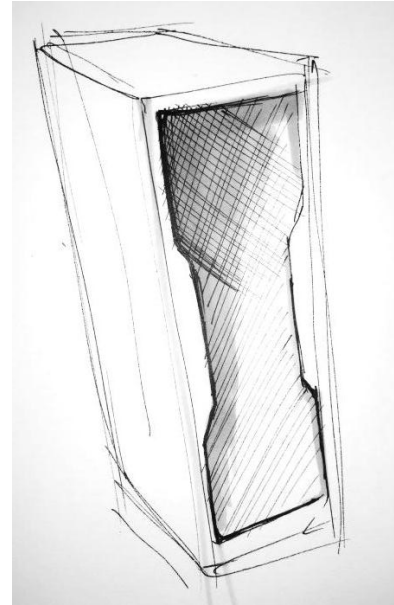
Figure[69] Dell Vostro 270s PC   Figure[70] Samsung refrigerator   Figure[71] Müller cabinet

Figure[72-77] Cabinet door sketches

DETAILS

Focus was also placed on some of the details that give character to the product like perforations and ribs. The cabinets need to be ventilated and need perforated doors or sides to improve air-flow. Different perforations were considered during the development process. The slotted perforation seemed most suitable to the author as it can be ended with a straight line by using round punching tool.
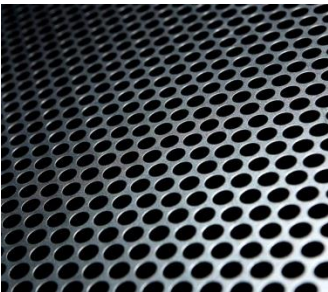

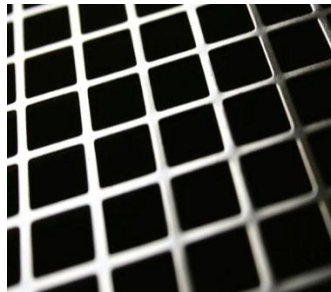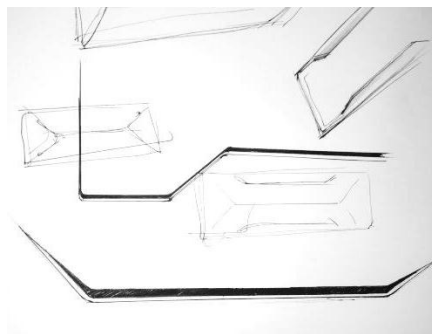Figure [78] Round perforation   Figure [79] Squared perforation   Figure [80] Slotted perforation
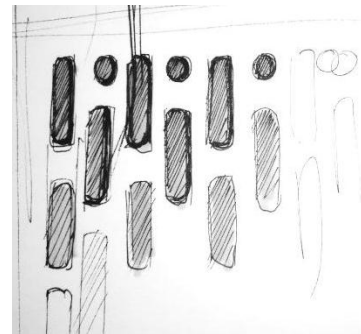
For the door design, the author considered adding punched and rolled ribs or cuts that make the door panel more rigid and also add detail to the design. This however requires special tools that are currently absent at Teletehnika.

Figure[81] Diagonal ribs   Figure[82] Cut sketch   Figure[83] Slot perforation ending

2.4.2. CHOICE OF KEY COMPONENTS

The author searched for hinges and locks from a Swedish manufacturer called Industrilas. They are well known for their variety of latching and hinge solutions for industrial purposes. (Industrilas, 2014)
The reason for picking the components from Industrilas is that Teletehnika already has experience with the company and uses one of their door handles for the current cabinet.

HINGE
A concealed hinge was selected for the new door solution. The hinge is welded onto the vertical profile and the door. The hinge has a 100° opening angle. (Industrilas, 2014)

LOCK AND HANDLE
Stainless steel swing handle was selected for the renewed product. With a relatively small depth of the handle it does not get in the way at closed position. Swing handle can be used for both one-point and two-point latching systems. (Industrilas, 2014)

INSERTS AND PINS
Inserts and pins were selected from a PEM brand catalogue. Teletehnika has the necessary bench for PEM components. These components can be replaced with other similar components that fit the dimensions. Current components are given as an example.

PEM threaded insert was selected for panel fixing. The insert is pressed into the rack frame and C-profile. (Pemnet, 2014)

PEM pins are used for guides in the side panels instead of a weld-on component that is currently used. (Pemnet, 2014)

2.4.3. FINAL DESIGN

FRAME
The frame consists of twelve 1.5 mm thick sheet metal profiles, which are joined together by punched joints **(1)**. The frame is symmetrical and easy to assemble. On the bottom each joint also need a bolt in case the cabinet needs to be lifted. The frame has vertical 19-inch rails that are connected to the ceiling and floor covers. The rails are supported by the C-profiles which share the same joint as the frame profiles **(2)**.

FIXINGS
Changes were made to the side panel fixings by replacing current solutions with PEMserter inserts **(3)** and pins **(4).** This reduces the amount of operations and comonents needed for the previous solutions **(5)(6)** and utilises the PEMserter bench better.

HINGES

The door hinges were replaces due to a new door solution that sits between the frame. The hinges are welded inside the vertical profiles and door panel and are hidden from sight **(7)**.

Figure[84] Frame render with details

DOORS

The doors are bent of 1.5 mm sheet metal and sit between the rack frame. This makes the doors more secure from malicious activities. The doors are design symetrically so they can be easily switched for other hand side. There are 3 types of doors – perforated door(for good ventilation and servers), glass door, and solid door. These versions also enable double-doors for narrow corridors or shortness of space.

CEILING AND FLOOR

The ceiling of the cabinet has cable inlet openings and it is possible to open the ceiling altogether.
The same applies for the bottom of the rack. The ceiling can be perforated or equipped with a ventilator.

SIDEPANELS

Sidepanels are made of 1 mm sheet metal and sit between the rack frame. The side panel is put to place using guides on the bottom, and fastened on top and mittle with bolts to the frame.

KEY FEATURES

During the design process the auhtor constanly looked for characteristic features that tie the products together and can be used as the basis for creating a new holistic product porftolio.
These features include the stainles steel door handles **(8)**. Swing handles can be used for both 2-point and 1-point latching and is also available in black plastic.

Another distinct feature is the shape of perforations that should be used in other products aswell. The slot-shaped perforation provides a possibility to end the jigged perforation line with round perforations, thus creating a neat, straight line **(9)**.

