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Investigating Loading Capabilities for Sofas and Armchairs for Domestic Use
A case study at a furniture manufacturer

Master's Thesis in the Master's Programme
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Abstract

Today information about loading capabilities of sofas and armchairs seems to be valuable to customer. Customers have requested this information for a period now and this has brought forward a discussion within company F, which is a Swedish furniture manufacture, regarding how one can choose loading capabilities for sofas and armchairs. Furthermore, how one can communicate the chosen loading capabilities to create value to customers.

The research in this study has been focusing on understanding what kind of value that information about loading capabilities can create to customers and how a furniture manufacturer can choose and communicate loading capabilities of sofas and armchairs to create value to customers. This have been done by performing a case study at company F with several research methods in order to collect both quantitative and qualitative data. The research methods that were used in this study were: semi-structured interviews, structured observations, self-completion questionnaires, simplified competitor benchmarking, risk analysis and literature review.

The findings in this study have shown that customers can value information about loading capabilities. This is because the information either provides customers with a comfort of safety that the sofa or armchair will not break down during usage or can be used as a mean to compare different sofas or armchairs. But the information might also cause negative or no value to customers. Furthermore, the findings also show that there are serval factors which need to be taken into consideration if a furniture manufacturer decides to choose and communicate loading capabilities of sofas and armchairs. The most important factor to highlight is that currently there is no practical way of truly verifying a loading capability of a sofa or an armchair, which means it needs to be carefully considered how loading capabilities should be communicated to customers in order to not provide any misleading information to them.

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1. Introduction

Today information about a seating furniture's loading capability seems to be of importance to people. For a long period now, customers have requested information about loading capabilities of domestic furniture such as sofas and armchairs. Because of this, a Swedish furniture manufacture, hereafter referred to as company F, have started to discuss regarding how one can choose good enough loading capabilities of seating furniture for domestic use. Furthermore, how one can communicate the chosen loading capabilities of the furniture to customers. This to respond to the customer requests and choose accurate levels of loading capabilities of seating furniture.

According to an interview with an employee of company F, testing of seating furniture for domestic use is partly done according to standards. Pedra (2013) state that according to the International Organization for Standardization (ISO), a standard is:

"A document that provides requirements, specification s, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purposes"

The standards which one uses and follows to test furniture for domestic use, describe how the stability, durability, strength and safety of the furniture is tested. It was explained during the interview that these standards have been developed by the European Committee for Standardization (CEN). It was also explained that there are legal requirements which demand organizations to show proof to country's agency that one's products are safe to be used by a consumer. Without any proof regarding the safety of the products, an organization is not allowed to sell products in specific countries and regions. According to the interview, adherence to a standard, regarding safety of strength or stability, is considered to be proof which shows that a furniture is safe. By showing adherence to standards developed by CEN, for example, a furniture manufacturer can be allowed to sell their products in the European market.

To show proof and be allowed to sell furniture in countries outside of Europe, one can show adherence to standards developed by other standard committees. For example, according to the interview, one can show adherence to standards developed by the Business Institutional Furniture Manufacturers Association (BIFMA). This to be allowed to sell products in the market of United States of America. It was explained during the interview, that showing adherence to standards developed by BIFMA and CEN tend to be sufficient in order to be allowed to sell furniture all around the globe. This since BIFMA and CEN are known to be trustworthy standard committees by many countries.

1.1 Problem description

It is a common perception among employees at company F that there is a large demand from their customers regarding information of load capabilities. Customers have especially requested and asked for information about the maximum load capability or "maximum weight" which the furniture can carry. However, customer requests are spread over several systems and a lack of stored data within the systems hinders a complete picture to be gathered. An important aspect of this issue is that it makes it difficult to understand the underlaying purposes of the requests and what kind of value the answers create to customers. Furthermore, lack of a complete picture can create misunderstandings between employees and create misplaced stress among them.

Since the underlying reasons to why customers request for information about loading capabilities are unknown, it becomes difficult to interpret and provide a clear respond to customer questions. For example, do customers want to know the recommend load which can be applied continuously for a long

period because they want to avoid damaging the furniture? Or are they asking about loading capabilities because they are afraid of damaging the furniture by having too many persons sit on it? However, this thesis will define loading capabilities of a furniture as: loads that can be applied on a furniture regularly for a long period of time without the furniture losing its ability to carry out the intended use. This way of defining loading capabilities is based upon the BIFMA definition of loss of serviceability and the European standards requirements to pass their test for strength and durability regarding furniture

There exists a knowledge gap regarding what is an appropriate level of loading capability for furniture at the company. This has brought forward a discussion if one specified level of load capability for furniture in the same category can be set or if several levels are needed. Furthermore, which level or levels the loading capabilities should be set to. Another discussion that has been brought forward is also understanding how the communication of the furniture's loading capabilities is supposed to be carried out to customers. Communication is defined by Business Dictionary as a "Two-way process of reaching mutual understanding, in which participants not only exchange (encode-decode) information, news, ideas and feelings but also create and share meaning" (Communications, 2018). The authors of this thesis have, however, chosen to integrate a one-way interaction as well in the definition of communication in this master thesis. Making communication both a one-way and two-way process of exchanging information, ideas and feelings. However, since the underlying reasons to why customers request for information about furniture loading capabilities are unknown, it becomes difficult to decided how the communication is supposed to be carried out to customers.

1.2 Aim and RQ

The purpose of this master thesis is to investigate the decision making when choosing loading capabilities of furniture and understanding how furniture's loading capabilities can be communicated to customers to create value to them.

In order to understand how information regarding furniture's loading capabilities can create value to customers, it is important to investigate what kind of value that could be created to customers regarding this subject. Is it an enhanced buying process which simplifies the purchase, or does it bring further comfort, mentally, while using the furniture? This lead to the first research question:

1. What kind of value to customers can information about furniture's loading capabilities create?

The information about a furniture's loading capability is based on the choices made by the manufacturer. The manufacturer decides what kind of loading capabilities a furniture will have and the levels of the loading capabilities. During these decisions, knowledge about important factors related to the choices is highly valuable. This lead to the second research question.

2. What factors are important to take into account during a decision process of choosing loading capabilities for furniture?

The next step would be deciding if the chosen loading capability of the furniture should be communicated to customers. This would require an understanding if and how communication regarding loading capabilities can create value to customers. This has led to the final research question:

3. How can information about furniture's loading capabilities be communicated to customer to create value to them?

1.3 Delimitations

It would be interesting to include all types of furniture, but in this study, the focus has been set to armchairs and sofas for domestic use, excluding swivel armchairs. Another interesting angle to investigate would be how information regarding loading capabilities can create value to secondhand and thirdhand users, but this have been excluded from the study. Discussions about users receiving direct feedback from the furniture regarding the current load was also found to be a compelling area. However, this aspect has been excluded for future research. The focus included firsthand users, standards and legal requirements mainly from Sweden, but also from USA and China. Since company F is a global company and users of furniture can be found in around the whole globe, a complete study of more countries and regions would be highly valuable. But this was not considered plausible to conduct by the researchers in this master thesis and were therefore excluded. Factors which may affect the performance of the furniture such as transport, handling and different climate have been brought forward as factors which affects the loading capabilities, but these have not be evaluated in detail in this master thesis and was considered future research.

2. Method

This chapter will present the research strategy, research design, research method, validity and reliability and ethics of this research.

2.1 Research strategy

Saunders et.al (2009) state that a research strategy is a "general plan of how the researcher will go about answering the research question(s)". The researchers of this thesis decided to take an abductive approach in answering the research questions and therefore selected systematic combining as the research strategy. Dubois & Gadde (2012) describes systematic combining as an ongoing movement between the theoretical world and the empirical world. It is a research strategy where the researcher is consistently moving "back and forth" from one research activity to another and between empirical observations and theory (Dubois & Gadde, 2012). Furthermore, this way of working enables the researchers to expand their understanding of both their theoretical and empirical findings (Dubois & Gadde, 2012). Systematic combining also enables surprises, which can occur along the way, to be well integrated into the research and not to only use the empirical findings for confirmation of previous understandings (Dubois & Gadde, 2012). These advantages, and the way of working with systematic combining, were considered important for the researchers. This because the researchers wanted to include both a literature study and gather empirical data, which could have affected one another and therefore the direction of the research. A graphical representation of the interaction between the framework, theory, case and the empirical world described by Dubois and Gadde (2002) can be seen below in figure 1.

Figure 1 - Systematic combining by Dubois & Gadde (2012)
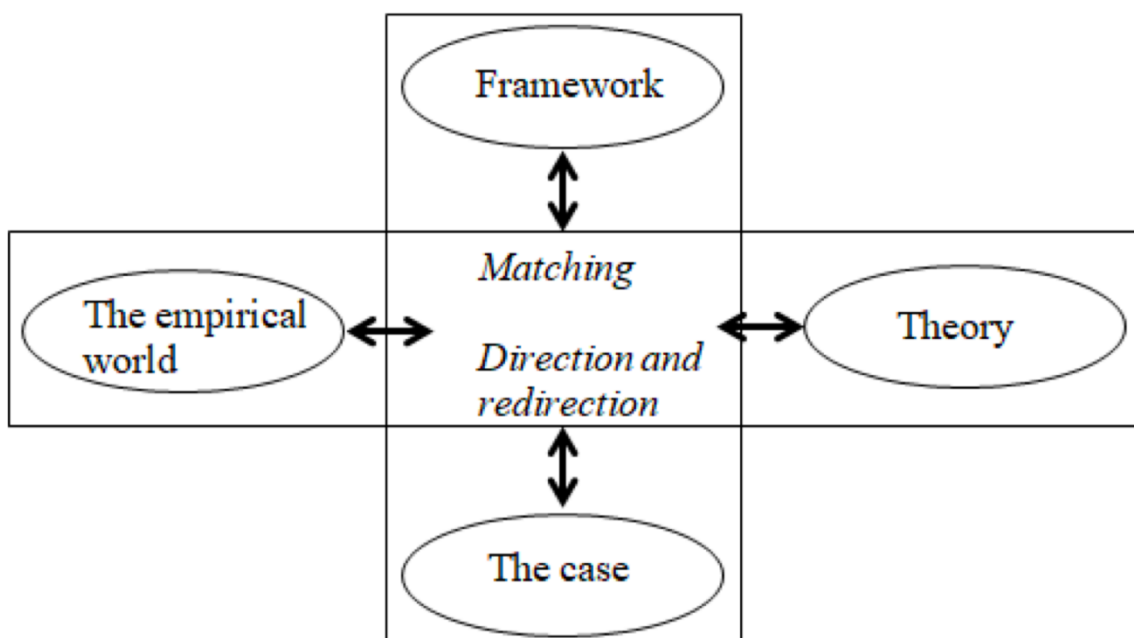
2.2 Research Design

A research design is referred by Bryman & Bell (2011) as a framework for the collection analysis of data. In other words, a research design is a framework which explains how the data collection and analysis will be performed. A case study was selected as the research design in this thesis, which Bryman & Bell (2011) describes as a structure to guide the use of research methods and the analysis of the collected data in the process. A case study involves doing an empirical investigation, either of a single organization, a single location, a person or a single event, during a period of time (Saunders et al., 2009; Bryman & Bell, 2011). This research has used a case study with focus on a single organization, company F. This because the researchers of this thesis decided to focus on understanding an issue currently occurring at the Swedish furniture manufacturer.

2.3 Research method

According to Bryman & Bell (2011), there are different methods for how to collect data in a research, while there is also different type of data that can be collected. Bryman & Bell (2011) brings forward the two most common types of data which a researcher focusses on collecting, these are quantitative and qualitative data. Quantitative data means numerical data or data have been quantified, such as graphs or statics, while qualitative data means non-numerical data such as data from interviews and questionnaires (Saunders et al., 2009). In this thesis, both quantitative and qualitative data have been collected, this to ensure that the researchers got a clear and wide understanding of the research topic. The research methods used in this thesis for data collection, are presented in the following section.

2.3.1 Literature Review

Collecting and reviewing literature have been considered necessary to do to answer the research questions. Bryman & Bell (2011) explains that collecting and reviewing existing literature on an area gives an understanding on what methods and strategies have been employed in studying the area. Therefore, a literature review has been performed to understand which concepts and theories that are relevant in this master thesis. Literature related to the research questions have been found through search engines such as Google Scholar and Chalmers library database. Previously introduced literature from Chalmers, such as books and articles, considered relevant to the research topic have also been collected and reviewed. Furthermore, standards and requirements domestic seating furniture's strength, durability, safety and stability developed by CEN and BIFMA were collected and reviewed. Standards and requirements regarding assistive products developed by IOS and Hjälpmedelsinstitutet (Hi) have also been collected and reviewed. Internal company documents regarding performance tests of domestic furniture have also been reviewed.

2.3.2 Semi-structure interviews

The authors of this thesis have conducted semi-structured interviews with company employees, customers and with employees from other organizations of interest. Semi-structured interviews refer to a context in which the interviewer has a series of questions prepared, but the questions are not necessarily followed in an exact order (Bryman & Bell, 2011). Furthermore, this way of performing an interview enables the interviewer to be more flexible during the interview and ask follow-up questions in order to get the interviewee to elaborate on his or her answer and collect more information (Bryman & Bell, 2011). Performing semi- structure interviews were believed by the authors to be an efficient method to gather qualitative data for the research. Therefore, this research method was selected, but also because

the authors wanted the ability to ask follow-up questions during the interviews. This in order to collect as much interesting data as possible from each interview.

The interviews with employees of company F were with personnel, e.g. from the customer service department, who the authors believed could provide valuable information within their field of research. These interviews were performed face-to-face and occasionally through e-mail. Regarding employees from other organizations of interest, the authors decided to contact other organizations that they thought could provide valuable information regarding the research topic. These were furniture stores, organizations who manufactures aid for people with reduced ability to move, organizations who focus on developing standard test procedures for furniture and test laboratories. These organizations where contacted through mail or in person and the semi-structured interviews with the personnel from these organizations were conducted through email, face-to face and through telephone.

Semi-structured interviews with customers were also conducted. These were with customers at the furniture stores, and with different customer groups which the researchers of this thesis had defined as primary customers of seating furniture. Six different customer groups were defined as primary customers of seating furniture based on a discussion between the two researchers. After the discussion, the researchers defined the six different customer groups as:

1. Customer group A: A person living alone in his/hers first home between 18-30 years old
2. Customer group B: Couple living together without kids and are between 18-30 years old
3. Customer group C: Couple living together with kids and are between 20-60 years old
4. Customer group D: Couple living without kids and are between 30-60 years old
5. Customer group E: Couple living without kids and are more than 60 years old
6. Customer group F: A person living alone and is more than 30 years old

The majority of interviews with all customers were performed face-to-face, expect the one with CGD which were performed through telephone. However, the interviews with customers at the furniture stores were conducted briefly compared to the interviews with the customer groups due to time constraints. Regarding the interviews with the different customer groups, the researchers created their own mock-ups of website presentations of armchairs. The aim with the mockups was to show them to the customers, during the interviews, and thereby trying to understand how information about loading capabilities can be communicated to create value to the customers. The researchers decided to create mockups regarding armchairs since early findings indicated that armchairs rather than sofas generated question connected to information about loading capabilities. This to keep the interviews as simple as possible. Each mockup illustrated a picture of an armchair along with product specific information including loading capability. Some of the mockups had a further explanation of the specific loading capability. These mockups were not showed to the customers at the furniture stores due to time constraints.

2.3.3 Simplified competitor benchmarking

Benchmarking can be described as way of investigating opportunities in order to improve processes and is a natural part of successful organizations today (Bergman & Klefsjö, 2010). Depending of the nature of the execution can benchmarking be classified into four different categories or types, which are:

- Internal benchmarking which might be a comparison between different sites within a company.
- Competitor benchmarking which is a comparison of one's own performance to direct competitor's performance.
- Functional benchmarking is a comparison of one's own performance to the best organizations in comparable areas or activities.

- Generic benchmarking which is a comparison of performance of one's own performance against the top performers in all areas or industries.

The researchers of this thesis have conducted a simplified competitor benchmarking on organizations which are within the same or similar market as Company F. The simplified competitor benchmarking was conducted on different furniture retailers and manufactures in Sweden, China, Great Britain and USA, and on other Swedish companies which focus on making sitting aids for people with reduced abilities. The aim was to gain knowledge of what level or levels of load capabilities had been chosen for armchairs and for the sitting aids. Furthermore, to understand what communication messages have been used by these organizations when informing their customers about the established loading capabilities of their armchairs and sitting aids. The information was gathered through visiting the homepages of the organizations. However, sofas were not investigated since the researchers wanted to be time efficient and early findings indicated that sofas did not generate this kind of questions.

2.3.4 Structured observations

Saunders et al. (2009), refers to an observation as the "recording, description, analysis and interpretation of people's behavior". Furthermore, there are two types observations which researchers tend to perform and these are referred to as structured and participant observation (Saunders et al, 2009). In this thesis, the researchers have performed structured observation. Structured observation means that the researcher has, before performing the observation, formulated rules for how to perform the observation and how to record the observation (Bryman & Bell, 2011).

In this study, the researchers performed observations on customers at furniture stores. The observations were performed on two occasions and at two furniture stores. Furthermore, the observations were performed in the seating furniture area in the furniture stores and before performing the observations, the researcher discussed and formulated rules for the observations. The aim with the observations was to observe how customer interact and use the seating furniture as well as the information discussed between customers regarding seating furniture.

2.3.5 Self-completion questionnaires

Self-completion questionnaire is a method in which the respondents themselves finish the questionnaire by answering the provided questions (Bryman and Bell, 2011). It can take several forms, such as postal or mail questionnaires, according to Bryman and Bell (2011), and the difference between the different forms covers the way of distribution and recovering of the questionnaires. There are similarities with this research method and semi-structured interviews but the central difference of lacking an interviewer puts high pressure on the questionnaire to be easy to follow and answer (Bryman and Bell, 2011).

A self-completion questionnaire to customers was formulated and created by the authors. The questions were based on the information gained from the interviews and the literature search. The aim with the questionnaire was to get an understanding of customer thoughts and wants regarding seating furniture loading capabilities and their interaction with the furniture. The questionnaires were created with Google Form which enabled the researchers to distribute the questionnaires through both mail and through social media, such as LinkedIn and Facebook.

The questionnaire contained a combination of open and closed questions. Open questions mean that the respondents are asked questions which they can reply however they wish (Bryman and Bell, 2011). While closed questions, are presented with a set of fixed alternatives from which the respondents must choose an answer (Bryman and Bell, 2011). A questionnaire with a combination of these two types of

questions was considered necessary. For example, with open questions, the researchers wanted to have the advantage of having the respondents answering questions in their own terms. This was in order to gain as detailed information as possible about customer thoughts and values regarding furniture loading capabilities, as well as how they interact and use their seating furniture. While with closed questions, the researchers wanted to create a questionnaire that was easy to complete for the respondents. According to Bryman & Bell (2011), closed questions are easier and quicker to answer for the respondents, while using too many open questions can be too time-consuming for the respondents to manage.

Except for open and closed question, the questionnaire also contained a 7-point scale. The aim with the 7-point scale, was to let customers rate the importance of information about sofas and armchairs loading capabilities. This was in order to understand how important customers believe information about loading capabilities are to them. The scale ranging from not important at all (1) to extremely important (7). To gain an overall view of how important the information was to customers, based on the rating of the respondents, the relative importance index method (RII) was used. According to Waris, Liew, Khamidi & Idrus (2014), RII is a method which can be used to determine the importance level of a criteria. The formula to calculate the RII values is presented below along with a categorization of the values used by Waris et al. (2014) in table 1.

$$RII = \frac{\sum w}{A \times N} = \frac{7n_7 + 6n_6 + 5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{7 \times N}$$

Table 1- Categorization of RII values

Categorization	RII value interval (x)
High	0.8 < x <1.0
High-Medium	0.6 < x < 0.8
Medium	0.4 < x < 0.6
Medium-Low	0.2 < x < 0.4
Low	0.0 < x <0.2

W represents the weight of importance which respondents assign to the factor at hand, A represents largest weight and N represents the whole amount of respondents (Waris et al., 2014).

The target group for the questionnaire was discussed between the authors of this thesis and was based on what had been mentioned during interviews with employees. The conclusion that the authors made was that everyone above the age of 15 living in a household could be a potential customer. Therefore, the questionnaire focused on people from the age of 15 and upwards. However, it is worth mentioning that when the researchers of thesis defined and interviewed the six different customer groups, mentioned in section 2.3.2, they decided to not include people who were younger than the age of 18. This means people with the age of 15 was not included in the customer groups and interviewed. The reason for not including people younger than 18 in the customer groups, was because the researchers wanted to interview and focus on customers who purchase seating furniture. Even though people with the age of 15-17 can be potential customers, the researchers believed that it was more common for people to start purchasing seating furniture when they are within the age of 18 and upwards. Therefore, people younger than 18 was not interviewed and included in the customer groups. Regarding the questionnaire, the authors created two versions of it. One was written in Swedish and the other one in English, this to enable a larger group to respond. Regarding the distribution area, the authors wanted to distribute the

questionnaire in both USA and China to gain a greater size and spread. But this was problematic from a practical point of view. Therefore, Sweden was chosen as the main target group area.

Finally, the researcher also contacted customers in person and asked them to answer the questionnaire. This was performed once by the authors and it was at a furniture store, where the area for seating furniture was placed. Both version of the questionnaires was provided to the customers, depending on what language they preferred to answer in. However, to get as many answers as possible. Which is why the authors decided to remove some of the questions from the original version of the two questionnaires, that the authors considered to be less important questions than others. When some questions had been removed, the researchers divided the remaining questions into one questionnaire regarding sofas and one regarding armchairs with equally many questions. This meant that each author had two questionnaires each, one in Swedish and one in English, and asked customer separately to answer them.

2.3.6 Risk analysis of potential usage of armchairs and sofas

A risk analysis of the potential usage in service of an armchair or a sofa was conducted to have a basis for both a decision of loading capabilities and performance testing. To conduct a risk analysis in order to build up performance tests was recommended by one of the interviewees. The risk analysis focuses on the potential usage of a sofa or an armchair in service and the approaches of the usage, because of this is a usage priority number (UPN) used instead of a RPN.

The assessment has been based upon the empirical findings, the theoretical framework and a discussion between the researchers. The occurrence of the usage and the different approaches were assessed along with a severity rate of the magnitude of the forces and potential damage it may cause. The assessment of the severity has tried to take both the manufacturer and the customer into account, as Shahin (2004) highlighted. The potential failure mode was not added since all scenarios could in the long run cause failure in the structure and adding those would result in a tedious document to read. Instead are different potential failure modes are discussed in the text below. Detection was not added since there is no way to detect the usage in service. Important to note is that this analysis should be seen as basis for discussion regarding usage in service and this usage are also depending on specific design choice which may promote or hinder specific usage. The values are not absolute, and the color coding is a further assessment done by the researchers of which usage to prioritize, green indicates a prioritized usage.

The potential failure modes connected to use of an armchair or a sofa were concluded to be the following, *Structural break down, non-reverse deflection, overturn* and *loosening of joints*. The potential effects of the potential failure modes range from the user becoming disappointed of the furniture to death. Regarding death is it important to bring forward that this is considered highly unlikely.

2.4 Validity

According to Bryman & Bell (2011), validity refers to whether "a measure is measuring what it is supposed to measure". This is also highlighted by Saunders et al. (2009) and to ensure that the research methods for data collection in this thesis have measured what they were designed to measure, the authors of this thesis did the following:

Self-completion questionnaires

Regarding the questionnaire, Ingelgård (2017) explains that the questions must be clearly formulated. This means that one should not ask two questions in one question and furthermore should all questionnaires be tested on a control group before they are used for collecting data (Ingelgård, 2017). Therefore, before the questionnaires was distributed by the authors, they were tested on a control group of 7 people, which were both men and women with various ages. This was to ensure that the questions were clearly formulated and that the customers interpret the questions accurate as the authors wanted them to, but also to ensure that customers understood the purpose of the questionnaire. Feedback from the control group resulted in adding, removing and reformulating questions before distributing the final versions of the questionnaires to more customers.

2.5 Reliability

Reliability refers to whether the results of a study are repeatable or not, and whether the findings from a study can be applied in another research topic as well (Bryman & Bell, 2011). In order to make the results of this thesis repeatable for other researchers, the authors have documented and summarized the notes from the observations, interviews, questionnaires and ensured that the literature is relevant for the research. Regarding if the he findings from this study can be applied in another research topic as well, it could be possible. For example, it could be possible that the findings can aid other research regarding how to choose and communicate loading capabilities of other furniture such as bookshelves as well.

2.6 Trustworthiness

Bryman & Bell (2011) state that trustworthiness is a set of criteria for how good a qualitative research is, and it is divided into four criteria, which are credibility, transferability, dependability and confirmability. How these were taking under consideration by the researchers will be presented in the following section.

Credibility

Credibility refers to how believable the findings are in a research (Bryman & Bell, 2011). To ensure the findings in this study are believable, the researchers did the following:

Triangulation

Triangulation means that a researcher uses more than one method to collect data, which can be way of ensuring that one's findings are believable according to Bryman & Bell (2011). Therefore, the researchers decide to use several research methods in this study and thereby ensure that the finding are believable.

Interviews

Before an interview was conducted, the authors established interview questions related to their research questions. This to ensure that valuable information about the research topic could be discovered as well

for the interview to not get off topic. Furthermore, the authors also decided to perform several interviews with other organizations of interest. This to obtained as much information as possible about the research topic as well as getting different perspective of the topic.

Observation

As mentioned before, the authors decided to establish a set of rules for how to perform the observations. Firstly, the researchers decided not to speak or interact with customer under any circumstances during the observations. Secondly, to record how customers interacted and used the seating furniture, the researchers decided to take notes discreetly on their cellphones during the observations. Finally, the researchers decided to perform the observations separately. This meant that the researchers observed customers from different locations inside the furniture stores. The authors believed it was important to stay unnoticed since, according to Bryman & Bell (2011), people tend to change behavior when they know that they are being observed. When people know that they are being observed, it might lead to an inaccurate image of a behavior for the observer (Bryman & Bell, 2011). Furthermore, the researchers were aware of that customers might be behave differently at stores compared to at home. However, the observation data were still believed to be useful due to the relaxed atmosphere at the stores and within the customers.

