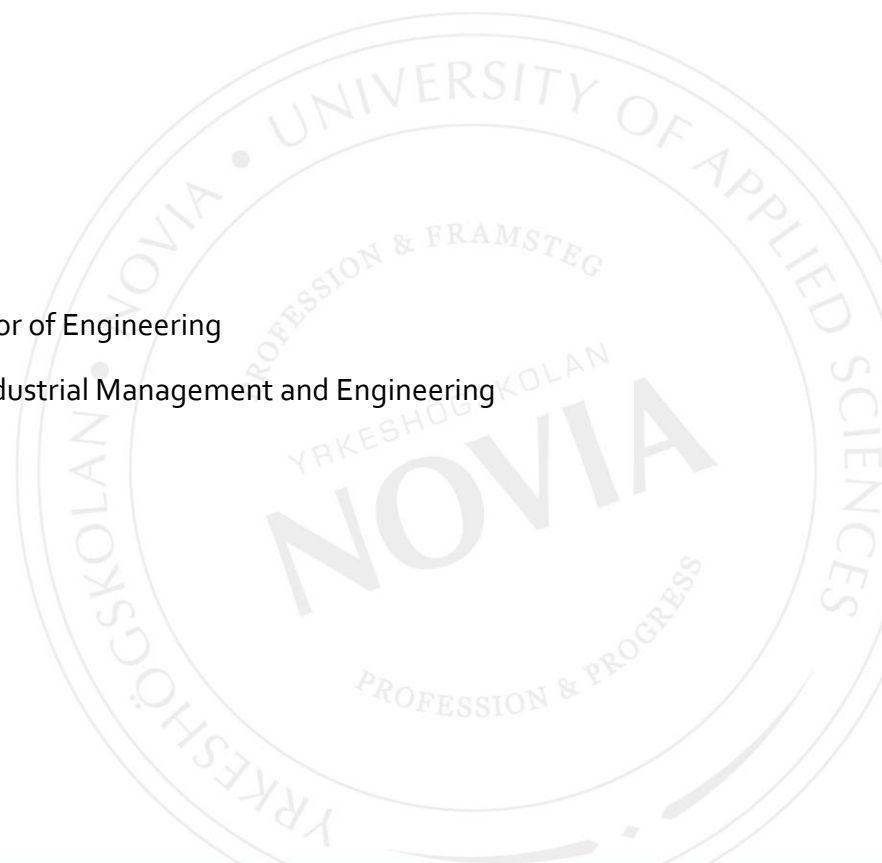# NOVIA

UNIVERSITY OF APPLIED SCIENCES

KPI Integration into Warranty Process

Isabella Pada

Degree Thesis for Bachelor of Engineering

Degree Programme in Industrial Management and Engineering

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EXAMENSARBETE

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Utbildning och ort: Produktionsekonomi, Vasa

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Titel: Integrering av nyckeltal i garantiprocessen

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Datum 11.4.2019   Sidantal 31
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Abstrakt

Detta examensarbete behandlar prestationsmätning och undersöker hur nyckeltal, som har en djupgående inverkan på prestationsförmågan inom en organisation, kan utvecklas. Huvudsyftet för examensarbetet var att undersöka hur man kan ställa upp olika nyckeltal som kan användas i garantiprocessen vid ABB Oy, Distribution Solutions.

För att hitta nyckeltal av betydelse låg fokus först på att identifiera garantiprocessens kritiska framgångsfaktorer. Dessa identifierades genom att studera strategiska dokument och genom att utföra intervjuer inom företaget. Följaktligen utvecklades nyckeltal utifrån den insamlade och analyserade informationen.

Som resultat föreslogs en uppsättning relevanta nyckeltal åt garantiteamet som kan vara till nytta för att följa upp och förbättra garantiprocessens prestanda. Dessa nyckeltal ska förhoppningsvis underlätta uppföljningen av prestationsförmågan och förbättra verksamheten, genom att exempelvis öka kundtillfredsställelsen. Sådana förbättringar borde också förbättra lönsamheten för verksamheten.

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BACHELOR'S THESIS

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Abstract

This bachelor's thesis deals with performance measurement and examines how to develop key performance indicators that have a profound impact on performance within an organization. The main purpose of this thesis was to investigate how to set up different key performance indicators that could be used in the warranty process at ABB Oy, Distribution Solutions.

For finding relevant key performance indicators, focus first lied on finding the warranty process' critical success factors. These were found through examining strategic documents and through conducting interviews within the company. From the gathered and analyzed information, key performance indicators were developed.

As a result, a set of relevant KPIs that could be useful for tracking and improving the performance of the warranty process were suggested to the warranty team. These key performance indicators should hopefully make it easier to track the performance of the warranty process and improve operations, for instance by increasing customer satisfaction. Such improvements should also improve the profitability of the operations.

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Table of contents

1   Introduction

In this introductory chapter the thesis background, the problem areas and purpose will be explained. Delimitation of the thesis will also be given.

1.1   Background

This assignment was given by ABB Oy, Distribution Solutions, Customer Care department. Distribution Solutions provides control and protection equipment for the medium voltage power network. A large part of the world's control and protection equipment for the medium voltage power network is in fact developed and manufactured by ABB's Distribution Solutions in Finland. The Customer Care department is providing technical support to the customers as well as warranty services. This thesis topic emerged, as the warranty team wished to be able to better track the performance of the warranty process.

1.2   Problem area

Currently there is not a set of key performance indicators, KPIs, that are measured on a regular basis for the warranty process within the Customer Care department. At present, only on-time delivery, OTD, is in use. In business strategy, more areas are important for successful operations. Performance relies on several factors, only monitoring one measurement will therefore not provide an accurate picture of how the business actually is performing. Since the level of success is not solely relying on OTD, the department wish to have set up more KPIs to better understand on what performance level the warranty handling is at.

