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Kano Model Deployment and its Relation to Customer Centricity

A study at a Swedish Machine Guarding Safety Company

Master's thesis in Quality and Operations Management

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Cover: Example of the Safety Simplifier (*The Product*) used in an industrial setting. An emergency stop push button is connected to the Safety Simplifier which is mounted on the side of a machine from where it can send signals wirelessly to other Safety Simplifiers.

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Summary

Many companies strive to become more customer centric due to its many advantages in the competitive landscape of today. However, to become truly customer centric is difficult for many companies. The case company of this study is developing a safety-PLC for the machine guarding safety industry and is aiming at becoming more customer centric. Hence, the purpose of this study is firstly to map how the users of machine guarding safety-PLCs rate the attributes according to the Kano model. Secondly, to elaborate on how the results from the Kano model can be used by companies to be become more customer centric.

Eleven interviews were conducted with company representatives, retailers, and machine guarding safety users to map customer needs and requirements. Following the interviews, a survey was distributed to gather the information needed to classify the attributes according to the Kano model. The sampling method can best be described as a combination of quota sampling and snowball sampling, and it resulted in a sample size of 132 respondents.

The result reveals that twelve of the twenty attributes are rated as Attractive, while the other eight are rated as Indifferent. There are some tendencies that the Steel & Metal, and Automation industries are more positive towards the attributes that are included in this study. However, no consistent or noteworthy differences are present when the results are segmented on company size or respondents' position.

It can be concluded that the Kano model provides necessary insights on customer needs and preferences which is a key aspect of customer centricity and thus can facilitate a company's strive towards it. However, becoming customer centric is a multifaceted concept which includes several factors, e.g., organizational changes, therefore the Kano model can only provide a small, although important, fraction of the tools and actions needed.

Keywords: Machine guarding safety, Safety-PLC, customer centricity, Kano-model

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Jacob Stegemyr & Lukas Thell, Gothenburg, May 2021

Abbreviations

AGV	***Automated Guided Vehicle*** – A mobile robot used in production.
HoQ	***House of Quality*** – A design tool that provides interfunctional planning and communication. Part of the Quality function Deployment framework
I/O	***Input/ Output*** – The communication between a processing system, such as a PLC, and another processing system or a human.
IOCM	***Inconsistent Ordered Choice Model*** – A model to measure customer preferences with regards to product features.
IPA	***Importance – Performance Analysis*** – A model to compare attribute performance in regard to its importance.
Machine guarding safety	A collective term for all products used in production to keep humans, products, and machines safe.
OEM	***Original Equipment Manufacturer*** – A company which produces and sells components to another company which then uses it in their final product.
PFHD	***Probability for dangerous Failure per Hour*** – One of the measurements to calculate the performance level of a safety system.
PL	***Performance Level –*** A value to define the ability of safety related parts to perform under foreseeable conditions. Ranked between performance level A to E.
PLC	***Programmable Logic Controller –*** An industrial computer, programmed to control machines in e.g., manufacturing processes.
QFD	***Quality Function Deployment*** – A product development framework to transform or link the voice of the customer, i.e., customer preferences, to product characteristics.
Safety-PLC	A programmable logic controller that allows for both safety- and standard control of a machine to detect any failures that might occur.
SIPA	***Sentiment Importance Performance Analysis*** – A framework for measuring customer preferences. Based on a combination of the IPA- and the IOCM model.
SME	***Small and Medium Enterprise –*** Businesses with number of employees, revenue or assets that fall below a certain limit
CAN-bus cable	***Control Area Network-bus cable –*** A system that allows for fast transmission of data by treating all devices as equal

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1 Introduction

Customer centricity is of outmost importance in the competitive landscape of today. This introductory chapter entails a review of previous research in the field of customer centricity and the Kano model, and a detailed background of the case company. The purpose of the study is to categorize the attributes of a machine guarding safety-PLC according to the Kano model and furthermore, to elaborate on how the Kano model can be used by companies to become more customer centric.

1.1 Background

The gains from innovating with the customer in focus are many. However, this is difficult for many companies to fully implement, which leads to them keeping their main focus on the product rather than the customer. It is possible that the Kano model, a model known for its ease of use, could facilitate companies to become more customer centric. This idea is elaborated on in the sections below, together with a description of the company used as the case company throughout the study.

1.1.1 The Relevance of Being Customer Centric

Small sized companies are key players in the Swedish economy and the ones with less than 50 employees constitute for 40 percent of the Swedish gross domestic product (Persson, Basfakta om företag, 2020A). Out of these small sized companies, approximately half have developed and sold new or greatly improved products or services over the last three years which can be used as a very rough measurement of innovation in a company (Persson, 2020B). However, using this measurement of innovation, it shows that service companies, with 50 percent of the companies having innovated in the last three years, tend to be more innovative compared to industrial companies where 39 percent had innovated. Innovation can be value adding and is important for the performance of these small- and medium sized enterprises (SME) (Rosenbusch, Brinckmann, & Bausch, 2011). Even though innovation comes with inherent risks and high costs, the benefits it brings in terms of differentiation from competitors, customer loyalty, price premiums and entry barriers for imitators to mention a few, exceeds the potential

drawbacks in many cases (Rosenbusch et al., 2011). The innovation impact becomes even more significant when product innovation is combined with strategic orientation innovation i.e., not merely developing an innovative product but also the strategic implications like to whom and how the product should be sold (Rosenbusch et al., 2011).

Though there are great gains in approaching innovation with a broader perspective than solely focusing on the product itself, companies tend to keep their focus on just the product anyway. Historically, economies of scale and scope have been key to gain market shares which in turn was the leading factor for achieving profit (Shah, Rust, Parasuraman, & Richard, 2006). This has led to companies being more focused on developing superior products rather than looking to the actual needs of the customers and users of the product thus resulting in a relatively internal viewpoint (Shah et al, 2006). Shah et al. (2006) presents the idea that many companies today lack the customer-centricity to really understand the benefits that comes with it. The customer-centric viewpoint as opposed to the product-centric one suggests a couple of aspects that separates the two. For example, a customer-centric approach is relationship-oriented, highlights benefit in terms of meeting customer needs and uses a portfolio of customers as their management criteria (Shah et al, 2006). Comparing a customer centric company to a product-centric company, which is transaction-oriented, highlights product features and uses product portfolio as their management criteria, the overarching difference in the companies approaches towards how they drive business is beginning to clear.

It is suggested that a good product is no longer enough if companies are to compete in the even more customer-oriented economy of today (Valls Giménez, 2018). Understanding customer needs in terms of product type and functionality, price and channel will be core competencies to thrive and remain innovative. To know what customers value in a product and incorporate that into the company's value proposition while addressing the right target customer groups, accounting for the competitive scenarios and the differentiating benefits of the offering, are evermore crucial in the strategic development of the company (Valls Giménez, 2018). Understanding the customers' needs enables companies to achieve a greater loyalty and in return allows them to follow the growth of the customer, which is key, not least in the industrial market since it is difficult to gain new customers in that industry (Campbell & Cunningham, 1983). Remaining product-, rather than customer-centric and having inadequate understanding of the customer needs has, to mention a few, negative implications on the level of innovation,

competitiveness, and strategic performance of companies especially in the industrial markets and thus needs to be addressed.

Being customer centric is a broad concept and involves many aspects of how an organization operates, however there are specific methodologies and tools deployed to support the quest towards it (Shah et al, 2006). The Kano model is one such tool that is used for measuring and categorizing customer preferences relative to specific product attributes and the method has gained popularity in literature in recent years (Kreuzer, Röglinger, & Rupprecht, 2020). Hence, depending on the situation, the Kano model could pose as a potentially useful tool for a company wanting to take a step closer to becoming more customer centric.

1.1.2 Description of *The Company* and *The Product*

To research how customer preferences and the Kano model can be used to become more customer centric, this study is conducted at Safety System Products North, a company aiming at doing so when they develop and deliver value through their products to the Swedish market. Safety System Products North (hereafter called *The Company*) is a small sized Swedish actor in the machine guarding safety industry.

The Company is family owned with the founder being the majority owner, a European partner company's majority owner has some ownership of *The Company* as well, and the rest of the shares are divided between employees. With roughly five years in operations *The Company* is in a relatively early and entrepreneurial phase and is building an organization that currently consists of an R&D-, sales- and aftermarket function. Even though *The Company* is quite new, there is a lot of know-how and market experience aggregated among the employees from being active in the machine guarding safety industry for many years.

The Company develops and assembles an innovative programmable logic controller (PLC) product named The Safety Simplifier (hereafter called *The Product*), that simplifies the way safeguarding systems for industrial applications are installed and managed. A PLC is a small computer used for controlling machines mainly within the manufacturing industry. *The Product* is sold both separately and as a part of a broader product offering within machine safeguarding solutions. *The Product* is developed by *The Company* with sourced parts from a

third-party supplier. The other products in *The Company's* offering are developed by the European partner company. *The Product* itself is a hardware product but comes with an internally developed software program for installing and managing *The Product*. One of the innovating features of *The Product* is that it is a distributed system, and that it can communicate wirelessly between the distributed units. Apart from using *The Product* to safeguard industrial machines, *The Product* could also be used for other industrial applications to merely control the machines to do certain things rather than having a specific safety related function. In other words, the application areas are much bigger than just machine safeguarding.

The whole product line, including *The Product*, is sold both by *The Company* as well as by the European partner company. The two companies share the same product portfolio. The whole product line is currently sold mainly through the European partner company's domestic market but also in the Nordic market with the majority in Sweden. The sales organizations are separate, and the cooperation could best be described as cross-selling. *The Company* is currently selling the majority of *The Product* through the partner company at their domestic market. They do so through an annual contract with predefined sales volumes. The remaining sales volumes are sold through a partnered retailer (hereafter *The Retailer*) and machine guarding safety installation firms in Sweden but also the other Nordic markets.

1.1.3 The Challenge of *The Company*

The Product has so far received good response from the market and new potential customers are continuously showing interest. *The Company* has for some years solely been distributing these products through other middle hands, being retailers, partner companies and installation firms. To scale their business, *The Company* is now looking into both expansion into new customer segments, application areas, and geographical markets in the Nordics. While looking at potential ways of doing this *The Product* is consistently developed to include new and improved features. For them to successfully address end-users and OEMs with both the right type of marketing and to make sure their product satisfies the specific challenges of the different customer segments, they need to improve their customer-centricity. By gaining deeper understanding of the customer needs, how they should prioritize these in the development of *The Product* and how these needs might differ between customer segments *The Company* aims

at developing insights to support their growth in the Swedish market and further develop *The Product* efficiently.

1.1.4 The Relevance of the Kano Model for *The Company*

With the requisites presented in the previous sections it is possible for *The Company* to work towards becoming more customer centric and further improve their products. Existing literature and product development theory proposes several methodologies and tools for discovering customer needs, and importance of different product characteristics. Examples of these methods and tools are the Kano model, Discrete Choice Modeling (DCM) and Quality Function Deployment (QFD). Given the situation of *The Company*, having limited resources and many development opportunities, the Kano model should be of great use given their aim at becoming more customer centric. By conducting the Kano model for *The Product, The Company* should receive guidance on how to prioritize the development of new product features based on user preferences.

The Kano model, originally created by Noriaki Kano, was the first to differentiate functions on how they satisfy the need and preferences of customers. Prior to Kano 's work, it was assumed that customer satisfaction is proportional to the level of fulfillment of each functionality (Matzler, Hinterhuber, Bailom, & Sauerwein, 1996). This is the case for some product attributes, which are called *One-dimensional* attributes. However, Kano (1984) identified that there also exist *Must-be,* and *Attractive* attributes. Must-be attributes are attributes that are expected by the customers and therefor never create a feeling of satisfaction even if it is fulfilled perfectly. The *Attractive* attributes are attributes that are not expected or required by the customers, but when they are fulfilled, they create a feeling of satisfaction (Matzler et al., 1996).

Matzler et al. (1996) developed the Kano model further and presented a method to determine the different attributes of a product. The authors also describe two more categories of attributes, namely *Indifferent* and *Reverse* attributes. Indifferent attributes are such that the customers do not care about them, the degree of fulfillment does not create either satisfaction or dissatisfaction. Reverse attributes are a bit different in the sense that the dissatisfaction increase when the level of fulfillment increase.

Matzler et al. (1996) state that there are many advantages with using the Kano model to classify the customer preferences. Some of the advantages are the possibility to differentiate products by fulfilling attractive attributes, and the possibility to segment and target the customers depending on their preferences. These are advantages that should be of great use for *The Company* to support their mission to become more customer centric and develop their product further.

However, the usefulness of Kano model has not been elaborated on, in the context of becoming more customer centric before, and there is limited research on strengths and weaknesses of the Kano model when using it as a tool to become customer centric. These circumstances and the strategical challenges that *The Company* is facing motivate the purpose of the thesis.

1.2 Purpose

The main purpose is to map what attributes the users of machine guarding safety-PLCs in Sweden classify as Attractive, One-dimensional, Must-be, Indifferent or Reverse according to the Kano model. Furthermore, the purpose is to elaborate on how the results from the Kano model can be used by companies to be become more customer centric.

1.3 Research Questions

To fulfil this purpose the following questions are answered in the thesis.

- What classification do the attributes of a machine guarding safety-PLC get according to the Kano model?
- What are the differences in classification of attributes between customer segments?
- How does the Kano model relate to customer centricity?
- How can the Kano model be used to increase customer centricity?

2 Method

This chapter presents important aspects to assess in terms of the methodology used in the study, such as research approach, - strategy, - processes, - quality and - ethics.

2.1 Research Approach and - Philosophy

The research was based on already known theory within the domain of customer centricity in general, and the Kano model in particular. The Kano model is further explained later in section 3.3. From the existing literature (Berger et al, 1993; Matzler et al.,1996), a hypothesis was formed, namely that the Kano model could be useful for improving the fit between products' attributes and customers' preferences in the machine guarding safety industry in the context of increasing *The Company's* customer centricity. To test this hypothesis, it was necessary to collect data and compile empirical findings. The empirical findings were analyzed and compared to the prevailing theory, with the purpose to either validate the previous theory or to invalidate the theory if necessary. This is referred to as a deductive approach (Bryman & Bell, 2011). The deductive approach was appropriate since an existing method, i.e., the Kano model, was applied in a new setting and elaborated with regards to another research area, i.e., customer centricity (Bryman & Bell, 2011). The deductive research approach is often associated with the epistemology which stems from natural science – positivism. Positivism implies that it would be possible to measure, collect data and create explanatory, general models from the data (Bryman & Bell, 2011). However, since interviews and other qualitative methods were used the research group needed to interpret and evaluate data. Hence, the epistemology approach could also be considered as interpretivism. Interpretivism is a theoretical stance that the researchers cannot fully remove their own beliefs and values (Bryman & Bell, 2011), thus the research will be a result of the persons socially interacting to yield a subjective result.

2.2 Research Strategy

The research strategy was mainly qualitative, but with some elements of quantitative analysis. This was a result from the process of conducting the Kano model proposed by Matzler et al. (1996). The combination of both quantitative and qualitative data in research is more common and accepted today than it used to be (Bryman & Bell, 2011). However, it is not accepted by

everyone and it is important that the use of a mixed approach is motivated and not only conducted because of "more is better" (Bryman & Bell, 2011). The qualitative aspect of the study includes both interviews and qualitative elements of a survey. The qualitative research strategy which was deployed through the interviews was motivated by the fact that the learnings from these interviews partly laid the foundation for the questions used in the more quantitative survey. The rationale behind the use of some quantitative approach in this thesis was that Kano questionnaire will induce the need of sampling. Moreover, some analyses of the respondents' answers were inspired by a quantitative approach, even though the answers were of qualitative descent.

2.3 Research Process

The research process can be divided into three main processes; the initial set-up phase, interviews to increase knowledge about the market and customer requirements, and the deployment of the Kano model. The Kano model is quite extensive and is therefore divided into three different subsections, namely *Kano Questionnaire Content*, *Creating and Administrating the Survey*, and lastly *Analysis of Kano Questionnaire.*

2.3.1 Initial Set-up Phase

The first step of the research process was to better understand the market and the entities that were to be studied. These can be summarized as *The Company*, *The Product*, and the potential customers of *The Product*. The main source of information about *The Company* and *The Product* was gathered through unstructured interviews with the *CEO* and the *Business Developer* of *The Company.* The research group also received training on how *The Product* operated and how it was programmed by one of the developers at *The Company.* The unstructured interview was appropriate because of two different reasons. Firstly, the form of interviewing is fitting when the interview is to be conducted only once, and therefore does not need to be repeated or compared to other interviews (Bryman & Bell, 2011), which was the case for this instant of the project. Secondly, the gap in knowledge on the subject was immense, and the main goal of the meeting was for the research group to better understand the view of the *CEO* and employees of *The Company*. According to Bryman and Bell (2011), for an

interview with this purpose, the unstructured interview is advantageous since the respondents in this setting have more control of what subjects to cover.

2.3.2 Interviews

Before the Kano questionnaire was designed there were some prerequisites that needed to be fulfilled. The questionnaire format required that the research group had good knowledge of the product attributes that should be categorized before the questionnaire was sent out. Some attributes were identified simply by mapping existing attributes of *The Product* and its competitors through desk research and unstructured interviews with the *CEO* and the *Business Developer* of *The Company*. However, some attributes are not invented yet and would therefore be overlooked if these were the only methods used to identify possible product attributes.

One method to cope with this problem is proposed by Matzler et al. (1996), which is to interview the customers with focus on problems, expectations, and desires. The method used to determine respondents can best be described as snowball sampling. This is a technique where the researchers make initial contact with a small group of people who then refer to new potential respondents (Bryman & Bell, 2011). This was executed by the *Business Developer* at *The Company* providing contact information to some employees at *The Retailer*, who in turn communicated new contacts to interview. In total, five interviews were conducted with *The Retailer*. A set of questions were written and used as a basis for the interviews with the employees of *The Retailer*. The questions were divided into subgroups with more detailed questions in each subgroup. The subgroups' question themes regarded the respondents professional background, description of their current daily work process, challenges, and problems they experienced while working with machine guarding safety, thoughts on some proposed product attributes, competitors, and trends and lastly any information they wanted to add themselves. The interviews were semi-structured. To increase the possibility of identifying latent and implicit needs, such as Attractive attributes and Must-be attributes, some special techniques were used. As Matzler et al. (1996) propose, questions such as "What are the greatest problems and challenges for the customers during the installation process?" were asked to identify latent needs. For a overview of all interview questions, see Appendix D.

The rationale for interviewing *The Retailer* was to get their gathered experience from working with *The Product* at several different customers in different industries. Thus, *The Retailer*

provided insightful and broad know-how of *The Product* as well as frequent challenges both they and the end users faced when dealing with *The Product* and similar products. In order to get the unfiltered aspects of the customers viewpoint on working with machine guarding safety products and safety-PLCs in particular, interviews with both current- and potential end users of *The Product* were conducted as well. The respondents were found by searching the web for people working with machine guarding safety within different industries. The interview questions were adjusted to better fit the perspective of an actual potential end user rather than a retailer, see Appendix D for an overview of the interview questions. A total of six interviews with end users and OEMs were conducted. At the end of each interview the respondents were asked if they would be willing to participate in a survey that if so, would be sent out to them in the coming weeks. Below is an exhaustive list of all interview respondents and their employer and position, see Table 1. Note that the names of the respondents are fictitious.

Table 1 - Interview respondents

Fictitious Name	**Company**	**Position**	**User type**
Per	*The Retailer*	Business Area Manager - Sweden	Retailer
Torgny	*The Retailer*	Product Manager - Finland	Retailer
Magnus	*The Retailer*	Sales - Southern Sweden	Retailer
Olle	*The Retailer*	Sales - Eastern Sweden	Retailer
Wilhelm	*The Company*	Co-owner of *The Company* and its partner company - Germany	Retailer
Tim	SKF	Automation engineer (on leave to study)	End user
Robert O	SKF	Project leader	End user
Benny	Malmö Ljus och Kraft - MLK	Machine safety specialist	End user
Markus	Toyota Material Handling	Machine safety specialist	End user
Pontus	Volvo Cars	Machine safety specialist	End user
Robert E	Domino Printing Sciences	Area Manager Special Solutions	End user

Each interview lasted about one hour and was recorded with the consent of the respondent to be able to review the interviews in case some information was missed or misinterpreted during the interview. Notes of the respondents' answers were taken during the interview, these later laid the foundation for the summarization of the results from the interviews. Once all eleven interviews were completed, based on the notes, commonalities and differences across the different interviews were analyzed. The findings from the analysis were summarized and can be read in Appendix C. These summaries would later be a building block for the design of the Kano questionnaire.

An efficient method to identify latent needs are to observe the customers when they use the product (Matzler et al., 1996). However, since the customers rarely interfere with the machine guarding safety product, e.g., installation or maintenance, and since the Corona virus heavily limited the possibility to visit companies, the observations needed to be replaced with interviews. Interviews are not considered as the best method to find latent needs (Matzler et al., 1996). However, it was possible to mitigate this by including questions where the respondents were asked to describe their entire daily work process step by step, as describe previously. By asking the respondent to thoroughly describe the work process it is much more likely that some latent needs are mentioned.

2.3.3 Kano Questionnaire Content

When designing the Kano questionnaire, the mapping of a products current or potential future attributes is the foundational building block (Matzler et al., 1996). As described in section 2.3.1 the first step of the attribute discovery process was to study the product manual and conduct workshops with *The Company*. A list of currently existing but also potential future product attributes were constructed and served as a basis for further research. The second step involved the discovery of product attributes of products from competing brands. A list of competing products was analyzed together with the *CEO* of *The Company*. This allowed for a more exhaustive mapping of product attributes currently offered in the market, not only *The Product's* own attributes. The third step was to include the stated needs of the end users from the interviews as well as translating their challenges and problems into concrete attributes. The fourth and last step of finalizing the gross list of potential product attributes to survey was to add any own ideas on product attributes that had surfaced during the process. Before adding these own ideas, they were once again discussed with the *CEO* and *Business Developer* of *The*

Company to get their experienced view on them to assure their relevance. Step three and four aimed at including potential future attributes, thus together with step one and two make the discovery process more exhaustive by capturing both existing as well as non-existing attributes.

The attributes were filtered to sort out any attributes that potentially could be considered overlapping or all to similar. In order to keep down the required time for taking the survey, a maximum of 20 attributes was decided to be included in the survey. The filtered gross list of attributes was carefully screened in collaboration with *The Company* to include the attributes that were considered most relevant. To make the results as insightful as possible, it was decided in accordance with *The Company* to mainly include attributes that were considered somewhat deviating from the standard set of attributes of a safety-PLC. The rationale for choosing to survey these attributes was to gather insights on customer preferences regarding features that could help *The Product* stand out and excel from the rest of the market. The Kano model demanded the mapping to be conducted by asking one functional and one so-called dysfunctional question related to each of the attributes (Matzler et al., 1996). Since there were 20 attributes to classify, the final questionnaire contained 40 Kano questions regarding the product attributes. E.g., for the attribute regarding wireless connection the functional and dysfunctional questions were phrased as follows.

Functional:

If your safety-PLCs could communicate wirelessly with each other, how would it make you feel?

Dysfunctional

If your safety-PLCs could not communicate wirelessly with each other, how would it make you feel?