Risk analysis of potential usage of armchairs and sofas

The researchers have conducted a risk analysis in form of a version of a Potential-FMEA (P-FMEA), regarding what kind of usage to consider when choosing levels of loading capabilities for sofas and armchairs. It is important to understand that it is difficult to create a risk analysis which take every possible usage into account, as well as one which take every past failure in service into consideration. This since there were a issue to gain access to information of past failures in service of specific products at company F. This because the product identifications numbers of products which are no longer available on the market are shifted into one single product identification number which covers all kinds of products which are not available on the market.

One also needs to consider the share of returns of failed products to the manufacturer or retailer. However, Bergman and Klefsjö (2010) stated that a very small part of customer complaints and experience reach back to the company and this does also question how true the failure history is compared to the reality. However, by basing the risk analysis on the observations, questionnaires and interviews, the researchers believe that the analysis brings forward the most important kind of usage to consider.

Quantitative data

To further ensure that the findings are believable, the authors also ensured that the sources which the quantitative data was gathered from were trustworthy. However, regarding how believable the findings are, it is important to understand that the first research question have been answered by solely focusing on customers in Sweden. Because of this, there might be other customer values regarding furniture loading capabilities that have not yet been discovered. One could also argue that the result from the reduced questionnaire gives a picture closer to the reality. This because the people visiting a furniture store could be thought to have a mindset where evaluating and comparing furniture is present compared to the people who did the complete questionnaire. However, the complete questionnaire might provide a better result regarding people who are about to start the process of purchasing new furniture. Which gives the combined result of the questionnaires a broad foundation of respondents.

Confirmability

Confirmability refers to whether the researcher has allowed his own personal values to affect the research or not (Bryman & Bell). It is important to understand that one of the researchers is currently employed at a sub-company of company F. The company culture and used languages in the two organizations are similar to a great extent which might have affected the research. This in the way that subjectivity has been brought to the table which might have affected the analysis of interview data and other parts. On the other hand, the other researcher of this thesis had no previous connections to company F and therefore the result from interview data and other parts have been assessed from an external viewpoint.

Transferability and dependability

Transferability refers to whether the findings of the research can apply to other contexts as well, while dependability refers to ensuring that records are kept of all phases of the research process (Bryman & Bell, 2011). To ensure dependability data from interviews, observations and questionnaires have been documented and stored by the researchers. Regarding transferability, as mentioned before, it could be possible that the findings in this research can aid other research regarding how choose and communicate loading capabilities of other furniture. Therefore, detailed descriptions are put forward in the thesis to provide context to the different subjects.

2.7 Ethics

According to Bryman & Bell (2011) there are four principles to consider regarding ethics in research, *harm to participants, lack of informed consent, invasion of privacy* and *Whether deception is involved.* How these was taking under consideration by the researcher will be presented in the following section

Harm to participants

According to Bryman & Bell (2011), a researcher has a responsibly to ensure that all the participants who are included in a study are not exposed to any harm. In this study, the authors decided to have all participants anonymous to not cause any harm to them. Furthermore, the data and analysis presented in this thesis have been discussed between the two authors, and with Company F, so it will not be presented in a way that may hurt the participants. Regarding the observations, it is also important to understand the customers were never exposed to any harm.

Lack of informed consent

Lack of informed consent means that that the researcher has not clearly informed the purpose of the research to the participants (Bryman & Bell, 2011). To avoid lack of informed consent, the authors decided to provide information about who the researchers were, what the aim of the research was and whom would be able to access the result before an interview was conducted. The authors also stated to the participants that if something was unclear they had the possibility to ask the authors for a further explanation.

Invasion of privacy

According to Bryman & Bell (2011), a researcher should not intrude on a person's privacy without permission. To ensure that the researchers of this thesis did not intruded on a participant's privacy, they decided to not use audio recording during interviews and clearly inform the participants that they had the possibly to stop an interview at any time. Furthermore, to not intrude on a customer's privacy at the furniture stores, the researchers stated clearly that it was of voluntary to be a participant in the study.

Whether deception is involved

Deception occurs when a researcher presents his or her research as something other than what it is to participants (Bryman & Bell, 2011). To avoid deception, the aim of the research was stated in the beginning of each interview and in the questionnaires.

3. Theoretical framework

This chapter presents the theoretical framework. The framework consists of literature regarding customer value and behavior, performance testing of furniture, global users, decision making and communication.

3.1 Customer value and behavior

Matzler et.al (1996) explains that organizations have realized that customer satisfaction is a crucial factor for future business success. Matzler et.al (1996) themselves also consider a high-level of customer satisfaction to be "one of the most powerful indicators for future of a business". In order to achieve customer satisfaction, Bergman and Klefsjö (2010) explains that an organization must be able to identify and fulfill customer needs and expectations. However, Bergman and Klefsjö (2010) state that "the future customers will have different needs and expectations than those of today's customers" which means that customer needs and expectations are continuously changing. This make it crucial for organizations to keep up with identifying their customers' needs and expectations, as well as continuously understanding how to fulfill them (Bergman and Klefsjö, 2010). However, to anticipate customer's future needs and expectations is a challenge for firms, which is why Hamilton and Karmarkar (2017) they have developed a framework, which is called "the 4 Minds of the customer" and is served as a diagnostic tool to aid firms' improvement in how to anticipate and serve their intended customers. Hamilton and Karmarkar (2017) believe their framework consider what customer value combined with how they make their purchase decision.

According to Hamilton and Karmarkar (2017), the 4 minds of the customers are:

1. The ideal point

The ideal point mind means that the customers already know what they want. In other words, according to Hamilton and Karmarkar (2017), customers know "exactly what they want". These types of customers make a decision based on their most desirable needs and expectations that they have at a certain point in time. Hamilton and Karmarkar (2017) explains this by given an example on how people make decisions based on the ideal point. In the example, Hamilton and Karmarkar (2017) explain that in a certain point of time a person might have a clear image of his "dream house" in mind. If this image is clear, the person will approach the market and select whichever house that comes closest to his dream house. In other words, in the ideal point, a person has created a the perfect "hypothetical option" in his mind and uses it as the point of comparison in order to evaluate other options when making a decision (Hamilton and Karmarkar, 2017). This hypothetical option has been created based on a person's experience, expertise and motivation, and is considered to be an internal reference point for which the person uses when making a purchase decision.

2. The market comparison

In the market comparison, the customers are performing product comparison based on what is currently available on the market. According to Hamilton and Karmarkar (2017), the customer tends to base their product comparison on quantitative attributes such as price or horsepower rather than qualitative attributes such as brand. This is because quantitative attributes are considered simpler to use as a reference point compared to qualitative attributes. Hamilton and Karmarkar (2017) explain further that customers do this comparison in order to construct a sort of reference standard for a specific product. For example, if a person wants to buy a new digital camera, the person might do a market research in

order to understand what a standard price is for a new digital camera. When the customer has gathered this information, he or she have created an internal reference point to make a product purchase decision.

3. Image

As mentioned before by Bergman and Klefsjö (2010), customer satisfaction is achieved when customer needs and expectations are fulfilled. However, Bergman and Klefsjö (2010) also explain that if a product achieves customer satisfaction, it will consider to be of high quality by the customers as well. Quality is a term that is often used by people to describe a product's ability "to satisfy and preferably exceed the needs and expectations of the customers" (Bergman and Klefsjö, 2010). But, it is important to understand that customers do not solely define high quality and receive satisfaction based on the performance of a product. Customers tend to also define quality and receive satisfaction based on the overall experience that they have with the organization that sell and make the product (Bergman and Klefsjö, 2010).

This can be related to the image mind, where the customers have a strong preference for a cooperate brand (Hamilton and Karmarkar, 2017). In the image mind, the customers have found a specific cooperate brand to be trustworthy service provider because of a great previous experience with it. This impression has also been based together with the brand's reputation for reliability (Hamilton and Karmarkar, 2017). An example of what customers found a great experience with a cooperate brand to be can be related to Bergman and Klefsjö (2010). For example, when buying a car, customers do not solely consider the performance and the characteristics of the car. Instead they also consider other aspects such as availability to spare parts, possibility of service and how they were treated by the sales employees during the purchase (Bergman and Klefsjö, 2010). This means that the performance of the product is only a part of a customer total quality experience and if the other aspects have been found to be satisfied, a customer have had great experience with an organization.

When customers consider a brand to be a trustworthy service provider, they tend to always choose products and service made by their preferred brand. Regardless if there is another cooperate brand that sell the same products, customers will claim that their preferred brand is the optimal choice for them (Hamilton and Karmarkar, 2017). This mindset can be related to Löwenheim (2017) who also believes a strong brand can create a great impression of trust. Löwenheim (2017) believes that a strong brand "is the best sales person we can get" since it creates a high awareness of trust and credibility to customers. Furthermore, Löwenheim (2017) also believes that a strong brand helps customers to distinguish and exclude other alternatives that are available on the market, and that a strong brand is consistently a desirable option to the customers. Compared to the ideal point and the market comparison, a brand creates an external reference point that helps customers to distinguishing and decide which product alternatives to choose.

4. Local comparison

Finally, in the local comparison, the customers will decide on a product based on the set of options that are in front of them at the time of choice (Hamilton and Karmarkar, 2017). In this mindset, compared to the market comparison, Hamilton and Karmarkar (2017) explain that customers tend to compare and decide on a set of products that are currently available on a "store shelf" rather than what is available on the whole market. Customers tend to use the local comparison when they do not have brand preferences or other references points to use, such as in the previous mindsets. This means when customers use the local comparison to choose a product, it is because they have little or no experience with a brand and lack motivation to inform themselves about other products that currently on the market (Hamilton and Karmarkar, 2017). Therefore, in this mindset, the customers will make objective evaluations of the

products presented in front them in order to establish an external reference to decide which product to choose.

Changing needs

What is important to understand regarding the 4 Minds of the customer, is that the four mindsets for decision making are not fixed within a person. This since, as well as Bergman and Klefsjö (2010), Hamilton and Karmarkar (2017) believes that customer needs are always changing. Hamilton and Karmarkar (2017) explain that the four mindsets exist within all types of the customer and that customers shifts between them depending on the needs that they have in a certain point in time. Even though it is difficult to satisfy all of the four minds of the customers, Hamilton and Karmarkar (2017) believe that organizations should determine which of the four minds they should focus in order to target a customer segment.

What type of needs customers have towards a specific product attribute can be explained by the Kano model, mentioned in both Emery (2006) and Bergman & Klefsjö (2010). According to Bergman & Klefsjö (2017), customers have:

- Basic needs, which do not create customer satisfaction when fulfilled. This since, according to Emery (2006), basic needs are more or less assumption that customers have about a product or service. However, it is important that these needs are fulfilled, otherwise customers will be dissatisfied with the product or service (Bergman & Klefsjö, 2010).
- Expected needs, which are needs that customers expect to be fulfilled when using the product or service (Bergman & Klefsjö, 2010). According to Emery (2006), when these needs are fulfilled customer satisfaction will be created in a linear rate.
- Excitement needs, which create a great customer satisfaction when fulfilled but customers are unaware of these needs (Bergman & Klefsjö, 2010). According to Emery (2006), if a provider does not fulfill these needs it will not result in customer dissatisfaction, but those who can identify these excitement needs will gain a competitive edge and gain loyal customers (Bergman & Klefsjö, 2010)

Since customer needs are continuously changing it is important to understand, regarding the Kano model, that excitement and expected needs can over time become basic needs. This according to Bergman & Klefsjö (2010) who mentioned an example of this, by explaining that the remote control to a TV was an excitement need in 1920s but today it is basic need for customers. Alänge (1994) is also another author who explains that what was considered to be a delight to customers can change rapidly and become something that is expected to customers since needs are continuously changing. Furthermore, Alänge (1994) explains that there also exist certain customer requirements which customers often take for granted that these will be fulfilled. Alänge (1994) refer these requirements as "base requirements" and if they are not fulfilled customers will gain a great negative reaction towards the service provider.

What is customer value

As mentioned before by Matzler et.al (1996), customer satisfaction is a crucial for future business success and according to Hamilton and Karmarkar (2017) it is hard for firms to anticipate and serve their customers. However, the 4 minds of the customer give some insight on how customers tend to make choices when approaching the marketplace to buy a product. As mentioned before Hamilton and Karmarkar (2017) believe their frame work consider what customer value and this is something that Woodruff (1997) believe organizations should focus more on. More specific, Woodruff (1997) believes organizations should focus on understanding:

1. What exactly do customers value?
2. Of all the things customers value, what should we focus on?
3. How well do customers think we delivery that value?
4. How will what customers value change in the future?

According to Butz Jr. and Goodstein (1996), customer value is defined as:

"The emotional bond established between a customer and a producer after the customer has used a salient product or service produced by that supplier and found the product to provide an added value."

If this emotional bond is achieved, customers will repeatedly buy products or services from one preferred company and excluded other companies. Customer will also recommend the preferred organization to friends and family and suggest them to buy products or services from the same organization. Furthermore, Butz Jr. and Goodstein (1996) explains that this bond develops when two things occur. Firstly, when organizations produce goods or services which meet or exceed customer expectation, and secondly when customers believe the produced goods or services to provide more benefits to them than the incurred costs for purchasing them. The secondly is referred as "net customer value", according to (Butz Jr. and Goodstein, 1996), and can be related to another definition of customer value which is "the difference between what a customer gets from a product, and what he or she has to give in order to get it" (Customer value, 2018). Christopher (1996) seem to also believe net customer value describe a truthful definition of customer value is since Christopher (1996) explains that customer value is "when the perceptions of benefits received from a transaction exceed the costs of ownership". However, Woodruff (1997) found most definitions of customer value, such the one by Butz Jr. and Goodstein (1996), to only provide a vague sense of what it means.

According Woodruff (1997), customer value cannot be defined by vague terms such as "benefits" since these terms are defined differently by customers. For example, some customers found a benefit to be part of product, while others found a benefit to be a great experience as a result of using a product or service. As well as the term benefits, Woodruff (1997) believe that the definition of customer value also differs because customers interpret the term value differently. Furthermore, Woodruff (1997) explains that customers may also, differently in time, acknowledge what is considered to be value to them. For example, a customer might not necessary understand what value is to him during the purchase of product, but perhaps realize it after or during the use of the product. Customers often tend to learn to what is value to them in forms of preferred attributes, attributes performances and consequences from using a product (Woodruff, 1997). It also is important to understand that customer values are continuously changing, just as their need and expectations. This is according to (Flint et.al, 2011) who also believe, as well mentioned by Woodruff (1997), that suppliers such as organizations must be able to anticipate what customer value and will value in the near future.

Another important aspect of customer value, mentioned by both Woodruff (1997) and by Butz Jr. and Goodstein (1996), is that it is not the same thing as customer satisfaction. Butz Jr. and Goodstein (1996) explains that customer satisfaction is about "attitudes" while customer value is about "behavior". Customer value is about understanding customers' behavior, which means understanding "what they do and how they behave in their relationship with the supplier "(Butz Jr and Goodstein, 1997). In other words, customer value is not about understanding customer's attitudes toward a product from a company but rather to understand how they have behave and interact with the product. Butz Jr and Goodstein (1997) believe there is great different between what customer say and feel about a product than how they behave with it. Therefore, only focusing on customer satisfaction will result in a misunderstanding of what customers value.

Woodruff (1996) seem to also believe customer satisfaction is about attitudes since he defined satisfaction as "the customer's feeling in response to evaluations of one or more use experiences with a product". Furthermore, Woodruff (1996) explains that customers tend to often acknowledge what is value to them after evaluating the experiences that they had with the product. According to Woodruff (1996), past and present experiences with products guide customers to understand what they value. This is because experiences help customers to determine how well or poorly a product has performed in a situation, which causes them to evaluate and determine what is value to them. Not until customer understand what value is to them, as well as an organization provided it to them, customer will not receive a feeling of satisfaction. This is according to Woodruff (1996), who believes received desired value will lead directly to a feeling of satisfaction for customers. This shows that customer value and customer satisfaction seem to have a great connection to each other which is highlighted by Flint et al. (2011). Flint et al. (2011) believe that customer satisfaction results when an organization can anticipate what their customer value and will value in the near future. On the other hand, Butz Jr. and Goodstein (1996) believe there is a connection between how successful quality improvements on products are and what customer value. Butz Jr. and Goodstein (1996) explains that when making quality improvements on products, the improvements must be based on customer values. Otherwise, the risk is making improvements that are irrelevant to customers, which will lead to decreased customer value.

3.2 Performance testing of furniture

One way to evaluate a furniture's characteristics and performance is to conduct performance tests. Eckelman (1988a) defines a performance test as "accelerated-use tests that predict the ability of a product to fulfill its intended function". Eckelman (1988a) brings forward two hypotheses which performance tests are developed upon, firstly, the consumer's expectations of performance of different products are possible to both define and measure. Secondly, a furniture contains special characteristics inherently which are plausible to both define and measure (Eckelman, 1988a).

Characteristics of performance tests

Eckelman (1988a) describes a typical procedure to develop performance test for furniture:

1. Perform observation of the usage of the furniture in service.
2. Use the observations to estimate the applied loads and frequency of the loads applications.
3. Develop a test method that is believed to simulate the usage of the furniture by the users.

In order to pass the tests developed in this way are acceptance levels created based upon the presumed usage. Though these kinds of test have been found valuable do they contain several issues: (Eckelman, 1988a)

- No unified test development. Which leads to several different tests being developed in different regions and the tests might not be directly comparable.
- The tests do not provide the manufacturer with the highest amount of valuable information.
- Useful information to aid the customers in the purchase or to the manufacturer's marketing department is usually not generated.

The first issue is supported by the fact that many countries or groups of countries has their own standardization organization who could choose to develop their own standards which may act as a barrier to overcome in order to sell products in a specific country (UNECE, n.d).

To create well-designed performance tests of furniture, Eckelman (1988a) brings forward five characteristics of which any can be used to evaluate any method of performance testing:

1. The tests should not reflect unique bias within the country they are developed in, they should offer a standard evaluation method of universal acceptance.
2. The tests should origin from the design process of the furniture in order to generate the highest plausible amount of information back to the design process.
3. The tests should provide both the customer and the manufacturer with valuable information. Information that lets the customer compare different products regarding the furniture's life-cycle costing and lets the company show the furniture's quality.
4. The tests should have the ability to quantify experience regarding, e.g., what furniture strength characteristics are connected to failure in service and to long lasting service. This is of high importance
5. The tests should offer a way to determine strength parameters of a furniture which are of most importance in a clear way. Along with a way to evaluate these parameters.

Important factors of furniture performance testing

Highly important factors within a performance test that should reflect the most important actions which the furniture is exposed to under service according to Eckelman (1988a) are: *The loads in the test*, *the stresses caused by the loads*, *the rate of cyclic application of the load* and finally *probable failure modes of the furniture*. According to Eckelman (2003), there are different kinds of loads, *static loads, repeated loads* and *impact loads* and explains them as follows. Static loads are loads of constant level and are applied gradually until the desired value is reached. Repeated loads are applied and removed for a number of cycles, often quite many, and the magnitude of the repeated load causing fatigue failures in joints or members in a furniture may be a lot less than the static load the furniture was designed to withstand. Performance tests using repeated loads are often called durability tests or durability cyclic tests in American and European standards (BIFMA, 2017; CEN, 2016). Impact loads are abruptly applied, often by a moving body. These loads produce greater effects on the furniture compared to the same level of load gradually applied (Eckelman, 2003). Furthermore, Eckelman (2003) puts forward the classification of concentrated or distributed loads, concentrated loads acts on tiny areas often viewed as points while distributed loads acts over an area.

Choice of loads

The choice of service loads is deemed to be the most important choice in the design process of furniture according to Eckelman (2003). This because if the loads are too heavy the furniture design will use unnecessary large amount of materials and if they are too light will the furniture most likely fail too soon (Eckelman, 2003). Interestingly, Wang (2007) states that there is no research of loads acting on a sofa frame and that just a hand full of service loads actually have been properly evaluated. This is further supported by Eckelman (1988b) and Eckelman (2003) who says that complete data of loads occurring in service is rare. Ratnasingam, Perkins and Ried (1997) does also highlight the lack of use of structural mechanics when developing furniture frames and public knowledge concerning this. Eckelman (2003) states that it is more or less up to the designer to choose the loads which the design process will be based upon along with the assumption that the public wants the strongest and durable furniture which lasts a lifetime. To assists the design process's choice of upper and lower levels of both durability and strength Eckelman (2003) proposes five categories of expected use and loads which are presented on the next page.

- Light duty household
- Medium duty household
- Heavy duty household or light duty institutional
- Medium duty institutional
- Heavy duty institutional

Regarding sofas does Eckelman (2003) state that selecting design load for vertical seat loads is quite difficult due to the large number of possible combinations of loads, either way must abusive loads be considered. Eckelman (2003) brings forward front-rail failures in sofas as an observation in service and two ways to apply vertical loads on a seat, either through 192,8 kg load anywhere on the seat or through two constant loads of 77,1 kg along with a repeating third load which can vary from around 79,4 kg to 127 kg. Eckelman (2003) proposes 45,7 cm or slightly greater as the seat allowance per person in a multi-seating furniture, up to 60 cm width for a person weighing 103,9 kg.

An important aspect when designing both sofas and arm chairs is the distribution of seat loads from the front to the back. It was found that no matter if a person were sitting down or performing the action of ingress in a sofa were the distribution on the front and back legs 50/50. (Eckelman, 2003).

Loads in service and in performance testing of furniture

Looking at the effects the loads have on furniture, the knowledge is still limited according to Paoliello and Carrasco (2008). Li, Wu, Tackett and Zhang (2017) brings forward that Hu, Tackett, Tor and Zhang (2016) reviewed the literature regarding the sitting forces expressed as percentage of the human body weight and found that it varied from 38% to 95% during normal ingress in a chair of people weighing less than 83 kg. But as Paoliello and Carrasco (2008) brings forward can a chair be used in many different scenarios and found that during hard ingress could the force in terms of percentage of body weight to 205%. Furthermore, that Hu et al. (2016) found that people weighing between 136 to 186 kg could produce sitting forces up to 213% of their body weight during hard ingress.

Li et al. (2017) investigated this area further with comparing the forces created by people weighing from 51 kg up to 115 kg compared to a test bag filled with sand falling freely upon the seat weighing 34 - 68 kg at different drop heights, 0 – 50 mm. The 34 kg sandbag caused impact forces from 157 to 408 percent of the weight depending on the drop height and seat structure. Findings from Li et al. (2017)'s research brought forward that during normal ingress, the average peak force regarding the participants weight reached 100% and 247 % during hard ingress. Li et al. described hard ingress as a user with its body relaxed dropping oneself down on a seat. Furthermore, Li et al (2017) put forward that their result indicates that loads in cyclic testing of the seat structure should be set to the entire body weight. Li et al. (2017) also found that both seat foundations and seat height in that study had no significant effect on the peaking seating forces during a motion of sitting down. However, it should be noted that the total seat height difference was only 76 mm in Li et al. (2017)'s study and Berglund (1988) puts forward that the sitting height of resting chairs varied from 30 cm to 50 cm in Sweden.

The seating durability test found in BIFMA (2011) were also tested in Li et al. (2017)'s research and the peak dropping forces reached 217% of the sand bag's weight. Li et al. (2017) implied that the forces created by the BIFMA sand bag of 57 kg would create sitting forces much greater than a 115 kg heavy person's normal ingress but compared to hard ingress would the force be much less in magnitude. Li et al. (2017) brings forward a possible conclusion that in order to represent a motion of hard ingress could it be viewed as a free fall of the body down on a seat. The drop test in BIFMA (2017) is carried at a higher height with a functional load of 102 kg concerning hard use and 136 as the proof load representing

excess hard use, but the bag is only dropped one time each. Regarding test for users weighing up to 181,4 kg could BIFMA (2015) act as inspiration.

It is easy to exert easy chairs to great loads in form of a person sitting in one's lap or due to hard ingress according to Eckelman (2003) and he further states that it seems it would be a good move to design the chairs to withstand such loads. Compared to side chairs is the likelihood of people sitting down on the armrests of an easy chair greater, but the likelihood of someone pulling an easy chair sideways is lower (Eckelman, 2003). The easy chair's armrest must be designed to withstand the forces created by people sitting on it according to Eckelman (2003). Side chairs will often be used as a mean to reach things placed high up and this action exerts forces equal or often greater than body weight of the person standing on the chair (Eckelman, 2003).

Development of a performance test method

When considering a comprehensive test method, Eckelman (1988a) brings forward two fundamental questions:

1. What should be the scope and range of application?

This concerns the functional use of the furniture, is it possible to apply a single test method for generic group of furniture or are specific tests needed for specific furniture? A narrow application range might result in less exceptions and is less likely to be misinterpreted but the sheer number of tests that would be needed would be great. The same line of reasoning goes for a broad range of applicability. (Eckelman, 1988a).

2. What is acceptable performance?

The two choices within this question are whether to use single level (pass or fail) or multi-level acceptance systems and this choice is supposed to have the greatest effect on the test method's value and usefulness (Eckelman, 1988a).

A single level system is often applied when the aim of the test requirements is to set the base level regarding both safety and performance (Eckelman, 1988a). Both BIFMA and CEN standards use this type of acceptance systems (BIFMA, 2017; CEN, 2016, CEN 2005). Furthermore, single level systems need to be set at the minimum level for acceptance, because if the bar is set too high it might hinder both the development of products and satisfactory products to be sold on the market (Eckelman 1988a). The problem however is that single level systems tend to lower the overall quality of high end products since there is no way to display quality difference those passing the tests (Eckelman,1988a). On the other hand, the value single level systems bring is that the customers responsibility regarding investigating performance and safety is removed (Eckelman, 1988a). Along with a way for the manufacturers to control the product quality (Eckelman, 1988a).

Multi-level acceptance systems are favored when the aim is to evaluate different performance in similar products (Eckelman, 1988a). Multi-level systems are also considered to be the system which are the most valuable of the two systems (Eckelman, 1988a). The benefits of multi-level systems are: provision of information which enables performance versus cost decisions for customers, a way for manufacturers to show the quality and performance of their products and a mean for product developers to evaluate the furniture's strength towards different sets of requirements (Eckelman, 1988a). The General Services Administration have used a multi-level acceptance system when evaluating the performance of upholstered furniture and used three acceptance levels, *Light, Medium* and *Heavy* (GSA, 1998).