The door perforation and cut out has a certain line that creates a fixing place for the handle. This line should be kept in same proportions for all the cabinets. For the solid door, this line is created with a bent edge of a cut-in. This ties the different door solutions together and creates consistency in the product line **(10)**.

A brushed steel company logo has been added to the corner of the rack cabinet for product recognition **(11)**. The position of the logo should be kept the same for all the products.

FINISHES

The cabinets can be painted according to the RAL-color catalogue. For better product recognition there should be a certain set of distinctive colors that are used by default if not specified in order. Hued colors give character to the product and can be used to make them differentiate from competitors products.

8.

9.

10.

11.
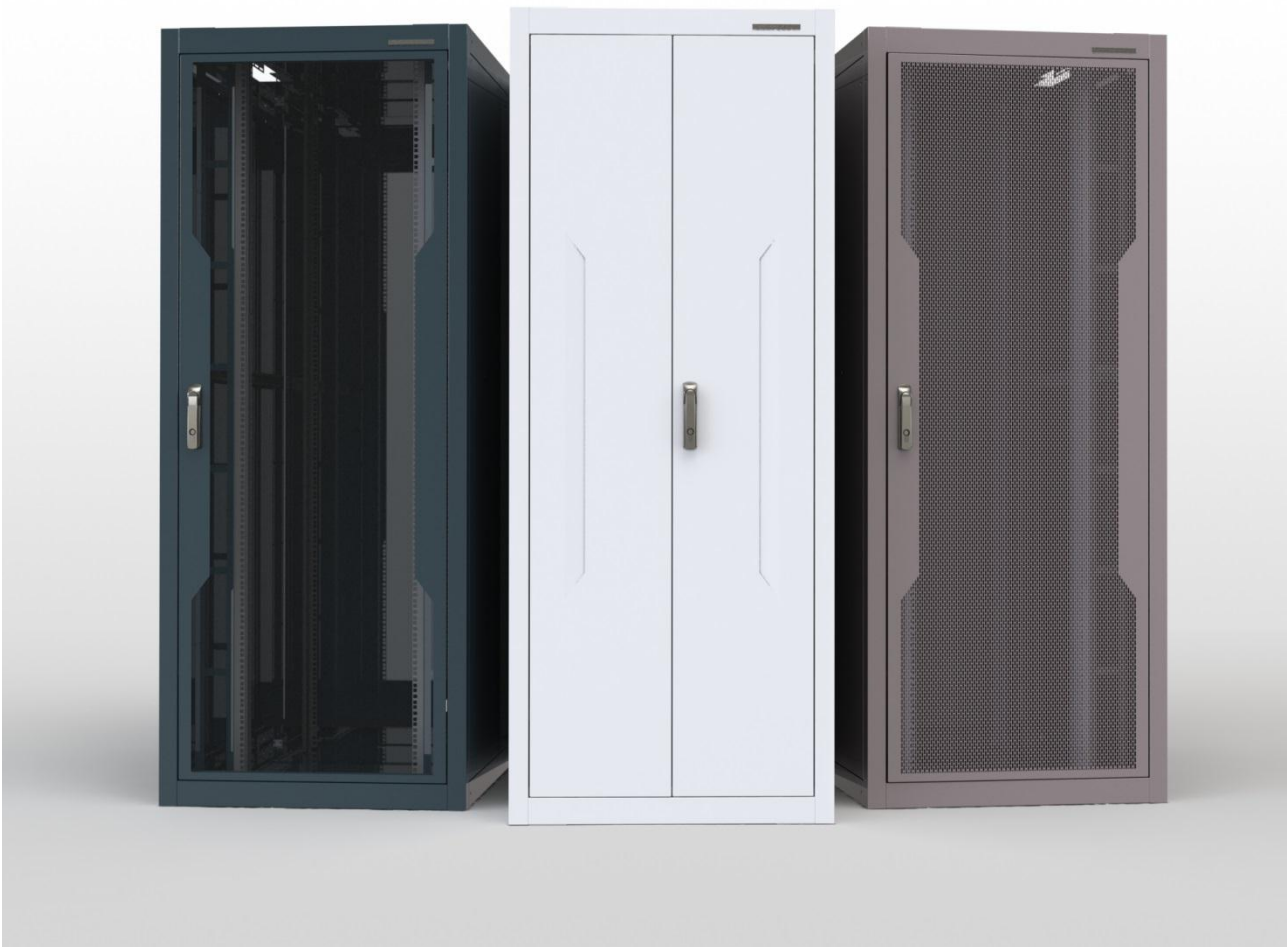
Figure[85] Cabinets render with details