For a full disclosure of the questions see Appendix B. All questions were written in both Swedish and English to enable for as many respondents as possible to take the survey. The phrasing of functional and dysfunctional questions for the 20 attributes were carefully iterated with *The Company* to assure a clear description of the attribute and avoid any misconceptions. Once the set of questions were finalized, they were tested on the project's supervisor and persons with experience from working with machine guarding safety products. The purpose of the test was to capture any miswording that made the questions ambiguous. The survey was adjusted based on the test persons' feedback.

2.3.4 Creating and Administrating the Survey

SurveyMonkey was used as the tool for collecting responses. It was chosen mainly because it was possible to prompt the pair of functional and dysfunctional questions side by side. This made the survey easy to overview for the respondents. Moreover, SurveyMonkey provided functionality such as sending individual links to different groups of respondents and allowed for both an English and Swedish version for the respondents to choose from.

The demographical section that was used to understand respondent background and later group the respondent into segments (Berger, et al., 1993) contained eight questions, with the purpose to enable a deeper analysis of the answers provided by the respondents. With the answers to the demographical questions, it was possible to create contingency tables when presenting the results to find interrelations between attributes classifications and demographical aspects such as industry belonging, or respondents' position at their companies. All the demographical questions that were prompted to the respondents, and the answer options that they were given, are presented in Table 2 on next page.

Table 2 - Demographical questions and the answer options

Question	Answer Options
In what industry do you work?	Automotive industry Steel and metal industry Robot & Automation industry Supplier and component industry Plastic industry Packaging industry Warehouse industry Construction industry Wood working industry Food industry Pharmaceutical industry Consulting industry OEM & Machine building industry Other (please specify)
What company do you work at?	Free form text response
How big is the turnover of your company?	Less than 50 million SEK 50-99 million SEK 100-500 million SEK 500-999 million SEK 1-10 billion SEK More than 10 billion SEK I don't know
How many employees are you at your company?	Fewer than 10 10-49 50-249 250-500 More than 500 I don't know
What position do you have at the company?	Free form text response
How many years of experience do you have from working with machine safety?	Free form text response
Which manufacturer do you use for your machine safety products currently?	ABB/Jokab Siemens SICK Pilz Rockwell Automation Schmersal Beckhoff Omron Schneider Electronics Bihl + Wiedermann SSPN Safety System Products North Other (please specify) None of the above

The answer options to the question about industry belonging stem from *The Company* and are all industries in which they believe that they have potential customers. The question regarding company size, both number of employees and turnover, might seem a bit redundant since the questionnaire also included a question on what company the respondent worked at. However, the reasoning was that not everyone would be willing to state the company name, but that some of the respondents who did not want to disclose the name of their company at least would be willing to reveal turnover or how many that worked at the company. Since it was not expected that all respondents would know in detail how much turnover or number of employees that their employer had, these answer options were stated as intervals. The intervals were determined by using the definition of small and medium enterprises, in combination with using input from *The Company* and what they believed would be insightful.

The questions regarding amount of experience and what products from competing brands that the respondents use was asked due to the conclusions from Berger et al. (1993) that these are aspects that might affect the Kano classification. From previous interviews it was clear that the position of the respondent also affected how different attributes were rated, hence the question regarding position was included as well.

The sampling of respondents was of major importance for the study. The aim was to reach enough respondents so that unambiguous results could be derived from each defined demographical segment, also called quota (Bryman & Bell, 2011). From previous interviews and the literature, the hypothesis was that company size, industry belonging, and position at company was especially important factors when classifying attributes and these were used when the respondents were targeted. There were no databases available for targeting respondents, instead the respondents were found through industry specific fairs' websites which made it possible to ensure that a good spread of industries was approached. To find respondents from large companies, fairs were not sufficient since most companies that attended them could be classed as either small or medium sized companies. To manage this, respondents from some of Sweden's largest manufacturing industry companies, by market capitalization, were targeted as well. Employees from the companies were targeted based on their position, such as automation engineers, production leaders, production maintenance, and project leaders in production, at the companies, either identified through the companies' websites or through LinkedIn.

The respondents were approached with e-mail in five different batches. Two of the batches contained targeted respondents found at fairs' websites, one batch included targeted respondents from large companies, and two batches were targeted respondents that were shared by *The Company* that they had been in contact with before. The respondents that were of highest importance were rung by phone to increase the probability that they would complete the survey or distribute the survey to other respondents that could answer the questionnaire. In all e-mails that were sent to the targeted respondents, they were asked to distribute the questionnaire to any person that they knew would have sufficient experience to answer the survey. This proved to be fruitful, many people that acted as CEOs at their companies, especially in the SMEs, forwarded the e-mail to more knowledgeable persons in their organization and asked them to participate in the survey. One of the targeted respondents even answered through e-mail that he forwarded the e-mail to over 2,000 persons in the Swedish OEM and manufacturing industry through a branch organization where he was active. This of course affects the possibility to track what respondents that has been targeted, but it was judged as overall positive since it increased the number of respondents drastically.

The collection method can thus be described as mainly quota sampling, but with some element of snowball sampling. Quota sampling is a very common method in commercial research, and it is similar to stratified random sampling with the major difference that the sampling is not carried out randomly (Bryman & Bell, 2011). With the addition of having respondents forward the e-mail to persons that they believed would fit for the survey, the sample cannot in any sense be called random, and it is not possible to make any statistical generalized conclusion about the population (Bryman & Bell, 2011). However, the main goal was not to make any generalized conclusion about the population, mostly since the population is difficult to frame. Instead, the focus was on getting as many respondents as possible to ensure that some qualitative insights could be generated from the results.

Some of the best ways to increase the response rate is to explain the purpose of the research, why it is important and why the specific respondent has been selected (Bryman & Bell, 2011). This was implemented both in the e-mails that were sent, and in the opening of the questionnaire. Another effective method is to send reminders every other week to respondents that have not yet answered (Bryman & Bell, 2011). Since it was not possible to know which respondents that had answered the questionnaire, and not obvious who had received the e-mail through a forwarded e-mail, this would have been cumbersome. As a substitute, all the targeted

respondents received an e-mail when it was one week left until the survey would close. The e-mail contained a thank you to those who already answered the survey and reminded the rest that only one week was left until the survey would close. Another technique to increase the response rate is to begin the questionnaire with the questions that are of interest for the respondent (Bryman & Bell, 2011). Hence, the questionnaire was designed such that the questions related to customer preferences were in the beginning, and the demographical questions were asked in the final part of the questionnaire.

2.3.5 Analysis of Kano Questionnaire

Once the survey was closed, the data was extracted from Survey Monkey and cleaned up in Excel. Analysis on distribution of respondents by industry, position, revenue of company, and number of employees of companies were conducted. Additionally, the number of years of experience from working with machine guarding safety and the frequency of usage of different safety-PLC-brands. This analysis was conducted to paint a picture of the respondents and to assure that their background was relevant in terms of answering the survey.

The responses to the Kano questions were analyzed with the method presented in section 3.3 to categorize the different attributes according to the Kano model. The distribution of which category each attribute resulted in is presented in Table 15 and Figure 7. Additionally, to the original so called statistical mode method, each attribute was also analyzed according to the Blauth, Richter, and Rubinhoff classification (BRR-classification) and the *Better* and *Worse* indexes proposed by Mike Timko. The different classification methods were used to give a more nuanced result instead of only providing e.g., the statistical mode classification and thus receive a somewhat more one-sided result.

The first classification of the attributes was made on an aggregated level without segmenting on demographics. In the next step, the classification was segmented on industry belonging, position, and number of employees of the respondent's company so that one could see how respondents within each subgroup of the segments had categorized the attributes. The result from this analysis is presented in section 4.3.2. This analysis was conducted for *The Company* to get insights on attractive industries and positions to approach and for those cases what attributes they should emphasize to market themselves effectively.

2.4 Research Quality

The research methods used in the study, which are interviews and implementation of the Kano model, are assessed with validity and reliability as main criteria.

2.4.1 Validity

The validity of the Kano model refers to how well it measures customer preferences related to the attributes that are researched. The most simplistic method to determine validity is through face validity, which basically requires that experienced people agree that the measure has high validity (Bryman & Bell, 2011). The Kano method that has been used for this thesis is well known and accepted as a method to measure customer preferences (Berger, et al., 1993). Moreover, the method was discussed with responsible and experienced persons at *The Company*, and they also approved to measure customer preferences using this method.

Another method to assess the validity is through construct validity – which states that two different methods to measure the same phenomenon should generate the same results (Bryman & Bell, 2011). This was partly done by first interviewing customers and other stakeholders about their requirements, needs, and preferences and then follow up on the preferences by conducting the Kano questionnaire. The interviews and the questionnaire are inherently different and do not generate the same information, hence it is not possible to make a direct comparison between the two. However, when comparing the statement from the interview and the results from the questionnaire there are no obvious contradictions that suggests that the validity would be insufficient.

2.4.2 Reliability

The reliability of the methodology in this thesis is heavily connected to the Kano model. Kano himself has declared that the attributes do change classification over time, however this does not necessarily mean that the measurement is unstable, it might just be that the attributes are perceived differently over time (Löfgren & Witell, 2017). Mikulic and Prebezac (2011) did a critical review of variations of Kano classification models and found that the traditional approach that has been used in this thesis has high reliability.

Since it is not possible to measure variations in the results of the Kano model, it is difficult to assess the internal reliability in measures such as Cronbach's alpha (Bryman & Bell, 2011). The interviews and the empirical findings from the interviews are of qualitative nature and need to be assessed in this context as well. The equivalent to reliability in qualitative research is dependability, which refers to how transparent and accessible the work is to peers. To maintain a high level of dependability, all material that has been collected and gathered has been stored and saved for the stakeholders to review. Another contribution to maintain a good level of dependability is that all interviews that have been held have been recorded.

To maintain a high level of transferability, i.e., the possibility to transfer the findings from this context to any other context, it is recommended to strive for a detailed description (Bryman & Bell, 2011). This has been achieved in this thesis by including a background description of all interview respondents and *The Company*. Moreover, the demographical data about the questionnaire respondents was presented in the result chapter for the reader to review the background of the respondents.

2.5 Ethics

According to Bryman and Bell (2011) research ethics should consider four overarching areas. Each area has been taken into consideration during this study.

1. Whether there is *harm to participants* regards if any sort of harm e.g., physical, mental financial etc. has been inflicted on the participants of the study. No risk of such has been identified during the project, nor during interviews or survey.

2. Whether there is a *lack of informed consent* addresses the principle of providing the research participants with as much information as needed for them to decide whether to participate or not. The study has taken this aspect of ethics into consideration during both interviews and the survey. The respondents were informed that the interviews and survey was a part of a master thesis at Chalmers with the intent to gather customer preferences within machine guarding safety solutions and primarily safety-PLCs. All this with the aim of developing new and improving existing safety-PLC features. The

survey takers were informed that participation was completely voluntary and urged only to participate if they had previous work experience from machine guarding safety.

3. Whether there is an *invasion of privacy* concerns the right for the participant to remain anonymous as well as refuse to answer any questions. *The Company*, persons and partner companies closely associated with them have either given their consent to have their name published or been anonymized in accordance with their request. The names of the interview respondents were fictitious to anonymize them as well. The anonymized respondents' companies and positions are presented in the study to preserve the realism of the study. All interview respondents gave their consent to letting the interviews be recorded to enable reviewing of the material later in the study. When distributing the survey, e-mail addresses available to the public on company websites and in articles were used. A week before closing the survey all respondents received an email, thanking the ones who had already taken the survey and reminded the rest that the survey was to close by the end of the week.

4. Whether *deception* is involved is the ethical aspect of researchers presenting their research as something else than it is and Bryman and Bell (2011) state that it can be hard to know where to draw the line of what is deception and not. All participants in the study have been informed that the research is intended to gather insights on customer preferences regarding machine guarding safety-PLCs to contribute to innovation and development of new products. Thus, the risk of labeling the research conducted as deceptive seems farfetched.

In conclusion, several actions have been taken to achieve a high ethical standard in the study including informing participants of the research's intentions, assuring consent from participants and anonymize respondents and stakeholder who requested so. Since the study does not inflict direct or highly sensitive risks on the wellbeing of people or companies the general ethical risk of the study is to be considered low.

3 Theoretical framework

The theoretical foundation of the study, presented in the chapter below, is based on previous research on customer centricity, how the insights of customer preferences can be leveraged in the organization, and the Kano model. The theory elaborates on the importance of developing products and services based on the customers preferences and how this can be achieved. It also present different ways of using knowledge about customer preferences to change both the product and the customers' perception, and lastly how the Kano model can be used to gather these customer insights and when it can be considered useful and not.

3.1 Customer Centricity

Customer centricity is a concept of creating value in a company with the customer in focus. This chapter elaborates on the reasons for why companies should aim at becoming more customer centric and perhaps more importantly, how to do this.

3.1.1 Fundamentals of Customer Centricity

Customer centricity is a term that has been frequently used in business literature since the 1950s (Fader, 2020) but to actually achieve it is easier said than done. Shah, Rust, Parasuraman, and Richard (2006) state that being customer centricity is something companies tend to use as a buzzword, but building and sustaining it, particularly in large organizations, is rather hard. This standpoint is supported by Fader (2020) who argues that a lot of companies adopt customer centric thinking in some aspects of their business while leaving other parts out, making them somewhat halfway committed. Lambverti (2013) weighs in on the ambiguity of customer centricity by describing it as a fluid topic with varying definitions depending on what theory is used.

The essence of customer centricity boils down to creating value for the customer and thereby the firm rather than solely focusing on innovating new product features (Shah et al., 2006). Furthermore, Shah et al. (2006) describe this aspect of customer centricity as a process of dual value creation. This viewpoint is supported by Fader (2020) who defines customer centricity as a strategy that aligns a company's products and services with the needs of their most valuable

customers with the aim of generating more profit in the long term. Fader (2020) explicitly expresses that finding the most valuable customers is a key factor of customer centricity as long as the company does everything in its power to maximize the profit generated from them.

The definition of customer centricity can be compared with the one of product centricity which is when the technology, resources, product knowledge, systems and organization structure control the behavior of companies as opposed to the customer's needs (Gummesson, 2008). The differences between product- and customer centricity are described in Table 3.

Table 3 - Characteristics of product- and customer centric approaches, adapted from Shah et al. (2006)

	Product-Centric Approach	**Customer-Centric Approach**
Basic philosophy	Sell products; we will sell to whoever will buy	Serve customers; all decisions start with the customer and opportunities for advantage
Business orientation	Transaction-oriented	Relationship-oriented
Product positioning	Highlight product features and advantages	Highlight product's benefits in terms of meeting individual customer needs
Organizational structure	Product profit centers, product managers, product sales team	Customer segment centers, customer relationship managers, customer segment sales team
Organizational focus	Internally focused, new product development, new account development, market share growth; customer relations are issues for the marketing department	Externally focused, customer relationship development, profitability through customer loyalty; employees are customer advocates
Performance metrics	Number of new products, profitability per product, market share by product/sub-brands	Share of wallet of customers, customer satisfaction, customer lifetime value, customer equity
Management criteria	Portfolio of products	Portfolio of customers
Selling approach	How many customers can we sell this product to?	How many products can we sell this customer?
Customer knowledge	Customer data are a control mechanism	Customer knowledge is a valuable asset

Fader (2020) does not imply that product centricity does not work, merely that it is insufficient in many of the situations companies find themselves in today. In the past, technology, geographical locations, and regulations have posed as entry barriers against competitors for product centric companies. With the emerging globalization, geographical barriers are torn down, deregulations and technological leaps can make current technologies obsolete over a

very short period of time. Among these threats the customer relationship remains and is making the company more resistant to competition. These relationships are developed through customer centric solutions and hence the concept's importance to firms in today's fast moving competitive landscapes.

3.1.2 Achieving Customer Centricity

As Lambverti (2013) concludes, implementation of customer centricity is a firm-wide process that stretches across organizational behavior, inter-department-, and inter-firm dynamics but also that it does not suit every company since several of the necessary factors are partly exogenous variables. Shah et al. (2006) describes four common roadblocks that companies must address when moving from product - to customer centricity. These roadblocks can partly be tied to the four building blocks Lambverti (2013) uses to describe customer centricity namely, customer integration, interactive CRM, internal integration, and supply-chain integration. The four roadblocks Shah et al. (2006) proposes are described as.

1. **Organizational culture**, does to a large extent, concern the inherent norms or shared beliefs of, and in, the organization. Destructive norms for customer centricity could be that the sales organization "owns" the customer thus restricts information sharing and value creation. Also, the management and employee's commitment to spend time with the customer affects the culture. If the organization is reluctant to change, the sense of urgency to do so is low and management commitment is limited, the chances of succeeding in turning the organizational culture into one that nurtures customer centric thinking is greatly reduced. This ties to what Lambverti (2013) describes as internal integration which emphasizes organizational alignment and shared culture around customer-centricity. Lambverti (2013) bundles organizational culture and structures under internal integration in his framework.

2. **Organizational structures** made for product centric companies tend to have functional silos for specific product categories or types. This is said to align badly with customer centricity since managers tend to push the product that they are responsible for rather than basing their sales strategy on the customers' needs. A lack of coordinated customer focused activities across functional silos are often hindered by contending forces such

as incentives, backgrounds, task priorities and interests. This is often associated with a lack of accountability for customer relationship management which, in itself, often correlates with an insufficient marketing organization and customer centric issues in the boardroom.

3. **Processes** differ drastically between companies who create lasting customer relationships and who merely conduct transactions. Five key processes are highlighted in order to achieve customer centricity namely, the inclusion of a customer strategy in the overarching business-strategy developing process, dual value creating process, a multichannel integration process, an information management process and a performance assessment process. Key to succeeding with these are cross functional cooperation in firms. Matching a product to customers' requirements are highlighted as a main process task. To succeed with the latter, it is of utter importance to break down the customer base into different segments with each of their specific needs in order to realize how to serve these needs and approach the customers. Lambverti (2013) stresses on companies' ability to include customers in their value creating processes such as product development. Lambverti (2013) calls this customer integration and interactive customer relationship management, which focuses specifically on establishing a strong customer to firm-trust.

   The way process for performance measurement is used is another potential roadblock and it is suggested to use customer centric metrics such as share of wallet, customer processes and satisfaction rather than e.g., market share. This to receive a more accurate measurement of the company's goal of creating value for the customer. Firms need financial metrics and management practices that breeds possessiveness of the customers and not possessiveness of the firm's products.

4. **Financial metrics** are important for motivating individual employees, but in a customer centric organization, more so for guiding marketing managers and their investments. Guiding investments is particularly important since the shift from product- to customer centricity often involves substantial investments and hence the need to track their impact. It can be difficult to quantify the financial impact from investments in customer centric metrics such as satisfaction and loyalty. The use of customer equity, which is

the discounted lifetime value of each customer is recommended by Rust et al. (2004). It helps guide the allocation of resources among different customers.

Lambverti (2013) also presents the supply-chain perspective of customer centricity which is something Shah et al. (2006) do not elaborate extensively on. Lambverti (2013) suggests that a supply-chain, constructed so that a vast majority of the touch points between a company and the end users occur through, or are managed by a third party e.g., a retailer, will greatly restrict a company from developing a close relationship to the customer and hence run the risk of losing out on valuable input and preferences. One executive, interviewed by Lambverti (2013), stated that with almost 90 percent of the interactions with the company's customers being managed by a third party they could totally lose the possibility to interact with the customers.

Shah et al. (2006) also proposes four focus areas for a broad roadmap, applicable to any business aiming at becoming more customer centric. These could serve as a potential guide to a solution for the roadblocks mentioned above.

1. **Leadership commitment** is crucial and the backbone for initiating and sustaining customer centric initiatives. Three actions that signals leadership commitment are enthusiastic emphasis on superior quality on products, services and relationships, spending time with and listening to customers' needs while urging colleagues to do the same, and lastly during strategic reviews be vocal and put emphasis on the customer and market issues such as trends, needs and opportunities. Committed leadership provides a strong basis for the following three actions.

2. **Organizational alignment** regards structuring an organization that has a horizontal workflow instead of vertical. This would facilitate information sharing between functional units and bring e.g., the marketing function with lots of knowledge about the customer needs closer to the development of the product. This can be hard to do, and a hybrid version is suggested where the integrating functions such as business development coordinate and allocate resources to R&D which solely focuses on providing new ideas.

3. **Systems and process support** is needed as organizational alignment in itself is not enough. Horizontal organizations need horizontal processes to support it, this could be

that customer satisfaction is a product of employee satisfaction, thus does the HR bare part in the responsibility of the customer value creation. This will of course apply to other functions of the organization as well. For the systems support, it is crucial for a firm to have a centralized customer database with individual customer key datapoints, products purchased, and channels used. Managing and sharing costumer information in an organization wide database is a key component for efficient and high customer retention rate in a customer centric organization.

4. **Revised metrics** is important for the shift towards customer centricity since what gets measured gets done. Typical metrics used by customer centric firms are customer equity, customer satisfaction, customer advocacy and customer loyalty. To embrace customer centricity firms should embrace at least two or three key customer metrics as top performance indicators when reporting to the top management or board. A part of this is to incentivize the personnel based on these customer metrics.

Succeeding in becoming truly customer centric is no easy task but to really incorporate these actions into the organization will help organizations get there. In this process, learning and continuous improvement is of outmost importance. By utilizing positive examples and success stories, iterate and integrate the learning cycle in the organization, innovation can be bred and facilitate the path towards customer centricity.

3.2 Leveraging Customer Preferences

To improve a company's customer centricity, it is fundamental to understand what customers want and need, thus it is of interest to elaborate on how companies can leverage their customer insights in this context.

3.2.1 Customer Preferences in Product Development

Collecting feedback and preferences of customers is key in becoming customer centric. This is something companies in all industries are doing to some extent since it helps them guide the direction of the research and product development as well as strategic decisions (Wang, Zhang, Zhao, Lu, & Peng, 2020). However, Bulsara and Thakkar (2015) state that many companies

fail to implement the suggestions from the customers in new product development. Although changing the attributes of the product might be the initial thought of ways to leverage the insights gained from customer preference, researcher Vinokurova (2019) presents an alternative viewpoint. Vinokurova (2019) suggests that in addition to changing the product according to customer preferences, companies could change the customers preferences since it's argued that these are not fixed. Also, Wang et al. (2020) state that customer preferences and product feature categorization should be utilized in marketing efforts as well. Hence, the literature presents two main alternative ways to go about using the knowledge of customer's preferences, either changing the product according to feedback or changing customer perception of the existing product.

Looking at changing the product, Bulsara and Thakkar (2015) argue that negative feedback is the most important type since it provides a basis for further improvements of the products in contrast to positive feedback. To be able to implement this feedback, Bulsara and Thakkar (2015) recommend working with continuous improvement of the product, so called Kaizen. By continuously implementing small improving changes to the product, smaller investments are needed, a sense of involvement for the group members are achieved and the changes are more likely to last. The Plan-Do-Check-Act (PDCA) cycle is one tool that can be used to support the continuous improvement process (Bulsara & Thakkar, 2015). The PDCA-cycle emphasizes small size testing prior to full scale implementation for validation of the changes value add. The steps of the PDCA-cycle are

1. *Plan* a change for product or process improvement
2. *Do* the change at a small scale
3. *Check* the effects of the change
4. *Act* if the desired effect is observed

Knowing what features to implement the continuous improvements on is discussed by Wang et al. (2020), who use a combination of an importance performance analysis (IPA) with an inconsistent ordered choice model (IOCM) to create the sentiment importance performance analysis (SIPA). The IPA supports product and service development by stating the customers' perception of a feature's importance and performance. The IOCM looks at whether a feature has a high or low positive and negative importance sentiment. The importance sentiment tracks whether the customer thinks it is important or not if a feature performs well (positive) or poorly

(negative). For example, a feature with low positive importance sentiment, but high negative importance sentiment is likely to be a basic requirement. I.e., a basic requirement feature's positive performance is not highly valued, but its low performance is very dissatisfying. Then depending on its performance, the feature is either categorized as a *Must be improved* or *Maintenance* feature. The SIPA model is a combination of the IPA- and the IOCM model where the I dimension of the IPA model have been extended with the IOCM model to create a three-dimensional framework for attribute prioritization based on customer preferences. For a more graphic explanation of the relationship between the three models, see Figure 1.