No matter which kind of acceptance system used within the test methods should the process of evaluation not leave room for ambiguous interpretations, definitions of failure which contain the phrases "loss of serviceability" or "excessive deflection" should not be used (1988a). BIFMA acknowledge the inherent subjectivity of loss of serviceability and have released guidelines to aid the evaluation process in their standards (BIFMA, 2016b).

The way of reporting test results needs to be adapted to the users regarding both the information itself and the presentation of it. If the manufacturer uses the result should detailed laboratory reports be used. If the information is aimed to be used by customers and users should only the most important information needed to make buying decisions be presented. However, the detailed tests reports should be available for interested customers. (Eckelman, 1988a).

Different performance test methods

Zhang, Chen and Daniewicz (2005) highlights that frame failure of upholster furniture in service seems to mainly be caused of fatigue. Zhang et al (2005) brings forward the following definition of fatigue "the progressive damage that occurs in a material subjected to cyclic loading". Fatigue is also emphasized by Eckelman (1988b) who states that most furniture failures in service seems connected to repeated use. The statement that most failures in service seem to be connected to repeated use is also highlighted by Ratnasingam et al. (1997).

BIFMA (2016a) cautions against using simple static load tests as a base for statements regarding furniture's strength and Eckelman (1988b) brings this subject one step further by stating that using static load models or simple fatigue load models to evaluate furniture performance does not seem appropriate. Tests using one given level of load in a fatigue load test can also be considered to be misguiding according to Eckelman (1988b). This because during the tests, it is often obvious that a tiny load increase during the test would cause the furniture to break down (Eckelman, 1988b). Furthermore, it can be argued that this increase of load is not uncommon in service (Eckelman, 1988b). Design stresses for wood in furniture have been put forward but these were based upon static loads, which make them most likely irrelevant and puts forward fatigue life data as a better candidate according to Ratnasingam et al. (1997).

The number of cycles of loading a material succeeds to endure is called fatigue life and is considered to be the most critical aspect during evaluation of fatigue performance of a material, however, there are several other factors as well (Ratnasingam et al., 1997). A summary of some of the factors affecting the fatigue performance of wood according to Ratnasingam et al. (1977) is presented in table 2 below. Ratnasingam et al. (1977) argues that furniture's fatigue life data needs to be extracted from case to case, being application specific in other words.

*Table 2 - factor affecting fatigue performance of wood*

Factor	Effect
Wood being compressed resulting in following fatigue limit	Resulted in one fourth of the maximum strength
Rate of testing	When tested at 40 Hz did internal heating arise which increased the strength. Due to being dried of the heat
Laminated wood	The fatigue resistance was 23 percent greater compared to solid wood

Time between load applications	Damage caused by fatigue were insignificant if the time between loading applications were greater than the time each load was applied for
Remaining strength	The samples had less strength left after fatigue testing compared to before the testing

To be able to develop load models which are closer to reality regarding repetitive loads of dynamic nature does Eckelman (1988b) consider that a reappraisal of failure modes and service history considered typical. Eckelman (1988b) strengthens this statement with the following example, during a furniture's lifetime will it be exposed to repeated applications of loads considered normal along with abusive loads from time to time. Berglund (1988) states that the same furniture will be used by several different people supports Eckelman (1988b)'s thinking. When the furniture is quite new, it is able to withstand these loads, but the strength decreases with time and at one point the furniture fails (Eckelman, 1988b). This concept which Eckelman (1988b) calls "first crossing" is built upon cumulative damage theory which says that when a subject is exposed to a load it is slightly damaged and therefore weakened. With time will the size of a load, most likely of abusive nature, exceed the remaining strength and cause failure (Eckelman, 1988b). Figure 2 below visualizes the concept.

Figure 2 - First crossing concept by Eckelman (1988b)
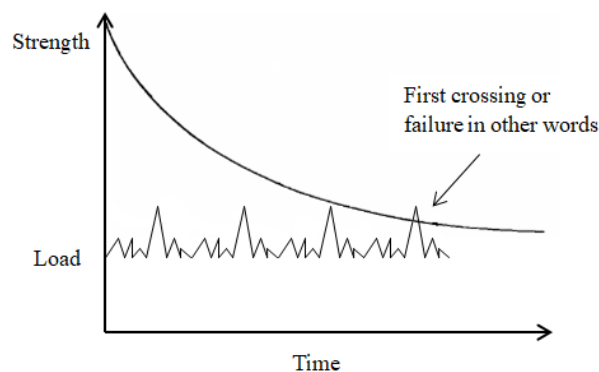
To truly represent a first crossing in a test would be hard according to Eckelman (1988b) but he presents a method called "cyclic stepped load" which he considers to be a useful compromise. The cyclic stepped load method uses a starting value of a load is applied at a certain rate of cyclic application for a number of cycles (Eckelman, 1988b). When the number of cycles has been accomplished is the load increased with a certain value (Eckelman, 1988b). This increase of loads is executed until an acceptance level of choice is reached or until the furniture breaks down (Eckelman, 1988b). Eckelman (1988b) put forward that most furniture would be exposed to secondary structural vibrations if the cyclic rate of application exceeds 20 cycles per minute.

BIFMA's standard for general purpose office chairs says that the rate of cyclic application should be 10 to 30 cycles per minute (BIFMA, 2017). CEN does not provide much information regarding this subject, regarding the durability test of castors and chair base (6.29) it is recommended to do the test at six cycles per minute as slow as possible (CEN, 2012). According to Eckelman (1988b) should a furniture be exposed to 25,000 test cycles before the load is increased, which requires a time consumption of about 21 hours for each load. Ratnasingam et al. (1997) criticizes previous tests found in standards for testing furniture for not providing knowledge to both customers and manufacturers and are encouraging further use of the cyclic stepping load model. Furthermore, Ratnasingam et al. (1997) states that being

knowledgeable about wood fatigue and using that kind of data in the furniture development process will most likely improve the products performance in use.

3.3 Global users

Since test methods' aim is to represent actual use in service, one needs to assess both the user and the development of the users. Eckelman (2003) states that to be able to properly design furniture, it is necessary to be aware of the weight trends. Furthermore, Eckelman (2003) brings forward that when developing seat loads for a sofa, anthropometric are data useful.

Global situation

The World Health Organization (WHO) brings forward that over 1.9 billion adults 18 years old or older were overweight in 2016 and 650 million of the 1.9 billion adults were obese (WHO, 2018). The evaluation if a person is overweight or obese done by WHO is based upon the body mass index (BMI) and a is calculated through the weight of the person divided by the person's height squared (kg/m^2) (WHO, 2018). The limits for overweight and obesity are a BMI of 25 or greater and a BMI of 30 or greater respectively (WHO, 2018). WHO are aware of the limits of the BMI method, but it is still used and considered useful according to WHO (2018). Ogden, Carroll, Kit & Flegal (2014) highlights issues with using BMI, for example does BMI not consider where the body fat is located in a person along with indications that Asians might have a larger amount of body fat compared to some others given the same BMI value. Comparing the 1.9 billion overweight and obese adults to the world's adult population means that 39 percent of the population were overweight, 40 percent of the women and 39 percent of the men (WHO, 2018). The result regarding obesity concluded that 13 percent of the adults were obese, 15 percent of the women and 11 percent of the men (WHO, 2018).

The Organisation for Economic Co-operation and Development (OECD) brings forward their own research that 19,5 percent of the adults in the OECD countries were obese in 2015 (OECD, 2017). The span of obesity prevalence in OECD countries goes from less than 6 percent in Japan and Korea up to over 30 percent in the United states and New Zealand for example (OECD, 2017). Von Ruesten, Steffen, Floegel, van der A, Masala, Tjonneland, Halkjaer, Palli, Wareham, Loos, Sorensen and Boeing (2011) states that the change of obesity prevalence is different across both countries and different groups within those countries. Four percent of the children and adolescents between five to 19 years old were overweight or obese in 1975 while in 2016 was this number 18 percent (WHO, 2018). WHO (2018) brings forward that both overweight and obesity has been viewed as a problem in high-income countries, but the problem is increasing in both low- and middle-income countries as of now (WHO, 2018). The BMI in 2014 regarding the mean BMI of men ranged from 21,4 in South Asia and Central America up to Polynesia and Micronesia's mean values of 29,2 (NCD-RisC, 2016b). The prevalence of obesity among men on a global scale have gone from 3,2 percent to 10,8 percent and from 6,4 percent to 14,9 percent regarding women (NCD-RisC, 2016b).

Overweight and obesity is caused by a higher consumption of calories compared to the number of expended calories (WHO, 2018). WHO states that around the globe has the consumption of energy-dense food with a high amount of fat have increase together with an increase of physical inactivity due to e.g. the nature of several work forms which are more or less sitting down are increasing (WHO, 2018). A report of people's health in Sweden brings forward that the Swedish population are becoming less physically active on their spare time along with a growing problem of overweight and obesity (Folkhälsomyndigheten, 2017). In 2016 were 51 percent of the Swedes who were between 16-84 years old overweight or obese, when looking at males and females were 44 percent of the women overweight or obese while 57 percent of the men were categorized as such (Folkhälsomyndigheten, 2017). Looking

at children under five years old were almost every other child in Asia overweight or obese in 2016 and in Africa have the increase of overweight or obese children under five years old been almost 50 percent since 2002 (WHO, 2018).

The situation in The United States of America

Ogden, Carroll, Kit & Flegal (2014) states that no trends regarding the prevalence of overweight in the United States were found between 1960-2010. In the United States were more than 67 percent of the adults overweight or obese, looking solely at obesity were 34,9 percent of the adult population obese and 6,4 percent had a BMI of 40 or more which are categorized as extremely obese (Ogden, Carroll, Kit & Flegal, 2014). A significant linear trend regarding an increase of both overall obesity and class 3 obesity (BMI equal or greater than 40) was found for women between 2005 to 2014, the underlaying reasons for it is however unknown (Flegal, Kruszon-Moran, Carroll, Fryar & Ogden, 2016).

NHANES

National Health and Nutrition Examination Survey (NHANES) is a survey conducted in USA by the National Center for Health Statistics (NCHS) and is a "stratified, multistage probability sample of the civilian noninstitutionalized population..." According to Fryar, Carrol & Ogden (2014). Worth mentioning is that since 2011 – 2012 have NHANES oversampled non-Hispanic Asians and in 2007-2008 started NHANES to oversample the Hispanic population (Fryar et al. 2014). NHANES targets people between 0 to 150 years old according to NCHS (2017) and the distribution of the crude data from NHANES 2015 – 2016 is shown in table 3 (NCHS, 2018; NHANES, 2018).

Table 3 - NHANES 2015 - 2016

NHANES 2015-2016	99,5th percentile	95th percentile	90th percentile	50th percentile	25th percentile	10th percentile
Body weight (kg)	152,3	114,2	101,6	65,4	36,7	15,0

Overweight and obesity indications in Europe

Von Ruesten et al. (2011) used about 98,000 participants to investigate the European prevalence of obesity in adults from seven cohorts in Europe in a longitudinal study. In 1995 to 1996 were 13 percent of both men and women obese, 50 percent of the men and 33 percent of the women were overweight according to Von Ruesten et al. (2011)'s research. The result from the follow up, which were on average 6,4 years later, put forward that 17 percent of both the men and the women were obese, 54 percent of the men and 37 percent of the women were overweight (Von Ruesten et al., 2011). Rising age were found to be a factor connected to the increase of prevalence of obesity, this were particularly present for women aged from 30 to 65 years old, however, the most apparent increase in obesity prevalence were found for male subjects (Von Ruesten et al., 2011). It should be made clear that the results of the research are not representative for the total population and the used data do not reflect a specific country (Von Ruesten et al., 2011).

SCB (2018) brings forward the following percentiles, which are shown in the table 4 below, regarding male and female weight in kg 2010-2011 of subjects who were 16 years old or older in Sweden.

Table 4 - SCB weight data

Weight (kg)	90th percentile	75th percentile	50th percentile	25th percentile	10th percentile
Men	100	90	82	74	67

Women	84	75	65	59	54
Total	95	85	74	64	57

Weight indications in China

Ren, Su, Wang, Wang, Du and Zhang (2016) puts forward that the prevalence of both obesity and overweight is increasing around the world, including China. Ren et al. (2016) performed their own research with chinse participants which showed that in 2006 were 34,1 percent of them overweight and in 2011 were the overweight prevalence 41,7 percent. Paynter, Koehler, Howard, Herring & Gordon-Larsen (2015) investigated the weight change in China from 1991 to 2009 in adults from 18 to 66 years old and found both weight gains and losses followed by a maintenance of the weight in some cases across all groups. Most of the groups had either a slow gain or a maintained weight as the largest share looking at the data Paynter et al. (2015) provides. The data Paynter et al. (2015)'s research was based upon was the China Health and Nutrition Survey (CHNS) with survey results from 1991 to 2009, which is a longitudinal study which collected information from 228 in nine different provinces (Paynter et al., 2015). The provinces taking part represented 56 percent of the population in China but it is not representative for China (Paynter et al., 2015).

CHNS

CHNS data regarding height and weight are collected from persons who are seven years old or older (CHNS, n.d). CHNS (2018) crude data regarding weight, in kg, of the subjects from the survey round in 2011 showed the distribution and is presented in table 5.

Table 5 - CHNS 2011

CHNS 2011	99,5[th] percentile	95th percentile	90th percentile	50th percentile	25th percentile	10th percentile
Body weight (kg)	95	82	76,3	59	49,9	31,3

Future trends

NCD-RisC (2016b) believes that if the trends found after 2000 in their research continues the prevalence of obesity worldwide will be 18 percent for men and over 21 percent for women by 2025, along with severe obesity becoming prevalent in more than 6 percent of the men and in 9 percent of the women. OECD have also made their own predictions that the rate of obesity will increase until 2030 at least (OECD, 2017). The United States, England and Mexico are believed to have the largest rates of obesity, 47 percent, 35 percent and 39 percent respectively in 2030 (OECD, 2017). Italy and Korea are expected to have much lower rates of 13 percent and 9 percent respectively in 2030, however, the pace of which the obesity rate in Korea increase with is expected to be greater than before (OECD, 2017).

Von Ruesten et al. (2011) thinks that a leveling off model of prediction is better compared to a linear model. The aspect of an increasing risk of diseases such as diabetes mellitues type 2 connected to the increase of the BMI value forces highly obese people to keep their weight in check is brought forward to question linear development through a human's life (Von Ruesten et al., 2011). Flegal, Kruszon-Moran, Carroll, Fryar & Ogden (2016) brings forward an important note that predicting future trends based on extrapolation of old data may not yield any valuable information. There is a problem to validate both short-term and long-term predictions and that there is a lack of knowledge regarding what factors that actually affect the prevalence of obesity (Flegal et al., 2016).

Chosen user weights in furniture standards

BIFMA have chosen to use the 95th percentile American male, 125 kg based on the NHANES 2007-2010 survey, regarding test loads for the standard of general purpose office chairs (BIFMA, 2017). They have also chosen to develop a standard for what they call larger occupants of general purpose office chairs where they have chosen the 99th percentile American male, 181,4 kg, to base their test loads on. Hu et al. (2016) brings also forward that according to the NHANES survey 1999-2004 had about 3 million Americans a body weight greater than 136 kg and that no standard in 2016 covered testing for people weighing more than 136 kg. The European counterpart have used a person weighing up to 110 kg to base their loads upon in their standard for strength, durability and safety (CEN, 2016).

Body measurement

Regarding the body height of both men and women, the difference between the tallest and smallest people country wise were nearly 20 cm. The difference between the tallest and shortest men born in 1996 were 22-23 cm, which are about 4 cm more compared to 1896. The top 25 tallest men comes from European countries with an exception of Australia. The difference in women's height were about 20 cm looking at the highest and lowest body height. Comparing the average height of men and women born in 1996 were men about 12 cm taller. (NCD-RisC, 2016a).

Berglund (1988) have brought forward different categories of body measurements to aid furniture designers. Men have two measurements, large which are based upon the 95th percentile and medium which are based upon the 50th percentile. Women also have two measurements, medium which are based upon the 50th percentile and small which are based upon the 5th percentile. These measurements have been compiled from four out of the most comprehensive measurements performed outside Sweden and on several Swedish investigations. Selected body measurements, in centimeters, representing people between 20-65 years old are presented in table 6 below. These measurements include both clothing and shoes where the shoe heels are set to 2,5 cm. (Berglund, 1988).

Table 6 - Body measurements

	Men – large 95th percentile	Men – medium 50th percentile	Women – medium 50th percentile	Women – small 5th percentile
1- Floor to popliteal when sitting down at about 90 degrees	52	47	44	40
2 - Bottom to kneecap	54	49	48	44
3 - Bottom width when sitting down	41	37	40	36
4 - Elbow to elbow with the underarms facing forward	55	47	46	39

Furthermore, Berglund (1988) mentions that the 95th percentile bottom width when sitting down for women is 45 cm, which is larger than the 95th percentile value for a man (41 cm). Most parts of the guide values are based upon Berglund (1988)'s own experience due to the lack of research.

Regarding the seating width should the seat enable a user to shift sitting position during use and free movement. The seat should neither be to wide or to small, the width be at least 45 cm which are the width of larger persons and to be able to use the armrests should the distance between those range from 45 to 52 cm. A sofa should have a minimum width for middle seats of 55 cm elbow to elbow, based

upon larger persons measurements, end seats with an armrest however suffices with about 48 cm. Taking the phycological aspect in to account should these dimensions be revised to 58 cm for the middle seat and 49 cm for the end seat. (Berglund, 1988).

BIFMA's standard for office chairs for larger occupants can only be applied for chairs which have a seat width of at least 56 cm (BIFMA, 2015).

3.4 Decision making

Several different roads can be pursued in the matter of both choosing loading capabilities and providing information about loading capabilities, which makes it important for this thesis to bring forward how choices can be made. Berglund (1988) brings forward that many persons who looks differently will be using the same furniture and therefore is it not a good solution to market different furniture sizes like the clothing industry have chosen to do.

Savage (2002) bring forward the issue of taking action based on average numbers and how those plans most often fail. Using average numbers does not take into account variation which is inevitable (Savage, 2002). Savage (2002) states that rather than to work with just a single number, one should work with a distribution of numbers and not forget about variation. Frick (2018) brings forward three ways to improve the decision making. Firstly, do not be so sure. By this, Frick (2018) means that over confidence is a great issue and that one should not be so sure about more or less everything, so one considers alternative outcomes than those thought to happen. Secondly, bring up the question "how often does that typically happen?" (Frick, 2018). This is a good start regarding predictions and this is an important factor within the process of decision making, involving both judgement and predictions is one way of taking the external perspective of a decision (Frick, 2018). The third and last recommendation is to gain basic knowledge of probability to remove parts of biases (Frick, 2018).

Furthermore, Frick (2018) points out that the strength of these recommendation is most powerful together. Courtney, Lovallo & Clarke (2013) highlights the areas which Frick (2018) brought forward from a decision tool selection point of view. Courtney et al. (2013) brings forward factors which concern the ability to see into the future regarding the span of outcomes that may follow a decision, what knowledge exists regarding success factors and the level of centralization of useful information. Kaplan & Mikes (2012) brings forward that people are overconfident about how much they actually can affect events which are strongly controlled by chance and a tendency to trust the precision of forecast to much. Which is not a good way to make decision according to the arguments of Frick (2018).

Hazelrigg (1998) boils down engineering design to basically two parts, to come up with all options that are possible to accomplish and to choose the best solution. Rietzschel, Nijstad & Stroebe (2010) highlights that it has been assumed that people are able to choose the best idea from a collection of ideas, but their research found people are bad at selecting. Rietzschel et al. (2010) states that the process of selecting is an important part of realizing innovation, and that the choosing of creative ideas gains most benefits when using selection criteria which are more specific. Hazelrigg (1998) supports the issue of people being bad at selecting partly when highlighting issues in the decision process like the enormous set of all possible solutions for a product design and the impossibility to sort out the best solution based on that extensive list.

Hazelrigg (1998) puts forward the importance of managing tradeoffs between performance and cost concerning a product which cannot be avoided and Wang (2013) does also highlight that that dealing with tradeoffs is a part of the design process. Rietzschel et al. (2010) concludes, with their results as the basis, that there is a tendency among people to choose those the ideas which they believe in compared

to ideas which are viewed as more creative and in order to achieve great improvements is risk taking necessary.

Hazelrigg (1998) brings forward three reasons for bad decisions in engineering design:

− Failing to both define and put "good" options in the pool of options
− Failing to assess expectations in an accurate or appropriate way
− Failing to conclude appropriate measure of value and using it

Hazelrigg (1998) points out that value is connected to what one wants and expectation is what one thinks will happened based on a specific decision, these should not be confused with each other. He describes design as a decision which aims to bring as much value as possible and that values are formulated as a real scalar compared to the thought of design as a compromise of different goals. However, Hazelrigg (1998) states that making money is really the only goal and all other goals falls behind. Building further on this area, Wang (2013) states that customer satisfaction is necessary to involve in the decision process. Wang (2013) says that the group of heterogeneous customers have a large variety in their wants or how they purchase products. Thus, the range customer needs which can be satisfied enters the picture. Furthermore, Wang (2013) brings forward that several firms have changed their target strategies and set focus on specific customer groups rather than going for the entire market.

According to Wang (2013), not only do the needs of different customers vary but also the importance of each feature varies from customer to customer. To achieve an effective way of ranking different product variants should both overall customer satisfaction and the cost the suppliers have connected to their production. Magee (1964) brings forward an interesting a way of deciding in form of what he calls a decision tree, which does not frame the decision as a single isolated choice nor a sequenced choice, but a tree of choices. A note worth mentioning is that future decision will be affected of the knowledge that will be gained in the meantime (Magee, 1964). Therefore, uncertainty is a great part of the decision making and that the aspect of time is also relevant.

Since decision making is about making choices, strategy within a company is brought into of the decision making. Because "The essence of strategy is choosing what not to do" according to Michael Porter (Frössevi, 2017). Frössevi (2017) brings forward three parts which are used to develop a good strategy, firstly, a diagnosis of the challenge at hand which identifies the critical factors and provides a simplified picture of the challenge. Secondly, a guiding policy which provides a common way that has been selected to handle the challenges found in the diagnosis stage. Thirdly, actions which are aligned with each other and the guiding policy. The last two parts are most interesting to this thesis since they together mean that decisions should be made in line with the existing strategy of the organization.

Risks and uncertainty

Risk and uncertainty is a natural part of decision making and Hazelrigg (1998) states that making design choices is about choosing in context of both risk and uncertainty. Courtney et al. (2013) brings forward that an increasing amount of decision needs to partly be based on uncertain information which are not covering the whole aspect of the issue at hand regarding matters of managerial kind. Kaplan & Mikes (2012) categorizes risks into three different kinds:

1. Preventable risks – Internal risks which can and should be either circumvented or removed and this type of risk is best encountered through active means, such as guide lines.
2. Strategy risks – Risks that are accepted by choice to prosper on the chosen strategy and they are not always unwanted like the preventable risks, it is more like a high risk high reward kind of thinking. This kind of risk needs a system which reduces the chance of them becoming reality.

3. External risks – Outside risks which cannot be controlled, and focus should be on identification of these risks and reducing the impact of the risks.

One way to work with risks is to do a failure mode and effect analysis (FMEA), Vandenbrande (1998) brings forward the flow of the stages in FMEA and those are presented in figure 3, the risk priority number (RPN) is an assessment of the potential failure mode.

Figure 3 - FMEA described by Vandenbrande (1998)

| Failure mode | → | Effect severity (S)
1-10 | → | Causes occurrence
(O)
1-10 | → | Controls detection
(D)
1-10 | → | RPN = S×O×D
1-1000 |
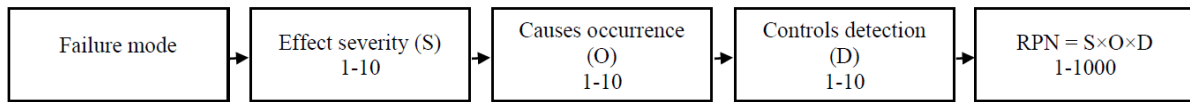
There are different types of FMEAs and Vandenbrande (1998) highlights two kinds, one which are used in the development of products and one which are used in the development of processes. The aim of the FMEA is to set numbers to potential failures effect to aid an organization to prioritize actions to encounter them (Vandenbrande, 1998). However, Shahin (2004) brings up the notice that most FMEAs consider the severity rates from the aspect of the company and not from the view of the customer and this is something he considers a flaw.

3.5 Communication

There are several definitions for communication but one of the definitions, mentioned in Spaho (2012), state that communication is the "transfer of information from sender to receiver under the condition that the receiver understands the message". Spaho (2012) believe this is an accurate definition of communication but believe that in order to achieve an efficient communication with someone, the receiver should also somehow indicate to the sender that the message has been understood. According to Spaho (2012), a communication process between two people consists of four elements, which are:

1. A sender – which is the person who will initiate the communication
2. A receiver – which is the person for whom the message is intended to
3. The message – what the sender wants the receiver to know. The message can either be in a verbal or non-verbal form. Verbal means that the message is delivered in spoken or written form. While non-verbal means that the message is delivered in a non-spoken form such as face expression or behavior.
4. Feedback, which Spaho (2012) consider to be the "lifeline" of effective communication. With feedback, the receiver should somehow indicate to the sender that the message has been understood. Otherwise without feedback, a mutual understanding of the message that was sent and delivered cannot be accomplished between a sender and a receiver.

A communication process between an organization and its customers is considered to be an important factor for business success. This according to Florea & Duica (2017) who explain that it is necessary for an organization to continuously listen and respond to customer needs, expectations and complaints in order to achieve customer satisfaction. However, according to Bergman & Kelfsjö (2010), dissatisfied customers do not often tend to complain directly to a company. Bergman & Klefsjö (2010) explains that about 5 percent of dissatisfied customers actually complain directly to the company, while the rest complain about the experience that they had with the company to friends, families and colleagues. Because of this, Bergman & Klefsjö (2010) believe that 100 dissatisfied customers can result in five complaints directly delivered to the company, but a loss of 1000 potential customers.