2.4.4. DRAWINGS AND DIMENSIONS

TITLE:
Server rack external dimensions

Author:
Aivo Arusaar, Design and Engineering

A4

SCALE:1:20   SHEET 1 OF 1

65

1970
1866
1125

1870
2000

65

1014

1110
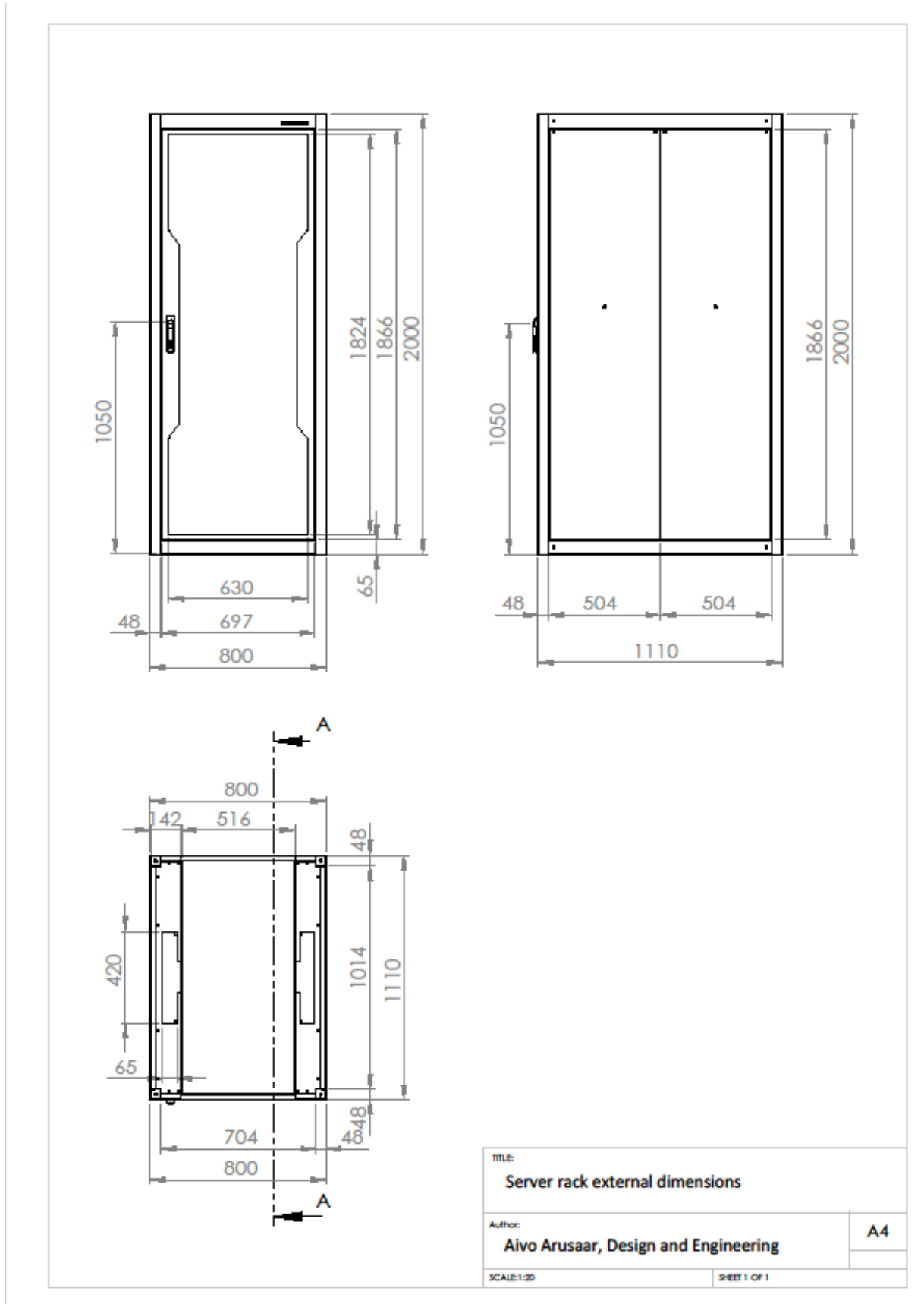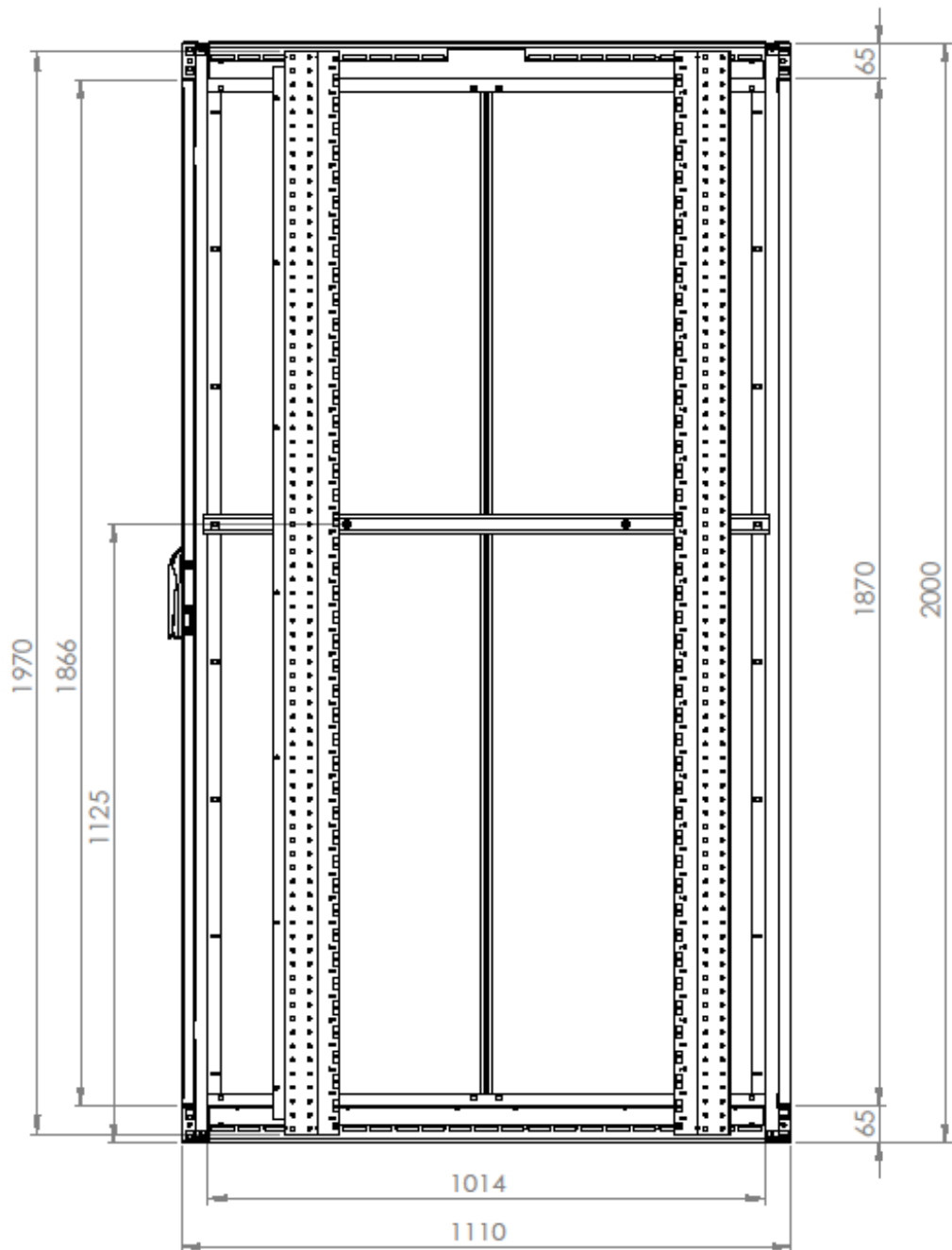
TITLE:
Server rack section view