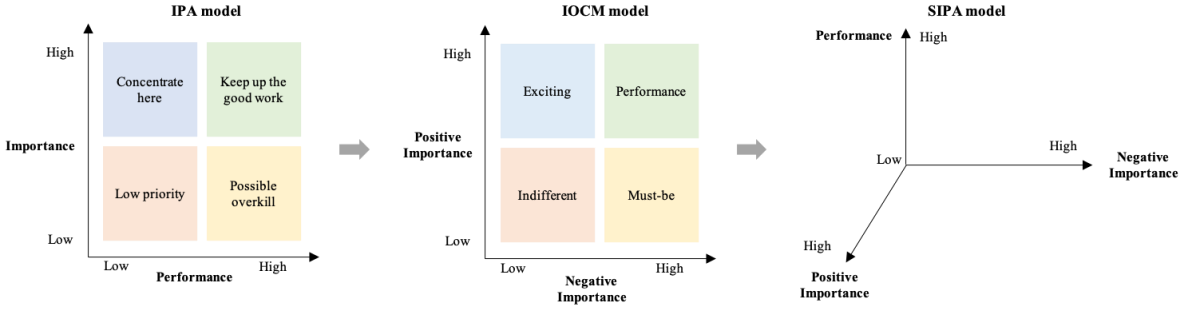

Figure 1 - The IPA-, IOCM- and SIPA model, adapted from Wang et al. (2020)

Wang et al. (2020) categorize different features into eight categories depending on their performance, positive importance, and negative importance. This categorization is an effective way of using customer preferences for prioritizing product development and set up a strategy for how to deal with each type of feature, see Table 4 on next page.

Table 4 - Feature categorizes and corresponding strategies of the SIPA-model, adapted from Wang et al. (2020)

Category	Performance	Positive importance	Negative importance	Implication & Strategy
Low priority	Low	Low	Low	Performance improvements yield low returns on customer satisfaction
Must-be improved	Low	Low	High	Performance improvements yield high returns on customer satisfaction
Maintenance	High	Low	High	Higher performance is indifferent to customers, adopt a cautious attitude
Possible overkill	High	Low	Low	Performance is not highly valued by customers, avoid over-investing
Priority innovation	Low	High	Low	Positive sentiments are important but negative sentiments indifferent, invest in innovation of these due to low risk
Priority improvement	Low	High	High	Current performance is low but important to customers, prioritize the improvement of these features
Continuous improvement	High	High	High	Current performance is high and important to customers, keep improving these features
Continuous innovation	High	High	Low	Further innovations yield high returns on customer satisfaction to low risk

These strategies that are based on the SIPA model by Wang et al. (2020) hold several common characteristics with the Kano model due to the IOCM being partwise based on it. Borgianni (2018) argues that using customer preferences through the Kano model can provide a rather good mean for categorizing and forecasting customer demands in the product design phase and that these seem to be rather accurate in the short to mid-term. Thus, the customer preferences will be valuable for the company since it rather accurately states the customer satisfaction for different product features at the time of the market launch even though the customer preferences were gathered in the beginning of the development phase. However, Borgianni (2018) urges users of the Kano model to be careful when it comes to forecasting customer preferences in the long term since the methodology has shown to be not very accurate in those cases. To utilize the insights on customer preferences gained in the Kano model, companies can leverage them through a quality functional deployment (QFD) approach (Hashim & Dawal, 2012). The QFD approach is commonly used for designing new or improving existing product characteristics. One main phase of the QFD approach is the house of quality (HoQ) where customer needs and preferences are linked with different product features. By entering the

customer preferences into the HoQ, a clear mapping and weighing of the preferences and the corresponding feature can be achieved and thus, guide the future product development work.

3.2.2 Customer Preferences in Marketing

On the other side of the spectra of using customer preferences for developing product features, is leveraging it in changing the customers' perception of the product or company. Vinokurova (2019) proposes the use of customer preferences knowledge to rather redistribute the customer preferences in the demand landscape. The demand landscape is an illustration of customers willingness to pay given a certain set of product attributes. Three ways of doing this is suggested by Vinokurova (2019), namely adding, removing, or transforming dimensions of the demand landscape. All these ideas aim at moving the ideal point of a customer, what a customer strives for in a product in relation to its willingness to pay, away from competing products and closer to the company's own product. These approaches can be achieved through marketing and does not necessarily have to include changing product features.

Adding dimensions to the demand landscape could mean to add a new feature to the typical product of a market, thus changing the ideal point of a customer, i.e., now that a new feature is offered the ideal product includes it. Removing dimensions simply regards innovating in a way that removes certain concerns for the customer so that the new ideal point is a product where the initial concerns are not even a part of the picture. Transforming dimensions instead relates to trying to move the customer's ideal point away from competing alternatives to the product and closer to the own product, e.g., by emphasizing the lack of certain features in that product. All these approaches can also be combined. These approaches cold not only be used for changing the demand landscape but also to change the customers perception of distance between a company and its competitors in that landscape. However, the decision to change the demand landscape and the customers perception of it, is affected by the products' and landscape's malleability according to Vinokurova (2019). A firm with a non-malleable product would first turn to landscape changes while a firm in a non-malleable landscape would focus on product changes. By researching and actively gaining knowledge about the customers preferences, companies can become more effective in the way they communicate and innovate to change customers perception.

Changing the demand landscape often needs to be done in an interplay between customers and companies. Bohlmann et al. (2012) state that especially innovative products tend to have uncertain benefits and thus requires more learning and new behaviors from the customer to change the preferences. Companies must not only know the needs and preferences of their customers, but also their customers' customers. Therefore, a broad customer research is needed downstream to facilitate for dynamic development of new features. Bohlmann et al. (2012) present a viewpoint which highlights a firms product platform strategy's dependency on both dynamic customer needs such as customers' downstream needs, knowledge, and experience as well as dynamics of product innovation through enabling technologies and competitors. The framework maps the linkage between the different dynamic building blocks. The key takeaway that Bohlmann et al. (2012) stress is that companies should not innovate without knowing about the customers' needs and preferences. Nor do customers express and formulate needs without learning about an innovative technology. The implication of this would be that customers might not always know what features they want in a product or service. Especially if the product or service possesses a high degree om innovation and the customer already have a preconceived notion about what a specific product or service should be like. Thus, it is important for companies to know about the customers learning dynamics and use this in their product innovation and marketing. This applies especially to high-tech markets with intense innovation and customer dynamics.

3.3 Kano model

The Kano model was originally developed by Noriaki Kano, and it was the first model to differentiate product attribute on how they satisfy the need and preferences of customers (Matzler et al., 1996). In the coming section the fundamentals of the Kano model, the process of applying the model, its applicability, the expected results, and existing criticism are presented.

3.3.1 Fundamentals of the Kano model

Prior to Kano 's work, it was assumed that customer satisfaction is proportional to the level of fulfillment of each attribute (Matzler et al., 1996). This is the case for some product attributes, which are called *One-dimensional* attributes. However, Kano (1984) identified that there also

exist *Must-be,* and *Attractive* attributes. Must-be attributes are attributes that are expected by the customers, and therefor never create a feeling of satisfaction even if they are fulfilled perfectly. Rather, these attributes are considered as requirements by the customers, and the absence of any of these attributes leads to the customer being dissatisfied. The Attractive attributes are attributes that are not expected or required by the customers, but when they are fulfilled, they create a feeling of satisfaction (Matzler et al., 1996). Especially the Attractive attributes, but to some extent also the Must-be attributes, are so called latent needs. Thus, the customers seldomly explicitly state that the needs and requirements fulfilled by Attractive and Must-be attributes (Matzler et al., 1996).

Matzler et al. (1996) developed the Kano model further and presented a method to determine the different attributes of a product. The authors also describe two more categories of attributes, namely *Indifferent* and *Reverse* attributes. Indifferent attributes are such that the customers do not care about them, the degree of fulfillment does not create either satisfaction or dissatisfaction. Reverse attributes are a bit different in the sense that the dissatisfaction increases when the level of fulfillment increases. The classifications are illustrated in Figure 2 below.

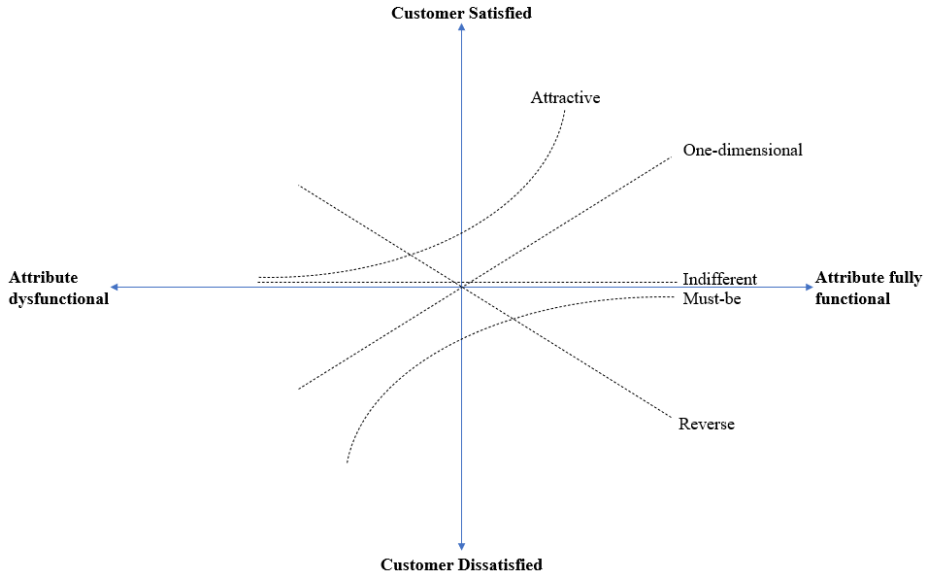

Figure 2 - The Kano model and the different attribute classes, adapted from Berger et al. (1993)

Kano developed his own model further in 2001 when he researched how people rated different attributes of a TV over time. He conducted the same research at three different occasions in; 1983; 1989; and 1998 (Löfgren & Witell, 2017). His finding was that the remote controller was

an attractive attribute in 1983, a one-dimensional attribute in 1989, and a Must-be attribute in 1998. From that observation he concluded that the attributes are not static, rather they develop as time passes and customers become used to certain attributes (Löfgren & Witell, 2017). The most common evolution for attributes is from attractive, to one-dimensional, and lastly Must-be – just as the remote controller. However, Kano states in his research that other possibilities also exist, such as indifferent to one-dimensional, to indifferent again.

3.3.2 Conducting the Kano Model

The process of applying the Kano model is rather straight forward and is one of the main reasons why it is so popular (Berger, et al., 1993). The core development of the questionnaire consists of five steps – develop the questionnaire, test the questionnaire and revise, administer the questionnaire to customers, process the results, and lastly analyze the results. However, before the questionnaire is developed it is necessary to determine what customer needs to test through the questionnaire. This is often done by either visiting and observing- or interviewing customers (Berger, et al., 1993).

The foundation of the Kano model is to ask a pair of question, one functional question and one dysfunctional question, for each attribute to classify. As described previously in section 2.3.3, the functional question contains a statement asking the customers how they would feel if the attribute were provided by the product. The dysfunctional question contains a statement asking the customers how they would feel if the attribute were not provided.

For each question, the customer could originally pick between five different alternative answers, namely, “I like it that way”, “It must be that way”, “I am neutral”, “I can live with it that way”, or “I dislike it that way”. However, these have been subject to scrutiny and there are other alternatives on what answers the customers should be able to choose from (Berger, et al., 1993). This is further enhanced by the research by Löfgren and Witell (2017), who conducted an extensive literature review of 33 different articles on the topic of Kano models. Out of these 33 articles, 28 were empirical investigations where the authors used the Kano model to classify attributes. The other five were conceptual contributions to the Kano model. The authors conclude that almost all the articles used alternative phrasing for the questionnaire answers. However, not much research has been done to explore the implications of these alternations (Löfgren & Witell, 2017).

It is not only the phrasing that has been modified in the articles that were studied by Löfgren and Witell (2017), but also the number of answering options has been tampered with. Kano himself suggested that three alternatives, namely "satisfied", "neutral", and "dissatisfied" could be used without decreasing the quality of the analysis. Furthermore, he suggested that it would be beneficial since it would facilitate the completion of the Kano questionnaires (Löfgren & Witell, 2017). The effect of decreasing the number of answering options were researched by the same authors, Löfgren and Witell (2017), and they found that eight out of nine attributes were classified differently depending on if the respondents got three or five different answering options. There was a tendency that Must-be attributes and Attractive attributes were classified as One-dimensional attributes when the respondents only had three options to choose from (Löfgren & Witell, 2017).

When developing the phrasing of the attributes in each question there are some important guidelines to keep in mind. It is favorable to construct a clear question, rather than an abstract one. The customer answering the question should not need to interpret the question or the attribute (Berger, et al., 1993). Moreover, it is important to not cramp more than one attribute into the same question. This is to be able to analyze each attribute individually. Another consideration is to construct the questions in the customers' terms, thus keeping the phrasing to benefits rather than solutions (Berger, et al., 1993). The number of questions to include is also of importance. While no research has been conducted to determine the optimal number of questions, it is clear in the literature review by Löfgren and Witell (2017) that the most common number of attributes lie between 10 and 30. The number of attributes that are investigated range between 7 to 43, with the median being 15 and the average number being roughly 19.

The questionnaire needs to be tested before it is administered to customers. The purpose of the test is to identify unclear wording, typographical errors, and unclear instructions. The tests are conducted through having the research team answer the questions before anyone else. Next, the questions can be answered by other persons that are not directly involved in the creation of the questionnaire, but still knowledgeable about the product. Before the questionnaires are distributed to the final customer sample, it is preferable, but not necessary, to test the questionnaire on a small subset of customers (Berger, et al., 1993).

When administering the questionnaire there are some details to consider. The first step is to determine which customers to approach. When this has been determined, the next step is to decide what medium to use when contacting the customers. The most common is through e-mail, to be able to reach as many as possible, or phone. It is in this stage that the demographical data is collected. Some categories of data that often are collected are company and personal characteristics, familiarity, or experience with the product, use of competitors' products and so forth (Berger, et al., 1993). In the literature review by Löfgren and Witell (2017) where they reviewed 28 empirical investigations, they found that the number of respondents varied between 30 and 4 229, with the median being 330 respondents.

Processing the results can be done in a few different ways. The first step is to classify each individual answer as any of the six classes One-dimensional (O), Attractive (A), Must-be (M), Indifferent (I), Reverse (R), or Questionable (Q) (Berger, et al., 1993). This is conducted based on the answers of the functional and dysfunctional pair of questions as stated in the evaluation table described in Table 5 below.

Table 5 - Classifying the attributes from Dysfunctional and Functional pair of questions, adapted from Berger et al. (1993)

Pair of question		Dysfunctional				
		1. Like	2. Must-be	3. Neutral	4. Live with	5. Dislike
Functional	1. Like	Q	A	A	A	O
	2. Must-be	R	I	I	I	M
	3. Neutral	R	I	I	I	M
	4. Live with	R	I	I	I	M
	5. Dislike	R	R	R	R	Q

There are some variations to this version of the evaluation table. Two of the most common versions were first presented by Lee and Newcomb in 1997, and by Berger et al. in 1993 (Löfgren & Witell, 2017) – these versions are presented in Table 6 and Table 7 below, and the variations from the original table are highlighted with bold letters.

Table 6 - Variation of classifying the attributes from Dysfunctional and Functional pair of questions, adapted from Löfgren and Witell (2017)

Pair of question		Dysfunctional				
		1. Like	2. Must-be	3. Neutral	4. Live with	5. Dislike
Functional	1. Like	Q	A	A	A	O
	2. Must-be	R	**Q**	I	I	M
	3. Neutral	R	I	I	I	M
	4. Live with	R	I	I	**Q**	M
	5. Dislike	R	R	R	R	Q

Table 7 - Variation of classifying the attributes from Dysfunctional and Functional pair of questions, adapted from Löfgren and Witell (2017)

Pair of question		Dysfunctional				
		1. Like	2. Must-be	3. Neutral	4. Live with	5. Dislike
Functional	1. Like	Q	**Q**	A	A	O
	2. Must-be	**Q**	**Q**	I	I	M
	3. Neutral	R	I	I	I	M
	4. Live with	R	I	I	I	M
	5. Dislike	R	R	R	R	Q

The Questionable classification differs from the other attributes in the sense that it is not expected for any attribute. The Questionable result means that the respondent either appreciate if the attribute both is present and absent at the same time, or that the respondent dislikes the attribute when it is both present and absent. This is often a result of the respondent either not understanding the question, or simply did an error when filling in the questionnaire (Berger, et al., 1993).

The next step is to analyze the results to determine the classification on an aggregate level. The most common approach is to use the statistical mode, thus the classification that appears most often when summarizing the individual results. However, if there are attributes that receive a substantial share of Questionable classifications the attributes should be deleted from the analysis until the reason for the classification has been understood (Berger, et al., 1993).

Another situation that needs to be addressed is when Indifferent is the classification that is most common. It could of course be true that most of the customers do not care about the attribute, then there is no need for action other than rating the attribute as Indifferent. However, it might be that the customers' answers are evenly distributed across Must-be, One-dimensional, or Attractive, but the Indifferent classification might receive a few percentages more of the respondents' answers. In that case, it would not be meaningful to classify the attribute as

Indifferent, since the total share of customer who think the attribute does matter to some extent is indeed bigger. E.g., if the Must-be, One-dimensional, and Attractive receive 25 percent, 25 percent, and 24 percent of the respondents answers respectively, and Indifferent receive 26 percent of the respondents' answers – it is not fair to say that the attribute should be categorizes as Indifferent as it would be according to the statistical mode classification. Blauth, Richter, and Rubinhoff consider this as noise in the answers and argue that the following logical expression, equation (1), should be used when classifying the attributes (Berger, et al., 1993).

$$\begin{gathered} If Attractive+One-dimensional+Must-be>Indifferent+Reverse+Questionable, \\ Then\ class\ is\ maximum\ Attractive, One-dimensional, Must-be, \\ Else\ class\ is\ maximum\ Indifferent, Reverse, Questionable \end{gathered} \quad (1)$$

Berger et al. (1993) argues that the equation increases the validity by filtering the noise that is created from asking too specific questions.

Another approach than using the statistical mode or the method by Blauth, Richter, and Rubinhoff, is to use a continuous and graphical analysis. One of these approaches was developed by Mike Timko at Analog Devices (Berger, et al., 1993). He came up with two quite simple equations to quantify how good or bad an attribute is perceived as, based on the Kano questionnaire, see equation (2) and equation (3).

$$Better = \frac{A + O}{A + O + M + I} \quad (2)$$

$$Worse = \frac{M + O}{A + O + M + I} \quad (3)$$

The logic behind these two equations is that the customers classifying the attribute as Attractive (A) or One-dimensional (O) are experiencing an increased sense of satisfaction if the attribute is fulfilled better. The customer classifying the attribute as Must-be (M), or One-dimensional (O) will experience a decreasing sense of satisfaction if the attribute is functioning worse. The numerical values can then be used to classify the attributes according to Figure 3.

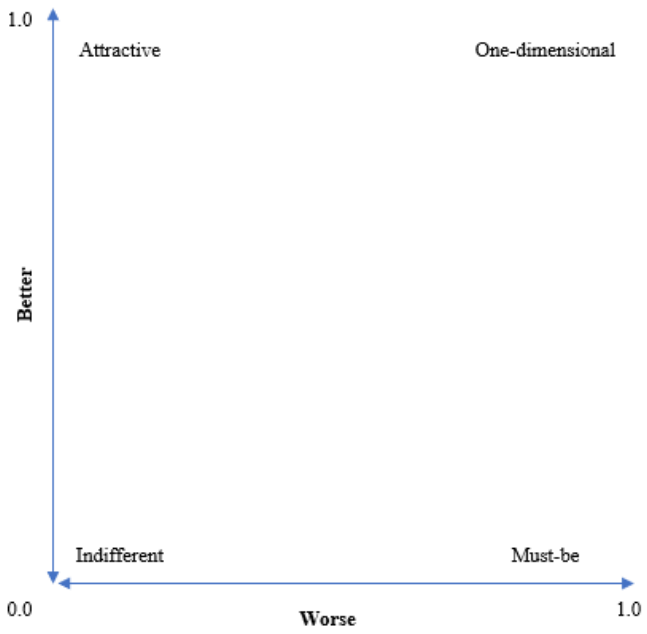

Figure 3 - Two-dimensional representation of Kano quality categories, adapted from Berger et al. (1993)

3.3.3 Applicability of the Kano Model

The Kano model comes with some inherent difficulties, hence it is not applicable in all circumstances. One of the prerequisites is that the customers understand how the model works, most importantly they need to understand that the purpose of the questionnaire is to classify the attributes and not to rank them. Berger et al. (1993) state that this risk can be mitigated by explaining the set-up of the questionnaire in the beginning of the questionnaire.

Moreover, the customers that are taking the survey may have different levels of experience of the product or product category that is being researched. This does not necessarily mean that the Kano models is redundant, but it would be of importance to measure the experience of the respondents, i.e., by asking how much experience they have from working with the kind of products in the section with demographical questions (Berger, et al., 1993).

At the same time, if the customers that are taking the survey are using complementary or competing products to fulfil some of the needs that are surveyed, there is a great chance that the survey will give a misleading result. The reasoning is that the customer might answer that one or more of the attributes would not affect the satisfaction solely since they already have a competing product that satisfies the specific need that the questionnaire asks about (Berger, et

al., 1993). It is therefore a good idea to ask this in the demographical section of the survey, i.e., by asking which competing products the respondent use.

One of the most prominent advantage of the Kano model is, even considering the difficulties above, that it is easily applied in many cases. The cost of conducting the Kano questionnaire is in most cases negligible, and it is possible to conduct without much preparation. This make the model very fitting for new product development, and this is also the most common application for which the model is used (Berger, o.a., 1993).

3.3.4 Expected results of the Kano Model

The expected result of performing the Kano model is that every attribute is classified to one of the five different classes. However, it is also expected that some of the attributes will be unambiguously classified, while there will be some attributes where the opinions differ from customer to customer (Matzler et al, 1996). Moreover, Matzler et al. (1996) state that there are many advantages with using the Kano model to classify the customer preferences. Some of the advantages are the possibility to differentiate products by fulfilling attractive attributes, and the possibility to segment and target the customers depending on their preferences. Hence, another expectation of the result is that the classification of some attributes will vary depending on the customer segment. More specifically, the expectation is that there will be a dependency between the attribute classification and some of the demographical data that is collected, i.e., type of industry, years of experience, size of the company, and the respondent's position at the company.