The success of listening and responding to customers, depends also how well the organization has developed their formal communication processes which they use for communicating with the customers. According to Florea & Duica (2017), organizations should develop formal communication processes which are simple for the customer to use and understand. However, Ramsey & Sohi (1997) believe the most challenging for a person in a communication process is listening which is considered to be the most used component in a communication process. According to Ramsey & Sohi (1997,) there seem to be differentiation between people regarding how well a person is at listening. In other words, some people tend to be more skilled listener than others

Ramsey & Sohi (1997) explains that there is a differentiation between understanding what a person is saying to "actually getting the meaning of what is being said". People who are getting the meaning of what is being said by have the skill of "effective listening" which is important skill to have, especially for a salesperson whose job is to listen and responds to customers verbal or non-verb messages (Ramsey & Sohi, 1997). Salespersons who have the skill of effective listening, is believed by Ramsey & Sohi (1997) to be better at understanding customer needs, values and expectations than a salesperson who do not have it. This shows that an efficient listen behavior plays a curial role in understanding the customer. However, after listen carefully to what customer are saying, it is important that the salesperson responds in an appropriate matter which shows that the sales has understood the saying of the customers (Ramsey & Sohi, 1997). This can be related to what was mentioned about feedback by Spaho (2012), which was that the receiver should somehow indicate to the sender that the message has been understood in order to achieve a mutual understanding of the message that was sent and delivered.

It is important that the salesperson give feedback to the customers which shows that they are saying about a subject has been understood. This is important because, for example, when sales representatives approach customers and start speaking to them about a subject, customers tend to also notice if a salesperson show interest in listening to them (Ramsey & Sohi, 1997). If customers notice that a salesperson is showing an interest in listening to them, regarding any type of subject, the salesperson will start building a trusting and open relationship with the customers. This will lead to customers founding the salesperson to be "honestly interesting in them" which further contribute to be better understanding customer needs, values and expectations for the salesperson (Ramsey & Sohi, 1997

4. Empirical findings

This chapter presents the empirical findings of this master thesis.

4.1 Simplified competitor benchmarking

Firstly, different furniture retailer's ways of communicating loading capabilities of armchairs through the website and the span of chosen levels of loading capabilities will be presented. Followed by examples of ways of communicating loading capabilities and the span of chosen levels of loading capabilities found in companies producing sitting aids for showering and similar usage. The different loading capability levels in the following tables are based on armchairs which had a loading capability level information, those products which did not have a loading capability level were excluded. The Lowest loading capability refers to the lowest loading capability level found for a specific product and the highest loading capability level refers to the highest loading capability level found for a specific product. All investigated products which had information about loading capabilities had only one level of load capability.

4.1.1 Furniture retailers and manufacturers

Companies in the Swedish market are presented in table 7 below. The communication messages have been translated from Swedish to English.

Table 7 – Loading capabilities of armchairs found in different companies in the Swedish market

	Company 1	Company 2	Company 3	Company 4
Communication message	None	None	Adapted to work up to X kg	Max load about: X kg
Average load capability (kg)	-	-	140	124
Mode load capability (kg)	-	-	120/160	120
Highest load capability (kg)	-	-	160	160
Lowest load capability (kg)	-	-	120	100

None of the first four companies were communicating information about loading capabilities on all of their armchairs. Company 4 had the highest rate of providing this information on the Swedish market, about one third of their armchairs provided this information, and company 3 did only provide this information on six of their armchairs.

Companies in the market in the United States are presented in table 8 below.

Table 8 - Loading capabilities of armchairs found in different companies in the market in the United States

	Company 5	Company 6	Company 7
Communication message	None	None	Weight capacity: X lbs
Average load capability (kg)	-	-	113,0*
Mode load capability (kg)	-	-	113,4*
Highest load capability (kg)	-	-	181,4*
Lowest load capability (kg)	-	-	56,7*

* These loading capability numbers have been recalculated from pound to kilograms.

Most of company 7's armchairs had information about loading capabilities.

Three companies in China and one in Great Britain was also looked into. None of the Chinese companies communicated any information about loading capabilities. However, the retailer in the British market used the communication message "maximum user weight X kg". The span of loading capabilities based on a selection of their armchairs ranged from 100 kg to 200 kg with a mode value of 120 kg. However, not all armchairs in the selection did contain this information.

4.1.2 Companies producing assistive products for personal hygiene

Companies in the Swedish market are presented in the table 9 below. Only sitting aids similar to armchairs, like stools and chairs for showering, have been looked in to. The pictures used as communication are shown in **Appendix A.**

Table 9 - Loading capabilities for assistive products found in companies in the Swedish market

	Company 9	Company 10	Company 11
Communication messages	Max user weight/picture of a person on a scale with the text "max kg"	Max user weight	Max user weight/Max safe user weight/picture of a person on a scale with the text "max kg"
Lowest load capability (kg)	125	100	100
Highest load capability (kg)	200	180	300

4.2 Questionnaire

The summery of the relevant findings from the questionnaires is presented in this section. The first subsection presents the result from the complete questionnaire which were distributed online, and the second part presents the result from the reduced questionnaire with respondents which were visiting a furniture store. The questions and answers are grouped together depending on the area of interest and the groups are marked with bold headlines.

4.2.1 Complete questionnaires

The respondent information and categorization are presented below.

- 68 persons were men and 62 persons were women, 130 persons in total.
- 3,8 percent were 15-20 years old, 66,9 percent were 21-30 years old, 12,3 percent were 31-40 years old, 3,8 percent were 41-50 years old, 9,2 percent were 51-60 years old and 3,8 percent were 61-70 years old.
- 26,9 percent of the respondent's households constituted of one person, 46,2 percent of the respondent's households constituted of two persons, 13,1 percent of the respondent's households constituted of three persons, 10 percent of the respondent's households constituted of four persons and 3,8 percent of the respondent's households constituted of five persons.
- 79,2 percent of the respondents did not have any children living in the household, 12,3 percent of the respondents had one or several children, younger than eleven years old, living in the household and 8,5 percent had one or several children between eleven to 18 years old living in the house hold.

Previous relations to loading capabilities of furniture

The answers whether the respondents had thought about a furniture's loading capabilities are presented in table 10 below.

Table 10 – Previous relations: thought of loading capabilities

	Yes, regarding an armchair	Yes, regarding a sofa	Yes, regarding a sofa and an armchair	Yes, regarding another type of furniture	No
Share of respondents	5,4 %	7,7 %	10%	21,5%	55,4 %

The result of the follow up question whether the respondents had sought information about an armchair's or a sofa's loading capabilities is presented in table 11.

Table 11 – Previous relations: sought information about loading capabilities

	Yes, regarding an armchair	Yes, regarding a sofa	Yes, regarding a sofa and an armchair	No, but regarding another type of furniture	No
Share of respondents	2,3 %	1,5 %	4,6 %	12,3%	79,2 %

The respondent's reasons for seeking information about loading capabilities of an armchair or a sofa resulted in the following distribution shown in table 12. There were 16 respondents who had answered but only 11 respondents had sought this kind of information. The respondents could choose several alternatives.

Table 12 - Reasons for seeking information about loading capabilities of an armchair or a sofa

	Share of respondents
The furniture looks weak/fragile	43,8 %
The furniture will be used in another way than sitting in	25,0 %
More persons than specified seats will sit in the furniture	18,8 %
Out of curiosity	18,8 %
Previous experience of breakage of a furniture during use	12,5 %
For sales purposes	6,3 %

The question regarding the respondent's interpretation of loading capability information gave the following result. The majority of the respondents, 54,6 percent, interpreted the following sentence "the 3-seat sofa has a maximum load of 360 kg" as if the sofa could handle a distributed load, weights or persons, of 360 and the rest interpreted the sentence as the sofa could handle a single weight or person of 360 kg.

Importance and value of loading capability information of armchairs and sofas

The importance of available information of loading capability of an armchair and a sofa according to the respondents is presented in table 13 below, ranging from not important at all (1) to Extremely important (7).

Table 13 - Importance of loading capability information of an armchair and a sofa

	1 (not important at all)	2	3	4	5	6	7 (Extremely important)
Armchair – share of respondents	9,2 %	13,1 %	13,1 %	20,8%	18,5 %	15,4 %	10 %
Sofa – share of respondents	8,5 %	12,3 %	13,1 %	16,9 %	20 %	18,5 %	10,7 %

The respondent's opinions if they would appreciate information of an armchair's or a sofa's loading capability in any of the following scenarios are presented in table 14 below. The respondents could choose several alternatives.

Table 14 – Scenarios of appreciation of loading capability information of armchairs and sofas

	Armchair – share of respondents	Sofa – share of respondents
To be able to compare different armchairs/sofas	57,7 %	60,8 %
The armchair/sofa will occasionally be used in another way than sitting in the seat	11,5 %	23,1 %
More persons than seats will occasionally sit in the armchair/sofa	22,3 %	37,7 %
The armchair/sofa looks weak/fragile	54,6 %	49,2 %
Previous experience of breakage of an armchair/sofa	16,9 %	18,5 %
Just out of curiosity	28,0 %	23,1 %
I do not care about that kind of information	7,7 %	7,7 %
Other	1,5 %	1,5 %

Preferences of information and communication of seating furniture's loading capabilities

The four most preferred versions of information regarding a seating furniture's strength is presented in table 15.

Table 15 - Preferred versions of communication

	Share of respondents
Tested for 120 kg during X number of years of usage per seat	27,7 %
Max load: 120 kg (in total for the furniture)	20,8 %
Max load: 120 per seat	18,5 %
Tested for a person weighing up to 120 kg during X number of years of usage per seat	16,2 %

In table 16 below, the distribution of where the respondents would appreciate to obtain information about furniture's loading capabilities is presented. The respondent could choose several alternatives.

Table 16 - Appreciated communication channels regarding loading capabilities

	Share of respondents
In the product guide/documents which accompany the product	60,0 %
On the website for the furniture	56,9 %
On the product packaging	46,9 %
On the product, e.g. a sticker on the bottom of the product	37,7 %
On the price tag	36,9 %
Sales personnel in a store	26,1 %
In the furniture company's app for smartphones	26,1 %
Nowhere	0,8 %

Usage of armchairs and sofas

The distribution of the answers to the question of how many times the respondent and those in the respondent's household sat down in the most frequently used armchair or sofa at home is shown in table 17. Given that the respondent had a sofa or an armchair at home, 75 out of 130 respondents had an armchair and 125 out of 130 respondents had a sofa at home.

Table 17 - Number of times sitting down

	1-6 times a week	1-10 times daily	11-20 times daily	21-30 times daily	More than 30 times daily
Armchair – share of respondents	53,3 %	37,3 %	9,3 %	-	-
Sofa – share of respondents	12 %	69,6 %	14,4 %	2,4 %	1,6 %

The stated usage of an armchair or a sofa in general of the respondent's or anyone in the respondent's household is presented in table 18 below, the respondents could choose several alternatives. Six of the respondents entered that they did not have any armchair, making the total number of respondents for armchairs 124. One of the respondents entered that he or she did not have a sofa at home making the total number of respondents 129 regarding usage of a sofa.

Table 18 - Usage of armchairs and sofas

	Armchair – Share of respondents	Sofa – Share of respondents
Sitting in the seat(s)	94,4 %	93,0 %
Sitting more than one person per seat	22,6 %	40,3 %
Sitting on the armrest	26,6 %	40,3 %
Sitting on the backrest	2,4 %	8,5 %
Standing on the seat	10,5 %	22,5 %
Standing on the armrest	2,4 %	16,3 %
Laying down in	-	87,6 %

A child is moving in the seat forcefully	7,3 %	13,9 %
A child jumping in the furniture	4,0 %	7,0 %
Several children jumping in the furniture	-	3,1 %
A child climbing on the furniture	6,5 %	14,7 %
Several children climbing on the furniture	-	6,2 %
Adults throwing themselves in the furniture	-	0,8 %
Other	4,0 %	2,3 %

4.2.2 Reduced questionnaires

Respondent information and categorization are presented below. The participants in this questionnaire participated during their visit at a furniture store.

- 23 persons were men, 13 persons were women and two persons did not categorize themselves as a man nor a woman, 38 persons in total.
- 34,2 percent were 21-30 years old, 34,2 percent were 31-40 years old, 10,5 percent were 41-50 years old, 5,3 percent were 51-60 years old, 10,5 percent were 61-70 years old and 5,3 percent were 71-80 years old.
- 15,8 percent of the respondent's households constituted of one person, 42,1 percent of the respondent's households constituted of two persons, 7,9 percent of the respondent's households constituted of three persons, 31,6 percent of the respondent's households constituted of four persons and 2,6 percent of the respondent's households constituted of five persons.
- 68,4 percent of the respondents did not have any children living in the household, 23,7 percent of the respondents have one or several children younger than eleven years old living in the household and 7,9 percent had one or several children between eleven to 18 years old living in the household.

Previous relations to loading capabilities of furniture

The answers to whether the respondents had thought about a furniture's loading capabilities is presented in table 19 below.

Table 19 - Previous relations: thought of loading capabilities

	Yes, regarding an armchair	Yes, regarding a sofa	Yes, regarding a sofa and an armchair	Yes, regarding another type of furniture	No
Share of respondents	5,3 %	21,1 %	7,9 %	36,8 %	28,9 %

The follow up question whether the respondent had sought information about an armchair's or a sofa's loading capabilities gave the following result seen in table 20.

Table 20 - Previous relations: sought information about loading capabilities

	Yes, regarding an armchair	Yes, regarding a sofa	Yes, regarding a sofa and an armchair	No, but regarding another type of furniture	No
Share of respondents	-	13,2 %	2,6 %	21,1 %	63,2 %

The reason for seeking information about an armchair's and/or a sofa's loading capabilities were answered by nine persons but only six persons had entered that they had sought this kind of information. The responses are shown below in table 21, the respondents could choose several alternatives.

Table 21 - Reasons for seeking information about loading capabilities of an armchair or a sofa

	Share of respondents
Out of curiosity	66,7 %
The furniture looks weak/fragile	44,4 %
More persons than specified seats will sit in the furniture	22,2 %
Previous experience of breakage of an armchair/sofa	11,1 %

Value of loading capability information of furniture

The respondent's opinions if they would appreciate information of an armchair's or a sofa's loading capability in any of the following scenarios is presented in table 22 below. The respondents could choose several alternatives. Due to the set up did 15 persons answer the questions regarding an armchair and 23 persons regarding a sofa.

Table 22 – Scenarios of appreciation of loading capability information of armchairs and sofas

	Armchair – Share of respondents	Sofa – Share of respondents
To be able to compare different armchairs/sofas	60,0 %	56,5 %
The armchair/sofa will occasionally be used in another way than sitting in the seat	6,7 %	21,7 %
More persons than seats will occasionally sit in the armchair/sofa	13,3 %	30,4 %
The armchair/sofa looks weak/fragile	46,7 %	26,1 %
Previous experience of breakage of an armchair/sofa	20,0 %	-
Just out of curiosity	53,3 %	30,4 %
I do not care about that kind of information	13,3 %	12,7 %

Preferences of information and communication of furniture's loading capabilities

The four most preferred versions of information regarding a seating furniture's strength is presented in table 23.

Table 23 - Preferred versions of communication

	Share of respondents
Max load: 120 kg per seat	34.2 %
Max load: 120 kg (in total for the furniture)	15,8 %
Tested for 120 during X number of years usage per seat	15,8 %
Tested for a person weighing up to 120 kg according to a standard regarding strength, durability and safety (per seat)	12,2 %

Table X below shows the distribution of where the respondents would appreciate to obtain information about furniture's loading capabilities, the respondent could choose several alternatives.

Table 24 - Appreciated communication channels regarding loading capabilities

	Share of respondents
On the product packaging	55,3 %
On the website for the furniture	50,0 %
On the price tag	50,0 %
In the product guide/documents which accompany the product	23,7 %
Sales personnel in a store	21,1 %
On the product, e.g. a sticker on the bottom of the product	18,4 %
In the furniture company's app for smartphones	10,5 %
Anywhere as long as it is before the purchase	2,6 %

Usage of armchairs and sofas

Table 25 below shows the distribution of the answers to the question of how many times the respondent and those in the respondent's household sat down in the most frequently used armchair or sofa at home. Given that they had a sofa or an armchair at home. Due to the set up did 15 persons answer the questions regarding an armchair and of those had 12 an armchair at home. 23 persons answered the question regarding a sofa and all of them had a sofa at home.

Table 25 - Number of times sitting down

	1-6 times a week	1-10 times daily	11-20 times daily	21-30 times daily	More than 30 times daily
Armchair – share of respondents	25,0 %	50,0 %	25,0 %	-	-
Sofa – share of respondents	21,7 %	69,6 %	-	4,3 %	4,3 %

The usage of the respondents or anyone in the respondent's household of an armchair or a sofa in general is presented in **Table x** below, the respondent could choose several alternatives. Due to the set up did 15 persons answer the questions regarding an armchair and 23 persons regarding a sofa.

Table 26 - Usage of armchairs and sofas

	Armchair – Share of respondents	Sofa – Share of respondents
Sitting in the seat(s)	86,7 %	91,3 %
Sitting more than one person per seat	-	17,4 %
Sitting on the armrest	40 %	21,7 %
Sitting on the backrest	-	4,3 %
Standing on the seat	6,7 %	17,4 %
Standing on the armrest	6,7 %	4,3 %
Laying down in	-	91,3 %
A child is moving in the seat forcefully	6,7 %	13,0 %
A child jumping in the furniture	-	13,0 %

Several children jumping in the furniture	-	8,7 %
A child climbing on the furniture	-	13,0 %
Several children climbing on the furniture	-	4,3 %
Adults throwing themselves in the furniture	-	-
Other	6,7 %	-

4.3 Observations

A summary of the findings from the from the customer observations at two different furniture stores is presented in this section. Furniture in this section, 4.3, refers to armchairs and sofas.

Interaction with the product information and communication

The first judgement call about a furniture were made with eyesight and were done in just a few seconds. The price tag was the most used communication. If there were documents with products information available for the customers to take with them, the customers took documents occasionally. It was not uncommon for customers to sit down in a furniture and then look around at other furniture. One customer pushed an armchair on the upper corner so it started to sway a bit and moved on directly to another product due to the swaying. The most discussed things among the customers were the color or design of the furniture, the price of the furniture and if the furniture felt comfortable or not. Customers did also feel the fabric and decided to move forward without sitting down. Very few customers asked the personnel for help or information.

Usage of armchairs and sofas

The most common way for adults to test the furniture were to sit down quite forcefully, which resulted in the person bouncing up a bit, and then a couple of seconds later getting up again. It was not uncommon for adults to bounce up and down in the seat. Some chose to "fall down" on the seat quite heavily without holding back. A couple of adults sat down on the armrest of the furniture. Two adults were sitting in the same seat in a sofa and another. In the public spaces of the stores were customers sitting on the front edge and sitting more towards the back edge of the seats of the furniture

Some children ran around and threw themselves lightly onto the sofas. Jumping on the seats of the sofas occurred together with climbing and standing in the furniture. Overall, the children had a little more aggressive approach of trying furniture.

4.4 Interviews

In this section, the summery of the findings from the interviews is presented. Firstly, the findings from the customer groups interviews is presented, followed by the interviews with personnel from company F, customers and personnel at furniture stores, standardization organizations, internal and external test laboratories and a company developing assistive products.

4.4.1 Interviews with customer groups

The six customer groups which were interviewed are described below.

- Customer group A (CGA): A person living alone in his/hers first home between 18-30 years old
- Customer group B (CGB): Couple living together without kids and are between 18-30 years old
- Customer group C (CGC): Couple living together with kids and are between 20-60 years old
- Customer group D (CGD): Couple living without kids and are between 30-60 years old
- Customer group E (CGE): Couple living without kids and are more than 60 years old
- Customer group F (CGE): A person living alone and is more than 30 years old

The answers from the customer groups is presented in table 27. All interviews except for the interview with CGC were performed in Swedish and translated into English, the CGC interview were conducted in English. The four mock-ups showed during the interviews can be found in **Appendix B**.

Table 27 - Customer group interview result

Have you thought about loading capabilities for a seating furniture?	CGA: *"Yes, regarding a chair or an armchair but never regarding a sofa"* CGB: Not for new furniture but we might have thought of it during a purchase of used furniture. *"We assume the furniture will last a long time if it looks robust"* CGC: *"It is supposed to handle most things and that's why we haven't thought of it"*, regarding a sofa or an armchair. CGD: *"No, it is not information we think about when purchasing a seating furniture"*. They assume the furniture will endure if it looks big and stable. Material information and warranty is considered more important. CGE: In the way that we have not chosen the furniture which looks weak and chosen furniture with more robust looks. But not as a number or other specific information. The requirements for a sofa are tougher compared to an armchair whether how long it should be able to survive. CGF: *"No I have never thought of it and I never received that question when I worked as a furniture salesman either"*.
How would you feel if information about loading capabilities for a seating furniture were present or not?	CGA: Would not care if a sofa lacked the information. *"sofas should be able to handle more people than seats"*. It would be good to have regarding a chair and an armchair, they are made for one person and one wants to know if they could handle one's weight. CGB: Would not care since this is not thought about. It is a warning sign if the furniture looks unstable. CGC: It would be good to have. *"Comparison is the key"*. Would not want to purchase a furniture from a company that does not have this information if others have it. But if none offers it, it wouldn't matter if it were missing. CGD: Suppose it would be good but would not care about it as long as the furniture looks stabile. CGE: One would not care since she does not have any interest in such information. The other one would find it interesting but would want to talk to personnel to discuss it further. But they would not care it if it weren't there.

	CGF: *"I would not think anything about it, as I said, I have never thought of it"*.
What kind of value would information about loading capabilities give you?	CGA: A feeling of comfort to know if the furniture would break during use or not. Along with a feeling of quality, the higher the load capability the better quality. CGB: "*might provide an indication of how good the quality is*". But information provided on only one furniture would not be valuable. A clear definition of it would be necessary. CGC: Gives a comfort feeling and it would act as an aid to make a suitable purchase for the needs at hand. CGD: A number would not tell them anything, they would rather prefer to know how many persons who can sit in a furniture. CGE: To be able to compare furniture and kind of a comfort factor. It could be a way to ensure oneself that the "best" furniture was chosen. They would lose trust in the information if a furniture with a fragile look had the same level as another one which looks robust. CGF: Did not think it would give any personal value. During his time as a furniture salesperson, he often received questions regarding the material in the furniture and believes that that kind of information would be more valuable to customers.
What do you think about the following information about loading capabilities? The different mock ups were showed during this question.	CGA: Critical towards the information and stability, mostly based upon the looks of the furniture but also the material. The text describing what kind of tests it had passed gave a feeling of comfort and they would only want information regarding the product of interest. CGB: "*110 kg is just a number that does not tell me anything, I got no reference to it*". Without description of loading capability, guesses it will handle 110 kg. With description, gained a better impression but would like a simple text with a clear description of specific loads in the tests. The image of the retailer/manufacturer plays a part in how believable the information is. CGC: Does not question the information but becomes more certain about it when an explanation to the tests are showed. Would not miss it if it weren't present. CGD: The level of loading capability was questioned if the armchair looked weak and/or unstable in the eyes of the interviewees. They felt more comforted with a description of conducted tests but were still skeptical towards a furniture which looked weak and/or unstable. CGE: Critical towards the information based on the looks, the materials in the furniture and previous experience. Before the explanation of the conducted tests, the information was just another word without real meaning. *"we would like to talk to personnel about it, no matter what kind of information that was presented"*. The information needs to be simple to understand. CGF: Critical towards the information without any explanation and depending on the looks of the furniture. *"It does not state how it has been tested and how can you then trust the information?"*. The information became trustworthy with an explanation. If this information is available for one seating furniture should it be available for all seating furniture.
How do you use an armchair?	CGA: Sitting down with medium speed, would use one to stand in depending on the design of it.

	CGB: For sitting and reading in. *"It does not look as robust as the sofa and that why I do not throw myself in it"*. One does not throw oneself on it if it is low, because the force would be to great and perhaps wreak the furniture. CGC: All kinds of ways, e.g. kids jumping and climbing, sitting down hard and standing in the armchair. All ways expect for sitting more people than seats in it. CGD: Sitting in, perhaps sleeping in and always sitting down gently in it. CGE: Sitting or sleeping in it, the armrests are very important during ingress and exit. *"you are not supposed to throw oneself or fall into the armchair, but it has happened when one were exhausted"*. CGF: Never had an armchair but reckons it would be the same usage as for a sofa.
How do you use a sofa?	CGA: Two scenarios, one: laying down quite fast and forcefully but not freefalling, sitting down medium fast and sometimes standing in the middle of a seat or on the backrest. Two, preparty and people sit down fast, not uncommon that more people than seats sits in the sofa. CGB: Sitting and sleeping in it, sometimes sitting or falling in it quite fast. Would sit on the armrest if there were any and, on the backrest, if it was not placed against a wall. A sofa should handle more people sitting in it than seats and children jumping in it since it does happen, maybe not often though. CGC: All kinds of ways, e.g. kids jumping and climbing, sitting down hard and standing. All ways expect for sitting more people than seats in it. But, *"a sofa should be able to handle at least twice the amount of people compared to seats"*. CGD: Sitting in, perhaps sleeping in and always sitting down gentle in it. They do not sit on the armrest, *"you would only destroy the sofa"*. When the two kids lived at home, the kids jumped in it, climbed on it and through themselves at it at high speed. CGE: Sitting and laying down in it. Most often, ingress is done slowly. But, if they have pain in their hips, it happens that they sit down forcefully. You should be able to sit on the armrests. And to sit more people than seats in a sofa but they would not do that because it would be tight. You should be able to throw oneself into a sofa. CGF: Sitting and laying down quite calmly, have sat on the armrests but do not think that sitting on the armrests is any good for the sofa.

4.4.2 Interviews with company F, organizations of interest and customers at furniture stores

The findings from the rest of the interviews are presented in this section. The findings are grouped together based on the areas of the information, these categories are marked with bold headlines. The interviews with the information owner, the operator at Customer Service Center the internal test laboratory, the returns analysist, the internal requirement developer, one of the standardization organizations, personnel from furniture stores, the majority of the customers at the furniture stores and the assistive product company were conducted in Swedish and then translated into English. The rest of the interviews were conducted in English.