Author:
Aivo Arusaar, Design and Engineering

A4

SCALE:1:10

SHEET 1 OF 1

DETAIL VERTICAL
PROFILE 1 : 1

DETAIL HORIZONTAL
PROFILE 1 : 1

TITLE:
Frame joint drawings

Author:
Aivo Arusaar, Design and Engineering

A4

SCALE:1:1   SHEET 1 OF 1

2.5. FURTHER DEVELOPMENTS
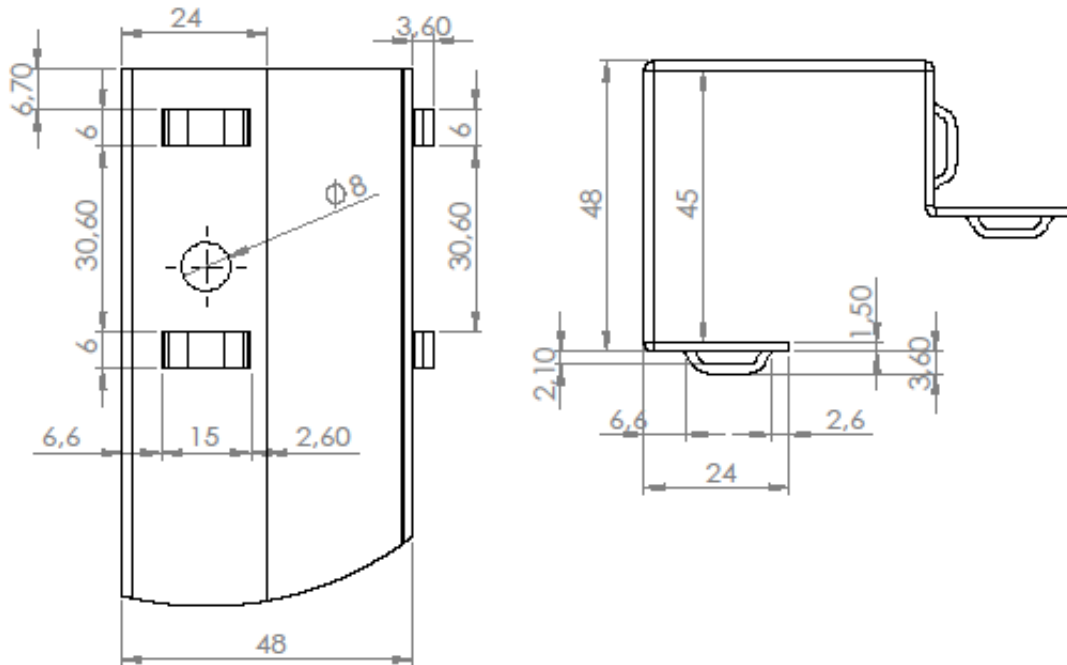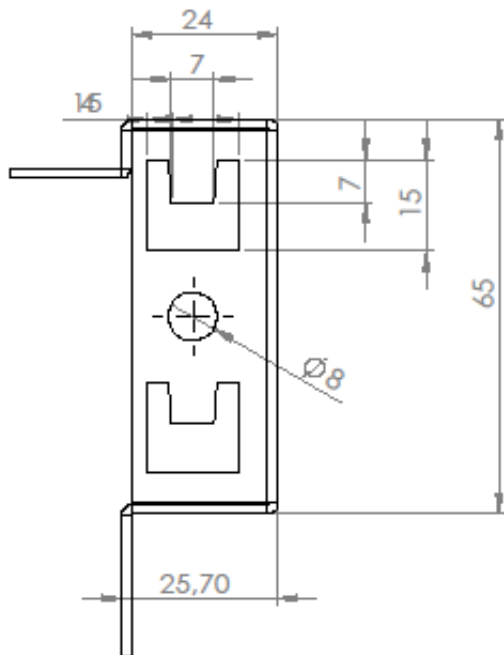
CREATE A UNIFIED DESIGN LANGUAGE!

Harju Elekter Teletehnika should use the final design of the renewed rack cabinet as a basis for the whole product portfolio renewal. The key elements and features brought out in the cabinet design should be considered as ground rules for further work and should be implemented with strict rules. This leaves out the possibility of inapt solutions or mismatches in the product line. Creating a product design language is a time consuming and a delicate process and should be done in cooperation with a professional designer.

PREPARE THE RENEWED PRODUCT FOR PRODUCTION!

The new design of the cabinet is still in the first stages of product development and should be developed further in order to prepare it for production. This may require some tweaks here and there according to the technical possibilities at hand. The choice of components and new solutions should also be discussed or substituted with an analogue if necessary. The renewed cabinet requires some tooling that is currently absent, therefore possible investments for new tools (group punch for perforation) should be considered. A prototype should be produced for testing the machinery and benches and the cabinets own capabilities should be examined.

CONCLUSION

This thesis had two tasks to solve. One was to carry out a design audit for Harju Elekter Teletehnika in order to define shortcomings and problems that could be improved or solved by design, the other was to redesign Teletehnika's core product and to create a distinct design language.

The design audit was carried out by gathering information from interviews, company and field visits and researching for background information. The collected data was then analysed and logically structured to create a whole picture. The design audit resulted in a set of key-findings that should be addressed by the company. Most important of them are:

1. Brand image – Harju Elekter Group fails to communicate its strengths and values through different mediums. There is also some controversy in the company's stated values and reality. Harju Elekter should set themselves appropriate strategies in order to create harmony between goals and actions.

2. Corporate visual identity – current CVI is old-fashioned and controversial to itself. There is inconsistency in the use of visual elements and imagery throughout the Group, which does not leave a trustworthy impression. The visual identity is the first thing that catches the eye and should be developed with dedication.

3. Development process – too little emphasis is placed on seeking for new solutions and experimenting. Harju Elekter Group wishes to be curious and innovative, however current development process deals mainly with adapting existing generic solutions for clients specifications. There are too little research and new development processes in motion.

4. No consistency in product portfolio – Teletehnika's products fail to give a coherent impression and seem to be developed with no regard toward each other. The product line leaves a messy impression due to lack of rules in product development processes.

5. Little regard towards design and aesthetics – there is not enough emphasis on design in Teletehnika's product development. Aesthetics and design are just as important as functional charateristics of a product. Good design helps to communicate those functions better, make the company competitive in the market and help to differentiate from competitors. A professional designer should be part of the company's development processes.

The second part of the thesis dealt with renewal of Teletehnika's core product – 19-inch telecommunication and server rack cabinet. The focus of the work was set on updating technical solutions, improving usability and creating a distinct design language that could be used as a basis for further development. During the design work several key aspects were improved:

1. Reduced amount of components – renewed cabinet design reduces the amount of components and operations compared to current solution. Side panel fixings and frame assembly joints are more incorporated and logical and use less "add-on" components.
2. Better usability – the assembly of the product was also bettered by using punched joints for the frame.