There are some expectations on what conclusions and implications that can be drawn from the results. The most common implications are to prioritize the development focus and resources. It is established that the attributes that are rated as Must-be, need to be prioritized so that they perform according to market standards, but not prioritized too much so that they overperform (Matzler et al, 1996). When the Must-be attributes are on a satisfactory level, the One-dimensional attributes need to be prioritized. Then it is beneficial to at least focus on including a few Attractive attribute in the new product development to be able to differentiate the product from its competitors (Matzler et al, 1996). The same reasoning is implicitly stated by Berger et al. (1993), furthermore they state that the Indifferent attributes should be least prioritized.

3.3.5 Existing criticism of the Kano Model

One prominent criticism of the Kano model is that it takes no consideration of how important every attribute is perceived as by the respondents. Yang (2007) exemplifies this by comparing the attributes of a car. According to the Yang (2007), both an automatic gearbox and luggage carrier are attractive attributes, but the automatic gearbox is generally considered to be more important. Berger et al. (1993) also acknowledge that the model lacks in this aspect and suggest the usage of self-stated importance questionnaire. However, this increases the number of questions that the respondents need to answer by 50 percent. Yang (2007) is using a similar method but develops it further in a model that he has named "The Refined Kano model". He asks the respondents about the perceived importance and split the attributes in half, the attributes with the highest importance rating are classified as *high importance*, while the lower half is classified as *low importance*. The attributes can then be classified with a more detailed classification, see Table 8 below.

Table 8 - Classification when using Yang's estimation of importance mode, adapted from (Yang, 2007)

Kano 's original attributes	**High Importance in Yang's model**	**Low Importance in Yang's model**
Attractive attributes	Highly attractive	Less attractive
One-dimensional	High value-add	Low value-add
Must-be	Critical quality attributes	Necessary quality attributes
Indifferent	Potential quality attributes	Care-free quality attributes

Löfgren and Witell (2017), who conducted the literature review, conclude their review with some criticism as well. First, they write that it is uncertain how much research that has been conducted regarding the theory of attractive quality. Second, there is a risk that the number of studies and the number of individual researchers that have contributed to the theory of Kano models have been overestimated. When the authors examine the authors of the literature that they review they can conclude that many of articles reference the same authors. Moreover, the same empirical data have been used in more than one paper.

However, the most worrying criticism is regarding the methodological and theoretical issues. As stated previously in this thesis they find that there is a lacking consensus on the phrasing and number of alternatives regarding the answer options. The authors clarify that many

different alternatives are being used, but almost no research has been conducted to determine what impact it has on the results. The authors themselves have researched the use of three answer alternatives and found that the results differ significantly. Hence, their recommendation is to use the original five answer alternatives. Regarding the alternation of phrasing, they find no evidence or research on which phrasing would be better, so they can only conclude that more research is needed.

The other methodological criticism is regarding the classification of attributes. As stated previously, there are numerous variations on how to classify the attributes. However, the choice of classification method, more specifically which of the evaluation tables previously described, rarely effects the result of the Kano model (Löfgren & Witell, 2017). The recommendation from Löfgren and Witell (2017) is to use the evaluation table that seems most fitting for the occasion. They also add that the combination of both the traditional classification and newer analysis methods, such as the *Better* and *Worse* indexes described previously have shown to be fruitful.

The theoretical issues are the validity of the attractive quality, the formal status of the model, and lastly the life cycle of attributes. The main criticism of the attractive quality is that there is no consensus on what the concept really means. This is identified as one of the obstacles that needs to be dealt with before managers and organizations can begin to create attractive qualities (Löfgren & Witell, 2017). There is also a misconception that the Kano model and attractive qualities can be used to measure how satisfied the customers of a company is with the product or even the company itself. This is not the case, and Kano himself stated that the correlation between the classification of a product's attribute and the customer's feelings toward the product and company needs to be researched further (Löfgren & Witell, 2017).

Regarding the formal status of the model, it is criticized for exaggerating its statistical and mathematical significance. The classifications and the axes in the graphical matrix give an impression of a continuous relationship between customer satisfaction and attribute fulfilment. However, this is not what is being measured since the questionnaire only contains questions how the respondent would feel if attributes were present or absent. The second order effects implied by the bend of the curves for attractive and Must-be attributes are also being questioned. Edvardsson and Nilsson-Witell did research in 2005 where they attempted to find

the non-linear relationship between attributes fulfilment and customer satisfaction, but they could not find any (Löfgren & Witell, 2017).

The last aspect that Löfgren and Witell (2017) considers is the lifecycle of attributes, that is that attributes normally develop through different classifications over time. According to the authors the theory of attribute life cycles is one of the most important findings in the research area of quality attributes. However, the lack of studies of the phenomenon is troublesome. The authors claim that more research is needed regarding the proportion of attributes that follow various life cycles, and that the various life cycles that exists need to be determined to a greater extent.

3.4 Previous Kano Model Cases

The Kano model has been used in previous empirical investigations and three of them will be described in more detail below. These cases show different ways of applying the Kano model in various and relatively niche markets.

3.4.1 Case 1 – Refined Kano Model on Pharmaceutical Logistics Services

The purpose of this study by Chen, Hsu and Lee (2020) was to assess how satisfied medical institutions were with, and the perceptions of importance, of domestic pharmaceutical logistics services. The authors used Kano's refined model by Yang (2007) and received 104 complete answers, from distributing 475 questionnaires. Their research contributes to the literature by demonstrating that provision of high value added, and crucial quality attributes can help service providers give them a competitive edge on the market.

The researchers use of Kano 's model to classify the attributes and they use a Likert scale to rank the importance. They find that there are some service attributes that have not been prioritized enough and recommend the industry to shift the focus towards these areas. The researchers were also able to confirm that some of the core attributes that were in the spotlight before are One-dimensional or Must-be, hence they are worthwhile to keep investing in. The conclusion is that there are segmental differences that could be investigated further to leverage each actor's provision of service further.

3.4.2 Case 2 – Kano Model on Mobile Brands Perception

Choudhury and Gulati (2020) use the Kano model in their research to find which attributes of a smart phone that are best preferred by the Indian customers. They conduct the model in a situation where the smart phone market is growing rapidly in their domestic market, and many Indian customers adapt to smart phones. The reasoning is that the customer knowledge is crucial in the growth phase, and that it can be used for the strategical decisions needed. Furthermore, they are interested in how important the brand is when choosing which smart phone to buy.

The researchers found that out of the 13 attributes that were investigated they found that four attributes were considered as Attractive, three were considered as Indifferent, three as Must-be, and three were considered as One-dimensional. The findings provided in the article will support marketers when approaching customers.

3.4.3 Case 3 – Kano Model on Jewelries Made Using the Art of Tile Making

Bilgili, Erciú, and Ünal (2011) deployed the Kano model in a rather narrow setting, to discover customer satisfaction and expectations for jewelry that adapted the traditional art of tile making to jewellery craftsmanship. The study was conducted in Turkey and its aim was to guide both future research in marketing and new product development as well as provide the jewelry sector with valuable insights. The sample group which had been generated using the snowball sampling method consisted of 102 women, well engaged in jewelry. First, one Kano questionnaire containing 23 product attributes were sent out to the sample group. Based on the results from that survey, sample jewelries were sent out to the participants together with a second Kano questionnaire to be able to develop a quality index for the jewelries.

The researchers concluded that the adaptation of the traditional art of tile making to jewelry would be an important opportunity to increase customers satisfaction. The classification and satisfaction of attributes correlated. Thus, the Kano model was found to be a useful tool for improving product development to achieve higher customer satisfaction. The combination of Kano questionnaires and product sample distribution was proposed as a useful customer preference discovery method in product development.

4 Results

The chapter is divided into three sections containing results. Firstly, the interviews with the retailers, secondly the results from the interviews with end users and OEMs, and thirdly the results from the Kano model.

4.1 Interviews with *The Retailer*

The Retailer's employees have extensive experience from interacting with the market and thus have gathered a lot of knowledge. Below are the results from the interviews with four different employees at *The Retailer*, and one of the Co-owners of *The Company*, who operates in Germany. The focus of the results from the interviews are on the process of selling *The Product*, challenges, problems and needs that the respondents experience from their customers.

4.1.1 Respondent Background – *The Retailer*

The respondents – except for Wilhelm who works at the German partner company – are all employees at *The Retailer* that is selling and distributing *The Product* in Sweden and Finland. They all work in the business area called Machine Safety and Sensors; however, they have different roles and responsibility. Per is the business area manager, Torgny is product manager in Finland, while Markus and Olle are salesmen for the southern and eastern parts of Sweden, respectively. See Table 9 for an overview of the respondents.

Table 9 - Interview respondents - The Retailer

Fictitious name	Position	Geographical focus
Per	Business Area Manager	Sweden
Markus	Sales	Southern Sweden
Olle	Sales	Eastern Sweden
Torgny	Product Manager	Finland
Wilhelm	Co-owner of *The Company* and its partner company	Germany

All respondents at *The Retailer* have experience from selling or interacting with *The Product*. Moreover, they all have extensive contact with end users and OEMs using *The Product* which

have resulted in many insights and great knowledge about customer requirements and needs. The two salesmen have roughly three years of experience at *The Retailer*, while the owner, product – and business area manager have more than 15 years of experience. *The Retailer* wants to offer a complete solution when it comes to sales, marketing, and technical expertise for the producer, which means that the end user never should need to be in contact with *The Company* directly.

4.1.2 Sales Process – *The Retailer*

The two salesmen explain that the context of business-to-business deals results in a very dynamic and flexible sales process that is adapted for every specific occasion. However, there are some general patterns that repeat from time to time. The initial contact is often initiated by the salesmen. The first meeting is usually a general meeting where the specific needs and challenges of the potential customer are identified, and the salesmen present and pitch *The Product* for the first time. Machine safety is not updated on a regular basis; hence it is rare that the need for the solution is so obvious that it leads to a quotation immediately. Thus, the next step in the process is for the salesmen to keep the relation warm and maximize the possibility that the end user or machine builder decide to call them when the need for a machine guarding safety solution arises. When the customers start assessing different solutions it is common with a new meeting where *The Product* is presented more in detail, often with a product manager from *The Retailer* present.

This general process, described above, is true for most cases, but there are some nuances that needs to be further described. Firstly, there are different kinds of customers that are potential buyers of *The Product*. The ones that are called *end users* are the industries that use *The Product* in their production to keep their employees and products safe. The *machine builders* (*OEMs*) are customers that design, construct and distribute machines to end users. This of course affect the sales process to some extent, e.g., there are different roles that are responsible for the purchase at the customer site. However, more importantly it results in different requirements and preferences for *The Product*.

Secondly, another aspect that varies from occasion to occasion is the knowledge of the customer, specifically in the end user segment. Sometimes the end users have great knowledge about the safety concerns that are present at their site – in some cases if the company is big

enough, they have their own team working solely with safety and automation of the production line. In other cases, often for small businesses, they use consultants to conduct the risk and safety analysis. According to Markus, the best possible solutions are designed when all parties, that is *The Retailer*, the consultants, and the end user, collaborate from early on in the project.

Thirdly, and lastly, there are some geographical differences that affect the sales process. According to Torgny, the product manager in Finland, the Finish market behaves a bit differently than the Swedish market. The customers are perceived as more cost sensitive, and the customers in Finland are a bit more skeptical of *The Product* and need to see and test for themselves before ordering.

4.1.3 Challenges & Problems – *The Retailer*

When asking the sales representatives about existing problems and challenges with products in the machine safeguarding industry, several topics reoccurred during the interviews. First and foremost, there seems to be a strong inherent inertia in the industry when it comes to testing new products. Reasons for this are the organizational culture and personal preferences, especially in conservative industries like mills and steel plants, sufficient satisfaction with current systems that customers use and the processes of changing the system being cumbersome.

Issues around installing and updating the software is another frequently occurring challenge. Whether this relates to e.g., programming the system correctly or mapping the existing code differs. The sales representative also got the impression that even though an option for safety-PLCs to communicate wireless exist, many customers still prefer CAN-bus cables - a cable used for sending information between PLCs. This could be due to several reasons, some of them being that wireless connection is less relevant for short distances in a factory, some wires need to be installed between different machines and electrical cabinets anyway, or that the customers simply do not trust the safe wireless connection.

One of the most common reasons for why some customers are hesitant towards specifically using *The Product* is that they need at least three units to establish a stable and trustworthy wireless connection. The sales representatives say that the customers had hoped that only two

units would be enough. This was an especially relevant problem for some customers who have been experiencing interception and disturbance from other wireless signals.

Some customers raise concerns to the sales representative about the casing of *The Product* potentially not being able to handle the rough environment e.g., due to high temperature. The number of input- and output-connectors (I/Os) is another concern that some customers have.

4.1.4 Needs – *The Retailer*

The challenges described above translate into needs and product requirements according to the sales representatives. One of them is the need for a simple installation process when the safeguarding system is subordinate to a bigger preexisting control system. It also needs to be flexible when it comes to adding new safeguarding units to the system or expanding and connecting the system with new machines. Another aspect of the flexibility of the system is that the customers appreciate the possibility to decide for themselves what push buttons they want to add to *The Product*, e.g., emergency and restart push buttons.

However, the casing and the push buttons of the current product does in fact satisfy the needs of the market quite well and for the most parts a higher IP-standard is not requested. With this being said, for some industries a metal casing could potentially be a good supplement to the current plastic casing of *The Product*. Some customers buy *The Product* because they want to save space inside their electrical cabinets where this type of product is usually installed. This while other customers ask for a product without the protective casing so that it actually can be installed inside the electrical cabinet and consume as little space as possible in there. Regarding the casing, several customers ask for more I/Os than *The Product* currently has but they also appreciate the possibility that each I/O can be used as a safe input and information output at the same time.

The design and simplicity of the software is important and an appreciated attribute of *The Product*, with its colorful layout and simple drag-and-drop functions as examples of appreciated qualities. The sales representatives agree that having the possibility to simulate and test a safety system would add a lot of value since the customers would not have to build an

entire system before testing it, but also emphasize its value when it comes to communicating with other parties and stakeholders in a project that concerns the safety system.

The possibility to easily change a unit without having to reprogram the logic in the software, but instead just change a memory card was mentioned as a potential unique selling point for *The Company* and the customers are often surprised by this feature. However, the sales representatives raise concerns about the feature initially being hard to explain to the customers.

Even though the wireless feature of *The Product* is greatly appreciated by some customers, it still relies on being able to use CAN-bus cable as well, otherwise it would be hard to convince the customers to buy it. This since the trust in the wireless system is not that big and some customers in fact do not buy *The Product* because of its wireless connection, but rather its compact size, ability to customize the push buttons and general ease of use. The CAN-bus cable connection was also mentioned during the interviews and it was said that customers would like the possibility to connect *The Product* to other safety field bus systems such as Profinet and Profisafe from Siemens.

Other features and attributes that were discussed was the importance of a strong brand in the machine safeguarding industry since trust is highly important, the need for more analytical and diagnostic tools to be able to monitor and see what happens in the system, and the possibility of doing this through an application in your phone. For a summary of all respondents and of their challenges and needs, see Appendix C.

4.1.5 Market and Trends – *The Retailer*

When the respondents were asked about the overall market, competitors, and trends there were some coherences, but also some contradictions. The respondents, among others Per and Magnus, agree that the safety requirements are similar for most industries and applications. However, they also agree that *The Product* probably would fit best in industries where there the spaces are small and difficult to access, e.g., the packaging industry. Another application where the respondents believe *The Product* will play to its strength is in the industry for automated guided vehicles (AGVs), due to the need for wireless safety systems. An industry most respondents do not see as a good fit is the traditional industries such as sawmills, steel

mills, and other industries with harsh environment. The respondents have different hypotheses to why these industries are less likely to order *The Product*. One theory of *The Retailer* is that some industries are inherently more skeptical of new solutions since they historically have been exposed to serious accidents and therefor want to use solutions and products they have used before. Another theory is that the harsh environment creates problem for PLCs and that they will continue to use more basic solutions, such as simple relays, in the foreseeable future.

The competitive landscape is somewhat difficult to assess. Per believes that the biggest competitors within small, external PLCs are ABB's Pluto and SICK. However, he adds that the greatest obstacles probably are the suppliers that offers both machine control and safety in the same solution, most prominent is Siemens. Markus and Wilhelm both state that which the strongest competitor heavily depends on what application the machine guarding safety unit is supposed to be used for.

When the respondents were asked to predict the trends for the market, they all answered that the integration between different PLC systems, both when it comes to software and hardware, will be the most important development subject during the coming years. As of now, it is difficult to use more than one brand for control and safety, but the demand for a solution that is possible to integrate with other control- and safety systems is huge. Another believe is that the demand for easily available data and data reports, e.g., through a mobile application will increase soon.

4.2 Interviews with End Users and OEMs

Another group that is of interest when trying to understand the market and the requirements on *The Product*, are the end users of *The Product* or other safety-PLCs currently offered in the market and OEMs. In the sections below are the results from the interviews with six end users and OEMs. Just as in the previous section the focus is on how the respondents interact with *The Product* or other safety-PLCs, what problems and challenges they encounter, and their current explicit needs.

4.2.1 Respondent Background – End Users and OEMs

For the interviews with potential end users of *The Product* and OEMs, the backgrounds of the respondents are varying in many ways. Experience vice, there are some with only a few years of experience, such as Tim at SKF, on the other end of the spectra there is Benny who has worked with safety the last 45 years – his entire professional life. There is also a mix of specialist and generalists, Tim, Robert O, Markus and Robert E have a more specialist focus and work hands on with designing and installing safety systems, while Markus and Pontus work with machine guarding safety on a holistic level. Another aspect to consider is that four of the respondents are interacting with safety-PLCs as end users, while two of the respondents use safety-PLCs in the role as machine builders (OEMs). Moreover, two of the respondents have used *The Product* themselves in different settings. The other four had varying knowledge about *The Product* before the interview. Below, see Table 10 for a summary of the respondents containing their fictious name, what company they work at, and their position.

Table 10 - Interview respondents - End users

Fictitious name	Company	Position
Tim	SKF	Automation engineer (on leave to study)
Robert O	SKF	Project leader
Benny	Malmö Ljus och Kraft (MLK) (OEM)	Machine safety specialist
Markus	Toyota Material Handling	Machine safety specialist
Pontus	Volvo Cars	Machine safety specialist
Robert E	Domino Printing Sciences (OEM)	Area Manager Special Solutions

4.2.2 Work Process – End Users and OEMs

How the different respondents interact with machine guarding safety differs because of different reasons mentioned in the text above, e.g., the kind of user they are, company size, if they work as specialist or generalist. Both Tim and Robert O work at SKF and have worked together before Tim went on leave to study. They both describe that a project, when a new safety solution is implemented, starts with a risk observation. There are three different kinds of risk observations. The least sever is the kind where someone sees a potential risk without anything happening. The second one is when something could have happened, but the operator were able to get out of the danger. The third one, the most sever, is when an accident happens.

The risk observation is then followed up on with a risk analysis with the purpose of determining what performance level (PL) that is needed. According to Robert O, the performance level depends on how sever a potential accident is, and how likely it is to happen, among other things. The risk analysis is important because it determines which solution will be used going forward with the project. In most cases, the performance level of the finished project does not underperform, nor overperform, compared to the initial performance level determined from the risk analysis.

The next phase of the project depends on how extensive the project is. Sometimes, e.g., when the machine is relatively new, it is sufficient to only change one part of the machine. If the machine is old, which it often is since SKF has a relatively old machine park according to Tim, they might need to buy a brand-new machine. If the project is cumbersome the project team might consist of a project leader, mechanics, and electricians. When it comes to designing the new system, they often use the same supplier as for the old machine. They also try to use standard components and standard solutions as much as possible. The last years they have become better at solely using Siemens' components. This is to minimize the number of spare parts in stock, time needed to learn new software, and for the overall confidence working with the machines. However, sometimes it is better to buy a separate PLC and then they always aim at using JOKAB's products. When they design the safety system, they always try to build the system at their desk before they go out and start the installation at the line, with the purpose of finding errors in the logic or any other problems with the hardware.

The installation phase is critical. Problems during the installation causing the production to stop more than necessary is very costly for the company. This is the main reason why they build the system at the desk before going to the line. At the line, the engineers responsible for the new safety system get a lot of requests from the operators. The requests seldomly regard machine guarding safety, rather they want the engineer to simplify their work at the line. Sometimes they can fulfil the request immediately, but most often they need to schedule a new meeting to discuss the requested change. The workers conducting the installation are often externally hired. They have some internal capacity, but it is not as reliable as an external firm which justifies the higher cost for buying the service. The next step is to test the new system according to a predetermined test plan. When this is complete, the last part is to document all the necessary information such as blueprints, PLC-programs, and more. Then the installation

is complete, and the responsibility is handed over to the operators and emergency task force if there are any problems with any of the machines on the line.

The process of interacting with machine guarding safety is quite different for Benny at MLK and Robert E at Domino Printing. They are OEMs who build machines for end users and are more restricted by what their end users expects or requires. Benny firmly believes that many of the safety solutions that are designed are focusing too much on the technical aspects of the system – and not considering the human error to a satisfactory level. He has a lot of experience of end users asking for the highest performance level when it comes to hardware, but then not using the safety products properly which means that the safety system becomes redundant. His hypothesis is that many responsible managers order the most well-known, technically advance systems only to have their backs free if something would happen. He has also noticed that many end users ask for the same brand they already are used to.

The last pair of respondents, Pontus and Markus at Volvo Cars and Toyota Material Handling respectively, are not using the machine guarding safety products hands on as the other respondents. Instead, they are responsible for the safety at a more holistic level. They are both involved in setting up frameworks for what safety products should be used in their respective company. According to Pontus, the philosophy at Volvo Cars is that they should be great at building cars, not machines for production. This means that they often outsource the work related to designing and installing new machine guarding safety solutions. Volvo Cars sets requirements for the design engineers and then count on them to solve the problems and install the system as well. According to Pontus they seldom change the entire machine but rather try to change only what is necessary. They are not fixed to using only one brand for machine guarding safety but use ABB, Sick, and Pilz to mention a few.

4.2.3 Challenges & Problems – End Users and OEMs

The problems and challenges that appear during the process of course also depend on what position the respondents have in the organization. Tim and Robert O are the ones with most recent hands-on experience, hence they have a lot of insights to share. Tim thinks that the most cumbersome projects are the ones where standard solutions cannot be used. Robert O adds that he sees a relationship between number of I/Os used in the solution and the complexity of the

project. According to both, the costliest part of the projects is the design, simply due to the time and capacity needed to design the solution. However, if wires need to be installed over long distances it also drives up the cost. Tim thinks that the greatest challenge during the project is the communication between all stakeholders. It is quite often difficult to explain why a certain solution is needed or preferable. It is common that the stakeholders have different viewpoints and therefor do not agree on the best solution. One example of this is the line operator working at the station. He or she might think that the new safety solution will affect their work negatively, e.g., making it more demanding or time consuming.

Another challenge has previously been that SKF has used many different suppliers of machine guarding safety solutions. This is unbeneficial since they then needed to have many different software on their computers, and that they needed to understand and be confident with all software. However, as previously stated, the last years they have become better at only using Siemens which means that it is not as big of a challenge anymore.

The process also contains some problems that are difficult to avoid. According to Robert O, the greatest problem when working with safety and machine programming is that the archived documents sometimes are outdated or simply misleading. This is often due to people not caring enough to finish the work properly after the installation of a new system, or not updating the changes that are made over time. The faulty documents create many problems; it takes much longer time to fix a problem if the electrical drawings are wrong; the confidence of the electrical engineer is negatively affected, and it is practically cumbersome because it means that they need to follow the wires to understand the connections. All this comes down to projects taking much longer time to conduct. However, the safety is hardly being affected by this. The system used for documentation, TRIX, is not well functioning and it is troublesome to add documents.