Previous relations with loading capabilities of furniture

In general, the customers had not thought about an armchair's or a sofa's loading capabilities before, one customer stated, "you assume that the furniture will manage" and another said, " you think that the armchairs are able to carry heavy things". One customer stated that one has an image of the quality of the product based on the brand.

- Customers at a furniture store

A couple of customers had asked the personnel about sofa's or armchair's loading capabilities and the questions were mainly concerning armchairs. It was not stated that sofas never generated this kind of questions, but no one mentioned it specifically. One armchair was mentioned by two of the three stores to generate this type of question. Personnel from one store mentioned that this armchair looks weak for their most common customers. Another armchair which has the same design as the other armchair, but in a smaller size, were mentioned to generate questions from customers about its loading capabilities by one store.

The department with office furniture at one store said that customer questions regarding loading capabilities were quite common. Noteworthy is that information about loading capabilities of work chairs were present on the displayed products in the store.

- Personnel from furniture stores

Customer questions about sofas' and armchairs' loading capabilities are not common. The customers are asking preemptively about loading capabilities.

- Operator at a customer service center at company F

It is hard to store all questions regarding loading capability which are received from customers today. The information needs to be entered manually and the way of entering data is not the best and takes a lot of time. Due to this lack of statistic are most conclusions of customer questions regarding loading capabilities based on an overall feeling.

- Information owner at company F

Value of furniture's loading capability information and communication

A certain interest was shown towards information about loading capabilities for sofas or armchairs. One customer brought forward that the information could be important when a lot of friends or family comes over and sits in the sofa. Another customer thought that people are getting bigger and therefore, such information could be important. It was also brought forward that it would be good knowledge to base an evaluation if the furniture has good quality or not. Several customers brought forward that if this kind of information is communicated to customers, then the information needs to be simple and easy to interpret.

- Customers at a furniture store

The reason customers are asking for the information seems to be because they want to know if they could use the armchair without breaking it. Furthermore, customers asked about the durability of the cushions in a sofa or an arm chair.

- Personnel from furniture stores

Customers asking about furniture loading capabilities becomes satisfied with the information that the furniture are tested towards their areas of usage and relevant international safety standards.

- Operator at a customer service center at company F

Customer questions regarding loading capabilities can be divided into two categories, those who want to know if the products can be used in a public environment and those who wants to know if the furniture can handle their weight. Customer questions overall is about what kind of quality the products have, and a slight skepticism might be present towards the products based on the brand. A lot of customer questions to the customer center in Sweden origin from customer who have visited the website.

Most of the questions could be answered by looking at the website. Several questions are so called "follow up" questions regarding technical information. The customer wants to know what this information actually means and wants a deeper explanation to understand. A lot of these questions could be answered by searching the web, however, customers seems to prefer to contact the company and ask instead. Customers often ask questions that they think they need to know about. However, when another kind of information which are considered more relevant or valuable according to the operators are presented, the becomes customers satisfied. When customers have asked about maximum loads, e.g. regarding an armchair, information about how they are tested have been presented and they have felt comforted by this information. Even though they might not necessarily understand the tests at hand.

- Information owner at Company F

Factors affecting the decision process of choosing loading capability levels

The products' different loading capability levels are set based on the specific area of use and the measurements of the products. A previous test organization within the field previously provided recommendations of different loading capability levels of the products. Organizations which purchases these kinds of products have embraced these recommendations. The recommended levels are presented in **Appendix D.** The chosen levels of loading capabilities for the company's products are evaluated on an ongoing basis.

- Company developing assistive products

It is recognized that people are getting bigger and this can be seen in table 28 where the body weight used as a basis for loads in ANSI/BIFMA X5.1 is shown. The members of BIFMA have made observation that products complying to other kinds of international standards often fail in the United States.

Table 28 - User weight used in BIFMA X5.1

	95th percentile male
BIFMA X5.1 2017 (NHANES 2007-2010 data)	124,7 kg
BIFMA X5.1 2011	114,8 kg
BIFMA X5.1 2002	102,1 kg

EN standards usually adapts products for the 5th to the 95th percentile of the population in Europe. However, EN 1022:2005 applies a user weight up to 110 kg and this weight is believed to be higher than the 95th percentile body weight in Europe. The choice of the 95th percentile is most likely due to old habits. EN standards bases their work on the information and data which the different participants bring

forward. Furthermore, using the xth percentile male instead of the average x^{th} percentile when developing performance tests could result in tougher tests due to the height of the male.

The choices of loads and test methods in EN standards are not always logical and there are a lot of politics involved in the standardization work. Choices of loads and test methods in EN standards have also been made from a practical viewpoint regarding test procedure. Today, "active loads" are not applied to all of the seats in a multiple seating furniture because there is a concern to make the tests too complicated in EN standards. It was brought forward that there is no way to validate the testing methods in EN standards today. Both ANSI/BIFMA and EN standards regarding furniture safety and strength have the aim to be revised after about five years.

<div align="center">- Standardization organizations</div>

The problem is to determine what is good enough, one could go for making the best furniture, but it would be too expensive. There is not much to base loading capabilities on except tests.

<div align="center">- Internal requirement developer company F</div>

It was brought forward that you cannot guarantee a specific user weight for a sofa or an armchair due to the large variation of usage. If a specific user weight is claimed in the loading capability information, one would be forced to state what you can and cannot do with the armchair or sofa. More "correct" usage should be encouraged rather than focusing on allowed usage. But the problem is to determine what "correct" use is. The main focus of the product should be customer satisfaction. Additionally, in some occasions could cleaning agents affect material's structural integrity, such as plastic, negatively.

<div align="center">- Test laboratory at company F</div>

One cannot develop a max load methodology due to the great variation in usage.

<div align="center">- External test laboratory</div>

Performance testing

The showering chairs are tested according to the current hygiene standard SS-ISO 17966:2016. SS-ISO 17966:2016 is used to verify the chosen maximum user weight level. Risk analyses are also performed continuously to evaluate if other tests than those in SS-ISO 17966:2016 are necessary to develop. If a failure occurs in service, it is analyzed, and tests are performed to represent the failure.

<div align="center">- Company developing assistive products</div>

Currently, there are lot of discussion about how to test products which have a target group of people weighing more than 110 kg, up to 150 or 180 kg. This because the belief of many parties is that these people sit differently and apply loads in a different way. Furthermore, a person who is 165 cm tall and weighs 120 kg sits in another way compared to a well-trained person who weighs 120 and is 190 cm tall. EN 12520:2016 only contains what is called "minimum safety requirements", therefore, properties which are not connected to safety are not considered. However, EN 1728:2012 aims to take all product properties, no matter what level of performance, into account. EN 1728:2012 is supposed to take into account "normal use" and "foreseeable misuse".

It was recommended to perform a risk analysis of the potential use of the furniture and develop tests based on such an analysis, the aim should be to be satisfied with the product. Previous personal experience of one of the interviewees regarding developing furniture tests stated that reclaims and past failures acted as a base to develop tests to develop better products. Experience is often the base for development. Failure of the front-rail in a sofa was acknowledged as a common problem. According to

previous personal experience of one of the interviewees, about 8 of 10 cases of failure of the front-rail in a sofa were due the use of wood with twigs in the front-rail.

- Standardization organizations

The tests performed today could be good, however, it could be that standards and tests do not cover the whole user picture. Tests have been added due to customer usage of the furniture, but this is not applicable for all kind of use. There are suspicions that users have jumped on the sofas and to be able to handle this kind of use would all rails be needed to be over dimensioned. Current reported product failures, during 2017 for four armchair and sofa families, can be connected to loads, but it is a long stretch and is rather connected to other problems, such as process control. Front-rail made of wood failures occurs, but this is rather connected to the use of wood with twigs and therefore the choice of material.

Another identified problem is cushions becoming compressed in service, but this is also connected to other reasons. Furthermore, sofas with defects are often a couple of years old. However, it is a challenge to follow up products for a long period of time because the identification number of a product change after a certain time when the product is no longer available on the market. The old identification number is changed into one specific number for all kinds of products which are no longer available the market.

- Returns analyst at company F

Tests and requirements are based upon standards and experience, such as reclaims and internal tests. A big reason for using standards is that it is a more trustworthy way of showing government bodies that you make a safe product compared to internal tests. This to be allowed to enter different markets around the globe. However, different standards around the globe have different tests and requirements and some of the tests or requirement are not considered relevant or too tough. When you develop own tests and requirements you need to consider that third-party test organizations need to have the right equipment and knowledge to be able to perform the tests as well. To categorize what kind of product that you are working with and which kind of tests and requirements are appropriate is a problem today. Combination furniture is an example of products which are causing this kind of problem. Risk analyses are used to assess the usage of the product but there is still issues with determining the probability of a certain use and what common sense regarding usage of the product actually is.

- Internal requirement developer at company F

A large part of the tests done internally are safety tests. This kind of test allows major deflections of the front-rail for example as long as the furniture does not break down. No requirements or measurement of aspects which does not affect the safety of use occurs in such tests. But these tests do not provide the complete picture of the performance. Furthermore, quality tests which takes deflections and such into account are also performed at the laboratory along with tests which are aimed to represent customer usage in service. There exist three levels of test severity, domestic, office and public, where domestic is the least severe and public the toughest.

Different cultures may have different ways of using the furniture and other behaviors which may affect the performance of the furniture over time. The dynamic drop test found in EN 12520:2016 does almost never result in any reaction in the furniture. The answer to solving new kinds of reclaim or failures in service are not always in the standards, one must get creative to create tests to cover the failure modes. Occasionally, when some failures have been tried to be reproduced have neither test found in standards or destructive tests managed to destroy the furniture at hand.

The 57 kg test bag in BIFMA X5.1 does not result in particularly many damages. Most often is only one specimen tested at the laboratory, a prototype or a finished product. This however only gives you a glimpse of the reality and it could be that the next four specimens fail the same tests. The suppliers on the other hand perform tests once or twice a year for products in production. Tests takes time to perform, to perform all tests in EN 12520:2016 requires about two weeks of testing. Some tests such as a stability test found in EN 1022:2005 can be performed in 30 minutes. Stability test is a great test to start with since the results affects the design of the furniture greatly. The stability test is one of few tests where feedback other than pass or fail is gained, in this case when the furniture overturned. The safety factor of actual failure compared to what is stated in standards needs to be considered.

The problems today are that some furniture are too big to be tested without modifying the test set up and to determine which kind of tests to apply to what kind of furniture. Combination furniture is an example of furniture which are difficult to choose which tests to apply. Some standards state that the tests should be performed to the largest possible extent, therefore, some tests might be excluded if one can argue for the specific case. Furthermore, there exists a problem to apply the loads of a test depending on the design of the furniture.

The standard committee cannot change the requirements or tests any way they want to. To raise the requirements drastically would result in noncompliance with a lot of current products worldwide. If complex and expensive test machines would be needed could this result in that smaller test facilities would not be able to afford the change. The machines today are adapted towards to loads found in EN and BIFMA standards which limits the abilities to increase the loads.

- Test laboratory at company F

The tests in EN 12520:2016 are believed to represent the usage of a seating furniture in service a good way. The static test on the seat pad using the seat loading pad which represent a human bottom is used to represent two persons sitting down and one standing on the furniture. If the smaller loading pad had been used, there would be no difference regarding the loads the structure would be exposed to. However, the cushion and cover material might be affected differently with the smaller loading pad.

Fatigue is important in performance testing, but static and dynamic tests are needed as well. This since different materials are affected differently. Timber, for example, is not affected by fatigue but the joints are. While material such plastic and metal are affected by fatigue, they tend to bend. The cyclic stepping load method seems more appropriate for academic purposes. Furthermore, it would be difficult to decide regarding a pass or fail judgement with this method.

It is a challenge to decide how furniture should be tested for heavier users. It seems that heavier sit down differently, there are indications that they sit down slower than users of lesser weight, and they apply their load differently on the seating furniture. However, we do not have much experience with testing furniture for heavier users and more research is needed. There exists great uncertainty of how the dynamic impacts are affected by soft tissue. This area needs further research and the knowledge could benefit the testing of furniture.

The effect the height of both the seating furniture and the height of the user might have an impact on drop tests but it is still unknown. The seat impactor used in EN 12520:2016 is a subject of discussion as of now, whether there is a better way of representing a human body falling down on the seat. A problem with the seat impactor is that the springs are not always activated during a drop test. An idea would be to use a dummy, but this would be too expensive plus other equipment would be needed to be acquired order move the body. The worst thing to do would be to use a bag full of sand. Since a bag of sand does

not come close of giving a truthful image of the human body. It is also important to understand that people do not fall down on stiff furniture, since there exists some common sense in people.

One way to provide more information from a performance test would be to measure the deflection. This should be done with several measurement areas and an uncertainty analysis would be necessary to conduct to evaluate what the deflection actually tells you. Measuring deflection of upholstery is more or less impossible while stiff material does not have this problem.

<div align="center">- External test laboratory</div>

Communication of loading capabilities

Since the products are prescribed by a profession, the set user weight limits are strict and products with a higher user weight limit should be used if necessary. If the product is approved for a maximum user weight X kg according to SS-ISO 17966-2016 is this weight communicated as the maximum user weight to customers. Instructions of how to use and not to use the products are communicated to customers and the approved usage are of importance to the set loading capability levels for each product.

<div align="center">- Company developing assistive products</div>

It is recommended for furniture manufactures to communicate adherence to a standard rather than a specific weight. This because it makes no sense that a person who weighs one kg more or similar than the specified weight limit of the furniture to not be able to use the furniture. The issue of communicating load capabilities is a big question to a lot of people.

<div align="center">- Standardization organizations</div>

There might be a need to clarify the information about products if they can handle the use of playing children. To share information is a big problem right now, information about loading capabilities is not centralized and is spread out in several places and different information is sometimes communicated on different places. Communication about what standards the seating products comply with are questioned due to their regional relevance.

<div align="center">- Information owner at company F</div>

5. Analysis and discussion

This chapter will analyze and discuss the empirical findings and compare the findings to relevant literature. This chapter is grouped based on the three research questions.

5.1 Customer value

Based on the interviews, observations and questionnaires, it seems that information about loading capabilities of sofas and armchairs can be of different valuable or no value to customers. Which Woodruff (1997) highlights. Why this information can be of different or no value to customers, is discussed in the following section.

5.1.1 Comfort of safety

Based on the interviews with company F's employees and with the personnel from the furniture stores, it can be confirmed that customers request information loading capabilities of sofas and armchairs. However, this does not seem to be a common request from customers. When the information is requested, the primary reason seems to be because customers want to know if the sofa or armchair can handle their weight and usage without breaking down. Based on this, it seems that customers believe information about these two furniture's loading capabilities provides a comfort of safety regarding the usage and therefore, the information is considered valuable to customers. It was also highlighted, during the customer groups interviews, that information about loading capabilities could provide a comfort of safety. However, only one customer highlighted this. But, based on the interviews with company F's employees and with the personnel from the furniture stores, it seems that there are several customers who sees the information as a comfort of safety.

The results from the complete and reduced questionnaires seems to also indicate that customer might believe the information could provide a comfort of safety. According to the result, customers would mostly prefer information about loading capabilities whenever "the sofa/armchair looks weak/fragile". This seems to show that a design of a sofa and an armchair can be deceiving to customers, which make them question if the sofa or the armchair can handle their weight and usage. However, it is important to understand that not all designs of armchairs and sofas make customers question whether the products are strong and durable or not. According to the customer groups interviews, it seems that a design of a seating furniture can also make customers take for granted that the sofa or armchair is robust and has a long product life. Several customers during the interviews mention that if a seating furniture looks robust and stable, it is assumed that the furniture will last a long time. Perhaps this indicate that a comfort of safety is solely needed to be created whenever a design is illustrating the sofa or armchairs as "weak/fragile"?

Another reason customers would want to be provided with a comfort a safety might be related to how customers use their sofas and armchairs. According to the result of the questionnaires and observations, there is a large variation of how customers use their armchairs and sofas. It seems that customers, among other things, sit on the armrests, backrest, lay down on the furniture, and sit more than one person per seat. However, the variation in usage also seems to differ depending on whether the seating furniture is a sofa or an armchair. According to the empirical findings, customers tend to more often sit on armrests and sit more than one person per sat if the seating furniture is sofa, compared to if it were an armchair. This seems to indicate that customer might tend to believe that sofas are more robust than armchairs. When customers intend to use their armchairs and sofas for more than sitting, it could be possible that they are searching for a comfort of safety which indicates that the furniture can handle their intended

usage. Customer might therefore search for a comfort of safety, such as information loading capabilities, but since it seems that customers have a perception that sofas are more robust than armchairs, a comfort of safety might be more valuable to customers regarding armchairs.

5.1.2 Product comparison

One of the customer groups stated during the interview, that they had not thought of loading capabilities of seating furniture specifically but when they choose furniture they chose the most robust looking piece. Another interviewee put forward that comparison is the key within a purchase. The questionnaires reveal that the ability to compare is the most favored use of information of armchair's and sofa's loading capabilities. All this highlights that information of an armchair's or a sofa's loading capabilities seems to provide a mean of comparing sofas and armchairs which seems to be of value to customers. Furthermore, a comparison in the aspect of a furniture's strength and durability is present today during a purchase of furniture to some extent based on the empirical findings. The question however is how this comparison is performed or will be carried out. Comparison is strongly highlighted by Hamilton and Karmarkar (2017) who brings forward four different ways of comparing products, which they believe are present at the same time within a customer. These four ways are:

- The ideal point
- The market comparison
- Image
- Local comparison.

The ideal point

The ideal point comparison presented by Hamilton and Karmarkar (2017) is most likely not a great part within the comparison of loading capability information between sofas or armchairs among customers. Several factors contribute to this conclusion, an example is that there has been a small number of customer requests regarding this information. Another factor is that the overall assessment of the researchers is that people in general have not specifically been interacting with loading capability information of armchairs and sofas, but rather dealt with it indirectly or not at all.

One factor which could strengthen the ideal point comparison use is that those who have had experience with furniture breaking down could have created an internal picture of the perfect furniture which could handle the specific use of the customer. However, according to the questionnaires, it seems that many customers are currently lacking experiences of when a furniture has broken down during usage. Based on the empirical findings, most customers have not sought information about loading capabilities due to previous failures which indicates that they have not created an image of the perfect armchair or sofa. Furthermore, the overall knowledge level among customers seems quite low regarding loading capability information of armchairs and sofas.

Market comparison

Market comparison is another way of comparing, according to Hamilton and Karmarkar (2017). The market comparison is more likely to be a greater part of a customer's way of using the information for comparison, compared to an ideal point. Since it does not require the customer to have the same extensive knowledge of the subject. Using information of seating furniture's loading capability to compare furniture's quality was highlighted in the customer groups interviews. One interviewee, for example, stated that loading capability information would be a way of choosing the "best" furniture and this way of comparing is very similar to the market comparison. While another customer group mentioned that the information "might provide an indication of how good the quality is", and finally

another customer group stated that the higher the level of load capability a seating furniture had the better would be quality be. Based on these interviews, it seems that customers would use information about furniture loading capabilities as a quality indicator of a furniture. This might aid customers with performing a market comparison and help to them to choose the "best" furniture.

An issue with using information about loading capabilities to compare different sofas and armchairs on the market, is that the number companies who provides this information is limited. Furthermore, the number of products who have this information is even more limited and this is according to the simplified competitor benchmarking. This limits the value which loading capability information would bring in terms of a market comparison to customers. In the empirical findings it was also put forward that price, design and comfort could act as other means of comparison. It can therefore be argued that loading capability information could act as the decisive factor of a purchase when customer considers the other means of comparison to be ineffective. On the other hand, the information could also be considered to overcomplicate the buying process for a customer, when being an additional factor for the customer to consider when several other factors already are present in the purchase process.

The image

As mentioned above, there are product attributes which can act as means of comparison, and one additional factor could be the brand of the product. Based on the empirical findings, a product's brand can affect image the customers hold regarding the quality of the product. Bergman and Klefsjö (2010) brings forward that quality is an overall feeling of the product based on all characteristics. If the brand affects the assessment of the overall quality could one argue that it also affects the assessment of the loading capabilities of an armchair or a sofa. During the customer groups interviews, when presenting the mock ups, the trustworthiness of the loading capability information was questioned. This was mostly depending on the material and the design of the armchair. When an armchair with a "weak looking design" had the same level of loading capability as a "strong and stable looking" armchair was the information considered less trustworthy by some of the customer groups. The brand image could affect this feeling, if the brand is strong and connected with great quality might the fragile look of a seating furniture be considered less important and might facilitate purchase compared to a brand associated with bad quality. The effect of the brand during a choice of products is also brought forward by Löwenheim (2017) and strengthens the brand comparison.

Local comparison

The local comparison brought forward by Hamilton and Karmarkar (2017) would put focus on the competing products from the same company. This would act as a mean for the customer to distinguish different products at a retailer and would require loading capability information to be present on more than one product. Applying this line of thinking to different products from the same company could those products without this information be ruled out directly from the customers' buying process or creating a discontent towards the company. The discontent could be created when armchairs or sofas are assessed by a customer and only a selected number of sofas or armchairs are provided with the information. Leaving the customer to wonder if only some of the products have been evaluated based on loading capabilities and question why all products have not been evaluated towards this. This could raise the question of safety of use or just the strength and durability of the products without the information. Such discontent could affect the overall quality image on the products offered by the company.

In the end, it seems that information about loading capabilities can act a mean of comparing different armchairs and sofas, and possibly their quality. Which is why customer seem to consider information about loading capabilities to be valuable as a mean to compare.

5.1.3 No value, negative value and changing values

No value

It has been brought forward that the information about furniture loading capabilities can create value to customers. However, it is worth mentioning that based on the customer groups interviews and on the questionnaires, it seems that information about loading capabilities can also be of no value to customers. Woodruff (1997) brings forward that what value is considered to be differs among customers, which is why it was of no surprise that some customers believed information about armchairs' and sofas' loading capabilities can be of no value to them. A reason some customers did not value information about loading capabilities could be that they had never thought about the subject before. According to the result of the questionnaires, most of the respondents have never thought about loading capabilities of sofas and armchairs before. It was also highlighted during the customer groups interviews that customers had never thought about loading capabilities before.

Another reason to why customer might not find information about loading capabilities to be of value can be related to the theoretical framework. As mentioned by Woodruff (1996), experiences with a product guide the customers to understand how well or poorly a product has performed, which further lead to customers acknowledge what is value to them. Based on this, it might be possible that customers who do not find information about loading capabilities to be valuable is because they have never had an experience when this information could have been useful. For example, it could be possible that these customers have never had an experience of a sofa or an armchair breaking down during usage.

Furthermore, it could also be possible that some customers have never considered information loading capabilities as a mean of comparison. These customers might prefer other product attributes to make a product comparison or determine the quality of the furniture. The armchair's or sofa's material and warranty was highlighted in the customer groups interviews as an important factor upon both purchase decisions and evaluations of the strength and durability of the products at hand. As mentioned by Hamiliton and Karmarkar (2017), customers seem to use several quantitative attributes such as price or horsepower to make product comparison. Based on this, perhaps customers believe there are other product attributes to use rather than loading capabilities to determine the quality of a seating furniture? Such as material or warranty which were highlighted in the interviews.

Negative value

Based on the questionnaires, it is difficult to understand why customers never had thought about furniture loading capabilities before and if these customers consider information about loading capabilities to be of no value to them. During the customer groups interviews, it was also revealed that customers had also never thought about loading capabilities before but a reason to this might have been found in the interview data. It seems that some customers assume that an armchair or a sofa can handle any usage if it looks stabile and robust, and therefore no further information about the furniture's loading capability is needed or of value. However, in the interviews when presenting the mock ups, were loading capability information questioned when one weak looking and one robust looking armchair had the same loading capabilities. This indicates that such information could be criticized by customers and could cause a negative value instead, due to e.g. the lack of trustworthiness.

There are several ways to test the strength and durability performance of a furniture. If different companies provide similar type of information but uses different levels of extensiveness of the testing might a customer be miss lead regarding loading capabilities. Due to probable low level of knowledge in this area, a comparison might not result in true value to the customers. But the customers would not know this before experiencing the result of the choice. This could result, as mentioned by Alänge (1994), in a negative reaction for the customer if the information and the comparison does not live up to the expectations of the customer. In other words, it seems that misleading information can cause customers to gain negative value regarding products or services. The statements by the interviewees that robust looking furniture and especially sofas are also of interest here. Because of information about loading capability would bring forward that certain usage that a customer has performed before are not covered by a sofa's loading capabilities or tested in the performance tests could this create negative value.

Changing values

Even though information about loading capabilities can be of no value to some customers, it seems that customers overall take an interest regarding the information. Based on the interviews, solely by asking customers about loading capabilities they seem to develop an interest of the subject, even though some customers have never thought about it before. This interest might lead to those customers valuing information about loading capabilities in the future. However, it is difficult to assure this when some customers have never thought about how this information can be of value since they have not yet had an experience when this information could have been of value.

Woodruff (1997) highlights that customer values and expectations change over time. Based on the empirical findings, different customers stated to value loading capability information to different extent. This can be related to a Kano perspective which was mentioned in Bergman & Klefsjö (2010) and in Emery (2006). The value of loading capability information could be considered attractive to a customer who have had experience of armchair or sofa failure. Those who usually interacts with such information could consider it to be an expected feature or even a basic feature. Based on the empirical findings, the value of the information could be considered both attractive and expected or even reverse if negative value is created. However, as mentioned before, the opinion of the values changes and using the Kano perspective would the value of loading capability information have less power to create customer satisfaction and could be taken for granted in the future. The level of importance of the values is unclear but looking at the questionnaire did the importance of the information end up in the medium or medium-high category according to the RII values in **Appendix C**. With the Kano perspective of time in mind, the level of importance is bound to change with time and depending on how the situation develops could it both gain importance and value but also lose those.

Additional analysis and discussion

As mentioned before by Woodruff (1997), value to is not known by the customer until he or she have had an experience with a product. As shown in section 4.2.1, the majority of the respondents of the questionnaires had never sought information about a furniture's loading capabilities. This complicates the assessment of the value the information would create and brings forward the question of how accurate the results are regarding why and if customers believe the information is of value. But about half of the respondents had thought about it, some had sought it and the interviews highlights that similar evaluations within the subject have been made. Furthermore, when the results regarding the importance of the information are divided into the groups of those who have thought about, never thought about, sought and never sought this information, see Appendix C, are the differences quite small. This speaks in favor of trusting the empirical findings.