This enables the product to be put together first and afterwards fixed with additional fasteners. This solution also maintains flat packable feature of the product and is a good selling argument for lower shipping costs.

3. Design language – the renewed cabinet incorporates several key components that help to create a distinct design language. This includes door handles, perforation type, cut outs and perforation lines, company logo and its placement. These features should be used consistently in order to create a holistic product portfolio.

The thesis concludes that Harju Elekter Teletehnika is a good example of how design could improve company's image, development processes and product range. All the topics and problems pointed out in the thesis are manageable with the right strategic approach and should be developed simultaneously in order to create a well-working brand. This master thesis can be considered as an introduction for design use in Harju Elekter Teletehnika's operations.

RESÜMEE

Käesolev magistritöö on valminud ettevõtte Harju Elekter Teletehnika põhjal, mille peamiseks tegevuseks on lehtmetall kappide valmistamine ja müük andmeside- ja telekommunikatsioonisektori ettevõtetele ja klientidele. Magistritöö eesmärk on otsida võimalusi ettevõtte konkurentsivõime tõstmiseks läbi disaini rakendamise, keskendudes just ettevõtte kaubamärgi kuvandile, tootearendusele ja -valikule. Magistritöö on jaotatud kaheks osaks: teoreetilise osana disainiauditi läbiviimine ning praktilise tööna Teletehnika võtme-toote uuendamine.

Disainiaudit viidi läbi koostöös Harju Elekter Teletehnikaga ja annab ülevaate ettevõtte tegevustest, ettevõttega seotud osapooltest, konkurentidest ja toodetest. Analüüsiks vajalik informatsioon koguti läbi intervjuudes, ettevõttekülastuste, interneti ja ettevõtte trükiste. Analüüsi tulemusena leiti mitmeid puudujääke ja probleeme, mida saaks disaini kasutades oluliselt parendada. Autor teeb probleemide lahendamiseks ja edasisteks sammudeks omapoolseid ettepanekuid ja toob välja peamised murekohad, mis ettevõtte tähelepanu vajavad. Nendeks on:

1. Brändi kuvand – Harju Elekter Grupp ei ole suutnud oma tugevusi ja väärtusi erinevate meediumite vahendusel edastada. Samuti on vaidlusttekitav vahe ettevõtte väidetud väärtuste ja reaalsuse vahel. Harju Elekter peaks seadma omale sobivad strateegiad, et luua kooskõla oma eesmärkide ja tegevuse vahel.

2. Ettevõtte visuaalne identiteet – praegune Harju Elektri visuaalne identiteet on vanamoodne ja iseendaga vastuolus. Märkamata ei jaa ka läbiv ebakõla visuaalsete elementide ja kujundite kasutuses, mis raskendab endast usaldusväärset mulje jätmist. Ettevõtte visuaalne identiteet on kõigile nähtav ja peaks seetõttu olema väljaarendatud pühendumusega.

3. Arendusprotsess – uute lahenduste leidmisele ja eksperimenteerimisele on pandud liiga vähe rõhku. Harju Elekter Grupp soovib olla teadmishimuline ja innovatiivne, kuid praegune arendusprotsess tegeleb peamiselt vaid olemasolevate geneeriliste lahenduste kohandamisega klientide soovidele. Liiga vähe rõhku pannakse uurimustele ja uutele arendustöödele.

4. Tooteportfell– Teletehnika tooted ei moodusta tervikut ja tunduvad olevat arendatud eraldiseisvalt. Tootesari jätab segase mulje just tootearendusprotsessist puuduvate kindlate reeglite tõttu.

5. Disainile ja esteetika – Teletehnika tootearendusprotsessis ei panda piisavalt rõhku disainile. Esteetika ja disain on täpselt sama olulised, kui toote funktsionaalsed omadused. Hea disain aitab neid funktsioone paremini edasi anda, muuta ettevõtet turul konkurentsivõimelisemaks ja eristuda paremini konkurentidest. Ettevõtte arendusprotsessidesse peaks olema kaasatud professionaalne disainer.

Teine magistritöö osa on praktiline ja tegeleb Harju Elekter Teletehnika põhitoote, 19-tollise telekommunikatsiooniseadmete ja serveri kapi uuendamisega. Vastavalt disainiauditile jagab autor soovitusi, kuidas praegust serverikappi täiustada, rõhudes nii selle tehnilistele lahendustele kui iseloomuliku disainikeele kujundamisele, mis ühendaks Teletehnika tooteid omavahel ja eristaks neid turul konkurentidest. Praktilise tööna valmis tootest ka 3D mudel ning tehnilised joonised.

Disainiprotsessi käigus täiustati mitmeid olulisi omadusi:

1. Komponentide arv koostus – uuendatud kapi lahendus vähendab koostus komponentide ning tootmiseks vajalike protsesside arvu. Külgpaneelide kinnitused ja kapi raami ühendused on loogilisemad ning seotumad, ära on jäetud hiljem „külge poogitud" detailid.

2. Kasutatavus – kapi kasutatavust parandati läbi raami ühendus sõlmede, mis võimaldavad lihtsamat kokkupanekut. Esmalt ühendatakse raam omavahel stantsitud keelte abil nin seejärel fikseeritakse poltidega. Antud lahendus säilitab ka võimaluse toote võimalikult väikeseks pakkimiseks, mis on oluline müügiargument madalamate transpordikulude tõttu.

3. Disaini keel – uuendatud kapp rõhub elementidele, mis aitavad luua äratuntava ja konkurentidest eristatava disainikeele. See hõlmab endas uste käepidemeid, perforatsoonitüüpe, väljalõikeid ja kontuurjooni, ettevõtte logo ja selle paigutust. Nende elementide kasutus peaks olema järjepidev ja kontrollitud, et luua terviklik tooteportfell.

Magistritöö järeldusena võib autor väita, et Harju Elekter Teletehnika hea näide selgitamaks, kuidas disain võib täiustada ettevõtte kuvandit, arendusprotsesse ja tootevalikut. Kõik magistritöö raames väljatoodud teemad ja probleemid on õige strateegilise lähenemise ning samaaegse arendamise korral edukalt lahendatavad ja võimelised looma hästi töötava brändi. Käesolevat magistritööd võib lugeda sissejuhatuseks disainikasutusele Harju Elekter Teletehnika tegevuses.