During the installation, it is common with error codes caused by humans, such as coupling the wrong cable to the wrong input or forgetting to clear the memory. However, sometimes the error codes are more difficult to explain and do not comply with the manual. This is critical since it will take long time to fix and most probably cause the installation to take longer time than planned.

As described previously, Pontus and Markus are also using safety-PLC as end users – but not at the same detailed level as Robert O and Tim do. The challenges and problems that they see

are more connected to long term challenges and coordinating safety on a global level. Pontus says that one of their greatest challenges at Volvo Cars is to keep the right competence regarding safety solutions in house, especially at the purchasing department. It is also a challenge to adapt the solutions and frameworks so that they are approved globally, due to rules and legislation varying from country to country where they operate.

Markus is deeply involved in the industry for AGVs. He has formulated many of the existing industry standards and is chairman for the ISO committee for AGVs. The challenges that he can see related to the subject of this thesis in the AGV industry is that the sensors and other equipment to AGV:s are expensive, and that it is difficult, although possible, to connect the AGV:s to the overarching system.

Benny and Robert E build and install machines at the end users' sites, and they have both used *The Product* when designing and installing machines before the interview. Hence, the discussion mostly circulated about challenges and problems they encounter when they use *The Product.* Benny says that most projects become more complex over time, and this trigger the need for flexible solutions. One problem he had when using *The Product* was that he misinterpreted how many I/Os it contains. *The Product* has 16 I/Os that can be programmed as either a safe input or a safe output. However, Benny thought he would have 16 inputs plus 16 outputs. When the project grew, he ended up needing to buy another PLC to program the control system for the machine, which meant that he needed to write two separate programs and integrate the two systems. This made the project more expensive in all aspects such as his time needed and more expensive hardware. During the installation he also encountered some problems. Due to interfering signals close to where *The Product* needed to be installed, the wireless communication did not work as intended. He got help from *The Retailer* and *The Company* to identify the root problem. However, the solution to the problem entailed that he needed to find new electrical components, and these were not easy to find close to the end user's site.

When Robert E elaborates on his experience with *The Product* it is quite similar to Benny's experience. They have found *The Product* very easy to interact and work with, considering both the software and the hardware. However, when they install *The Product* on their machines, they have noticed some connection problems when only using two units to communicate with each other which would be solved by adding a third unit to reinforce the signal. This has led to

them using CAN-bus cables for the communication, which in most cases is not a problem since the end users seldom have a need for wireless connections as their machines are static (not mobile) and stand close to each other. Just as Benny, they have noticed that the 16 I/Os often are insufficient to cover their needs. Robert E and his team would like to be able to control both the machine functionality and safety from the same PLC. The main reasons are because it is cheaper, and easier for the end user to operate the machine then.

4.2.4 Needs – End Users and OEMs

Tim, Robert O, and Pontus mentioned that wireless connection of machine safeguarding products would be a good thing, especially if there are long distances between the different machines and if you for example need to check or troubleshoot something in the system from another part of the factory. Pontus have experienced requests for more wireless safety products from the workers in the factory since they need to reduce the number of wires used in a specific setting. Markus stated that in the AGV industry there is sometimes a need for sending wireless emergence stop signals once an AGV drives into, or if a person enters, a restricted area. However, Benny also raised some concerns about transmitting safety signals wirelessly. The wireless function being redundant because the transmitting unit still needs a power cable from the machine, disturbance from other signals, consumption of too much band width, loss of signals or general hesitation towards new technology were some of the reasons stated.

A flexible system where new units can easily be added to existing machinery or safety systems was mentioned as a need by Tim, Robert O and Robert E. They experience this as an expensive and complicated procedure, while others like Pontus solves it together with the machine supplier and think that it is an easy way to do it. Benny and Robert E who themselves have used *The Product* have chosen it because of its small size, since they often lacked space inside their electrical cabinets, and *The Product* was easy to fit directly into their machines instead. Although they like the ease of which *The Product* can be installed, they request it to be able to connect to field bus systems from other safety product brands. The possibility to send both safe input- and output signals from one channel is a feature that Tim and Robert O like. Being able to reach and connect to the safety systems on all machines without having to physically be at the machine to plug in a computer to each unit is also a need they stated. This goes for both monitoring of the safety system as well as reprograming it. Markus emphasize that it is

important that the performance of the products remains spotless and that someone cannot accidentally change a setting in the program.

Robert O is in need for a simple solution for automatically calculating PFHD-values of the safety units since the system he uses today is time consuming and requires a lot of manual work. He wants something that allows him to see the PFHD-values and how they change for specific units in the safety system as he programs and builds it. The functionality to simulate how the safety system would work, already in the design phase, is something that Tim, Robert O and Benny would like. It would help them discover mistakes in the programing and system design early on and most noticeably, allow them to easily present the solution to other stakeholders. Benny really likes the idea of being able to simulate the system before building it since this is exactly what the end user is forced to do for several projects, building the system just to realize some vital parts are missing or the programming is not adding up.

The software is a key determinate for the end users' and OEMs' perception of the system. It needs to be intuitive, easy to understand, have a good project documentation function, preferably some diagnostics and analytics feature. Pontus requests that in the program, there needs to be preprogramed and defined software blocks for specific use cases. Adding to the need of an easy-to-use software, several users request a smartphone application for e.g., monitoring the system.

When looking at the requests on the hardware of *The Product*, the users Robert O and Benny like the idea of having a memory card with *The Product's* logic saved on which would enable them to easily change hardware units and then re-plug the memory card without having to reprogram the entire logic for the unit. Robert E emphasizes that having the possibility to decide for themselves what push buttons they want on *The Product* is a great attribute.

When asked about the end users preferences concerning brand of the machine safeguarding supplier it became clear that it differs a lot depending on the individual preferences of the end users. However, the larger industrial manufacturers emphasize that they have a need for using one single brand to maintain standardization across their factory and to manage internal know-how of the systems efficiently. Using many different brands would jeopardize their ability to assure all maintenance personnel have the sufficient knowledge about the safety products as well as making it more complex to integrate and change systems.

4.2.5 Market and Trends – End Users and OEMs

Looking ahead, the end users and OEMs expect the market to move towards more wireless products as the supporting systems and safety products themselves becomes more reliable. Pontus is curious about how 5G, the use of artificial intelligence and machine learning might affect the machine guarding safety industry onward. However, even though users think the industry will move towards more wireless solutions, they see a big hurdle in that the industry is very conservative when it comes to new technology and that already today, suppliers develop new innovations faster than many of the users can adopt according to Pontus. For a summary of all respondents and of their challenges and needs, see Appendix C.

4.3 Results from the Kano Questionnaire

The results from the Kano questionnaire are key for the study. Firstly, the demographical data of the respondents that participated in the survey is presented. Following this is the Kano results on an aggregate level for all respondents, and the results when segmented by the demographical data to find differences in customer preferences between segments.

4.3.1 Respondent Demographics

The survey was taken by 132 respondents. Some respondents skipped a few Kano questions and a couple of demographic questions. However, these respondents had answered the majority of questions, so their answers were included as well. The respondents work at 74 different companies within 15 industries. The distribution of respondents by industry is somewhat tilted towards typical Swedish manufacturing industries such as Automotive, Steel & Metal, Automation and OEM. These four industries account for 81 respondents, or 61 percent of the total number of respondents. The remaining 62 respondents, or 39 percent, are divided between eleven industries plus undisclosed industries. The number of respondents within each one of these remaining industries varies between 7 and 1, accounting for 5 percent to 1 percent of the total number of respondents. 8 respondents, being 6 percent of the respondent group, did not disclose the company or industry they work in, see Figure 4 on next page.

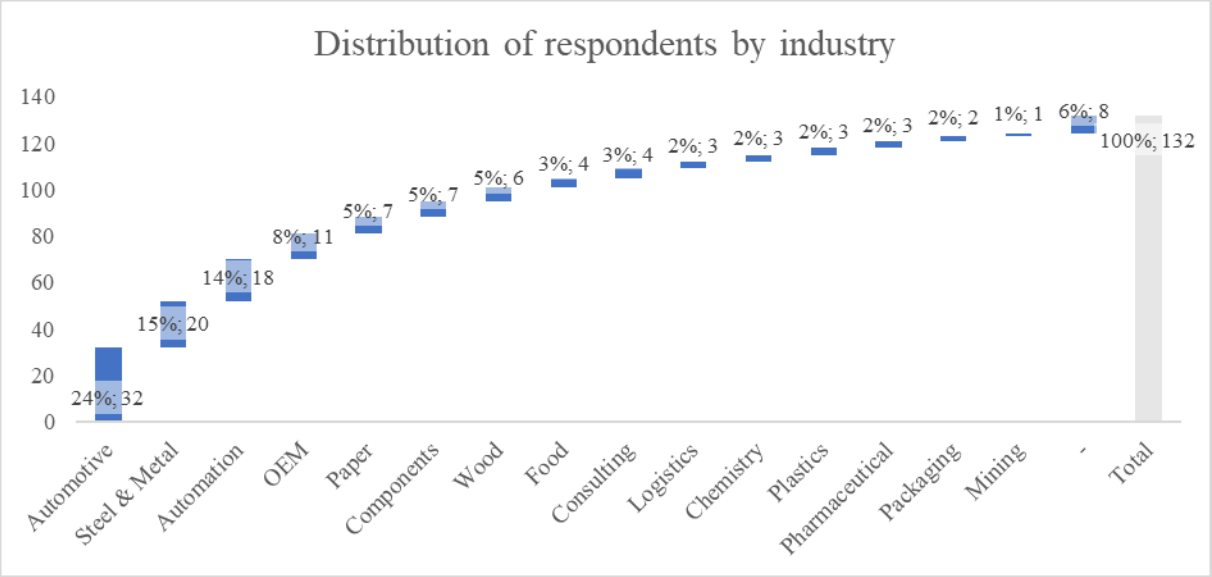

Figure 4 - Distribution of respondents by industry, share and number

The respondents are divided into six different groups depending on their position in the company, see Figure 5. 63 respondents work in a technical but non-managerial position, mainly weighted towards R&D or Installation & Maintenance. This accounts for 48 percent of the respondents. A small fraction of the respondents, 6 respondents or 5 percent, work mainly with sales. 48 persons or 36 percent of the respondents have some sort of managerial position ranging from project leader to manager and executives. The majority of these are some sort of manager. 15 persons, accounting for 11 percent of the respondents, did not disclose their position.

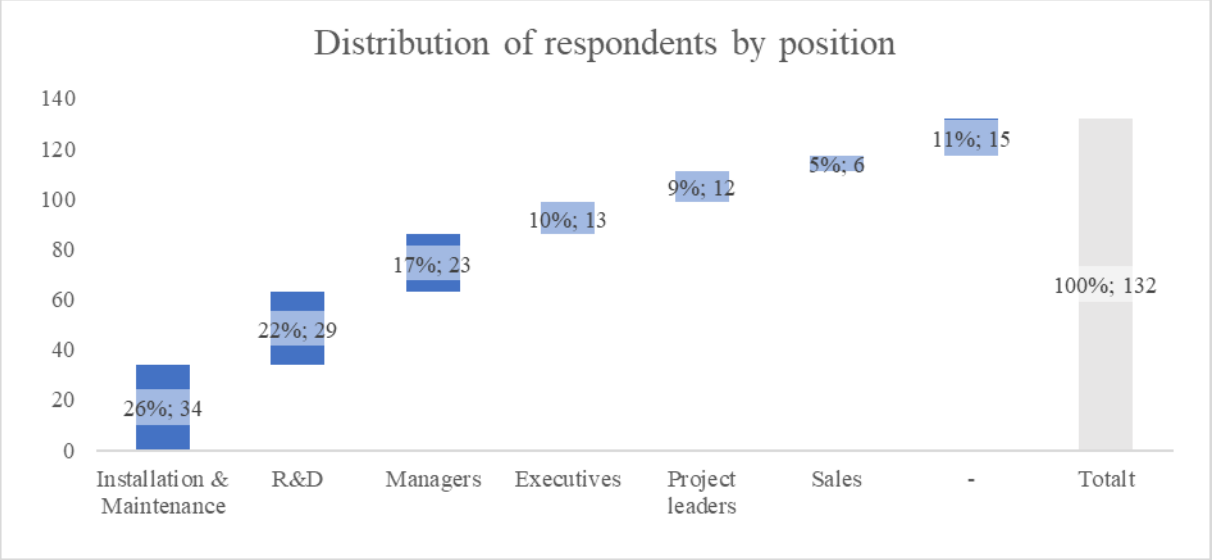

Figure 5 - Distribution of respondents by position, share and number

The distribution of respondents by revenue and number of employees of their companies are tilted towards bigger companies. The number of respondents from companies with an annual revenue of more than one billion Swedish kronor were 65, or 49 percent of all respondents. The rest of the respondents are distributed across the remaining revenue intervals, and per interval accounted for 5 percent to 16 percent of the total number of respondents. 11 respondents or 8 percent did not disclose enough information to conclude the revenue of the company, see Table 11.

Table 11 - Distribution of respondents by the revenue of their company

Revenue	<50 msek	50-99 msek	100-499 msek	500-999 msek	1-10 bsek	> 10 bsek	-	Total
#	17	6	21	12	24	41	11	132
%	13%	5%	16%	9%	18%	31%	8%	100%

The distribution of respondents by the number of employees of their company does look quite similar to the one of revenue. The number of respondents from bigger companies with more than 500 employees are 56 and accounted for 42 percent of the total number of respondents. The remaining intervals each account for 10 percent to 15 percent of the respondents. 8 respondents or 6 percent did not disclose enough information to conclude the number of employees of the company, see Table 12.

Table 12 - Distribution of respondents by the number of employees of their company

Employees	<10	10-49	50-249	250-500	> 500	-	Total
#	16	19	20	13	56	8	132
%	12%	14%	15%	10%	42%	6%	100%

The amount of experience from working with machine guarding safety is 17 years on average, with a median of 18 years, see Table 13. The distribution of the number of years of work experience within machine guarding safety is quite even across different roles. However, sales personnel, project leaders and executives tended to have a few more years of experience than the remaining roles. It should be noted however, that the sample of respondents working mainly within sales are smaller than the rest of position and therefore less representative. The respondents who did not disclose their position have the least years of work experience from machine guarding safety.

Table 13 - The number of years of work experience within machine guarding safety per position

	R&D	Installation & Maintenance	Sales	Project leaders	Managers	Executives	-	Total
Avg.	15	17	20	20	16	20	13	**17**
Med.	15	20	20	21	15	20	11	**18**

In total, the respondents collectively have experience from working with 25 different PLC brands. Most of the respondents have used PLCs from JOKAB, Siemens and SICK. Pilz, Schineider Electronics, Schemersal, Beckhoff and Rockwell – Allen Bradley are other relatively frequently used PLC brands, see Figure 6. The remaining 17 brands have between one and ten users each. It should be noted that some respondent had experience from working with multiple brands. The answers solely represent the frequency of which individual respondents have used the specific brands and does not entail the frequency of specific brands within certain companies or industries.

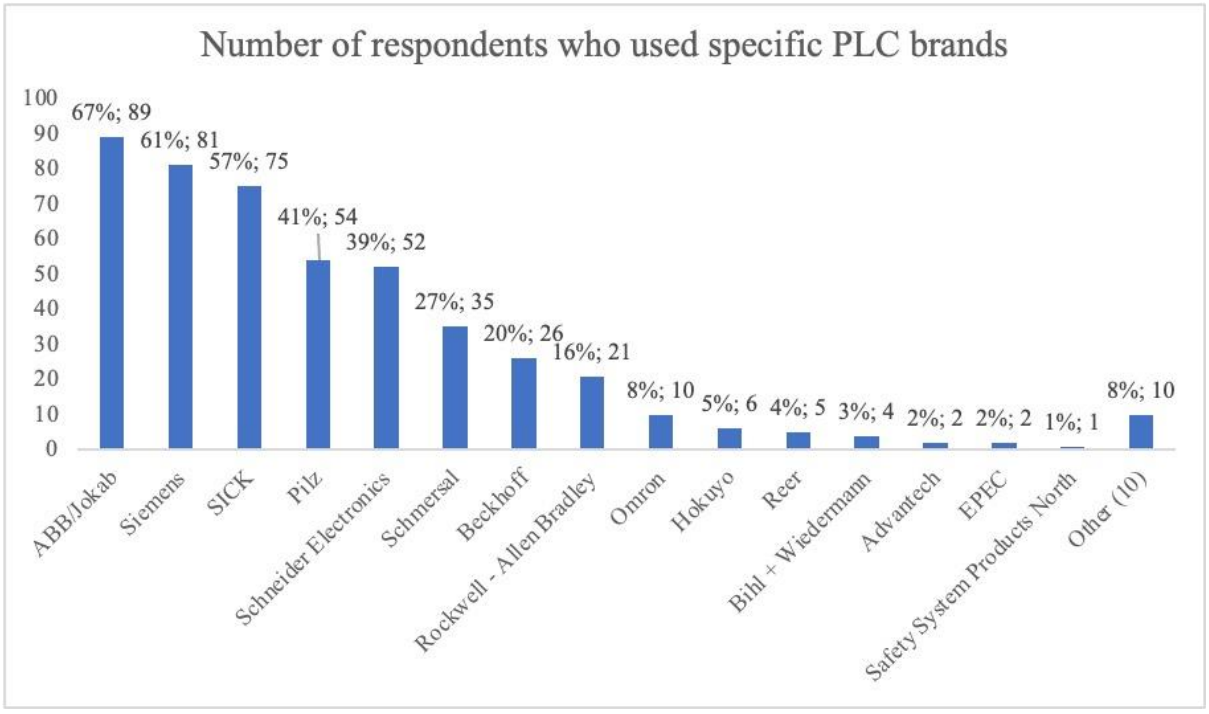

Figure 6 - Usage frequency of PLC brands among respondents

4.3.2 Attribute Classification on Aggregate Level

From the interviews with *The Retailer*, and especially from the interviews with the end users, it was possible to map 20 needs. These needs are paired with an attribute in Table 14 below.

Table 14 - Attribute label and description, paired with corresponding need

Label	Short Description	Need	Exist on *The Product*
A1	Wireless communication	To communicate between PLCs that are difficult to connect by wire	Yes
A2	Wireless PC-PLC connection	To connect a PC to a PLC when it is cumbersome to do so by wire	Yes
A3	Move PLC logic	To transfer PLC logic to a new unit without having to reprogram the safety system	Yes
A4	Mobile app	To monitor and receive diagnostics from the safety system easily and accessible all the time	No
A5	Daily report	To facilitate improvements, and discover potential problems in the safety system	No
A6	Electrical cabinet	To protect the safety-PLC from dust and water	No
A7	Plug-and-Play	To limit the time and effort needed for the installation of the safety-PLC	Yes
A8	Connect to other field bus systems	To be able to connect safety-PLCs to other brands safety systems	No
A9	Software library	To quickly program safety-PLCs for certain standard situations	Yes
A10	Simulation	To simplify communication in the design phase, and to minimize unforeseen problems during installation of safety systems	No
A11	Instruction videos	To easily access guidance before and during installation and operation	No
A12	Safe input or safe output	To minimize the number of I/Os needed for a safety solution	Yes
A13	Safe input and information output	To minimize the number of I/Os needed for a safety solution	Yes
A14	I/O status display	To easily overview the PLC logic when error occurs	No
A15	Waterproof casing	To be able to install safety-PLCs outside of an electrical cabinet	Yes
A16	Push buttons on PLC casing	To decrease the number of hardware units needed for a safety system	Yes
A17	Customizable push buttons	To minimize the number of buttons that are needed for a certain safety system	Yes
A18	Standardized interface	To facilitate that safety hardware is easily integrated to all other hardware	No
A19	Same brand	To easily onboard and teach new recruits all software that is needed, and to minimize the number of spare parts in stock	N/A
A20	Well-known brand	To be able to rely on the producer of safety systems if something would go wrong	No

The results from the Kano questionnaire show that all attributes are classed as either Attractive or Indifferent, and they are presented in Table 15 below. In the left most column is the attribute number from the questionnaire presented, followed by the percentage of respondents that classified each attribute as A, O, M, I, R, or Q, respectively. Next are two different methods for classifying attributes, the mode classification, and the BRR-classification to filter noise from the respondents – these methods are explained more thoroughly in chapter 3.3.2. The second to last column are the *Better* and *Worse* indexes originally proposed by Mike Timko (Berger, et al., 1993) – the indexes are also more thoroughly described in chapter 3.3.2. The number of total responses for each question is presented in the last column, it ranges from 129 to 132. The 20 attributes are referred to as A1 – A20 hereafter. All the functional and dysfunctional questions that were stated in the questionnaire are presented in Appendix B.

Table 15 - Kano answers on an aggregate level

	Statistical mode classification						**BRR-classification**	**Better and worse indexes**		
	A	**O**	**M**	**I**	**R**	**Q**	**Classification**	***Better***	***Worse***	**Total responses**
A1	37,1%	2,3%	1,5%	**47,7%**	11,4%	0,0%	I	0,44	0,04	132
A2	44,7%	4,5%	0,8%	**45,5%**	4,5%	0,0%	A	0,52	0,06	132
A3	**44,7%**	28,8%	10,6%	15,2%	0,8%	0,0%	A	0,74	0,40	132
A4	46,5%	4,7%	0,0%	**47,3%**	1,6%	0,0%	A	0,52	0,05	129
A5	34,1%	8,3%	2,3%	**53,8%**	0,8%	0,8%	I	0,43	0,11	132
A6	3,1%	6,9%	3,1%	**66,2%**	20,0%	0,8%	I	0,13	0,13	130
A7	44,7%	3,0%	0,0%	**50,8%**	1,5%	0,0%	I	0,48	0,03	132
A8	**40,2%**	15,2%	12,1%	31,8%	0,8%	0,0%	A	0,56	0,27	132
A9	36,9%	10,8%	6,9%	**43,1%**	2,3%	0,0%	A	0,49	0,18	130
A10	**46,6%**	18,3%	6,1%	29,0%	0,0%	0,0%	A	0,65	0,24	131
A11	36,6%	13,0%	2,3%	**46,6%**	1,5%	0,0%	A	0,50	0,16	131
A12	**48,5%**	5,4%	1,5%	42,3%	1,5%	0,8%	A	0,55	0,07	130
A13	45,4%	2,3%	0,0%	**49,2%**	3,1%	0,0%	I	0,49	0,02	130
A14	**38,9%**	11,5%	9,9%	**38,9%**	0,8%	0,0%	A	0,51	0,22	131
A15	22,3%	6,9%	2,3%	**67,7%**	0,8%	0,0%	I	0,29	0,09	130
A16	19,2%	6,2%	3,1%	**70,8%**	0,8%	0,0%	I	0,26	0,09	130
A17	32,3%	10,8%	8,5%	**48,5%**	0,0%	0,0%	A	0,43	0,19	130
A18	**50,8%**	18,5%	3,8%	26,9%	0,0%	0,0%	A	0,69	0,22	130
A19	**43,8%**	12,3%	3,1%	40,0%	0,8%	0,0%	A	0,57	0,16	130
A20	28,2%	9,9%	9,2%	**52,7%**	0,0%	0,0%	I	0,38	0,19	131

As presented in the table above, there are no attributes that are classified as either Must-be or Reverse on an aggregate level. When using the mode classification method, six out of the 20 attributes are classed as Attractive, 13 are classed as Indifferent and one attribute received the same number of Attractive as Indifferent classifications. When using the BRR-classification, the attributes are classified a bit differently. Then there are twelve Attractive and eight that are categorized as Indifferent.