5.2 Factors to be aware of in the decision making of choosing loading capabilities for armchairs and sofas

Hazelrigg (1998) and Rietzschel et al. (2010) highlights the difficulty of making a good decision and Rietzschel et al. (2010) brings forward that specific decision criteria were found to be most useful in enhancing the decision making. Within the area of loading capability of armchairs and sofas, a lot of things are still unclear or uncertain and too specific decision criteria might cause more harm than benefits. Kaplan and Mikes (2012) puts forward a caution of being too confident both regarding how well one actually can predict future events and how much one can affect them. Because of this will important factors be presented in this section rather than specific criteria to follow. This chapter is divided into five section, *Value and aim*, *Uncertainty of verification*, *Variation of users, Usage to take into account* and *Limitations of performance testing*.

5.2.1 Customer value and aim

As mentioned in the previous chapter, customers can value information about loading capabilities since it can provide a comfort of safety and act as a mean to compare quality of different sofas or armchairs. These reasons why customers value the information should be taken into consideration when choosing loading capabilities for sofas and armchairs, this to choose loading capabilities which create value to customers. To choose a loading capability which provides a comfort of safety to customers one could for example, early in the design process, ensure that the sofas or armchairs have been designed as strong and durable. To choose a loading capability which can act as a mean to compare, one should focus on choosing different levels of loading capabilities on sofas and armchairs. One could have different levels of testing sofas' and armchairs' durability and strength. For example, Eckelman (2003) mentioned five categories which can assist the design process with choosing upper and lower levels of strength and durability for furniture. These categories were:

1. Light duty household
2. Medium duty household
3. Heavy duty household or light duty institutional
4. Medium duty institutional
5. Heavy duty institutional

Perhaps developing different levels of testing sofas' and armchairs' durability and strength, and categorize the levels as light, medium and heavy household, could be a way of choosing different loading capabilities for the furniture? However, if this would be taken into consideration, it could be important that early in the design process understand what kind of usage the armchair and sofa can be exposed to. This to distinguish what levels of testing are accurate for the different armchairs or sofas to choose different levels of loading capabilities on the product.

Regarding focus, Woodruff (1996) mentioned, which was "of all the things customer value, what should we focus on?". With this statement, it seems that it is important to always focus on fulfilling customer values, but it is necessary to understand not all values can be fulfilled. If this is the case, an organization should decide which customer values to focus on based on the strategy of the organization and the aim of the product. However, before deciding which customer value to focus, what was mentioned by Hazelrigg (1998) could also be of important to understand. This regarding that one should not get confused that value is related to what a person wants and not what a person expects, and that most fail to conclude appropriate measure of value and using it.

5.2.2 Uncertainty of verifying loading capabilities

The most important factor to consider, when choosing loading capabilities of sofas and armchairs, is that there no practical way of verifying that the chosen loading capability is achieved. Based on the empirical findings, the researchers can conclude that there are many various factors which affects the performance and the life time of a sofa and an armchair. To take all these factors into consideration when choosing loading capabilities could result in an almost endless set of tests to perform to verify that the chosen loading capability have been achieved. These factors will be presented and discussed in the following section.

Large variation of usage

According to the observations, interviews and questionnaires, a great factor to why loading capabilities cannot be truly verified seems to be because there is large variation in usage. The two test laboratories, which were interviewed, stated that one cannot truly verify a loading capability of a seating furniture due to this large variation in usage. However, a suggestion to gain greater knowledge about the loading capabilities of the sofas and armchairs would be to set a list of approved usage to the customers and perform tests per the list of usage. This is approach of testing is present in the industry of assistive products. However, this can create discussions of what exact the approved usage means which could be unbeneficial to the company. Furthermore, there are other factors which also affects the loading capabilities, these are discussed in the next subchapter. It is important to understand that not all possible usage can be included during testing performance of armchairs and sofas, but one should use a selection of usages. This to get as close possible regarding understand what kind of usage a sofa and an armchair can be exposed without being considered damaged.

Other factors

Based on the interviews, it seems that there many factors which affect a product life of a furniture and its loading capability. The internal test laboratory stated that they were unable to destroy a furniture according to service failures using both standard and own test, which could indicate that there are more factors than usage affecting the loading capabilities of furniture. BIFMA (2017) also mentioned several factors which can affect a product life of an office chair, which most certainty could also affect the product life and loading capabilities of sofas and armchairs. These factors are the weight of the user, care and maintenance of the product and the environment which the product is exposed during usage. Regarding care and maintenance, one example of how this can affect the product life was brought forward by company F's test laboratory, some cleaning agents can affect the materials' structural integrity negatively. The time aspect of how often the furniture is exposed to factors which can cause its product to decrease needs to be taken into consideration. For example, furniture can be exposed to cleaning agents without breaking down if it solely happens once. On the other hand, if the furniture is exposed to certain cleaning agents on a daily basis, it is a possibility that the furniture will break down due sooner than expected. To take the time aspect and all the other factors mentioned by BIMFA (2017) into consideration when choosing loading capabilities could be extremely difficult. Overall it seems that there are too many factors to consider if one decides to verify a loading capability of an armchair or a sofa and that is why loading capabilities of these products cannot be truly verified.

Difficulties with testing

Today it seems that there exists an uncertainty regarding what kind of tests should be applied on a specific furniture to test its performance, which is another great factor why not loading capabilities of sofas and armchairs cannot be truly verified. The difficulty of choosing tests were brought forward by the internal test laboratory, and this especially concerns combination furniture. The usage that different designs invites to should be considered during the choice of performance tests. For example, if an armchair has a one-and-a-half-meter high backrest would this most likely rule out the usage of sitting on the backrest in service, making, such test unnecessary to perform. However, an armchair with a low, wide and stuffed backrest could mostly likely invite to a usage of sitting and then does testing of such usage become relevant. This indicate that usage assessment needs to be done of the specific piece of furniture to decide which tests that are necessary to apply. This assessment would be extra important for combination furniture which might trigger different usage. An example of when an assessment needs to be done to decide which tests that are necessary to apply on the specific furniture is shown in the exhibit 1 below.

Exhibit 1 – Choice of performance tests

The "lifting the furniture in one end" usage in section 5.2.4 is an example of the need of different test for different furniture. To test the usage of lifting and dropping one end of a sofa does CEN (2012) provides such a test called drop test for multiple seating units. However, the test adjusts the drop height depending on the force needed to lift one end and the weight of one end of the multi seating. A discussion between the authors concluded that to lift one end of the sofa up to 20 cm off the floor would be sufficient to put a broom, vacuum cleaner handle or similar under the sofa. When the sofa is let go will the movement of the fingers not allow a free fall directly and freefall would rather happen from a lower height. 18 cm is considered a useful height and should be set as the minimum drop height of the sofa. The number of times it should be conducted could also depending on the design of the sofa, however, CEN 2016 performs their "leg forward static load test" could be considered to occur during the same situations as lifting one end and it performs this test ten times.

Due to this uncertainty regarding what kind of tests to apply, a suggestion would be to have an ongoing discussion during the development of the furniture. The discussion should be between designers and persons responsible for testing the furniture, together they should decide the intended and likely usage that the furniture should be tested for. This could be a great way to assist the test laboratory when deciding which test apply to on a furniture when it has been designed and developed as a combination of different kinds of furniture.

The interview with the test laboratory brought forward that applying loads on furniture during testing, precisely as mentioned in the standard tests, can be difficult. This issue in performance testing should therefore also be a part of the ongoing discussion between the designer and the test personnel. Designers, together with the test personnel, should decide how the loads mentioned in the test standards should be applied to test the furniture as accurate as possible according to the intended and likely usage that the furniture can be exposed to.

If one of the types of usage is intended to the main usage and the other use is intended to only be applied from time to time, it could be useful to review the chosen tests of the furniture. Perhaps mostly regarding the type of test (static, dynamic or cyclic) and the number of cycles in the test. But if this approach is chosen, this information also needs to reach the customer to avoid miss understandings which could cause dissatisfaction.

Problems with a specific user weight limit

Furthermore, there is a problem with using a specific user weight limit in loading capabilities. For example, according to one of the interviewees, a person weighing up to 140 kg could use a furniture compliant with CEN (2016) from time to time. On the other hand, if the usage is supposed to be on a regular basis for a long period of time, a person weighing around 110 kg is recommended. This is aspect is also highlighted by BIFMA (2017, 2016a), that a furniture could be safely and comfortably used by a person which weighs more than person which the tests are based upon, it is the product life time which are mainly affected. Making it important to also consider that a loading capability "limit" does not strictly limit a safe usage depending on the user weight. However, a user or several users which together weighs as much or less could still cause a furniture compliant to a standard regarding furniture's strength, durability and safety to fail depending on the usage.

5.2.3 Variation of users

To be able to make a decision regarding choosing a certain level or levels of loading capabilities it is necessary to take the distribution of user weights and user weight trends into account along with other anthropological information. This is highlighted by Eckelman (2003) and it is a quite natural to agree with since the users could be considered the main cause of the loads the sofas and armchairs experience in service. To use the distribution of user weights rather than mean values is recommended by Savage (2002) to avoid making bad decisions due to not taking the variation into account.

Distribution of user weight

A quite large spread of size of the body weight across different countries does most likely exist. The data from the different weight data sets are not representative for any region but one could argue that it provides an indication of the situation. The crude data shows that that $99,5^{th}$ percentile from the NHANES 2015-2016 sample shows a weight of 152,3 kg while the CHNS 2011 sample's $99,5^{th}$ percentile shows a weight of 95 kg (NHANES, 2018; CHNS, 2018). When the 90th percentile is analyzed, the data sets provides the following values. 95 kg was found the weight for men and women together, 100 kg for the 90th percentile man and 84 kg for the 90th percentile woman in Sweden between 2010 to 2011 (SCB, 2018). The CHNS 2011 data shows a 90th percentile of 76,3 kg and the NHANES data shows a 90th percentile of 101,6 kg (CHNS, 2018; NHANES, 2018). With this data in mind, it can be argued that a large amount of people would be covered when using a weight of 110 kg as the basis for loading capabilities for sofas and armchairs. A user weight of 110 kg is used in CEN (2016) as the basis for the performance testing and BIFMA (2017)'s choice of 124,7 kg would cover an even larger part of the population.

However, based on the interviews and the data of the Swedish population's weight, there are indications that the weight and length of the xth percentile male is greater than the xth percentile of both men and women. This highlights that a choice of the xth percentile man and women might cover the xth percentile of the group of men or women.

User weight basis for loading capabilities

The question is if the 95th percentile male or average person of a region or country is a useful value or not as the basis for loading capabilities of armchairs and sofas. If one wants to export furniture is CEN (2016) more or less necessary to comply with and this puts forward a choice of a user weight basis of at least 110 kg if CEN (2016) is used. To choose 110 kg as a basis could be considered as a "good enough" loading capability limit since as of today there are not any strong connections with the assessed products of company F failures to failures connected to overload or similar causes.

The discussions of investigating loads caused by a user weighing up to 150 kg would almost cover the 99,5th percentile in the NHANES 2015-2016 sample. Discussions of investigating loads caused by a user weighing up to 180 kg could nearly cover the 99,5th American male which BIFMA (2015) brings forward that might weigh up to 181,4 kg. As brought forward by Hu et al (2016), there are about 3 million people in the US weighing more than 136 kg, which acts as a potential target group for seating furniture with the ability to carry heavier loads than 110 and 124,7kg. To choose a user weight of 150 or 180 kg as a minimum base for all armchairs and sofas is not recommended. Since it would mostly likely result in an over dimensioning of the load bearing parts in the furniture compared to the needed strength for the majority of the customers. This could lead to unnecessary high amount of material use which would be negative for the environment and most likely to the majority of the customers due to a higher price. Another important aspect is that choosing a too low level of loading capability could result in more failures which could affect the opinion of the manufacturer negatively.

Trends to take into account

Section 3.3 brought forward information that the prevalence of both overweight and obesity appears in both high and low-income countries and has increased around the globe. Furthermore, both estimates and concerns are put forward that the prevalence of both overweight and obesity will increase in the future. The 22,1 percent increase of the user weight of the ANSI/BIFMA X5.1 standard from 2002 to 2017 is another sign that people are getting heavier. However, health issues connected with obesity and overweight brought forward by Von Ruesten et al. (2011) will force people to keep track of their weight and the increase in bodyweight will much likely not go on freely because of this. Either way, the weight trend is still something that needs to be considered when choosing loading capabilities of armchairs and sofas to be able to assess the relevance of a specific loading capability level.

Especially since the interviews with one of the standard organizations and the external test laboratory put forward suspicions that people weighing more than 110 kg are sitting differently and causing different loads on the furniture. If people weighing more than 110 kg are sitting differently, it could mean that they would need different designs to sit comfortably which could affect the armchair's or sofa's ability to withstand usage. By investigating and experimenting with developing furniture able to handle users exceeding a body weight of 110 kg valuable knowledge might be gained regarding comfort and structural strength requirements and economic factors.

The most important thing to take into account is that a chosen level regarding loading capabilities needs to be revised after a certain time due to the uncertainty of the development of users. The user development could be viewed as an external risk according to Kaplan and Mikes (2012)'s reasoning. Kaplan and Mikes (2012) state that one should aim to reduce the impact of the external risks, which a revision could facilitate. To follow the furniture standards could be a way to keep up with the weight development, but there is one problem regarding CEN developed standards. They base their decision on anthropometrical data which are put forward by the participants, if none of the participants puts forward new or reliable data might the standard fall behind the true weight development. This could call for own attention from furniture manufacturers of the overweight, obesity and weight development.

5.2.4 Variation of usage

When deciding on what loading capability level or levels to choose, it is important to be aware of the different usage of the armchair or sofa in service to make a choice of which usage to cover. Since it is the usage which exerts the forces an armchair and a sofa experience in service. One also needs to test if a sofa or an armchair can handle this usage and therefore, the analysis were made with different test methods regarding strength and durability in mind.

There exists a wide range of possible usage of an armchair and a sofa according to the empirical findings and a great challenge is to choose what usage to take o into account. To be able to make such an evaluation, a risk analysis of the usage found in this research has been made, in form of a version of a Potential-FMEA (P-FMEA). A risk analysis was recommended to perform by one standard organizations and it can be found in **Appendix E**. The empirical findings and the literature study indicates that the design of a sofa or an armchair could affect the usage of it, therefore is it important to adapt future risk analyses from case to case. This risk analysis however is kept on a more general level to not limit the analysis to a specific case.

Results of the risk analysis

The risk analysis is considered to follow the usage found in CEN (2016) with some exceptions, the exceptions are presented below. The usage coverage of CEN (2016) were also highlighted in the interviews to not cover all existing usage in service. Each usage is visualized with a picture below the heading of the usage.
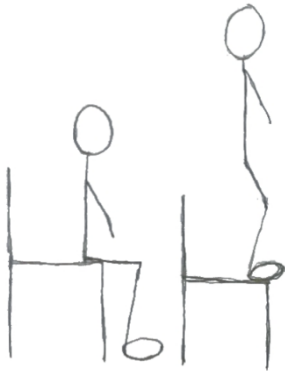
Sitting down hard on the seat

Figure 4 - Sitting down hard on the seat

Sitting down hard received the highest UPN value in the risk analysis since this usage appeared quite often in the observations and in the interviews, furthermore, it is argued to create large forces. The high level of severity of the sitting down usage is based mostly on the literature framework in which Hu et al. (2016) bring forward that a sitting down force could be as low as 38 percent of the body weight and Li et al. (2017) found that a sitting down force could reach 247 percent of the body weight. CEN (2016) tests impact but the empirical findings put forward a greater prevalence compared to CEN (2016)'s set up. The importance of the occurrence in service is important since Zang et al. (2005) and Eckelman (1988b) highlights the repeated use as a large factor in furniture failures. Making it important to be aware of according to the researchers.

Sitting down easy, sitting and standing on the front edge of the seat

Figure 5 - Sitting down easy, sitting and standing on the front edge of the seat

Sitting down easy and sitting down on the front edge were found in the observations. Standing on the front edge was not found explicitly in the empirical findings but standing on the seat was. To stand in the middle of the seat, the front edge could   be used to get up on the seat making standing on the front edge a plausible usage. Standing on the front edge were also a usage the authors themselves have performed themselves on both sofas and armchairs in different scenarios. Sitting down easy, sitting and standing on the front edge received a high UPN number partly since the loads are more likely to be more severe than sitting down or sitting in the middle of the seat on the front-rail.

Depending on the construction of the armchair or sofa could the ability to handle such usage vary and testing of such usage could be preferable. However, Eckelman (2003) states that the loads would be transferred equally between the back and the front structure during ingress or sitting in the seat. Failure of the front-rail of sofas have been encountered according to the returns analyst at company F. The front-rail failures are rather connected to twigs in the wood material according to the returns analyst and twigs were also highlight as a great cause of failure by one of the standardization interviewees. This could indicate that there are great forces affecting the front-rail more often than the back-rail since a back-rail failure have not been explicitly encountered so far. Either way, these usages are important to be aware of according to the authors of this master thesis due to the severity of forces these brings and the occurrence in service.

Standing, walking and jumping on the seat

Figure 6 - Standing, walking and jumping on the seat

Standing in the seat were found in the observations, interviews and the questionnaires. Suspicions of users jumping in sofas were brought forward by the return analyst and children standing and jumping in sofas were brought forward in the interviews and the observations. If both standing and jumping are conducted in service could one argue that walking on the seats also appears in service. Standing is supposedly covered in CEN (2016) according to the interviews but it is tested with a load applicator

shaped as a bottom. Since a pair of feet has a smaller contact area could the cover material be affected in another way than appears in the test of CEN (2016). Furthermore, walking and jumping could induce large dynamic forces which could be different compared to the dynamic forces of sitting down.

All together did the usages resulted in a relatively high UPN values and the usages are considered important to be aware of due to the presence and severity of them. If it is reasonable construct furniture which could withstand jumping, walking and climbing by a kid or several kids is a though question, but it seems to be a present usage in service. Standing is considered by the authors to rather be tested with load applicators which represent standing more accurately.

Sitting down, sitting and standing on an armrest

*Figure 7 - Sitting and standing on an armrest*

Sitting down easy and sitting on the armrest received a high UPN and is a considered an important usage to take into account due to high occurrence in the empirical findings. This usage is considered highly dependent on the design of the furniture since a low and wide armrest with padding would according to the researchers be much more inviting to sit on compared to a thin and stiff armrest. Either way, sitting down and sitting on an armrest is believed to occur on thin and stiff armrest as well, but to a relatively small extent. Standing on an armrest follows the same reasoning but the extent of this usage is believed to be much smaller compared to sitting on it.

If a single armrest would be exposed to the entire body weight or about the half of the body weight (due to standing on one feet on one armrest each) during standing is highly dependent on the furniture type according to the authors. The distance between the armrests in a sofa would probably be too great to stand on both armrests at the same time and thusly could one single armrest be forced to handle the enitre body weight compared to an armchair. Furthermore, Eckelman (2003) states that armrests of easy chairs should be designed to withstand sitting on. Sitting down hard or falling down on the armrest were also put forward in the risk analysis but the occurrence could be argued to be less than sitting down easy due to a relatively stiffer sitting area than the seat. Extra tests regarding these usages might not be valuable enough to perform due to the low occurrence.

Laying down

Figure 8 - Laying down
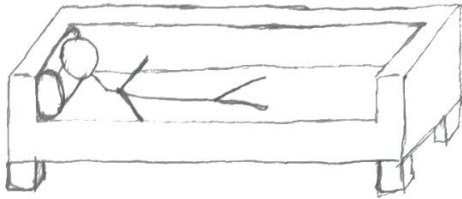
Laying down was almost on pair with sitting down, in a sofa, regarding the share of respondents from the questionnaires and it was a common usage among the customer groups as well. The intended use of a sofa could be argued to not include sleeping or laying down for a long period of time. However, as the loads most likely will be less severe compared to sitting down due to a greater contact area and is considered to not require any extra tests.

Lifting the furniture in one end

Figure 9 - Lifting the furniture in one end
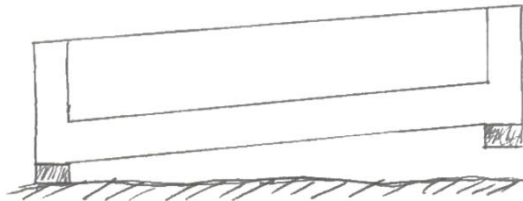
Lifting an armchair or a sofa in one end received an UPN value which makes testing of such a usage considerable. This use was not directly found in the empirical findings, but the researchers argues that this could happen during cleaning, e.g. of the room the furniture is placed in, during children's play or when an item ends up under the furniture and needs to be retrieved. When the furniture is lifted could it be dropped freely if the user does not care to set it down carefully or if the user e.g. does not have the strength left to set it down carefully. In this scenario, the legs are exposed to a dynamic impact, dynamic loads are highlighted by Eckelman (2003) to be more severe than static loads of the same magnitude and the empirical findings bring forward that those are important to take into account. Furthermore, this usage is found in CEN (2012). The probable occurrence in service along with the severity of dynamic forces makes this usage to be aware of according to the authors. However, an armchair usually covers a lot less area and could be much easier to move compared to a sofa, depending on the design. Because of this, the need for an armchair to be lifted in one end could be considered much less.

Number of users

A crucial aspect regarding variation of usage is the number of persons using a sofa or an armchair. The number of users affects the loads which are exerted on the furniture and this affects the performance test as well. The empirical findings clearly highlight the usage of more people than seats. The questionnaires brought forward that people occasionally sit more people than seat in an armchair and especially in a sofa. About one fifth of the respondents who had sought loading capability information regarding armchairs and sofas had done it because or partly because the furniture would occasionally be used by more people than seats. Furthermore, some interviewees in the customer groups put forward it was assumed or in practice that a sofa is capable of carrying more people than seats.

Seat width is brought up by Eckelman (2003) in connection to seating furniture testing and Berglund (1988) brings this up along with user width in connection to seating furniture design. Berglund (1988) put forward 45 cm seat width as the minimum design width and Eckelman (2003) put forward 45,7 cm required seat width of an 103,9 kg person. These measurements could be unfit to use as a basis in an evaluation of the number of people which are able to sit in a seat due to the variation of user width. The distribution put forward by Berglund (1988), measurement 4 and 5 in section 3.3 could be considered to take the variation into account. Furthermore, people could also sit on the armrests and/or backrests depending on the design of the sofa or armchair.

The question is whether one should adapt the furniture according to how many that could fit in it in total. However, one must be aware of that more people than seats use a sofa or armchair occasionally according to the researchers. This issue seems to be more apparent for sofas than for armchairs according to the questionnaires' result and the interviews and some people expects a sofa to handle more users than seats. The reason for this unknown but it could be that a sofa offers more potential seats and that more people are used to sit more people than seats in a sofa compared to an armchair. This might also call for a different set of tests for armchairs and sofas regarding the number of users. In CEN (2012) and CEN (2016) are sofas and armchairs partly grouped together.

5.2.5 Performance testing

Performing tests according to CEN (2016) with some additions seem to be a good way of performance test sofas and armchairs based on the lack of failures connected to load issues according to the interviews. However, in this study, the researchers want to highlight that there seems to be limitations regarding the current test methods which one uses for sofas and armchairs. These limitations are important to take into consideration since they affect the ability and procedure of conducting performance tests regarding the chosen loading capabilities. They will be presented in this following section.

Test methods

The interviews put forward that a stability test of sofas and armchairs is quickly conducted and has great impact on the design of the furniture. Since the design could affect the loading capabilities and the customers opinion of the robustness of the furniture, as seen in the interviews and the observations, the use of a stability test is considered a good approach to apply early in the development process. Such tests can be found in CEN (2005) and to follow Eckelman (1988a)'s reasoning of providing information back to the design process could the force needed to overturn the armchairs or sofas be measured, which the interviews brought forward.

The interviews brought forward that static, dynamic and cyclic tests are needed to evaluate the performance of a sofa or an armchair, especially when different materials are used. Static load tests were mentioned to be useful when evaluating the ability to withstand usage which do not occur very often. However, the interviews brought forward that sofas that have failed usually are couple of years old. Zhang et al. (2005), Eckelman (1988b) and Ratnasingam (1997) all highlighted that fatigue seems to be the main reason of furniture failure in service and Eckelman (1988b) criticizes the use of simple static and fatigue performance testing. Even BIFMA (2016a) have cautioned against the use of simple static load tests as a sole base for load capability claims. Looking at the effect of dynamic loads, both BIFMA (2016a) and Li et al. (2017) highlights such loads as important to consider. A mix of static, dynamic and cyclic performance tests are recommended given the empirical findings and the literature.

Tested items

The interviews also bring forward that the testing of a single piece of furniture does only provide a glimpse of the reality. To provide more reliable information would several furniture be needed to be tested. One also needs to consider that an item which is a handmade prototype might yield different result compared to an item from the ordinary production. This calls for testing of both to provide important information connected to the performance, which also are important from a customer point of view due to in service use and evaluation. By testing both can one also assess the production process's ability to produce the intended qualities of the armchair or sofa.

Testing of sitting down motions

Sitting down or to sit in an armchair or a sofa could be considered the main use in service based on the findings from the observations, questionnaires and interviews. Being the main usage along with indications of limitations of current methods of testing sitting down motions from the interviews and the literature calls for further analysis of the subject.

Both interviews and observations put forward that hard sitting down is not uncommon in service. As previously discussed, the usage is considered to affect the severity of the loads which occur due to a usage, and the usage of sitting down hard is not covered in CEN (2016) or by the tests at company F. Li et al. (2017) brings forward that hard ingress could be viewed as free falling and this is important to take into account since this affects the type of test to apply. This usage calls for a dynamic test with several cycles rather than just a handful of cycles based on occurrence put forward in the empirical findings. Furthermore, Zhang et al. (2005), Eckelman (1988a) and Ratnasingam (1997) statements that fatigue is a big contributor to failure in service could mean that a cyclic dynamic testing rather than just a dynamic testing would more accurate represent causes of failures in service. Sitting down motions would then be required to be tested with impact, and depending on the usage, cyclic tests on the seat pad since normal ingress and great falling downs also needs to be evaluated, such tests are found in CEN (2016). Taking the risk analysis found in **Appendix E** into account, the usage of the front edge of the seat pad could also need testing accordingly.