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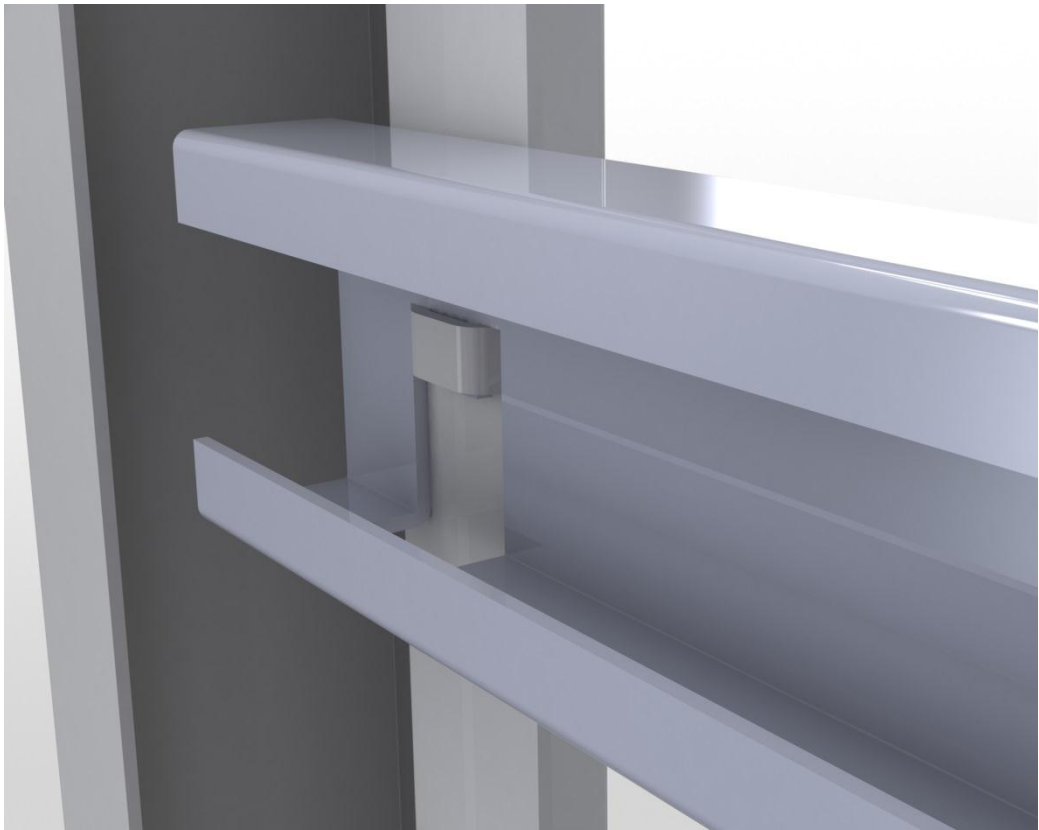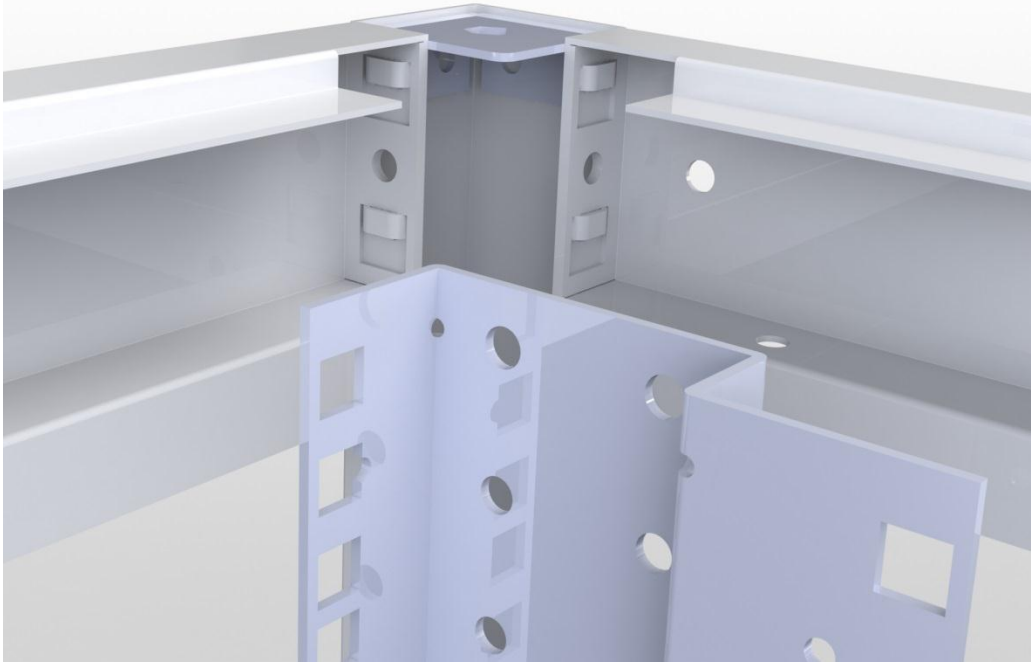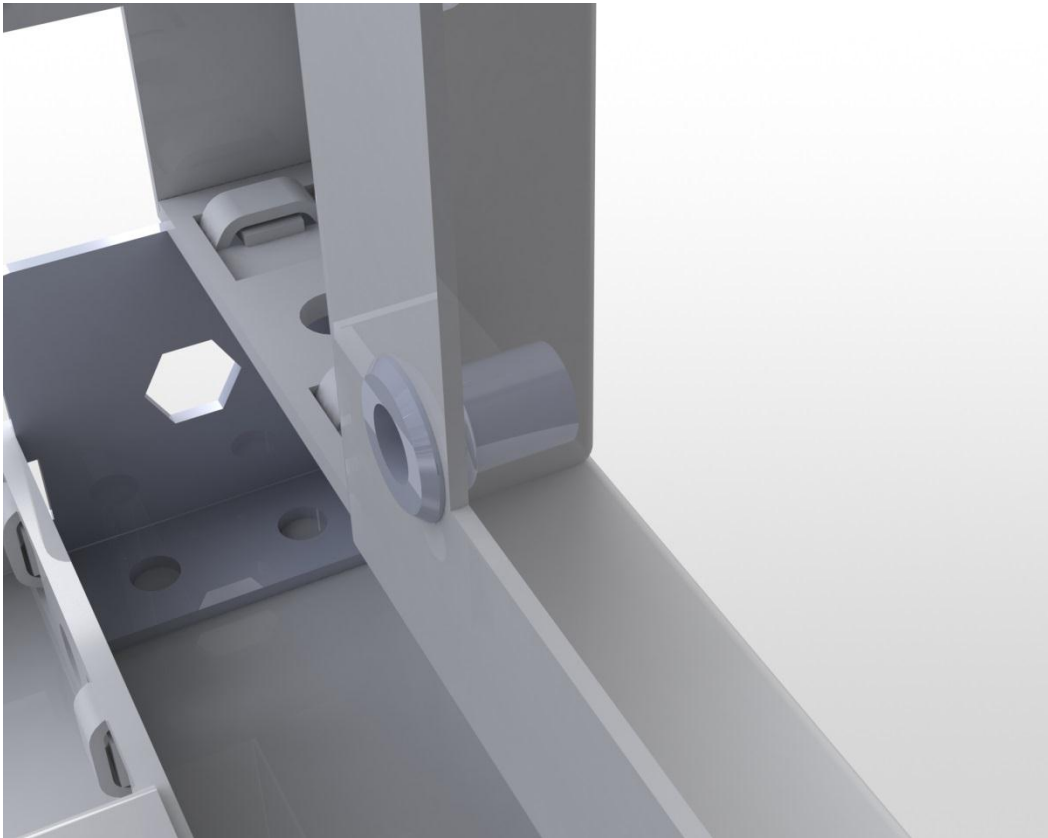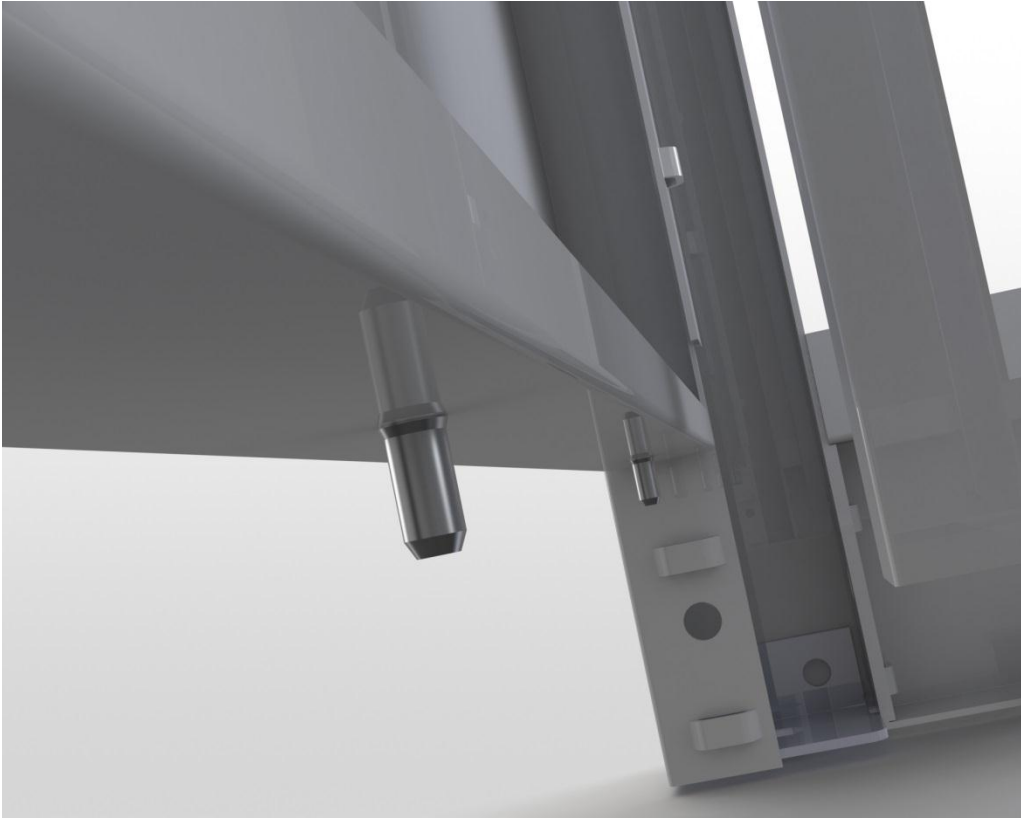
APPENDIXES