When reading Table 15 there are some variations in the answers that are interesting. To better visualize these nuances the answers are plotted in a bar graph in Figure 7 below. The y-axis shows the percentage of respondents who classifies an attribute a certain way and the x-axis shows the attributes surveyed.

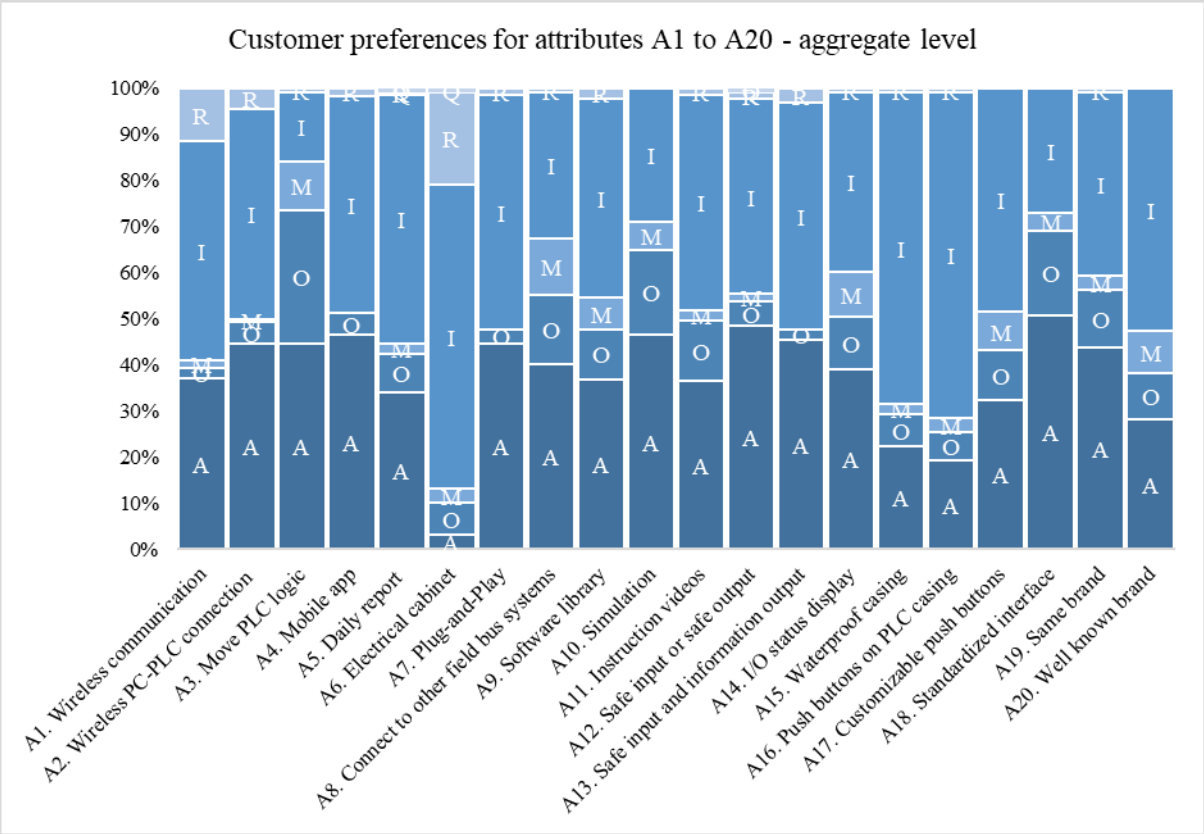

Figure 7 - Customer preferences for attributes A1 to A20 on an aggregate level

Another possibility to visualize the nuances in the answers is to use the *Better* and *Worse* indexes that are presented in Table 15. The *Better and Worse* indexes are used to plot each attribute into a matrix, where each attribute is labelled from A1 to A20. The matrix is a method to classify the attributes, see Figure 8.

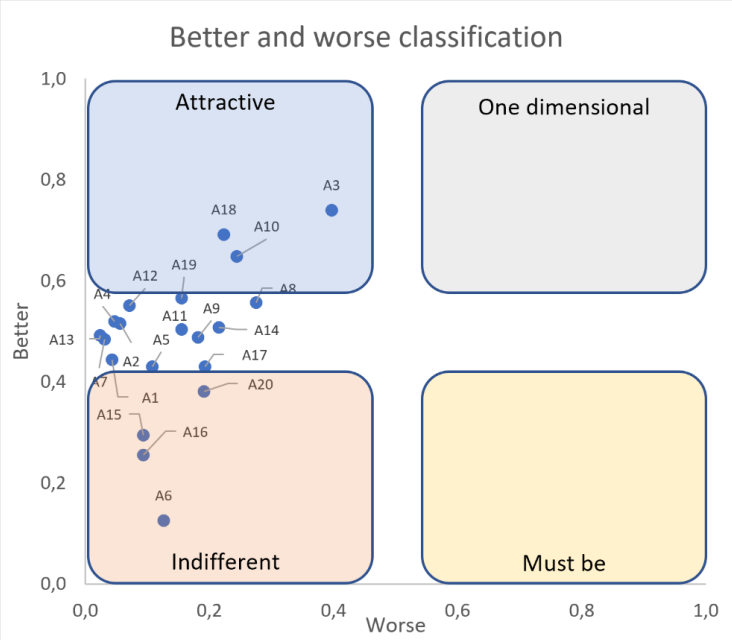

Figure 8 - Better and worse classification for all 20 attributes.

All the attributes are, with this method also, classified as either Attractive or Indifferent – just as in the chart above. However, there are some nuances that are visible in the matrix. E.g., there are many attributes that are in the joint between Attractive and Indifferent. Attribute *Move PLC logic* (A3), *Simulation* (A10), and *Standardized interface* (A18) are the attributes that are the most attractive, while the respondents are most indifferent regarding attributes *Electrical cabinet* (A6), *Waterproof casing* (A15), and *Push buttons on PLC casing* (A16).

Given that there are many respondents from different companies, industries, and with varying degree of experience and different positions, it is necessary to segment the results by these different categories.

4.3.3 Attribute Classification on Segmented Level

The first segmentation is based on what industry the respondents belong to. The nine industries with most respondents, ranging from 32 respondents from the automotive industry to four respondents from the consulting industry, are plotted on the x-axis. The respondents that belong to any other industry or did not answer the question is grouped into the category “other”. All 20 attributes, in groups of four, and how the answers are distributed for each industry are plotted in Figure 9 and Figure 10. Figure 9 is bigger in size to increase the readability, while Figure 10

contains smaller graphs but contain the same information for attributes 5 - 20. Figure 10 has been rotated 90 degrees to the left to make room for the graphs, the same goes for Figure 12 and Figure 14. The number of respondents for each category is presented within the parenthesis on the x-axis categories.

There are some differences between the industry preferences that are worth highlighting. *Steel & Metal* and *Automation* seems to classify attributes as Attractive or One dimensional to a higher degree than *Automotive* for most, but not all, of the attributes. E.g., using the statistical mode to classify *Wireless communication* (A1), the attribute would be Indifferent for *Automotive*, but Attractive for *Steel & Metal* and *Automation*. One could easily think that *Consulting* and *Food* stand out as extreme for some attributes, e.g., for the attribute *Move PLC logic* (A3), where all respondents from Consulting rated the attribute as Attractive. However, it is important to bear in mind that they only consist of four respondents.

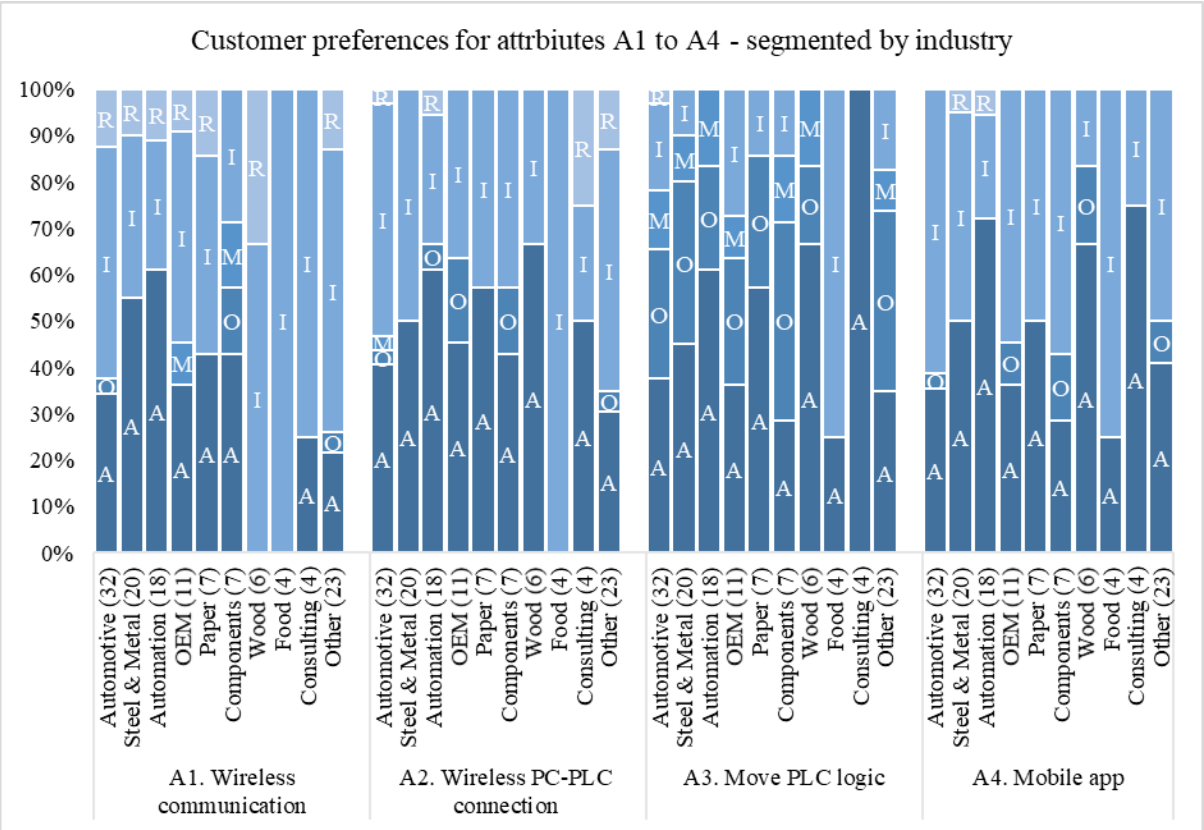

Figure 9 - Customer preferences for attributes A1 to A4 – segmented by industry

Figure 10 - Customer preferences for attributes A5 to A20 segmented by industry

There are also some differences for how different positions rate the attributes, however there are no coherent tendencies, and the differences are generally small. The distribution of answers is presented in Figure 11 and Figure 12. The number of respondents for each category is presented within the parenthesis. Even though no consistent noteworthy patterns are present some tendencies can be observed such as respondents from *R&D* rate some attributes to be less Attractive and more Indifferent than other positions. This is obvious for the attributes *Mobile app* (A4) and *Daily report* (A5), which are Indifferent for *R&D* while they are mostly Attractive or One dimensional for *Managers* and *Sales*. *Customizable push buttons* (A17) are also rated to be more Attractive by *Managers*, *Project Leaders*, and *Sales* than by *R&D*. Executives on the other hand think that a *Well-known brand* (A20) and *Same brand* (A19) is more Attractive, compared to the other categories.

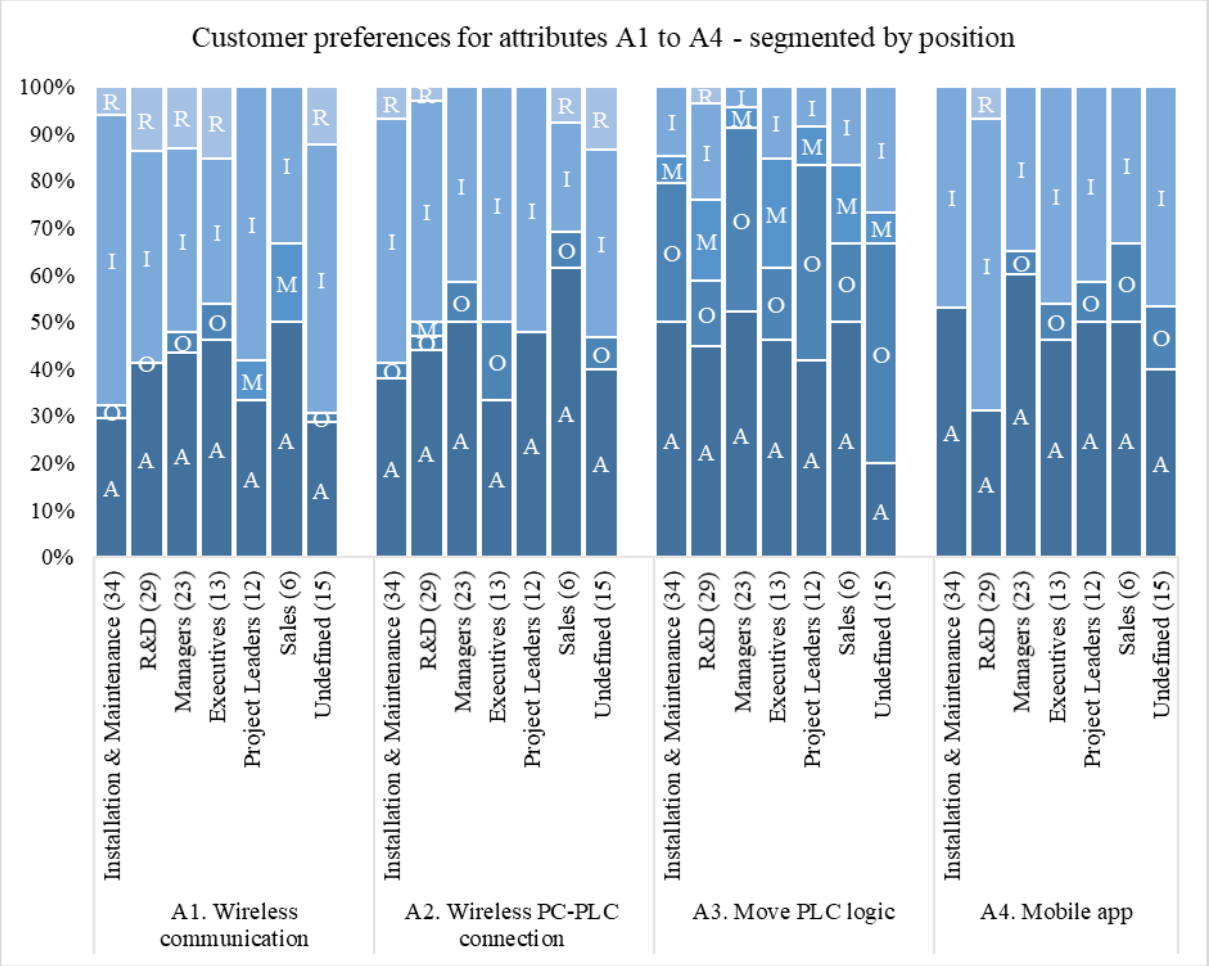

Figure 11- Customer preferences for attributes A1 to A4 - segmented by position

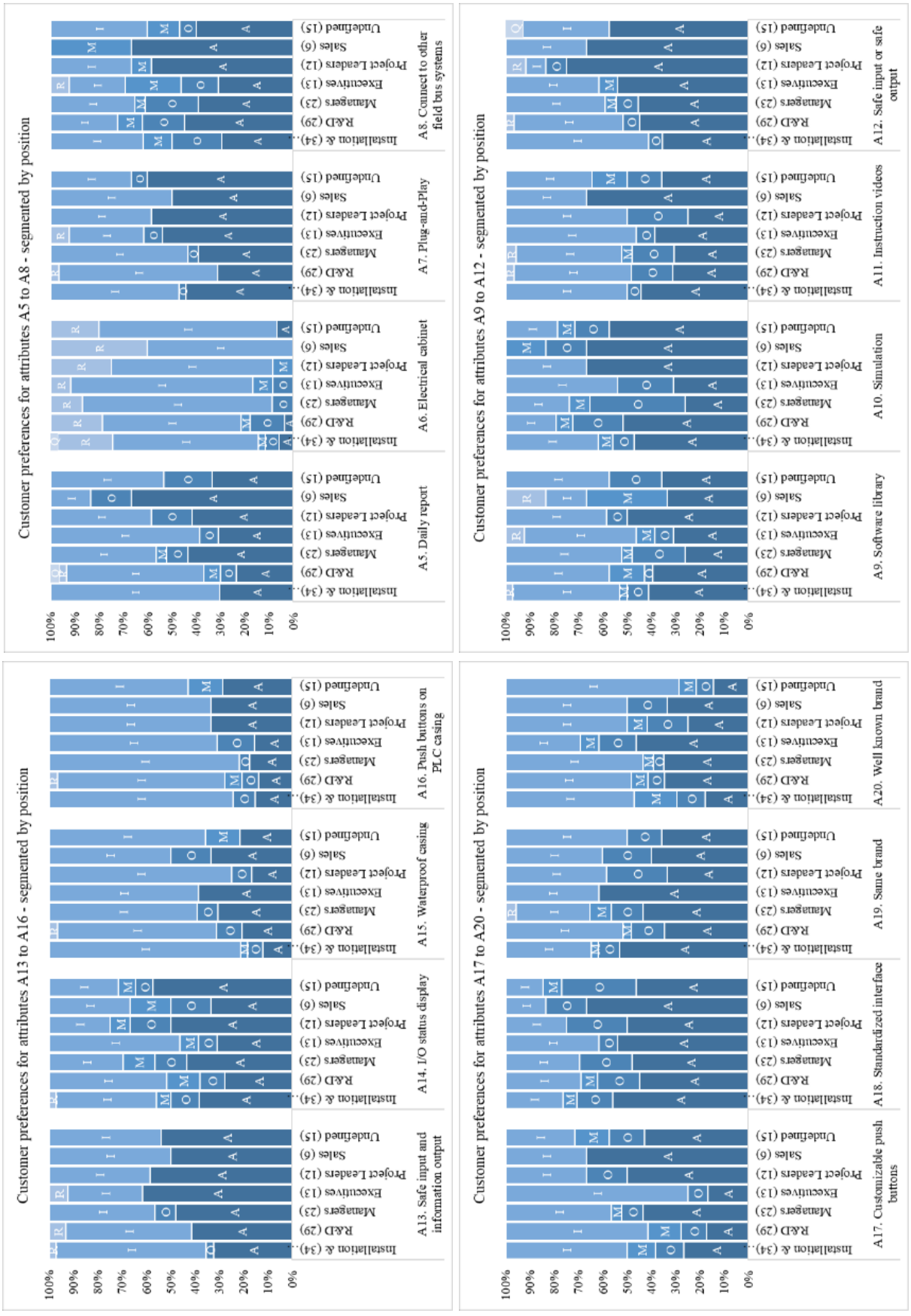

Figure 12 - Customer preferences for attributes A5 to A20 - segmented by position

Lastly, the classification is also segmented on company size – more specifically the number of employees that work at the respondent's company. See Figure 13 and Figure 14. There are some attributes where the number of employees seem to affect the classification. Three examples are *Move PLC logic* (A3), *Software library* (A9) and, *Well-known brand* (A20) where the smaller companies seem to rate the attributes as more Attractive or One-dimensional than the larger companies. However, for most attributes the classifications seem to be non-correlating to how many that are employed at the company.

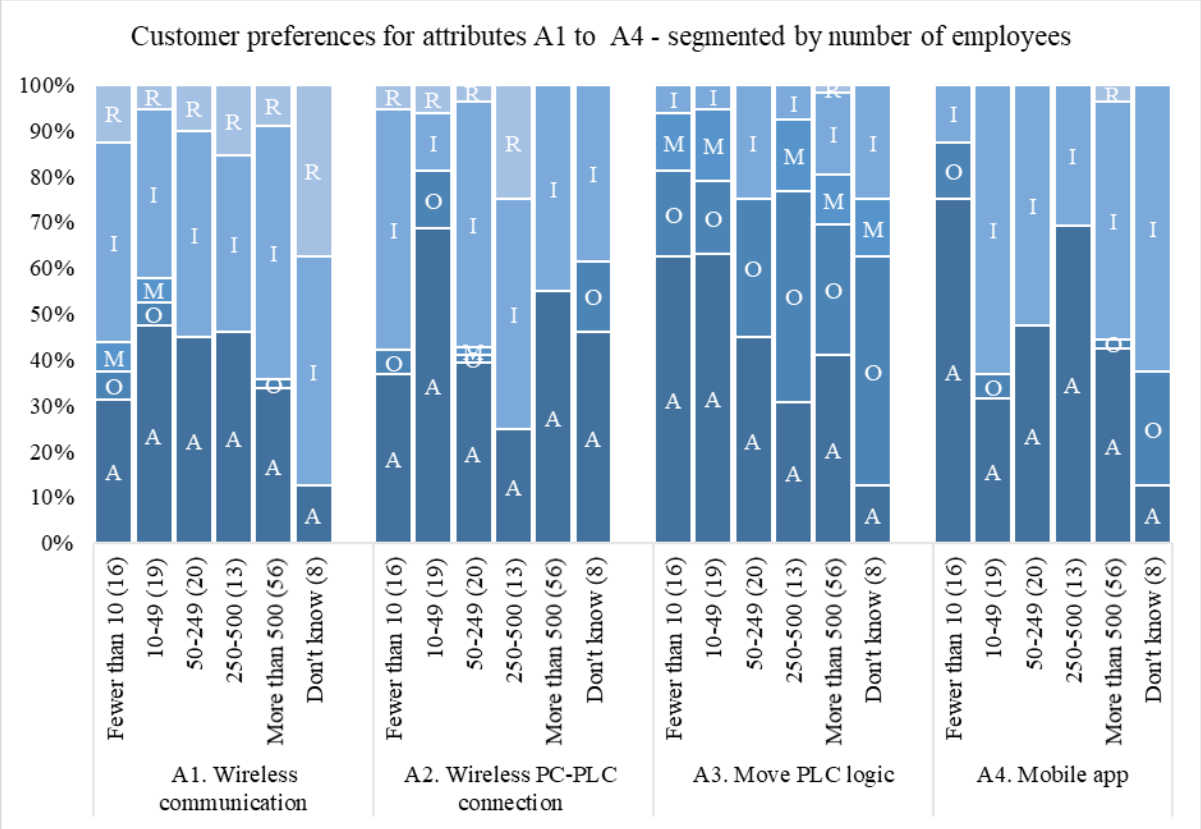

Figure 13 - Customer preferences for attributes A1 to A4 - segmented by number of employees