How the dynamic motion of sitting should be tested is on the other hand unclear. BIFMA (2017) uses a bag with metal media, visualized in figure 11, to test the office chairs abilities to withstand dynamic forces. CEN (2016) uses a spring-loaded device, which is visualized in figure 12 and is called a seat impactor. Both tests use foams with specific indentation force deflection characteristics depending on the seat type (BIFMA, 2017; CEN, 2016).

The external test laboratory stated that there exists a lack of knowledge of soft tissues effects on impact forces, e.g. during ingress, and a test using a sandbag is disregarded since it does not take soft tissue into account. This makes the accuracy of BIFMA (2017)'s tests using a bag with metal media and foam to represent sitting down unclear.

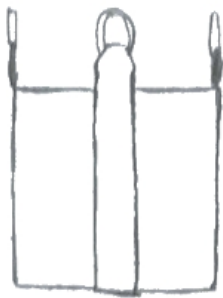*Figure 11 - Test bag with metal media*

Figure 12 - Seat impactor

Furthermore, the interviews put forward that a seat impactor is considered a better tool to test dynamic loads with compared to the bag with metal media, because the loaded springs and the additional foam are believed to better represent human ingress onto a seat. However, the seat impactor does have some issues according to the interviews, e.g. springs are not always activated in a test. The issues have led to a reevaluation of the seat impactor by the European standard organization, which is currently ongoing. The interviews put forward that the dynamic drop test in CEN (2016) with the seat impactor almost never caused any damages to the test subjects. This could mean that the furniture is well built but it could also indicate that the drop tests is not useful to represent a human falling onto a seat.

Taking all of this into account, the seat impactor seems to be a preferred instrument to test dynamic sitting down forces, but it needs to be revised to produce similar loads to those which occurs in service. One aspect that does not promote an additional test to represent hard sitting down is that there does not seem to be any failures reported to company F connected to loads of the assessed reclaims according to the returns analyst. On the other hand, to develop such a test might reveal more information of the strength and durability of sofas. The interviews proposed a use of a dummy, but the costs connected to the use of it were considered too high. Either way, this could be one approach. Performance tests to represent normal and hard ingress are more thoroughly discussed in exhibit 2 and exhibit 3.

According to the interview data, there are not any reclaims with strong association to load capabilities as a cause of failure. However, Li et al. (2017) indicate that cyclic durability tests of the seat should be set to the entire body weight of the user, as a minimum load. Other performance tests seem to have been set up this way. The durability test of the seat in ISO (2016) uses the entire body weight. BIFMA (2017)'s seating durability test probably produces forces greater than the entire body weight in the impact test but lower in the cyclic test looking at the results of Li et al (2017)'s research. Altogether, Li et al. (2017)'s indications seems useful and it is recommended to at least use the entire body weight of the intended user to represent normal ingress in cyclic durability tests of sitting areas. This includes armrests and backrests if these areas are chosen to be able to be used as sitting areas when choosing loading capabilities of sofas and armchairs.

Exhibit 3 - Hard ingress testing

The risk analysis in **Appendix E** proposes a fall height of 40 mm to represent hard ingress into a seat after a discussion between the researchers that at this distance could a complete relaxation in the motion of ingress occur relatively often. BIFMA (2017) partly uses a 57 kg test bag with metal media dropped from almost the same height to test seating durability of general office chairs. Based on Paoliello and Carrasco (2008), Hu et al. (2016) and Li et al. (2017), a person weighing 110 kg could produce a force during sitting down between 225,5 and 271,7 kg given a force of 2,05 to 2,47 times the body weight. Li et al. (2017) described hard ingress as a user with its body relaxed dropping oneself down on a seat. Such drop will most likely produce greater forces compared to a body falling from a height of 40 mm, but it does provide a frame of reference regarding the forces in action. No literature was found regarding CEN (2012)'s seat impactor's performance but Li et al. (2017)'s research could be considered the closest literature found on the subject. The 57 kg sandbag dropped from 13 and 50 mm produced a force of 268 % (158,8 kg) and 342 % (194,7 kg) respectively on a seat with a panel and foam structure. If the cyclic test of the seating durability is set to 100 percent of the body weight, one could argue for the dynamic cyclic test to be set to create forces between 100 to 247 of the user weight percent depending on how severe one wishes the test to be.

Risks and benefits using a standard of strength, durability and safety

To adhere to a standard concerning strength, durability and safety is brought forward in the interviews as a tool to facilitate entrance and presence on different markets. This opens a discussion about the risks and benefits involved in using such a standard, e.g. EN 12520:2016. These risks and benefits are important to be aware of in the decision making of choosing loading capabilities to determine how and if to integrate EN 12520:2016 in the performance testing of loading capabilities. The risks and benefits of using EN 12520:2016 brings up the question of the scope of a performance test which Eckelman (1988a) important.

One risk which also could be seen as a benefit is the aim to keep a standard practical which were brought forward in the empirical findings. An example is the static seat test in EN 12520:2016 which uses the seating pad to apply loads to the seat to represent standing and sitting two people in one seat for practical reasons according to one of the interviewees. Instead of applying one separate test which uses a load applicator which represents a pair of feet to assess the quality aspect. This way reduces the number of tests and also the cost but limits the knowledge of the performance of the tested item.

Another example brought forward in the interviews is that active loads only are applied to two seats at the same time at most in EN 12520:2016, to avoid too complicated tests. As the case is considered to become if active loads would be needed to be applied on all seats on a multiple seating unit according to one of the standard organizations. This is not a problem for an armchair since it only has one seat, but the issue occurs regarding sofas. The interviews also reveal that there is a challenge today to test larger furniture according to EN 12520:2016. To come even closer to the reality would active loads on all seats be necessary. Not regarding durability tests since one could argue that a sofa is not fully occupied every day in a house hold, especially when looking at the data in **Appendix C** regarding amount of times people in a house hold sit down in a sofa.

However, this could be useful for static and impact test to evaluate what happens if as many persons as seats, or more, sit down at the same time. Since the front-rail of a sofa would be exposed to great forces during such usage along with the findings that the front-rail has previously failed could this be a further argument for such a test. Along with the assumption that a customer would most likely assume that users of a sofa should be able to sit down at the same time. Since the interviews brought forward indications that some people expects sofas to handle more users than seats. One factor which does not promote such tests is that there does not seem to be any failures with the choice of assessed reclaims of company F which are caused by loads. Even though a great part of the respondents in the questionnaires stated that they sit more than one people per seat in a sofa, and partly in an armchair. Either way is this important to be aware of regarding sofas according to the researchers due to the magnitude of the involved forces.

Eckelman (2003) highlights the importance of the choice of loads representing usage in service for the design process. The lack of knowledge of loads appearing in service on furniture put forward by Wang (2007) and Eckelman (2003) and highlights the benefit of using a standard such as EN 12520:2016, it provides a set of loads to use or to base performance tests on.

CEN (2016) and BIFMA (2017) provides specific loads but not a mean to change the load depending on the weight of the intended user. ISO (2016) on the other hand provides equations to adapt the loads depending on the user weight. Interestingly, ISO (2016) applies a safety factor to the loads in static tests but not to the loads in the static tests. It seems that a safety factor should be applied in the durability test, regarding the number of cycles or the size of the load, instead given the empirical data regarding failures and Eckelman (2003)'s and Zhang et al (2005)'s statements that repeated use seems to be the main factor. The interview data from the external test laboratory and one of the standardization organizations states that just increasing the loads in the tests in CEN (2016) are not useful. People which weigh more than 110 kg are believed to use seating furniture differently and distributing the loads differently, e.g. there are indication that they sit down more carefully according to the interviews. This could mean that the test methods need to be changed to reflect actual usage in service more accurately. This along with the limited knowledge of soft tissue's effect on impact and load effects could mean that scaling up loads of currently used tests for testing armchair's and sofa's strength and durability would provide an incorrect image of real performance. It is not recommended to scale up the forces in tests for armchairs and sofas, e.g. in EN 12520:2016, without further knowledge of the usage of people weighing more than 110 kg. This to avoid both over and under dimensioning of loadbearing parts. BIFMA X5.11 can act as inspiration if tests for users weighing more than 110 kg are developed but this standard concerns general purpose office chairs and not sofas or armchairs.

The lack of knowledge of loads occurring in service also covers the occurrence rate and thus the number of cycles to apply in durability tests. The benefit of using a standard, such as EN 12520:2016, is that it gives you a frame of reference regarding how often different usage occurs. The empirical findings and the additional analysis in **Appendix C** put forward that sofas tends to be more frequently sat down in. which is not strange since it offers more seats than an armchair. Most of the questionnaires' respondents

sat down 1-10 times daily in a sofa. If a life expectancy is set to 10 years, as in BIFMA (2017), and the sofa is used every day, the number of cycles to apply would range from 3650 to 36500. Applying Savage (2002)'s reasoning of variation further, given the variation of the respondents' usage could the usage range from 520-3120 cycles to more than 109 500 cycles. The total number of cycles found in the durability tests for the seat and the front edge of the seat in CEN (2016) is 45 000 cycles, which covers the stated usage of the majority of the respondents in the questionnaires. The numbers put forward in this thesis are not representative for any region or country but could act as a base for evaluating how tough tests to apply regarding durability of sitting in for armchairs and sofas.

The issue of keeping a standard both practical and relevant is further highlighted in the interviews. If additional tests or higher requirements are set might this result in increased costs which furniture manufacturers or test laboratories cannot afford. The empirical data highlighted that one company producing assistive products uses ISO (2016) to verify the chosen loading capabilities with a specific user weight, however, they did also perform additional tests which are found in service. This together brings forward that one needs to assess the actual usage and requirements that occur in the specific market or situation and not only using standard regarding strength and durability to ensure customer satisfaction with the products. Especially due to the politics involved in the standardization work brought forward in the interviews. The use of CEN (2016) with some additions seems useful due to the lack of furniture reclaims due to load failures brought forward by the return analyst. However, one cannot add tests without considering the time consumption highlighted in the interviews.

Quality assessment and acceptance systems

Failure in the surface material is not a factor which fails a furniture according to CEN (2016). This is the same case for a front-rail which would bend down but not break during the tests in CEN (2016) However, from a customer point of view, a furniture which has a bent front-rail would most certainly be considered as damaged. Therefore, it is important to understand that a quality assessment of furniture also needs to be made. This to not dissatisfy customer expectations regarding the quality of the furniture. A suggestion to perform a quality assessment could to be measure quality and below in exhibit 4 below is an example on how this can be performed on furniture.

Exhibit 4 – Measuring deflections

To measure quality of a furniture one could measure deflections, such as bending of a front-rail for example, if it has occurred during testing. The external test laboratory explained that if someone decides to measure the deflection, the measurement should not be performed on a single location of the tested area. The measurement should instead be performed on several locations of the area and this to measure the deflection more accurate. If deflection is going to be measured, it was also explained that an uncertainty assessment of the measurement of the deflection need to be made. This in order to understand what the measurement of the deflection is demonstrating. The external test also highlighted that measuring deflection on upholstery material are almost impossible to perform, compared to measuring deflection on stiff material.

Performance testing of armchair's and sofa's loading capabilities would most likely need to take quality assessments into consideration as well. This raises the question of adapting the load applicators in performance tests to more closely reflect the use of armchairs and sofas. If a specific usage is evaluated in performance testing, a load applicator which closely reflects the usage could be used in order to e.g. evaluate the performance of cover materials. An example is presented in exhibit 5 below.

The interviews highlight that the cyclic stepping method are perhaps relevant for academic use but not for practical for a manufacturer, since it is hard to assess what is good enough. Which already is a problem today regarding setting good enough requirements according to the interviews. Using a multi-level acceptance system have the same problem of setting the limits but it could provide a mean for customers to compare products.

Except for an issue in deciding an acceptable performance of a furniture, it was also highlighted in the interviews that there is an issue with interpretation within the standards, e.g. how to interpret the results and requirements. The proposed discussion between the designers and the test laboratory could perhaps enhance this issue regarding relevant tests. However, a suggestion to avoid the issues with interpretation within standards and to minimize the performing of quality and safety tests of furniture, could be to take previous experiences into consideration. This means to investigate what have been done before that resulted in customer satisfaction regarding furniture's quality. For example, what kind of design requirement of furniture have resulted in strong and durable sofas and armchairs which created customer satisfaction, and which design requirement did not. By establishing which design requirement to have, such as construction material or dimension, based on previous experience might remove the need of some performance or quality tests.

Choice of material

The interviews put forward that reclaims which could possibly be connected to load issues at company F were rather connected to twigs in the wood. This issue is supported by the interviewee from one of the standard organizations which stated that the majority of failures, according to his experience, were a result of using wood with twigs. This makes the choice of material important to be aware of according to the authors since it can affect the loading capabilities of armchairs and sofas greatly. In exhibit 6, the choice of materials effect on performance testing of strength and durability is presented.

Exhibit 6 – Choice of material's effect on performance testing

Wood was given as an example by the external test laboratory as a material not affected by fatigue. While plastic or metal and the joints of the frame is on the other hand tends to bend due to fatigue. This is interesting since Eckelman (1988b), Zhang et al. (2005) and Ratnasingam (1997) states that most failures occur in service due to fatigue. Especially since several interviews brought forward the use of wood in furniture frames. However, Ratnasingam (1997) brings forward that if the time of the loading intervals were greater than the time which the loads were applied were no damage due to fatigue worth mentioning found in one research. If the applications of loads in service are assessed, loads could be applied for a longer time compared to the interval between the loads, e.g. watching tv and checking how a stew comes along once in a while.

The rate of force application of the combined seat and back durability test is not specified in CEN (2012), but the forces in the durability tests in CEN (2012) are specified to be applied for 2+- 1 seconds each cycle. According to Ratnasingam (1997)'s reasoning could an application rate of loads in cyclic tests under 10 cycles per minute mean that no damage to the wood would occur if the loads are applied for 3 seconds. BIFMA (2017) advises on a load rate of 10 to 30 cycles per minute in the seating durability test and if Ratnasingam (1997) is correct could the results of using a load rate of 10 cycles per minute compared to 30 cycles per minute differ greatly. But as Eckelman (1988b) stated, an application rate which exceeds 20 cycles per minute could induce secondary structural vibrations in furniture making this a possible additional restriction. Taking all of this into account might a load application duration of 3 seconds needs a load application rate in durability tests to be set between 10 to 20 cycles per minute to contribute with interesting result regarding the strength and durability of wood material according to the authors. On the other hand, since not all usage in service might constitute of longer load durations than the interval between the next load occurrence could this testing be tougher than the usage in service.

Seat and user height

The researchers have a hypothesis that the height difference between the area of sitting down on and the bottom of a user affects the magnitude of force which is exerted during sitting down in an armchair or a sofa. This is based upon the potential energy equation in which an increased height increases the potential energy that is converted to kinetic energy during a sitting down motion for a sofa or an armchair to handle. There might also indications in the empirical findings of this. One of the interviewees put forward that the height of men could result in tougher test and another stated that the physical appearance of the user affects the load applications on a furniture in service. Furthermore, the impact time was shorter for hard ingress compared to normal ingress and hard ingress created greater sitting down forces according to Li et al. (2017)'s results. Which also could be of interest in connection with magnitude of forces and height difference. A deeper discussion and analysis of the subject is presented in exhibit 7.

Li et al. (2017) research found seat height to be non-significant regarding the impact force. However, Li et al. (2017)'s research only altered the seat height 76 mm in total and eliminated potential variation in the foot to popliteal distance since they used a test rig with a single seat height. Variation in the foot to popliteal distance could exists and Berglund (1988) presented differences in furniture seat height between 30 to 50 cm. If one adds Berglund (1988)'s measurement 1 and 2, showed in section 3.3, the distance from the floor to about the waist is gained. If the shoe height which Berglund (1988) included in the measurement is removed, one receives a height span from 103,5 cm for the 95th percentile male to 89,5 cm for the 50th percentile woman, which gives a height difference of 14 cm.

If the seat height difference presented by Berglund (1988) is added to the user waist height difference is a potential total height difference of 34 cm put forward. A height difference of 34 cm between the seat pad and the waist is relative large and this difference might affect the impact loads according to the researchers. NCD-RisC (2016a)'s findings on the variation of human height contributes to the variation of heights, but this area needs further research to determine the height difference effect.

5.3 Communication of load capabilities to create value to customers

This section presents the analysis and discussion of the third research question. The section is divided into the two subsections ways of communicating and communication approaches. Since value to customer is a great part of this section are the values presented in section 5.1 listed here for convenience, *comfort of safety*, *comparison, no value* and *negative value*.

5.3.1 Ways of communication

This following section will bring forward different ways of how information about loading capabilities of sofas and armchairs can be communicated to customers. Spaho (2012) puts forward that communication can be both verbal and non-verbal. This opens up to use both direct and indirect communication of loading capabilities to customers.

Design of armchairs and sofas

The empirical findings put forward that the design of an armchair or a sofa is a very strong communicator of loading capabilities. An evaluation of the strength and durability seems to be made directly upon a visual encounter of an armchair and a sofa, both regarding an image or a physical encounter with the armchair or sofa. The customer's judgement of the furniture seems to greatly affect the customer's opinion of the armchair's or sofa's ability to handle the customer's usage or the stated loading capability level. In the customer group interviews when presenting mock-ups, FRID which can be seen in figure 13, were heavily questioned if it could handle the stated loading capability. While DAL, figure 14, which had the same loading capability were not. This is very important to consider since the customer could eliminate a specific armchair or sofa from a potential purchase if the product is considered weak looking or unstable, based on the results from the interviews and observations. This action by the customer could remove all value the other information or communication could bring to the customer regarding the specific armchair or sofa.

Not only the visual encounter is affected by the design but also the physical interaction with the armchair or sofa. As shown in the empirical findings did customers physically interact with the products without sitting down in them and most likely made a decision partly based on this interaction, those interactions

included both testing of the stability and of the cover material. This could indicate that a judgement of an armchair's or a sofa's loading capabilities are not solely connected to strength and durability but to an overall judgement of the product.
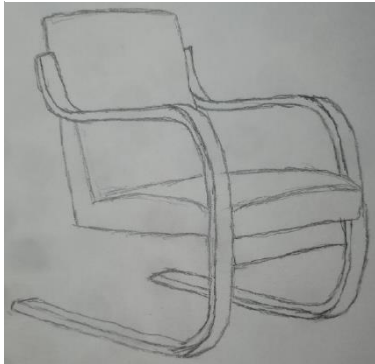

Figure 14 - FRID

Figure 13 -DAL

The material of a sofa or an armchair could be considered to be a part of the design and based on the interviews, the material also acts as a communicator of loading capabilities. One could argue that people have greater experience with different material compared test results and other kinds of loading capability information. Furthermore, experience is important in customers' acknowledgement of value according to Woodruff (1997). If material which are associated with strength and durability are used in the furniture might this create greater value compared to loading capability communication of technical nature. Altogether, if a sofa or armchair would have a design which looked stabile, robust and used materials which are associated with strength and durability. The armchair or sofa itself would it most likely communicate loading capabilities that would create a comfort of safety to customers.

Brand

The brand of the manufacturer is another way of communicating loading capabilities. One might not be able to communicate specific loading capabilities, but as brought forward in the interviews, the image of the brand could affect a customer's opinion about the products. Thus, both the strength and durability of an armchair or a sofa could be evaluated based on the brand. The interviews put forward that loading capability information could act as a quality indicator and Bergman and Klefsjö (2010) puts forward that the quality assessment of a product is based on an overall experience with the manufacturer. Since loading capability was connected to quality could the brand be argued to affect the perceived level of loading capability. Which could affect the comfort of safety the customers would gain from the brand. Furthermore, the trustworthiness of the loading capability information could also be affected. If the brand is strong could it bring a higher value to the loading capability information due to the belief and trust of the brand. This is also highlighted by Löwenheim (2017) which states that the brand can create an impression of trust and credibility to customers.

Warranty

Several interviewees put forward the time aspect of loading capabilities, for example one of the customer groups stated, "*we assume the furniture will last a long time if it looks robust"*. This was also highlighted in the result of the questionnaires, loading capability information with a time aspect ended up among the top three most preferred versions of communications. Warranty is a way of communicating loading capabilities with a time aspect, given that the warranty covers construction or materials. One of the customer groups put forward that warranty was considered more important than specific loading capability information of sofas and armchairs. Comfort of safety was found to be one of the values
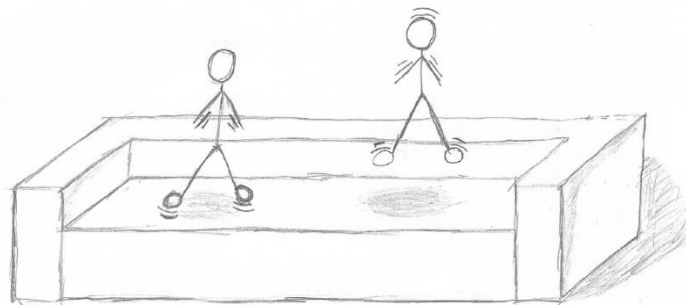
information about loading capability could bring and warranty can contribute to the comfort of safety by setting a time frame to the manufacturers trust in the sofa or armchair.

Visual communication

Visual communication could also be a way to create valuable communication of loading capabilities. It could be a way to communicate the information in a simple way to understand and this simplicity in communication and information was highlighted by several interviews as important and necessary. The visual communication could be a picture which shows the usage which the armchair or sofa have been designed for or a video that shows performance test procedures of the sofas or armchairs, e.g. on the website or in a store.

This way of communicating could be a way which customers are already familiar with from other situations and therefore more likely to bring value to the customers due to previous experience according to Woodruff (1996). Such communication could also trigger additional interest of the subject which either could increase or decrease the value of the area of loading capabilities. An example of a visual communication of a sofa which can handle children jumping in it is presented in figure 15.

Figure 15 - Children jumping on a sofa

Accessibility

The empirical findings put forward that information about an armchair's and a sofa's loading capabilities are appreciated in several different channels and on several different places. This could be an indication that this information should not be limited to specific customer communication channels. The value might be reduced or not created at all to customers if they must access additional communication interfaces than the one they are already interacting with. This argumentation is based on need of simplicity of the information put forward by the customers at a furniture store. Because the needed simplicity could stretch to the way of acquiring this information. By providing communication of loading capabilities on several customer communication channels could value be created due to the simplicity of accessing the information.

However, it does not necessarily mean that loading capability information needs to be communicated on the website or on price tags. Since there has been a low number of requests of this information given the empirical findings and that loading capability was also found to bring no value to customers. One of the customer groups put forward a want to discuss loading capability with personnel. This highlights the importance of accessing the information through two-way communication, which the interviews brought forward as an issue at company F. Ramsey and Sohi (1997) states that an interest in customers during a conversation could provide a better understanding of customer values. This can be achieved through two-way communication but not through one-way communication, which could mean that greater or other value are created through two-way communication compared to one-way communication. To conclude, both one way and two-way communication could create value to customers.

One interesting aspect is that this information was wanted by most respondents in the complete questionnaire to be communicated in the documents which accompanies a product. This could be an indication that this information is apricated after the purchase and not only before the purchase which the interview with the operator at a customer service at company F pointed towards. However, one could question how often these documents are read. It could be that the knowledge of knowing that the information is available in the documents when needed brings a value of comfort to the customers.

5.3.2 Communication approaches

There are two major approaches to go about regarding communication of sofas' and armchairs' loading capabilities, either one communicates the information, or one does not communicate directly. The following section will discuss what to take into consideration if deciding on one of these approaches.

Direct communication

It is questionable whether information about loading capabilities of sofas and armchairs should be communicated to customers since one cannot truly verify loading capabilities. However, if one decides to direct communicate loading capabilities of sofas and armchairs to create value to customers there are important factors which need to be taken into consideration. These are:

Avoid mentioning limits

An organization should avoid communicating limit of the sofa's or armchair's loading capability, such as stating that an armchair has a "maximum load of 120 kg" for example. Since loading capabilities cannot truly be verified, there is no reason to state a limit. Because loading capabilities cannot truly be verified, it is also important to understand that communicating a limit could be misleading to customers. The communication might provide value to customers at first, but when realizing that the information is misleading a negative value could be created. If a customer realizes that the information is misleading it might also result in legal penalties towards the producer. Furthermore, communicating a limit could result in losing potential customers, based on the discussion in section 5.2.2.

Avoid mentioning solely a number

Solely having a number which represent the level of a loading capability, e.g. 110 kg, might not be a good way of communicating loading capabilities to customers. During the customer groups interviews, it was highlighted that solely mentioning a number did not give a proper explanation of the loading capability of an armchair. Therefore, an interviewee wanted further explanation regarding what the term "loading capability" meant. This seems to indicate that some customers might want to be educated in understanding the term "loading capability". Based on the interviews, asking follow-up question regarding information of technical kind is something that customers tend to do. Therefore, it was not a surprise that customer would ask for further information regarding the term "loading capability. Perhaps an education regarding this will be valuable to customers? This to perhaps aid customers in understand if information about loading capabilities is valuable to be used to evaluated the strength, quality and durability of sofas and armchairs? However, as mentioned by the information owner, information on how a seating furniture have been tested makes customers feel comforted when asking about loading capabilities. This seems to indicate that information on how a seating furniture have been tested might be the information that could be used to educate customers that an armchair and a sofa is robust and has a great longevity.

Information on all furniture

It was brought forward by the empirical findings that if information about loading capabilities is communicated it should be present on all armchairs and sofas. This could be a useful approach if one decides to use different levels of loading capabilities of sofas and armchairs, since it can be connected to the value of comparison and to the trustworthiness of both products and the information. If just a few products are supplied with the communication is a comparison based on loading capabilities hindered. Those comparable products which lacks this communication could create a negative value towards the products without the communication and the products could be questioned regarding their performance. If customers are informed that those without loading capability information also are tested regarding strength and durability could the other information lose potential value.