RENDERINGS

ABOUT THE 19-INCH STANDARD

The industry standard comes from America and as its name says it is meant for equipment with a 19 inch (482.6 mm) wide front. These modules are installed onto a pair of rack rails with fixing edges and screws. Another dimension that is standardized in this system is the height of the equipment which has a fixed unit height of 1.75 inches (44.45 mm). The equipment dimensions are marked according to the number of units it occupies (e.g. 1U, 4U). The number of units a rack cabinet can facilitate varies. A standard enclosure has a 42U capacity, however there are smaller cabinets and wall enclosures that have less height.

The depth of the racks also varies for different purposes. For cabling and network ports the cabinet can be smaller in depth. Servers however require greater depth due to the size of the equipment. The width of the cabinet also differs.

The equipment is fixed to the cabinet either from the front or from front and back. Heavier equipment needs 4 point fixing. Some equipment like heavy servers have independent glides that are fixed from 4 points. This helps to pull out the server and change modules more easily.

It is also possible to mount shelves, cable guides, power supply units to the rack. They share the same logic for installation as the electronics.

SPECIFICS OF TELETEHNIKA'S PRODUCTION

As the bussiness is moslty made to order each project or product has to be developed according to the clients specifications. Teletehnika has 3 technologists who are also responsible for product development. For development Teletehnika uses Solid Edge, a 3D modelling software after which layouts of the components are created and prepared for CAM software for production. The technologists know Teletehnikas' machinepark and its possibilities thoroughly. This reduces the time of development.

Teletehnika has not set very firm principles for product development. They operate according to a certain situation and order. However some principles for development derive from the capalities of Teletehnikas' machinepark and the tools at hand. For instance round bends are not done due to absence of a specific tool.

Teletehnikas machinepark shares its facility with Harju Elekter Elektrotehnika. Even though both of them are part of the same company the production lines are still seperate and machines double eachother. . The whole park is quite powerful and is one of the best sheetmetal fabrication parks in Estonia with over 20 CNC-type machines.