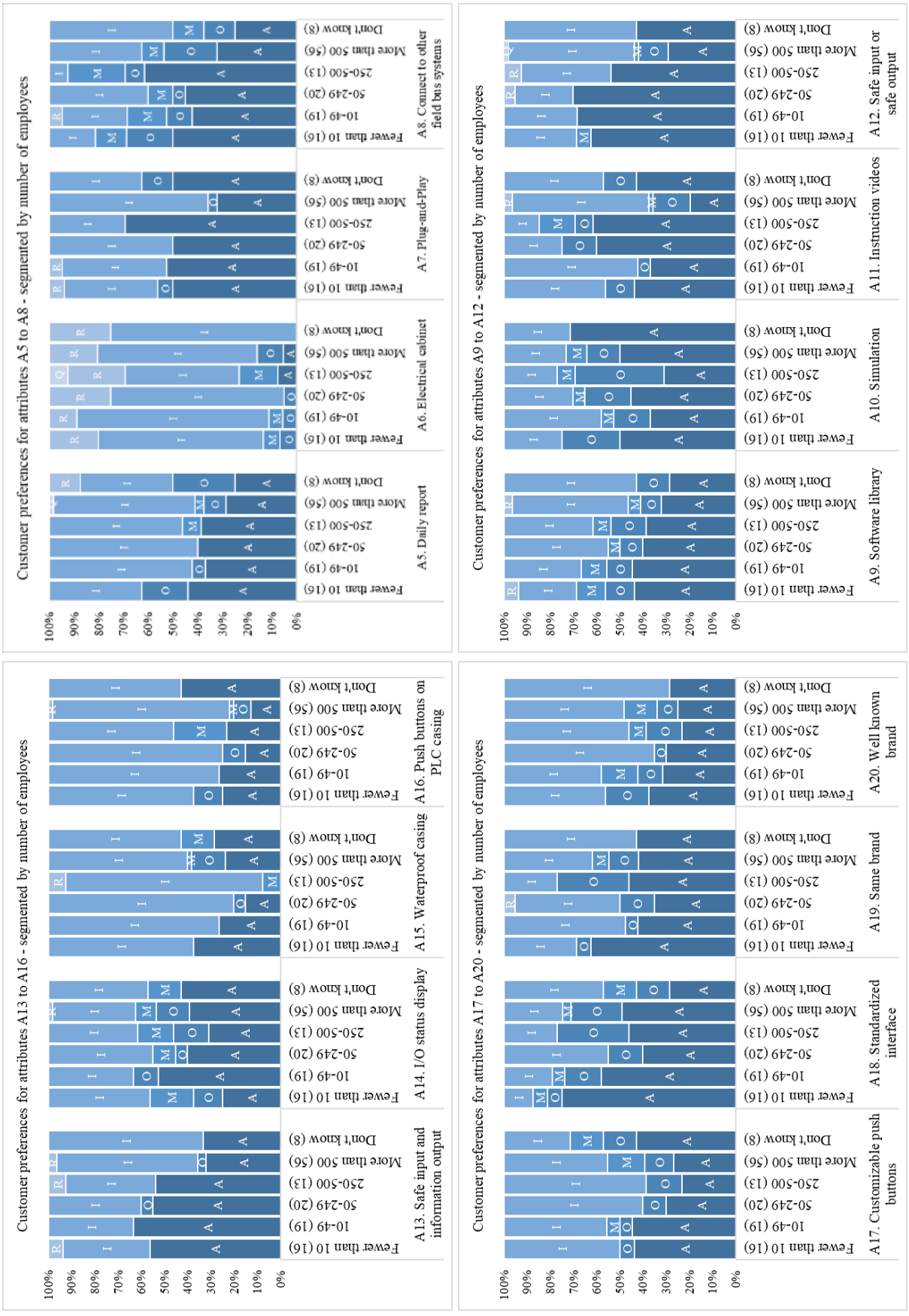

Figure 14 - Customer preferences for attributes A5 to A20 - segmented by number of employees

5 Discussion

The results presented in the previous chapter facilitate interesting insights when analyzed in the light of literature on the topics. These insights are discussed in this chapter. Firstly, the research method and how it might have affected the results is elaborated on, comparing the methodology used to previous research on implementing the Kano model. Secondly, the results are discussed and related to previous knowledge and research in the field of customer centricity and the Kano model.

5.1 Discussion of Research Method

The results that are discussed later in this chapter are highly affected by the methods applied throughout the research. Hence, it is of interest to initially discuss the methods and the implications it has on the results. Some of the most critical processes in the method are how the needs and requirements are identified, which attributes that are submitted in the survey, the choice of demographical questions, and the sampling of respondents for the Kano questionnaire, which eventually leads to the conclusion of the study.

The method used to identify needs and requirements were interviews. Some of the literature proposes that observations are beneficial to identify latent needs, thus Must-be and Attractive attributes (Matzler et al., 1996). However, it was not applicable to use observations in this survey mainly due to two different reasons. First, the Corona virus heavily restricted the possibility to conduct company visits since all non-critical activities had been rescheduled to online meetings. Second, *The Product* that has been assessed is rarely interfered with. As presented in the empirical findings from the interviews, the installation of machine guarding safety-PLCs are quite irregularly updated, and while in use it is rare that personnel interact with the PLC. From the results it is obvious that many Attractive attributes were identified regardless of the lack of observations, contradicting the recommended research process proposed by Matzler et al. (1996). A possible explanation for why none of the attributes were classified as Must-be attributes might be the lack of observations. However, the most likely explanation to why no attributes were classified as Must-be stems from the method of choosing which attributes to include in the questionnaire.

When all needs and requirements were gathered from the interviews they were translated into many different attributes. The 20 most interesting attributes, and their corresponding needs, are presented in Table 14. The argument to limit the number of attributes to 20 is to keep the survey from taking too much time to complete, moreover the median number of attributes from Löfgren and Witell's (2017) literature review is 15 which gives a good indication for how many attributes that are fitting to classify through one questionnaire. However, the gross list of attributes and needs entailed more than 20 needs, hence it was necessary to filter the number of attributes down to 20 for the final questionnaire. To determine which attributes to include in the questionnaire, the attributes with an inventive step were prioritized over well-established attributes. Hence, most attributes were deviating from the standard set of attributes of a safety-PLC. This is probably one of the main explanations to why the attributes were classified as only either Indifferent or Attractive.

Another methodological aspect that needs to be discussed is the choice of demographical questions asked in the survey. All the demographical categories used in the survey are well argued for in the previous research by authors such as Berger et al. (1993). However, no clear patterns of different customer preferences between segments could be distinguished, as discussed further in section 5.2. It is difficult to determine if this is a result of inadequate demographical questions being asked, or if the differences between customer segments are not significant enough to measure with the set of data being used in this thesis. However, if more demographical data would have been collected, it would increase the probability of finding any differences between segments, if they exist. Although the possibility to segment market on customer preferences is being presented as one of the greatest advantages with the Kano model (Berger, et al., 1993; Matzler et al, 1996), the literature is not presenting methods to find these segments, nor how a segment can be defined using only data from the Kano survey together with demographical data.

The last methodological aspect to discuss is how the respondents of the Kano survey were sampled. As described in the section 2.3.4, there were no databases of potential respondents available, and it was prioritized to reach as many respondents as possible to achieve as unambiguous results as possible. To facilitate this, the only passable method was to distribute the survey through asking the targeted respondent to first participate in the survey themselves, and to then forward the questionnaire to other persons that they thought could participate too. This is worrying since the repeatability of the study decreases using this method, moreover the

final sample cannot be considered a representative sample for the entire population of machine guarding safety users in Sweden. The implication is that one must be very conservative regarding the conclusions that can be drawn for the entire population. The fact that one of the targeted respondents forwarded the survey to over 2,000 persons is in some respects positive. The positive aspect is that many got the opportunity to answer, which might mitigate the skewness created by targeted respondents only forwarding the survey to people they know well. However, the 2,000 persons cannot be considered randomly selected, hence the original problem discussed earlier is still critical.

5.2 Discussion of Results

This study is conducted with the purpose of mapping what attributes the users of machine guarding safety-PLCs in Sweden classify as Attractive, One-dimensional, Must-be, Indifferent or Reverse according to the Kano model. Furthermore, to elaborate on the Kano models relation to customer centricity and how the Kano model can be used by companies to become more customer centric. The study was conducted at *The Company* with focus on *The Product* which is a machine guarding safety-PLC. The Kano model was the method deployed in the study and its results have been discussed using theory on the Kano model, customer centricity and utilization of customer preferences in product and marketing strategy.

The categorization of the attributes in this study would, according to both the statistical mode- and BRR-classification methods (Berger, et al., 1993), result in each attribute being either Attractive or Indifferent. Although the outcome of the classification depends on the attributes chosen to be included in the questionnaire, it is noteworthy that no other categorization than Attractive or Indifferent is obtained. This result is contrary to the findings in the literature that is used in this study, in that all of these studies conclude that the attributes they surveyed could be categorized as more than two different classifications and not solely Attractive or Indifferent. E.g., Chen et al. (2020), Choudhury and Gulati (2020), Bilgili et al. (2011) and Yang (2007) are all able to categorize their attributes as more than two different categorizes.

Depending on whether statistical mode- or BRR-classification method is used, the classification of the attributes differs. With the statistical mode, six attributes are classed as Attractive while 13 are classified as Indifferent, and one attribute is not possible to distinguish

between Attractive and Indifferent. When using the BRR-classification, there are twelve attributes classified as Attractive, and eight are classed as Indifferent. The attributes that are classified differently, thus classed as Attractive instead of Indifferent with the BRR-classification are, A2, A4, A9, A11, A14, and A17. However, it should be noted that in several cases the share of respondents who thought an attribute were Attractive versus Indifferent is rather similar, while in some cases the difference between the two is more significant. This is a result that could be expected according to Matzler (1996) who argues that the ambiguity in classification is expected to vary between individual attributes.

As described above, the results in this study are presented using different evaluation methods. Except for the statistical mode- and the BRR-classification, the *Better* and *Worse* indexes are used as well. Löfgren and Witell (2017) conclude in their literature review that the combination of evaluation methods has proven fruitful. This is true in this study as well, since the insights gained from using the statistical mode, BRR-classification, and the *Better* and *Worse* indexes are quite different. The *Better* and *Worse* index is the method that deliver the most nuanced results, while the clear and unambiguous results that are produced from both the statistical mode classification, and the BRR-classification, might give a false sense of unanimity. The implication is that one needs to be aware that the method of choice does affect the final classification.

In the light of this ambiguity between the classification of the attributes some notable attributes stand out, with a more distinct difference between the share of respondents who appreciate the attribute or not. *Move PLC logic* (A3), *Simulation* (A10), and *Standardized interface* (A18) all have a vast majority of respondents who think the attributes are Attractive or One-dimensional. But also, *Connect to other field bus systems* (A8), *I/O status display* (A14), and *Same brand* (A19) are considered important attributes. On the other side of the spectrum, attributes such as *Electrical cabinet* (A6), *Waterproof casing* (A15), and *Push buttons on PLC* (A16) have a vast majority of respondents who think the attributes are Indifferent or even Reversed. A possible explanation for why some attributes receives their respective classification could be found in the reasoning by Bohlmann et al. (2012) on Dynamic Innovative Markets. Bohlmann et al. (2012) argues that for customers to express needs and appreciate features they often first need to learn about that feature and its implications. Given that many of the attributes surveyed in this study do not exist as a feature on safety-PLCs currently available on the market, it could be argued that some customers would have answered differently if the attributes were more

common. If these features were introduced, it is according to Bohlmann et al. (2012) reasoning, likely that some attributes would be categorized differently, with some becoming much more appreciated by the customers and other less so. During the interviews, several respondents state that they expect new attributes to be added to the machine guarding safety-PLCs currently available in the market, some of which were not considered Attractive in this study. E.g., Pontus and Robert E both expect wireless communication to be a more frequently used functionality of machine guarding safety-PLCs. However, the attribute *Wireless communication* (A1), was considered Indifferent in the Kano model.

The findings stated above may be limited by some aspects of the Kano model. As previously stated, it is not well known how stable the results of the classifications are. Kano presents in his work from 2001 that the attributes seem to develop from Attractive, to One-dimensional, and lastly Must-be (Löfgren & Witell, 2017). However, it is also established that other possible cycles exist, such as Indifferent to One-dimensional, to Indifferent again. As Löfgren and Witell (2017) conclude in their literature review, it is troublesome that not more research have been conducted to determine the average time span that each attribute is classified as Attractive or Indifferent. Moreover, it is not determined how large share of the attributes that develop over time. The fact that the classification results of the Kano model would change over time is also supported by Borgianni (2018), who states that the classification of the attributes are likely to change beyond the short to mid-term. Borgianni (2018) argues that the Kano results provide a good guidance for a short perspective product development horizon. Thus, the attributes mentioned previously can indeed be leveraged to the company's product development and marketing in the short term. However, it is difficult to make any strategic decisions based on the results of the Kano model in the long term.

The development - or improvement prioritization of the surveyed attributes should follow the one proposed by Matzler et al. (1996) who roughly states that Must-be attributes are top priority followed by One-dimensional, Attractive, and lastly Indifferent attributes. To derive clearer product- and marketing implications from these insights the performance level of each attribute needs to be assessed. It should be noted that the Kano model process, that several of the authors on the subject presents such as Berger et al. (1993) and Matzler et al. (1996), do not address the measurement of the performance aspect but rather leaves this assessment to the company to determine themselves. Contrary to this, assessment of attribute performance is recommended by Wang et al. (2020) in their proposed SIPA model. The performance of the attributes can be

determined by the company through benchmarking against competitors. If the company manages to accurately assess the performance of the attributes surveyed, an individual improvement or innovation strategy for each attribute could be developed, similar to the ones proposed by Wang et al. (2020). Given the theory's emphasis on performance assessment it could be fair to argue that a next step for *The Company* could be to begin determining the performance, when it applies, of the most crucial attributes from the Kano model, which are *Move PLC logic* (A3), *Simulation* (A10), and *Standardized interface* (A18) followed by *Connect to other field bus systems* (A8), *I/O status display* (A14), and *Same brand* (A19).

The results of the Kano model could either be used for changing the product through product development (Bulsara & Thakkar, 2015), or changing the customers perception of the product through e.g., marketing (Vinokurova, 2019). The implication of this could be interesting since the results show that some of the attributes the customers showed interest in currently exists on *The Product* while others do not. For the ones that already exist, but for which the customer so far showed limited interest in, e.g., *Wireless communication* (A1), marketing may be used to change the customers perception, e.g., by adding or transforming the demand landscape which is proposed by Vinokurova (2019). An interesting aspect of this, as previously mentioned by Bohlmann et al. (2012), is that a company might have to educate a customer on the potential implications and benefits of a feature before the customer can truly appreciate and feel the need for it, especially in an innovative high-tech market as the one *The Company* is operating in. For existing attributes which got a rather positive response in the Kano model, e.g., *Move PLC logic* (A3), it could be argued that these attributes would fit better as a concrete sales argument in comparison to an attribute in need of prior education of the customer.

In terms of product development, the theory suggests different frameworks for how the Kano results could be integrated into the development process, the PDCA-cycle or House of Quality suggested by Bulsara and Thakkar (2015) and Hasim and Dawal (2012) are two of those. How these frameworks should be applied to the individual attributes are likely to be related to the performance rating and hence the prioritization they are given e.g., through the SIPA model by Wang et al. (2020). An obviously Indifferent attribute with currently sufficient performance level, e.g., *Waterproof casing* (A15), would not be a top candidate attribute to put into the development frameworks proposed.

Due to the possible applicability of Kano results in companies' short and mid-term marketing- and product development endeavors to increase customers satisfaction, it is likely that some connections between the strive towards customer centricity and the Kano model exists. Fader (2020) emphasizes the importance of aligning a company's products and services with the needs of their most important customers, thus a need for clear customer segments exists. This viewpoint is supported by Shah et al. (2006) who states that parts of the organizational structure in a customer centric organization is preferably centered around customer segments. Since the Kano model partwise aims at discovering customer segments with specific preferences (Berger, et al., 1993), it could be expected that use of the Kano model would be well suited for the customer centricity strive. The result from this study shows attribute preferences for different industry segments, respondent position, and company sizes. One interesting finding in the results is that in most cases, a larger share of the industry segments *Steel & Metal* and *Automation* thinks the attributes are Attractive or One-dimensional compared to *Automotive* and therefore highlights a potential differentiation in industry preferences around machine guarding safety products. These are the three largest segments and comparison to the remaining industry segments could be somewhat misleading due to the big difference in the number of respondents. Surprisingly, no consistent and noteworthy differences were found when segmenting on different positions, or company sizes of the respondents. Thus, this study was unable to clearly show differences between customer segments the way Berger et al. (1993) state that the Kano model would be able to do. This finding is partly supported by the statements made by *The Retailer* and end users during the interviews. E.g., do Per and Magnus from *The Retailer* state that the safety requirements is rather similar no matter the industry. However, this finding could also be due to the choice of sampling method as previously discussed.

Looking at the demographics of the respondents in the results, it could be argued that the answers they give in the survey are valid in the context. With a broad distribution of respondents across different industries, an average relevant work life experience of 17 years and most of the respondents currently working hands on with machine guarding safety, the relevance of the input could indeed be considered high and thus provide more bearing to the trustworthiness of the attributes classification. This result provides some proof that it actually is the type of customer *The Company* is trying to target that has been surveyed, which is key for customer centric companies since they need to find and connect with their most valuable customers according to Fader (2020).

When looking at the characteristics of a customer centric organization according to Shah et al. (2006), one could argue that the use of the Kano model could facilitate several of these. An implication of the results in this study is that they could help *The Company* with basing business decisions on customer preferences, highlighting product benefits in terms of meeting customer needs, segmenting customer groups and viewing customer knowledge as a valuable asset. All of these are things that Shah et al. (2006) emphasize as prevailing characteristics of customer centricity. It is also possible to see some connections between the results and literature's suggestion on overcoming hurdles when aiming at customer centricity in an organization. Deploying the Kano model could potentially facilitate the important aspect of spending time with customers to build customer relationships which is emphasized by both Shah et al. (2006) and (Lambverti, 2013). The results of this study could serve as a mean for the management of *The Company* to align both the internal and external sales organization around, which is something proposed by Shah et al. (2006), but also to motivate future endeavors with the goal of listen to the customer.

Shah et al. (2006) also state the importance of sharing customer needs across silos in organizations to improve both R&D- and marketing efforts. It is possible that the results from the Kano model could be used in that context, to be spread across *The Company's* organizational functions all the way to *The Retailers*. Lambverti (2013) argues that an inherent risk to customer centricity is the outsourcing of the customer touchpoints. This is partly the case for *The Company* in that most of the sales and end user interactions occurs through *The Retailer*. Therefore, the results of this study and similar studies in the future could provide *The Company* and other companies in the same situation with a tool to partly reclaim the ownership of the knowledge of the customer preferences and needs. This is something the literature constantly circles back to when discussion the basics of customer centricity, e.g., like Gummesson (2008) who highlights this in his comparison of customer centricity and product centricity. However, it should be noted that a lot of criticism towards the Kano model has been raised by authors such as (Löfgren & Witell, 2017) who claims Kano lacks statistical and mathematical significance, thus the reader of this study is urged to consider the findings and implications of the study with this is in mind.

Looking at how the results can affect *The Company's* journey towards customer centricity in the light of the literature on both customer centricity, the ways of using customer preferences and the Kano model, it seems rather clear that the Kano model could facilitate this strive.

However, assuming the results of this study or results from other Kano models in general would provide anything more than a fraction of the components necessary to become truly customer centric appears farfetched, although the small contribution that the results make should be considered a valuable asset of customer knowledge.

6 Conclusion

This study has mapped what attributes the users of safety-PLCs in Sweden classify as Attractive, One-dimensional, Must-be, Indifferent or Reverse according to the Kano model. Furthermore, the Kano models relation to customer centricity and how the Kano model can be used by companies to become more customer centric was elaborated on.

Out of the 20 attributes surveyed, twelve was categorized as Attractive attributes and eight as Indifferent attributes. No other attribute classifications than Attractive and Indifferent are represented in the result, which can be explained by the choice of new and innovative attributes included in the survey. The **twelve Attractive** attributes are *Wireless PC-PLC connection* (A2), *Move PLC logic* (A3), *Mobile app* (A4), *Connect to other field BUS systems* (A8), *Software library* (A9), *Simulation* (A10), *Instruction videos* (A11), *Safe input or safe output* (A12), *I/O status display* (A14), *Customizable push buttons* (A17), *Standardized interface* (A18), and *Same brand* (A19). The **eight Indifferent** attributes are *Wireless communication* (A1), *Daily report* (A5), *Electrical Cabinet* (A6), *Plug-and-Play* (A7), *Safe input and information output* (A13), *Waterproof casing* (A15), *Push buttons on PLC casing* (A16), and *Well-known brand* (A20).

For the three biggest industry segments in the study there are some tendencies that *Steel & Metal* and *Automation* are more positive towards the 20 surveyed attributes than the *Automotive* industry is. Meaning *Steel & Metal*, and *Automation* classed the attributes as Attractive and One-dimensional to a greater extent. Remaining industry segments lacked noteworthy and consequent patterns in the responses. For the other segmentations, i.e., company size and respondent position, there are no significant signs of differences between segments. Small sample sizes and non-randomized samples result in weak proof for this conclusion and more research is needed to determine certain clear customer segments and their preferences.

The Kano model provides necessary insights on customer needs and preferences which is a key aspect of customer centricity and thus can facilitate a company's strive towards it. However, becoming customer centric is a multifaceted concept which includes several factors, e.g., organizational changes, therefore the Kano model can only provide a small, although important, fraction of the tools and actions needed.

It has been concluded that the ways the Kano model applies to companies' customer centric strives are mainly relevant in the short- and mid-term. The Kano model can be used by serving either as a guideline for changing product features or changing customer preferences. E.g., it can be used for prioritizing feature improvements and supply product development frameworks with useful input to build products better fitted to the customers' needs. But also, by providing guidance on what product features to highlight in campaigns, or what attributes to educate the customer on rather than using as sales arguments, to achieve more efficient marketing. However, the results from the Kano model lacks long term reliability and validity, thus has shown to be insufficient for long term strategic use.

The study has shown several areas where further research within the domain of the Kano model and customer centricity is needed. To get a more representable result from the market in general, a similar study using the Kano model should be conducted but using a bigger and fully randomized sample to remove potential bias that comes with the sampling method used in this study. Furthermore, it would be interesting to redo the study in the future when more of the surveyed attributes have been implemented in products and adapted by the market to research how it affects the classifications. It is also recommended to conduct some more qualitative research on the classification of attributes, especially the ones that received an Indifferent categorization, to investigate why the customers feel the way they do about them. It would be interesting to follow up on *The Company* further ahead and over longer period of time to see how the implications from the results of the Kano model affect the customer satisfaction of *The Product* and the customer centricity. During this study, there has been an experienced lack of empirical research on the explicit relation between the Kano model and customer centricity, thus, having future research study this is believed to be a valuable contribution to the field.

References

Berger, C., Blauth, R., Boger, D., Bolster, C., Burchill, G., William, D., . . . Walden, D. (1993). Kano's Method for Understanding Customer-defined Quality. *Center for Quality of Management Journal, 2*(4), 2-28.

Bilgili, B., Erciú, A., & Ünal, S. (2011). Kano model application in new product development and customer satisfaction (adaptation of traditional art of tile making to jewelries). *Procedia Social and Behavioral Sciences, 24*, 829-846.

Bohlmann, J. D., Spanjol, J., Qualls, W. J., & Rosa, J. A. (2012). The Interplay of Customer and Product Innovation Dynamics: An Exploratory Study. *Product Development & Management Association, 30*(2), 228-244.

Borgianni, Y. (2018). Verifying Dynamic Kano's Model to Support New Product/Service Development. *Journal of Industrial Engineering and Management, 11*(3), 569-587.

Bryman, A., & Bell, E. (2011). *Business Research Methods.* Oxford: Oxford University Press.