Before presenting information about loading capabilities, one should consider if the information should be present on the armchairs rather than sofas. Solely the questionnaire puts forward specific information requests of loading capabilities of sofas. There also seems to be an opinion that sofas are more robust and capable of handling tougher usage than armchairs. For example, some interviewees stated that they would not care about loading capability information regarding sofas but would want it regarding armchairs. If one relies on CEN (2016), an armchair or a sofa are not particularly differentiated and communication of the same loading capabilities on both armchairs and sofas could create negative value instead. Therefore, to solely communicate loading capabilities on armchairs could be an approach instead since the interest seems lower regarding sofas.

Communicating of usage

Communication which states that the products have been developed for a certain group of usage, e.g. domestic use, public use or families with children, might be a better way to communicate loading capabilities of sofas and armchairs. As stated before, it is questionable whether levels of loading capabilities should be communicated to customers since they cannot be truly verified. Furthermore, based on interviews, customers seem to ask for a further explanation regarding what the term "loading capability" means due to its complexity. Therefore, a suggestion could be to communicate the certain group of usage which the armchairs and sofas have been designed and tested for.

This way of communicating loading capabilities of sofas and armchairs can be value to customer since it can provide them with a comfort of safety, regarding what kind usage the furniture can be exposed to without breaking down. It can also be of value to because based on the interviews, customers tend to request for information regarding the usage area which the sofa or armchair have been designed for. This information can also act as a mean of comparison, where customer distinguish sofas and armchairs based on their intended usages. However, this communication could trigger a discussion of approved usage which could cause discontent of customers if they are told that they cannot use the sofa or armchair as they have done previously. Legal penalties could also be a potential risk with communication of specific usage based on the same reasoning as with mentioning a limit.

One-way and two-way communication

If information about sofas' and armchairs' loading capabilities are communicated to customers, an organization will probably provide the information through a one-way communication, e.g. through price tags. However, based on the empirical findings, if an furniture manufacturer or retailer decides to communicate loading capabilities, questions regarding further detail of the subject will most likely still arise. Based on the interviews, it is important to understand that occasionally customers tend to ask for information even though it has already been provided to them. This could be because customers either do not read the information, do not understand it or want to ask follow-up question regarding the

subject. When this occur, a two-way communication is needed to inform customers with further details regarding the furniture's loading capability. This can be related to what was explained by Spaho (2012) that feedback is the "lifeline" of effective communication.

If an organization want to explain the difficulties with verification of loading capabilities to customer, one could argue that a two-way communication is best suited for this task. Then could the issues involved be put forward and discussed between customers and personnel without resulting in any misunderstandings and negative values compared to one-way communication. It seems that specific loading capability information could best delivered through two-way interactions, while more general information of the subject should be through one-way communication. Furthermore, a two-way communication enables the company to pick up changes in behavior and facial expressions towards the communication of loading capabilities and enables them to adapt the communication to the situation. This feedback and communication message is highlighted by Spaho (2012) as parts of a two-way communication.

Interaction of communication

Different ways of communication interact with each other and this was discovered during the customer groups interviews, where interviewees used both pictures and other information in the evaluation of the strength and durability of the mock ups. Similar behavior was discovered in the observations. Therefore, one could argue that different ways of communication affect both the value and creation of value, meaning that one needs to consider all of them regarding communication of loading capabilities of armchairs and sofas. Taking the availability of information and communication in several channels into account does this follow the reasoning of Bergman and Klefsjö (2010) regarding customer satisfaction.

Simplicity

Finally, it is important to understand that if any kind of communication is used to explain loading capabilities of armchairs and sofas, the communication need to be simple. According to the interviews, any kind of information which describes loading capabilities of armchairs and sofas need to simple and be easy to interpret for customers. Based on the interviews, it seems that simplicity of communications creates value to customers. Since if complex information is presented, a customer could lose interest in the information and may not understand it as well. Therefore, a suggestion could to not be too technical when describing any kind of information regarding loading capabilities of sofas and armchairs. Another suggestion to provide customer with simple information regarding loading capabilities could be to visualize the usage which the sofas and armchairs have been designed for. A visualization of this information could be, as mentioned before, with pictures that illustrate the usage of the sofa or armchair.

Indirect communication

Indirect communication of loading capabilities could be a useful approach if one level of loading capabilities is used. This since one level of loading capabilities would not provide a mean to distinguish different armchairs or sofas from each other. However, there are several factors to consider if one choose to use indirect communication.

A risk with no direct communication of loading capabilities is that products might be ruled out of a customer's purchase consideration due to the lack of the information. This could especially be the case if customers start to use comparison sites which uses specific user weight limits, even though this is considered a bad way of comparing. The lack of communication of loading capabilities could also cause a discontent towards the company in a customer if such comparisons become common. Another risk with indirect communication is that customers cannot perform direct product comparison on sofas or

armchairs based on the communicated loading capabilities. This could cause dissatisfaction for the customers who value the information as a mean of comparison.

On the other hand, an advantage with no direct communication, is that organizations could avoid creating negative value to customers regarding information about loading capabilities. Since the information could be of no value to some customers and loading capabilities cannot be truly verified, one could also argue that an organization should consider indirect communication of loading capabilities. As mentioned before, the design and the brand are communicating or affecting a customer's opinion of an armchair's or a sofa's strength and durability, which means that indirect communication of loading capabilities already exists and this perhaps enough? However, based on the simplified benchmarking, it seems that some furniture retailers are currently communicate loading capabilities of their products. This might force a need for other actors to communicate loading capabilities even though specific loading capability limits is a troublesome area. It could be an even greater problem if comparison websites start to use such information in their evaluation. Then is it possible that the limits or levels are solely considered and the use of user weights or load weights is a likely factor which will be used taking Hamilton and Karmarkar (2017)'s statement into account regarding the use of quantitative data during comparison. But this could create a wrongful image to the customer if not the same set up of tests and requirements are used by all furniture manufacturers regarding loading capabilities.

Finally, based on the empirical findings, it seems that customer ask for information about loading capabilities and that they ask for information which have already been provided to them. This indicates that even if one decides to indirect communicate loading capabilities, the information might still need to be provided to customers through a two-way communication.

Communication from customers

Finally, what one need to take into consideration regarding communication of loading capabilities, is that Florera and Ducia (2017) highlights the importance of listening and responding to the customers. Applying this to the area of loading capability communication could the returns of broken armchairs and sofas be an important area. It was put forward that all returned products which are no longer available on the market are given the same identification number. This hinders an evaluation of e.g. how specific design choices affected the performance or usage in service or if specific communication affected usage in service. The authors think that a separation of products could both facilitate improvements of communication and development.

6. Conclusion

This chapter presents the conclusion to the research questions presented in section 1.2.

6.1 Research findings

What kind of value to customers can information about furniture's loading capabilities create?

Based on the empirical findings, it can be concluded that information about loading capabilities of sofas and armchairs could create value, no vale or negative value to customers. This indicates that what is considered to be valuable information differs among customers. The found values were:

- A comfort of safety, which could indicate whether a sofa or armchairs can handle a certain usage of a customer
- A mean for comparison. Furthermore, it can act as a quality indicator which can be used for comparison.

Information about loading capabilities could, on the other hand, create negative value when the information is misleading to customers due to the complexity of the subject. For example, if a customer realizes that the information about the loading capability of the sofa is not accurate compared to what has been informed, the information will be considered misleading. However, regarding why information about loading capabilities do not create value to some customers, seems to be because customers are lacking experiences of when the information could have been valuable to them. As mentioned in the empirical findings, it could be possible that some customers have never had an experience of a sofa or an armchair breaking down during usage, which is why they do not desire a comfort of safety. Furthermore, some customers might prefer to use other types of information than loading capabilities when performing product comparison, which could be another reason to why the information is not valuable to some customers.

It is important to understand that what the customers value also changes over time. Therefore, it could be possible that customers who currently believe that information about loading capabilities is not valuable, will in the near furniture change their mind and believe the information is valuable. Since customer values change over time, customers could also stop considering the information to be valuable.

What factors are important to take into account during a decision process of choosing loading capabilities for furniture?

There are several factors one needs to consider within the choice of loading capabilities for armchairs and sofas for domestic use.

Customer value and aim

The value loading capability information brings to customers should be taken into account in the decision making to facilitate customer satisfaction. One cannot always focus on all values and the strategy of the company can act as a guide in the decision. Furthermore, the strategy of the company should be guiding in the decisions regarding loading capabilities.

Uncertainty of verifying loading capabilities

The main thing is that one cannot truly verify a certain loading capability. This is mainly connected to a large variation of usage of a sofa or an armchair in service. Even if a specific user weight is used as a base in the performance testing of the loading capabilities, this does not limit users of larger weight to

use the sofa or armchair safely depending on the usage. It is mostly the life time of the products which is affected.

A set of approved usage communicated to customers might facilitate tests which could provide close to reality results, however, this approach could trigger other effects which makes it risky to use. Furthermore, there are other factors which affects the loading capabilities, e.g. care and maintenance affects the loading capabilities over time. This is important since the empirical findings highlights the durability of an armchair and a sofa which puts loading capability into a time perspective.

Design

Different designs of the sofa or armchair seem to trigger certain usage, which affects the choice of performance tests to apply. The design can also hinder some tests to be conducted, this issue is proposed to be an ongoing discussion between the designers and the test personnel.

Variation of users

User weight and weight trends are necessary to consider since those two have major effects of the loads which a user exert on a sofa or armchair. There are indications that a user weight of 110 kg covers a great share of people and therefore a weight of 110 kg is a good base for loading capabilities. However, there are indications that the physical appearance of people will change with time and this highlights the need to review the choices regarding loading capabilities further on.

Performance testing

Testing of the performance of the armchair or the sofa requires a choice of which usage to include in the tests. This calls for a need to obtain knowledge of usage in service. Standards provide certain knowledge of the subject but does not cover the complete picture. A risk analysis of the potential usage of a specific product can be used in the decision process. The number of users which could use the sofa or armchair at the same time is an important factor to be aware of due to its effects on the loads which will be exerted on the sofa or armchair.

A mix of dynamic, static and cyclic tests is considered necessary to apply due to the nature and occurrence of usage in service. Along with how different material of a sofa and an armchair are affected differently by different kinds of tests, which also highlights the need of a mix of dynamic, static and cyclic tests. Based on the risk analysis, sitting down and sitting is considered the main usage of a sofa or an armchair and how to test sitting down properly is unclear given the investigated performance testing methods in this research.

There is a lack of knowledge about how loads occurs during usage of a sofa or an armchair and to use different standards is one way to counter this problem, however, there are issues and risks of using and relying on standards. Quality aspects are proposed to be a part of loading capabilities due to empirical findings. Applying requirements of bending to performance testing is one approach which seems useful to apply due to the customer aspect.

How can information about furniture's loading capabilities be communicated to create value to customers?

There are two different approaches to communicate information about loading capabilities of sofas and armchairs, either you choose to communicate the information directly or not.

Direct communication

If one choose to communicate the information directly to customers, there are several important factors to take into consideration.

Firstly, it would be wiser to communicate loading capabilities through the usage which the armchair or sofa have been developed for. By communicating the usage rather than user weights, unnecessary limits can be avoided and the information would be less misleading due to the complications with weight limits. Since loading capabilities cannot be truly verified it might also be wiser to communicate the usage rather than user weights.

Secondly, it is important to have the information present on all sofas or armchairs through a one-way communication, e.g. price tags. This gives the customers an opportunity to compare different sofas or armchairs. The information should also be available in several communication channels to facilitate the communication of loading capabilities.

Thirdly, if any information regarding loading capabilities is communicated, it needs to be simple for the customers to interpret. Since if complex information is presented, a customer could lose interest in the information and may not understand it as well. However, it is important to understand that customers might request information about loading capabilities even though it might be already communicated. If this occur, then more detailed information about the loading capabilities could be provided through a two-way communication.

Finally, based on the empirical findings, it seems that customers request for loading capabilities of armchairs rather than sofas. It seems that customers are sometimes uncertain if an armchair is robust enough handle a customer's usage compared to a sofa. Since customers request for loading capabilities of armchairs rather than sofas due to this uncertainty, one could decide to solely communicate loading capabilities of armchairs in order to provide a comfort of safety to customers.

Indirect communication

Due to the low number of customer requests for loading capabilities found in this research, the problem of not being able to truly verify loading capabilities and because some customers do not consider the information to be valuable, one might not want to directly communicate the information. If no direct communication is chosen, there several factors that need to be taken into consideration.

Firstly, it is important to understand that there are other factors which seems to communicate strength and durability of an armchair and a sofa. The design of the furniture, warranty, the materials used in the furniture and the brand are factors which indirectly communicates loading capabilities.

Secondly, since the information is not directly communicated one need to be prepared that customer might request the information. As mentioned before, the information could be of value to some customers and those customers might therefore request the information. If this occurs, then information

about the subject could be provided through a two-way communication between customers and personnel.

Finally, a risk with indirect communication is that customers cannot perform direct product comparison on sofas or armchairs based on the communicated loading capabilities.

6.2 Future research

The effects of the height difference between the seat height and the bottom of a user on impact loads have not been assessed in this research and is considered interesting to investigate. This in order to understand if and how this height difference needs to be accounted in furniture performance testing depending on the chosen seat height and the distribution of the body length of users.

Another interesting topic for future research would be to investigate how to test furniture for heavier users, people weighing more than 110 kg. Indications show that heavier users use and apply their loads differently on sofas and armchairs, as mentioned by the external laboratory, which means one cannot solely increase the loads when testing sofas and armchairs.

Loads occurring in service and testing of sitting down motions is an area which needs further attention to provide performance testing which more accurately represents usage in service.

Direct feedback of how certain usage exerts different loads and stresses upon a furniture is considered an interesting area. This might enable customers to determine which usage that their furniture can manage which can prolong the life of the sofa or armchair. Taking this one step further, the usage of an armchair or a sofa could be logged in an app so the users could get information about how often and how much they use their furniture. For example, one challenge could be to spend less than seven hours in the sofa during a week. Furthermore, the usage information could be a valuable source of information to the furniture manufacturer to gain more knowledge regarding usage in service and usage which could have caused failures.

A final suggestion for future research, according to the researchers of this thesis could be to investigate how dynamic impacts on furniture are affected by soft tissues. As mentioned by the external test laboratory, the effect of soft tissues could plausibly benefit the testing, which makes this an interesting further researcher to perform.

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8. Appendix

Appendix A – Communication pictures

The pictures used for communicating max load capabilities for assistive products are presented in figure 16 and 17.
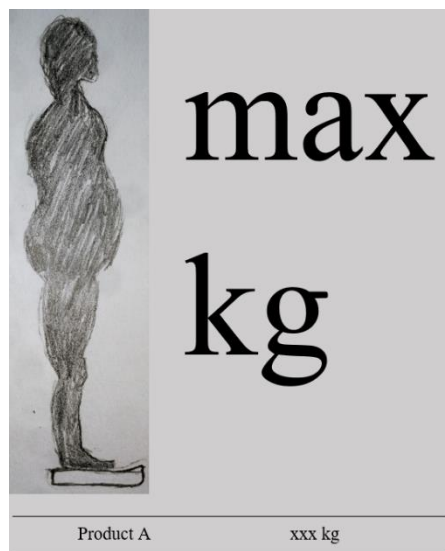
Figure 17 - Company 9's visual communication

Figure 16 - Company 11's visual communication

Appendix B – Mock-ups

The different mock-ups of loading capability information used during interviews with the customers groups are presented here, the prices are in SEK.

Mock up 1 – HAVET

HAVET
Article: 11111

1799:-

Available in several colors

Add to cart

Product description

An elegant and comfortable armchair which fits in most environments with a design which provides great support.

Product specifications

Materials	Pinewood, Cold foam, Plastic, Polyester
Color	Gray
Height	93 cm
Width	67 cm
Depth	60 cm
Seat height	45 cm
Seat depth	50 cm
Weight	30 kg
Loading capability	110 kg

Mock up 2 – STRAND

STRAND
Article: 12112

799:-

Available in several colors

[Add to cart]

Product description

An armchair suitable for most homes with a design which gives a light impression

Product specifications

Materials	Pinewood, Cold foam, Plastic, Polyester
Color	Gray
Height	93 cm
Width	67 cm
Depth	60 cm
Seat height	45 cm
Seat depth	50 cm
Weight	30 kg
Loading capability*	110 kg

* Click here to read more about loading capability

Loading capability

It is important for us to develop strong and durable furniture, that is why we test other furniture carefully.

Seating furniture for domestic indoor use
(Armchairs, sofas, chairs)
We are using three different kinds of tests regarding strength and durability:

- Static tests: loads which are applied slowly on the furniture, mainly to test strength
- Dynamic tests: loads which are applied rapidly on the furniture, mainly to test strength
- Cyclic tests: loads which are applied slowly many times, mainly to test durability

The size of the loads in the tests are based on a user, if the armchair has a load capability of 110 kg have a person weighing up to 110 kg been the basis. We leave a 10-year warranty on most of our seating furniture and that's why we have based our tests on 10 years of usage.

Mock up 3 – DAL

DAL
Article: 12112

799:-

Available in several colors

[Add to cart]

Product description

A nice armchair which fits in several environments and provides cozy feeling.

Product specifications

Materials	Pinewood, Cold foam, Plastic, Polyester
Color	Gray
Height	93 cm
Width	67 cm
Depth	60 cm
Seat height	45 cm
Seat depth	50 cm
Weight	30 kg
Loading capability*	110 kg

Loading capability

It is important for us to develop strong and durable furniture, that is why we test other furniture carefully.

Seating furniture for domestic indoor use
(Armchairs, sofas, chairs)
We are using three different kinds of tests regarding strength and durability:

- Static tests: loads which are applied slowly on the furniture, mainly to test strength
- Dynamic tests: loads which are applied rapidly on the furniture, mainly to test strength
- Cyclic tests: loads which are applied slowly many times, mainly to test durability

The size of the loads in the tests are based on a user, if the armchair has a load capability of 110 kg have a person weighing up to 110 kg been the basis. We leave a 10-year warranty on most of our seating furniture and that's why we have based our tests on 10 years of usage.

Shelves
(Book shelves, separate shelves)

We are using three different kinds of tests regarding strength and durability:

- Static tests: loads which are applied slowly on the furniture, mainly to test strength
- Dynamic tests: loads which are applied rapidly on the furniture, mainly to test strength
- Cyclic tests: loads which are applied slowly many times, mainly to test durability

The loads we are using in the tests are distributed over the whole surface and are thusly not point loads (loads which are applied on a very small area)

Mock up 4 – FRID
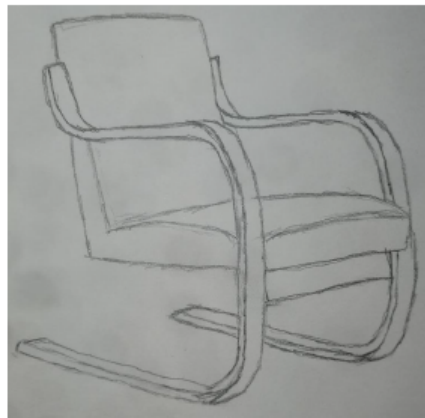
FRID
Article: 11341

3799:-

Available in several colors

[Add to cart]

Product description

An elegant and nice armchair which fits in most environments with a design which offers great support.

Product specifications

Materials	Pinewood, Cold foam, Plastic, Polyester
Color	Gray
Height	93 cm
Width	67 cm
Depth	60 cm
Seat height	45 cm
Seat depth	50 cm
Weight	30 kg
Loading capability	110 kg

Loading capability:

We are testing the furniture regarding strength and durability based on a person who weighs up to 110 kg. Tests use loads which are applied slowly, applied rapidly/free falling and applied slowly several thousand times. This to represent ordinary domestic use.

Appendix C – Analysis of questionnaire data

Respondent distribution of families with kids living at home

Distribution of the respondents who had thought, not thought, sought and not sought information about loading capabilities of any kind furniture whether they had kids living in their household is presented in table 29 below.

Table 29 - respondent distribution of families with kids living at home

	Had no kids living at home	Had kids living at home
Have thought - complete	79,3 %	20,7 %
Have not thought - complete	79,2 %	20.8 %
Have sought - complete	74,1 %	25,9 %
Have not sought - complete	80,6 %	19,4 %
Have thought – reduced	70,4 %	29,6 %
Have not thought – reduced	63,6 %	36,4 %
Have sought - reduced	85,5 %	14,3 %
Have not sought - reduced	58,3 %	41,7 %

Relative Important Index (RII)

Table 30 below presents the RII values and categories, the same headings as previously brought forward are used.

Table 30 - RII analysis

	All respondents	Had thought	Had not thought	Had sought	Had not sought
Armchair	0,59 (Medium)	0,65 (High-Medium)	0,54 (Medium)	0,66 (High-Medium)	0,57 (Medium)
Sofa	0,61 (High-Medium)	0,67 (High-Medium)	0,56 (Medium	0,68 (High-Medium)	0,59 (Medium)

Number of times sitting down in an armchair or a sofa

In table 31 to 34, the distribution of the respondents' answers of how many times they and those living in their household sit down in a sofa or an armchair are presented and grouped after the size of the household in number of persons.

Armchairs - Complete

Table 31 - Armchairs complete

	1-6 times a week	1-10 times daily	11-20 times daily	21-30 times daily	More than 30 times daily
1 person	71,4 %	21,4 %	7,1 %	-	-
2 persons	50,0 %	41,7 %	8,3 %	-	-
3 persons	41,7 %	58,3 %	-	-	-
4 persons	60 %	20 %	20 %	-	-
5 persons	33,3 %	33,3 %	33,3 %	-	-

Armchairs - Reduced

Table 32 - Armchairs reduced

	1-6 times a week	1-10 times daily	11-20 times daily	21-30 times daily	More than 30 times daily
1 person	-	66,7 %	33,3 %	-	-
2 persons	-	100 %	-	-	-
3 persons	-	-	-	-	-
4 persons	42,9 %	28,6 %	28,6 %	-	-
5 persons	-	-	-	-	-

Sofas – Complete

Table 33 - Sofas complete

	1-6 times a week	1-10 times daily	11-20 times daily	21-30 times daily	More than 30 times daily
1 person	19,4 %	61,3 %	19,4 %	-	-
2 persons	6,8 %	74,6 %	15,3 %	3,4 %	-
3 persons	11,8 %	76,6 %	-	5,9 %	5,9 %
4 persons	15,4 %	61,5 %	15,4 %	-	7,7 %
5 persons	20,0 %	60,0 %	20,0%	-	-

Sofas - Reduced

Table 34 - Sofas reduced

	1-6 times a week	1-10 times daily	11-20 times daily	21-30 times daily	More than 30 times daily
1 person	33,3 %	66,7 %	-	-	-
2 persons	33,3 %	50,0 %	-	-	-
3 persons	-	100 %	-	-	-
4 persons	-	100 %	-	-	-
5 persons	-	100%	-	-	-

Appendix D – Recommended loading capability levels

The loading capability levels presented below are brought forward by Hi (2003), a previous organization within the field of assistive products. The levels are set as user weight and concerns the following products; moveable toilet chairs, toilet seat heightener, armrests and backrests to be mounted on a toilet and bath and shower chairs.

User weights:

- 25 kg
- 35 kg
- 50 kg
- 75 kg
- 100 kg
- 120 kg
- 135 kg
- 150 kg

Appendix E – Risk analysis of usage of sofas and armchairs

The UPN value was calculated through the formula presented below and the occurrence and severity scale are presented in table 35. The visualization of the risk analysis is shown in figure 18 below.

$$UPN = Occurrence \times \frac{Occurrence\ of\ approach}{5} \times Severity$$

Table 35 - Description of the occurrence and the severity scale

Occurrence scale		Severity scale	
1	Rarely happens	1	Low magnitude of severity and force
2	Happens > 10 % of the time	2	
3	Happens > 30 % of the time	3	
4	Happens > 50 % of the time	4	
5	Happens 100 % of the time	5	Highly severe, major forces involved

- Falling down means that the body is falling freely from a height about 200 mm above the seat pan.
- Sitting down hard means that the body is falling freely from a height about 40 mm above the seat pan.
- Sitting down easy means that the body is sat down on the seat in a controlled manner, no free falling is involved.

Figure 18 - Risk analysis

Process	Part/item	Occurance	Approach	Occurance of approach	Severity	UPN	Color coding
Sitting down	In the middle of the seat	4	Falling down	1	5	4	
			Sitting down hard	3	4	9,6	
			Sitting down easy	4	2	6,4	
	On the front edge of the seat	2	Falling down	1	5	2	
			Sitting down hard	2	4	3,2	
			Sitting down easy	4	2	3,2	
	On armrest	2	Sitting down hard	1	4	1,6	
			Sitting down easy	4	2	3,2	
	On the backrest	1	Sitting down hard	2	4	1,6	
			Sitting down easy	4	2	1,6	
Sitting	In the middle of the seat	4	Sitting	-	1	4	
	On the front edge of the seat	2	Sitting	-	2	4	
	On armrest	2	Sitting	-	2	4	
	On the backrest	1	Sitting	-	2	2	
Standing	In the middle of the seat	1	Standing	-	4	4	
	On the front edge of the seat	1	Standing	-	3	3	
	On one armrest	1	Standing	-	2	2	
	On two armrests	1	Standing	-	2	2	
	On the backrest	1	Standing	-	2	2	
Walking	On the seats	1	Adults walking	2	5	2	
			Kids walking	4	3	2,4	
Jumping	On the seats	1	Adults jumping	1	5	1	
			Kids jumping	4	4	3,2	
	On armrest	1	Adults jumping	1	5	1	
			Kids jumping	2	4	1,6	
Getting up from furniture	Using the seat	2	Pushing down with hands	-	1	2	
	Using one armrest and other area	2	Pushing down with hands	-	1	2	
	Using two armrests	3	Pushing down with hands	-	2	6	
	Using backrest	1	Pushing down with hands	-	1	1	
Climbing	Whole piece of furniture	1	Adults climbing	1	4	0,8	
			Kids climbing	4	3	2,4	
Moving	Whole piece of furniture	2	Lifting one side	4	2	3,2	
			Lifting whole piece	1	3	1,2	
			Pushing it around	3	2	2,4	
Sitting perpendicular to backrest	Seat/armrests	2	Sitting with legs and or back supported by armrests	-	2	4	
Swinging side-to-side	On the seats	1	Swinging	-	2	2	
Laying down	On the seats	3	Laying down	-	1	3	