Some of the major equipment in Teletehnika's machinepark is:

- 3 meter guillotine (sheet thickness 0.5 mm – 3 mm)
- small guillotines (sheet thickness – 3mm)
- small revolver punch (sheet thickness 0.5 mm – 3 mm, stainless sheet thickness-2 mm)
- FinnPower SG6 punch-gilliotine (sheet thickness – 3 mm), working area 1500 x 3000 mm
- FinnPower LP laser-punch (punhing sheet thickness– 3 mm, cutting sheet thickness: steel – 8 mm, stainless – 6 mm, aluminium – 4 mm), working area 1500 x 3000 mm
- bending benches in multiple sizes(800 mm, 1600 mm, 2000 mm, 2500 mm, 3000 mm)
- MIG welding
- PEMserter- for inserts and rivets

- Fully automatic powdercoat over with washing and phosphating, dimensions of the powder coat over are 400 mm x 1200 mm x 2100 mm

Another thing that Teletehnika strictly follows is the use of sheet metal. This has to be as effective as possible for optimizing waste and cost of the raw material. The layout of the cutouts is always planned and empty slots are filled. One of the benches has a gilliotine that leaves the excess with a straight cut, not a negative sheet. Smaller sheet metal benches are able to use the excess for other products.

Teletehnika buys the sheet metal from Ruukki and Favor, some from B-Grupp. Teletehnika also buys perforated sheet metal due to absence of a group punching tool and use a lot of buy-in components and parts such as nuts and bolts, inserts and rivets, locks, wheels and feet, extension cords, cable in-lets, safety glass, hinges etc. Teletehnika has created many partnerships with companies that can provide these components (eg. Würth, Bufab, Mink Bürsten, MP Systems, Kaidosk etc). For risk management there are several partners Teletehnika can order from.

Teletehnika is always focused on how to minimize the production time. Because they do not produce to stock they have to be able to fullfil their orders relatively fast from order confirmation to shipping. One of the key factors for winning a contest is the time of delivery. For example Finnish clients expect a 30 day period, however some klients even expect 2 weeks for delivery.
Quality is always important and there cannot be any giving way. Another important aspect is the price which is set by the market over the years. Due to relatively low quantities, optimizing production cost is also something Teletehnika keeps their eye on. At the moment they sell approximately 40 telecom floor racks, 50 wall cabinets and 5 server rack per month.

TECHNICAL DESCRIPTION OF HARJU ELEKTER TELETEHNIKA'S PRODUCTS AND ACCESSORIES

PRODUCTS:

19-inch floor cabinet - General features include a metal frame, 19" rails, roof, side and rear panels, a door and plinth corners. Standard structure includes a lockable front door. Adjustable cable inlet with brush strip is fitted in the top panel and can be replaced by flange plates or fan tray on request. Rear panel can be changed for a rear door. The floor rack cabinets come in two main heights – 42U (internal height 1867 mm) and 32U (internal height 1423 mm) and two main widths – 600 mm and 800 mm. The depth of the cabinets varies from 650 mm and 850 mm to 1050 mm.

19-inch server rack - Servers are quite powerful and emit lots of heat which requires more attention to ventilation. This is solved with perforated doors and backs that enable better airflow. These racks can support up to 1400 kg of static load which comes in handy when the rack is filled with heavy server units. The server rack comes in one height – 42U (internal height 1867 mm) and two main widths – 600 mm and 800 mm. The depth of the cabinets is 1200 mm.

19-inch open racks – Frames are fitted with 19" rails in the front with option to install back rails as well. 800mm width frames are fitted with cable guide rails. They are supplied with adjustable levelling feet.

19-inch floor frame – Open floor frame consists of 19" frame, base and upper panel. It can also be fastened to the wall. The frame is delivered in parts. The open floor frame comes in one height - 41U (internal height 1823 mm) and width of 570 mm. The depth of the frame is 600 mm.

19-inch wall frame – Wall frame consists of 19" frame and two or three mounting holders. It is delivered in parts and is fastened to a wall. The open wall frame comes in 5 different heights - 7U (internal height 311 mm), 12U (internal height 533 mm), 16U (internal height 711 mm), 24U (internal height 1067 mm) and 42 U (internal height 1867 mm) and one width – 19''rails. There are two options for the depth of the cabinet – 300 mm and 400 mm.

19-inch wall cabinet – The wall rack is equipped with C-profile pairs as well as with 19" rails in the front. Cable inlets with brush strips are fitted in the top and bottom panels and can be replaced by flange plates on request. The side panels are passively ventilated. The wall cabinets come in 4 different heights – 7U (internal height 311 mm), 12U (internal height 533 mm), 16U (internal height 711 mm) and 24U (internal height 1067 mm) and one width – 600 mm. There are two options for the depth of the wall cabinet – 400 mm and 600 mm.

Home box – Fibre optic cables are installed into this enclosure for faster data transfer. It also requires a converter to transform the optical signal into an electrical signal. This product is quite popular in the Finnish market and new housing developments. The lightweight SKM home-box series is very easy to assemble. Fasten the mounting plate on the wall, attach all the devices and lastly attach the cabinet frame to the plate. The cabinet frame is symmetrical which means that you can place the hinges either on the left or right hand side. The door is passively ventilated and cable inlets are fitted in the top and bottom panels.

Outdoor containers – Due to different client's needs the containers are engineered specially for the customer's specifications. These cabinets also come in higher IP classes and give protection against moisture and cold temperature.
General features of the container include data rack for power unit, batteries, complete electrical installation, cable inlets, adjustable levelling feet, heating and cooling units and other additional equipment.

ACCESSORIES:

19-inch rails for racks and frames – 600mm or 800 mm rail pair is supplementary accessory for racks or frames. Fastening kit is supplied with racks and frames. Rail pair for 800 mm width includes rails and cable guides.

Roof fan panel – For installation in all network and server cabinets, fan panel is mounted on the ceiling and fastened with screws. Airflow direction is out of the cabinet.

19-inch RJ45 panel - 19" Panel RJ45/24 UTP/FTP is equipped with equipotential earthing panel and cable tidy rail.

19-inch FO distribution panel – The panel is equipped with a cable shelf and can be mounted to a 19" wall frame or rack. Front panel and lid are removable. Cable entry openings are in the back plate.

19-inch back mount frames – comes in sizes of 7U (300 mm) , 2U (90 mm) and 4U (150 mm)

19-inch sliding shelf – the shelf is mounted between the front and rear rails.

19-inch stationary shelf – the shelf has passive venting and is mounted between the front and rear rails.

Adjustable levelling feet – used for floor racks. Corners of plinth have to be removed for installation.

Wheels – fitted below the floor racks and bolted in place. Plinth corners have to be removed before installing the wheels.