Bulsara, M., & Thakkar, H. (2015). Customer Feedback–based Product Improvement: A Case Study. *Productivity, 56*(1), 107-115.

Campbell, N. C., & Cunningham, M. T. (1983). Customer Analysis for Strategy Development in Industrial Markets. *Strategic Management Journal, 4*(4), 369-380.

Chen, M.-C., Hsu, C.-L., & Lee, L.-H. (2020). Investigating pharmaceutical logistics service quality with refined Kano's model. *Journal of Retailing and Consumer Services*, 1-12.

Choudhury, D., & Gulati, U. (2020, March). Product attributes based on customer's perception and their effect on customer satisfaction: the Kano analysis of mobile brands. *Decision*, 49-60.

Fader, P. (2020). *Customer Centricity: Focus on the Right Customers for Strategic Advantage.* Philadelphia: Wharton Digital Press.

Gummesson, E. (2008). Customer centricity: reality or a wild goose chase? *European Business Review, 20*(4), 315-330.

Hashim, A., & Dawal, S. Z. (2012). Kano Model and QFD integration approach for Ergonomic Design Improvement. *Procedia - Social and Behavioral Sciences, 57*, 22-32.

Kano, N. (1984). Attractive quality and must-be quality. *The Journal of the Japanese Society for Quality Control*, 39-48.

Kreuzer, T., Röglinger, M., & Rupprecht, L. (2020, June). Customer-centric prioritization of process improvement projects. *Decision Support Systems, 133*, 1-14.

Lambverti, L. (2013). Customer centricity: the construct and the operational antecedents. *Journal of Strategic Marketing, 21*(7), 588-612.

Löfgren, M., & Witell, L. (2017). Two Decades of Using Kano's Theory of Attractive Quality: A Literature Review. *Quality Management Journal, 15*(1), 59-75.

Matzler, K., Hinterhuber, H. H., Bailom, F., & Sauerwein, E. (1996). How to delight your customers. *JOURNAL OF PRODUCT & BRAND MANAGEMENT*, 6-18.

Mikulic, J., & prebezac, D. (2011). A critical review of techniques for classifying quality attrbiutes in the Kano model. *Journal of Service Theory and Practice*, 1-13.

Persson, J. (2020A, November 11). *Basfakta om företag*. Retrieved from Tillväxtverket: https://tillvaxtverket.se/statistik/foretagande/basfakta-om-foretag.html

Persson, J. (2020B, July 8). *Många företag är innovativa*. Retrieved from Tillväxtverket: https://tillvaxtverket.se/statistik/foretagande/innovationsformaga.html#:~:text=N%C3%A4stan%20h%C3%A4lften%20av%20f%C3%B6retagen%20av,%C3%A4r%20mer%20innovativ%20%C3%A4n%20industrisektorn

Rosenbusch, N., Brinckmann, J., & Bausch, A. (2011, July). Is innovation always beneficial? A meta-analysis of the relationship between innovation and performance in SMEs. *Journal of Business Venturing, 26*(4), 441-457.
Rust, R. T., Lemon, K. N., & Zeithaml, V. A. (2004). Return on Marketing: Using Customer Equity to Focus Marketing Strategy. *68*(1), 109-127.
Shah, D., Rust, R. T., Parasuraman, A. P., & Richard, S. (2006, November). The Path to Customer Centricity. *Journal of Service Research, 9*(2), 113-24.
Valls Giménez, J. F. (2018). *Customer-Centricity : The New Path to Product Innovation and Profitability.* Newcastle upon Tyne: Cambridge Scholars Publisher.
Vinokurova, N. (2019). Reshaping demand landscapes: How firms change customer preferences to better fit their products. *Strategic Management Journal, 40*, 2107-2137.
Wang, A., Zhang, Q., Zhao, S., Lu, X., & Peng, Z. (2020). A review-driven customer preference measurement model for product improvement: sentiment-based importance–performance analysis. *Information Systems & e-Business Management, 18*(1), X-Y.
Yang, C.-C. (2007). The refined Kano's model and its application. *Total Quality Managment & Business Excellence*, 1127-1137.

Appendix

A. Respondent Data

A 1 - Distribution of respondents by industry and position

Industry	R&D	Installation & Maintenance	Project leader	Sales	Manager	Executive	-	Total - #	Total - %
Automotive	7	11	4	0	6	2	2	32	24%
Steel & Metal	9	4	0	0	4	1	2	20	15%
Automation	7	4	1	2	3	1	0	18	14%
OEM	3	2	1	1	0	4	0	11	8%
Paper	0	1	1	0	5	0	0	7	5%
Components	0	0	1	3	0	2	1	7	5%
Wood	0	3	0	0	2	1	0	6	5%
Food	1	1	0	0	1	0	1	4	3%
Consulting	1	0	1	0	0	1	1	4	3%
Logistics	0	0	1	0	1	0	1	3	2%
Chemistry	0	1	1	0	1	0	0	3	2%
Plastics	0	2	0	0	0	1	0	3	2%
Pharmaceutical	0	2	1	0	0	0	0	3	2%
Packaging	0	2	0	0	0	0	0	2	2%
Mining	0	1	0	0	0	0	0	1	1%
-	1	0	0	0	0	0	7	8	6%
Total - #	29	34	12	6	23	13	15	132	-
Total - %	22%	26%	9%	5%	17%	10%	11%	-	100%

A 2 - Distribution of respondents by the revenue of their company

Industry	<50 msek	50-99 msek	100-499 msek	500-999 msek	1-10 mdsek	>10 mdsek	-	Total
Automotive	2	2	4	3	3	17	1	32
Steel & Metal	1	0	2	2	4	10	1	20
Automation	4	0	3	2	7	2	0	18
OEM	4	0	5	0	1	1	0	11
Paper	0	0	1	2	1	3	0	7
Components	3	1	2	0	0	0	1	7
Wood	0	1	1	1	2	0	1	6
Food	0	0	0	0	2	2	0	4
Consulting	1	1	1	0	1	0	0	4
Logistics	0	0	1	0	2	0	0	3
Chemistry	0	1	1	0	0	1	0	3
Plastics	1	0	0	1	0	1	0	3
Pharmaceutical	1	0	0	1	1	0	0	3
Packaging	0	0	0	0	0	2	0	2
Mining	0	0	0	0	0	1	0	1
-	0	0	0	0	0	1	7	8
Total - #	17	6	21	12	24	41	11	132
Total - %	13%	5%	16%	9%	18%	31%	8%	100%

A 3 - Distribution of respondents by the number of employees of their company

Industry	<10	10-49	50-249	250-500	>500	-	Total
Automotive	1	5	5	3	18	0	32
Steel & Metal	1	0	3	4	11	1	20
Automation	4	2	2	2	8	0	18
OEM	3	4	2	0	2	0	11
Paper	0	0	3	0	4	0	7
Components	2	4	0	0	1	0	7
Wood	1	2	1	1	1	0	6
Food	0	0	0	2	2	0	4
Consulting	2	1	1	0	0	0	4
Logistics	0	0	1	0	2	0	3
Chemistry	1	0	1	0	1	0	3
Plastics	0	1	1	0	1	0	3
Pharmaceutical	1	0	0	1	1	0	3
Packaging	0	0	0	0	2	0	2
Mining	0	0	0	0	1	0	1
-	0	0	0	0	1	7	8
Total - #	16	19	20	13	56	8	132
Total - %	12%	14%	15%	10%	42%	6%	100%

A 4 - Average (segmented data) and median years of respondents work experience from machine guarding safety

Industry	R&D	Installation & Maintenance	Project leader	Sales	Manager	Executive	-	Avg.	Med.
Automotive	16	20	14	-	17	23	14	**17**	**19**
Steel & Metal	16	19	-	-	16	10	0	**16**	**15**
Automation	16	17	25	21	7	26	-	**16**	**20**
OEM	4	15	30	35	-	20	-	**17**	**15**
Paper	-	0	30	-	20	-	-	**18**	**15**
Components	-	-	20	15	-	23	-	**18**	**18**
Wood	-	14	-	-	14	15	-	**14**	**14**
Food	15	20	-	-	10	-	30	**19**	**18**
Consulting	10	-	20	-	-	25	0	**14**	**15**
Logistics	-	-	30	-	30	-	20	**27**	**30**
Chemistry	-	10	13	-	20	-	-	**14**	**13**
Plastics	-	23	-	-	-	10	-	**18**	**20**
Pharmaceutical	-	15	20	-	-	-	-	**17**	**20**
Packaging	-	11	-	-	-	-	-	**11**	**11**
Mining	-	30	-	-	-	-	-	**30**	**30**
-	20	-	-	-	-	-	-	**20**	**20**
Avg.	**15**	**17**	**20**	**20**	**16**	**20**	**13**	**17**	**-**
Med.	**15**	**20**	**20**	**21**	**15**	**20**	**11**	**-**	**18**

B. Kano Questionnaire

B 1 - Questions used in Kano survey

Functional	Dysfunctional
If your safety-PLCs could communicate wirelessly with each other, how would it make you feel?	If your safety-PLCs could not communicate wirelessly with each other, how would it make you feel?
If you could connect your computer wirelessly to your safety-PLC instead of using e.g., an USB-cable, how would it make you feel?	If you could not connect your computer wirelessly to your safety-PLC instead of using e.g., an USB-cable, how would it make you feel?
If you in an easy manner could move your PLC-logic to a new safety-PLC when you change your hardware, e.g., because it is broken, how would it make you feel?	If you could not, in an easy manner, move your PLC-logic to a new safety-PLC when you change your hardware, e.g., because it is broken, how would it make you feel?
If there was a mobile app where you could monitor and receive diagnostics from your safety system, how would it make you feel?	If there was no mobile app where you could monitor and receive diagnostics from your safety system, how would it make you feel?
If you could receive a report with daily operating data, how would it make you feel?	If you could not receive a report with daily operating data, how would it make you feel?
If you needed an electrical cabinet for your safety-PLC, how would it make you feel?	If you didn't need an electrical cabinet for your safety-PLC, how would it make you feel?
If you could buy a safety system where the wiring between the buttons, safety sensors and PLC as well as the wiring diagram was already set up, i.e., plug-and-play, how would it make you feel?	If you could not buy a safety system where the wiring between the buttons, safety sensors and PLC as well as the wiring diagram was already set up, i.e., plug-and-play, how would it make you feel?
If you could connect your safety-PLC with field bus systems to other PLCs from the most well-known manufacturers, how would it make you feel?	If you could not connect your safety-PLC with field bus systems to other PLCs from the most well-known manufacturers, how would it make you feel?
If you could choose preprogrammed PLC-logic from a software library for different specific safety occasions, how would it make you feel?	If you could not choose preprogrammed PLC-logic from a software library for different specific safety occasions, how would it make you feel?
If you could try your safety system already in the design phase by simulating it in a software program, how would it make you feel?	If you could not try your safety system already in the design phase by simulating it in a software program, how would it make you feel?
If the supplier of your safety-PLC had uploaded instruction videos to the internet to show how the safety-	If the supplier of your safety-PLC had not uploaded instruction videos to the internet to

PLC works and is programmed, how would it make you feel?	show, how the safety-PLC works and is programmed, how would it make you feel?
If you, for each I/O on the PLC, could program it so that it is either a safe input or safe output, how would it make you feel?	If you, for each I/O on the PLC, could not program it so that it is either a safe input or safe output, how would it make you feel?
If you could use each I/O on the PLC as a safe input and an information output at the same time, e.g., so that an illuminated push button only requires one I/O instead of two, how would it make you feel?	If you could not use each I/O on the PLC as a safe input and an information output at the same time, e.g., so that a illuminated push button only requires one I/O instead of two, how would it make you feel?
If you could see the status (OK or Not OK) for different I/Os directly on a display on the safety-PLC's casing, how would it make you feel?	If you could not see the status (OK or Not OK) for different I/Os directly on a display on the safety-PLC's casing, how would it make you feel?
If you could choose between buying your safety-PLC with or without a waterproof casing, how would it make you feel?	If you could not choose between buying your safety-PLC with or without a waterproof casing, how would it make you feel?
If you could have a safety-PLC in the safe box as the buttons, e.g., e-stop buttons, are on, how would it make you feel?	If you could not have a safety-PLC in the safe box as the buttons, e.g., e-stop buttons, are on, how would it make you feel?
If you could customize which buttons you wanted on your safety button box with a safety-PLC inside, how would it make you feel?	If you could not customize which buttons you wanted on your safety button box with a safety-PLC inside, how would it make you feel?
If there was a standardized interface between machine guarding safety products from different manufacturers, e.g., so that you could connect sensors from different brands to each other, how would it make you feel?	If there was no standardized interface between machine guarding safety products from different manufacturers, e.g., so that you could connect sensors from different brands to each other, how would it make you feel?
If you could standardize your safety system by using the same brand for all safety components in the entire factory, how would it make you feel?	If you could not standardize your safety system by using the same brand for all safety components in the entire factory, how would it make you feel?
If the manufacturers of the safety components hade a strong and well-known brand, how would it make you feel?	If the manufacturers of the safety components did not have a strong and well-known brand, how would it make you feel?

C. Interview Summary

C 1 - Summary of interviews with The Retailer

Name	Position	Challenges & Problems	Needs
Per	Business Area Manager - Sweden	• Conservative industries • Need to reprogram PLC when updating the software • Wireless communication not working properly when only using two units of *The Product* • Challenging environments for the casing • Customers prefer CAN-bus cable	• Easy to integrate with bigger control system • Flexible in adding new units to the safety system • Good looking software design
Torgny	Product Manager - Finland	• Customers need help with programming • Adding new machine guarding safety products to old machines	• Flexible in adding new units to the safety system • Easy to use and intuitive software • Simulation to test the system before building it • Casing for challenging environments
Magnus	Sales – Southern Sweden	• Conservative industries • Customers need help with programming • Wireless communication not working properly when only using two units of *The Product*. • Wireless connection is less relevant for short distances • Reliability of wireless connection	• Easy to use and intuitive software • Option to use I/Os as either safe inputs or/and outputs • Option to buy *The Product* without the protective casing for use inside electrical cabinets • Easy to install • Flexible in adding new units to the safety system • Simulation to test the system before building it • Reliable connection with only two units of *The Product* • Interchangeable memory card for storing software logic • Modular buttons on the casing to eliminate need for separate push button box • Automatic calculation of PFHD-values
Olle	Sales – Eastern Sweden	• Challenging environments for the casing • Wireless communication not working properly when only using two units of *The Product* • Customers prefer CAN-bus cable • Cumbersome process of changing machine guarding safety systems	• Strong and trustworthy brand • Easy to integrate with bigger control system • Reliable connection with only two units of *The Product* • Interchangeable memory card for storing software logic • Good looking software design • Option to use I/Os as either safe inputs or/and safe outputs • Possibility to connect to other brands' field bus systems • Simulation to show and communicate the safety system to other stakeholders • Modular buttons on the casing to eliminate need for separate push button box • USB-transmitter for wireless connection between computers and units
Wilhelm	Co-owner of The Company and its sister company - Germany	• Wireless communication interrupted by signals from surrounding components	• Easy to use and intuitive software • Compact casing • Diagnostic and analytic tools in software • More than 14 I/Os • Smartphone application

C 2 - Summary of interviews with end users

Name	Position	Challenges & Problems	Needs
Tim	SKF - Automation engineer (on leave to study)	• Communication between stakeholders • Non-standard solutions • Need to install wires over long distances • Using non-standard components and having to calculate PFH values manually • Error codes caused by human error • Error codes not complying with manuals	• Wireless connection for communication over long distances • Option to use I/Os as either safe inputs or/and safe outputs • A cost-effective solution for expanding current safety systems. • Simulation to show and communicate the safety system to stakeholders
Robert O	SKF - Project leader	• Many I/O's needed results in a complex project • Line operator thinking the new solution will make his/her job more demanding or time consuming • Documents are not up to date • Unforeseen problems during the installation, such as too short wires or components not being compatible as expected	• Receive information from all machines at the same time • Communicate via PLC with machines, who currently use safety relays, without having to change safety parameters • Smartphone application • Wireless connection for troubleshooting a machine without having to physically be at the machine • Simulation to show and communicate the safety system to stakeholders • Interchangeable memory card for storing software logic • Automatic calculation of PFHD-values
Benny	Malmö Ljus och Kraft (MLK) - Machine safety specialist	• Projects grow over time to becoming more complex • Too few I/O's • Wireless communication interrupted by signals from surrounding components	• Clear visualization on *The Product* of what I/Os that are inputs and outputs • Easy to install • Smartphone application • Simulation to test the system before building it • Interchangeable memory card for storing software logic • Reliable connection with only two units of *The Product*
Markus	Toyota Material Handling - Machine safety specialist	• Expensive sensors and equipment to AGV:s • Difficult to connect AGV:s to overarching system	• Should not be disturbed by other signals nearby • Should not consume too much band width • Send emergence stop signals when AGVs or persons enters a restricted zone • Protect the system from unauthorized changes in the software settings
Pontus	Volvo Cars - Machine safety specialist	• Keep a sufficient level of internal competence regarding machine safety • Different legislations from country to country	• Preprogramed and predefined software blocks for specific use cases • Diagnostics and analytic tools in the software • Wireless connection to reduce the number of wires
Robert E	Domino Printing Sciences – Area Manager Special Solutions	• Wireless communication not working properly when only using two units of *The Product*. • Too few I/O's • Installation and integration of *The Product*	• Small size to make it fit into tight places on machines • Easy to use and intuitive software • Easy to install • Possibility to connect to other brands' field bus systems • Modular buttons on the casing to eliminate need for separate push button box

D. Interview Questions

D 1 - Interview questions for The Retailer

Section	Questions
Introduction of the research group and thesis	• The educational background of research group. • Explanation of the field of studies where the master thesis is conducted.
Introduction to the master thesis	• Identify customers preferences to better satisfy the end users in machine guarding safety industry and OEMs. • Identify differences between customer segments. • Conduct a questionnaire based on Kano model.
The reasons to talk with *The Retailer*	• Good overview of the market and customer needs. • Help us understand *The Product* better, what problems to solve and what end users and OEMs that are relevant to speak to. • The input will be used to develop the questionnaire. • It is okey to skip any of the questions. • Is it okey if we record the meeting so that we can go back and listen later?
Respondent background, position and information about *The Retailer*	• Could you please introduce yourself, your role at *The Retailer* and a typical day of work?

Sales process and value chain	• Could you please describe the process from the initial contact with a potential customer to point where *The Product* is in use at the customer? Such as:
	  ○ Initial contact
	  ○ Follow-up meeting/phone call
	  ○ Project plan and quotation
	  ○ Order and manufacturing of *The Product*
	  ○ Delivery
	  ○ Installation
	  ○ Test and follow-up
	  ○ After market and service
	• Do you most often contact the customer, or do they contact you?
	• How knowledgeable are the potential customers about their needs, and how far have they come in their plans when they contact you?

	• What position or role is most often responsible or involved in the process of buying safety-PLCs? • What third parties are involved in the process? • How long is usually the delivery time for *The Product?* • Who conducts the installation and testing at the customer's site? • How big portion of the cost comes from installation vs hardware? • Are the installation cost dependent on what brand of safety-PLCs the customers buy?
Common problems and challenges	• What are the most common problems and challenges that the customers experience during the process previously described? • What are the most common problems during the installation? • What are the most common problems after the installation?
Most important functionality for the customers	• What are the most important functionalities for the customers? • What functionalities are important for the customers to even consider buying *The Product*? • What functionalities already exists on *The Product* surprises the customers in a positive way? • Are there any functionalities that are redundant or annoying for the customers? • How important do the customers consider these following attributes to be? o Wireless communication o Flexibility when extending the safety system o Software for the safety-PLCs o Possibility to simulate the system before installing o Possibility to use can-BUS cables o The quality of the casing (heat-, water resistant) o Using a SIM-card to quickly reprogram the hardware o Customizable push buttons on the casing o Possibility to communicate through other protocols such as Profinet and Profisafe o Time to install and cost associated with the installation o Automatically updated safety documents – such as PFH values o Simple to understand software and safety system
Customer segments	• How does the need for safety solutions differ between different customer segments? • What customer segments are most or least well suited for The Products functionality?

	• What would it take for *The Product* to be used in customer segments where it is currently not used?
Competing brands	• What other product act as competitors to or has the same functionality as *The Product*? • Who are *The Company*'s biggest competitors currently? • Is there any products that are very similar to *The Product*, if so which and how do they differ? • Is there any competitor that is especially strong withing some specific segment?
Trends	• What trends within machine guarding safety do you see ahead?
Future help with the study	• We will conduct a survey to research customer preferences regarding features for a machine guarding safety-PLC. Would you like to help us by answering and distributing this survey at your company? • Is there something you would like to add? • Can we get back to you if we have any further questions? • What makes customer choose *The Product* instead of other solutions?

D 2 - interview questions for end users and OEMs

Section	**Questions**
Introduction of the research group and thesis	• The educational background of research group. • Explanation of the field of studies where the master thesis is conducted.
Introduction to the master thesis	• Identify customers preferences to better satisfy the end users in machine guarding safety industry and OEMs. • Identify differences between customer segments. • Conduct a questionnaire based on Kano model.
The reasons to talk with *The Retailer*	• Good overview of the market and customer needs. • Help us understand *The Product* better, what problems to solve and what end users and OEMs that are relevant to speak to. • The input will be used to develop the questionnaire. • It is okey to skip any of the questions. • Is it okey if we record the meeting so that we can go back and listen later?
Respondent background,	• Can you present yourself, your connection to machine guarding safety and what a day at work looks like for you?

position and daily work	
Sales process and value chain	• What does the daily work process related to machine guarding safety look like? • What do you do when you replace or expand the safety system of your current machinery? • Can you describe what the process looks like from an initial machine guarding safety need until a safety system is obsolete and uninstalled? • Who do you contact when a new safety system is needed? Is it one supplier or several? • What does the internal procurement process of safety systems look like? • Do you use a third party for designing and ordering the safety system? If so, who? What third parties are involved in the process? • Who conducts the installation and testing at the customer's site? • How big portion of the cost comes from installation vs hardware?
Common problems and challenges	• What are the most common problems and challenges that the customers experience during the process previously described? • What are the most common problems during the installation? • What are the most common problems after the installation? • Out of the problems you mentioned, which one is the biggest, hardest to solve or predict?

Wanted features	• Given the problems you experience, what features do you wish would have existed in a machine guarding safety-PLC or other safety related products?
	• Are there any features that have surprised you in a positive way?
	• What features of your machine guarding safety products do you feel are redundant?
	• How important do the customers consider these following attributes to be?
	  ○ Wireless communication
	  ○ Flexibility when extending the safety system
	  ○ Software for the safety-PLCs
	  ○ Possibility to simulate the system before installing
	  ○ Possibility to use can-BUS cables
	  ○ The quality of the casing (heat-, water resistant)
	  ○ Using a SIM-card to quickly reprogram the hardware
	  ○ Customizable push buttons on the casing
	  ○ Possibility to communicate through other protocols such as Profinet and Profisafe
	  ○ Time to install and cost associated with the installation
	  ○ Automatically updated safety documents – such as PFH values

	• Simple to understand software and safety system?
Competing brands	• What other machine guarding safety product brands do you use and why?
Trends	• What trends within machine guarding safety do you see ahead?
Future help with the study	• We will conduct a survey to research customer preferences regarding features for a machine guarding safety-PLC. Would you like to help us by answering and distributing this survey at your company? • Is there something you would like to add? • Can we get back to you if we have any further questions? • What makes customer choose *The Product* instead of other solutions?

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