1.3   Purpose

The purpose of this thesis is to investigate how to set up different KPIs, that could be used in the warranty process. The aim is to find areas within the process that need measurements and define a way to measure them. By measuring the performance with several KPIs the desire is to improve operations, which would result in for instance improved customer satisfaction and less 'non-faulty' devices returned. Such improvements should also improve the profitability of the operations.

1.4   Delimitation

Finding relevant key performance indicators will be limited to only concern the warranty team in the Customer Care department. KPIs that could be relevant for the whole Customer Care department or even for the Distribution Solutions as a whole is therefore not addressed. This thesis work will result in a presentation of a set of KPIs that can be useful for the warranty team. The assignment will not address practical implementation and testing of suggested KPIs. The reason is that practical implementation is a rather large topic as it is not a trivial matter, which if included would make this bachelor's thesis the size of a master's thesis.

2   Theory

In this chapter, relevant theory regarding performance measurements will be provided and serve as a foundation for this thesis. Topics that will be covered are history in brief regarding how performance was measured in the past and the balanced scorecard methodology, which served as the foundation of the development of today's key performance indicators. Furthermore, the key performance indicator methodology from definition, to design, to implementation of KPIs will be covered.

2.1   Balanced Scorecard

Before the balanced scorecard the main measuring system for a company's performance was economically oriented. In the 20th century, focus laid on monitoring several financial indicators, such as return on investment and operating budgets. At the end of the 20th century the economical aspect of the company's result had strongly developed. However, many began to criticize the vast use of financial indicators, as they do not tell much about what to do in the future. (Kaplan & Norton, 1999)

The issue is that they only show results of already made decisions and at that time, when companies were mainly financially controlled, they did not provide a sufficient foundation for long-term strategic emphasis. (Olve, et al., 1999) The exaggerated emphasis on attaining short-term economical results could in the worst case lead to overinvestment in short-term solutions, and underinvestment in long-term value creation. (Kaplan & Norton, 1999)

Many began to realize during the 1980's that a more extensive report of the business's different sections is needed in order to be competitive on the market. Tools and concepts such as Kaizen, Top Quality Management and Lean Production began to evolve. These initiatives, however, rarely came from economists. The goal of the tools was therefore often in conflict with the traditional financial control. (Olve, et al., 1999)

In the 1990's Robert Kaplan and David Norton conducted research on measuring performance in the organization of the future. The aim was to develop a new model for result measurement. The research resulted in the balanced scorecard. (Kaplan & Norton, 1999)

The balanced scorecard offers a comprehensive tool for executives, that converts a company's vision, business idea and strategy into a consecutive set of performance measures. The balanced scorecard converts a company's vision, business idea and strategy into objectives and measures that can be sectioned into four perspectives: financial, customers, internal business process and learning and growth. The four different perspectives create balance between short-term and long-term objectives, between desired outcome and factors that affect the outcome, as well as between hard objectives measures and soft, more subjective measures. In a well-constructed scorecard, all measures will form a whole that contributes to achieving an integrated strategy. (Kaplan & Norton, 1999)

2.1.1 Financial perspective

The balanced scorecard is keeping the financial perspective, since financial measures are useful for summarizing the economic consequences of actions already performed. The measures indicate if the company's strategy and implementation of it is contributing to improving the profit. The financial objectives act as the focus for the objectives and measures in the other scorecard perspectives. Each chosen measure should be part of a link of cause-and-effect relationships that results in improving financial performance. Depending on at what stage of the life cycle the company is at; growth, sustain or harvest, the financial objectives can vary. (Kaplan & Norton, 1999)

2.1.2 Customer perspective

In the customer perspective, managers identify the customers and market segments that the business unit should concentrate on and the measures that should measure the business unit's performance within the chosen segments. This perspective usually contains several core or generic measures on success for a well formulated and implemented strategy, such as

customer satisfaction, customer retention and new customer acquisition. It should however also contain specific measures for the products and services the organization is planning on offering the customers within the selected segments. (Kaplan & Norton, 1999)

2.1.3 Internal business process perspective

The internal business process perspective should show which processes create the correct customer values, while also meeting the shareholders' expectations regarding economical yield. (Olve, et al., 1999) With this perspective, the target is to identify the processes that the organization must master to perfection to succeed. (Kaplan & Norton, 1999)

By identifying and analyzing the internal processes, the processes that do not create customer value will be eliminated. (Olve, et al., 1999) With this approach, it is also possible to identify completely new processes that the organization must master in order to achieve its customer related and financial objectives. The analyzation of the internal processes might lead to the conclusion that there is a need to develop a new process to be able to satisfy customer needs or add value. In the balanced scorecard model, the internal business process perspective contains objectives and measures for the long-wave innovation cycle as well as for the short-wave operations cycle. (Kaplan & Norton, 1999)

2.1.4 Learning and growth perspective

In the learning and growth perspective the long-term renewal of the organization and the ability to survive is ensured. (Olve, et al., 1999) The infrastructure the company needs to create long-term growth and improvement is identified. (Kaplan & Norton, 1999)

Learning and growth in the organization usually come from three different sources: humans, systems and routines. Usually the three earlier mentioned perspectives – financial, customer and internal business process – show that there are large gaps between the employees' skills and the systems' and procedures' support for what is needed to achieve an outstanding result. In order to fill these gaps, the companies must invest in in-service training of the employees, strengthen IT and harmonize the organization's routines. These goals are reflected in the learning and growth perspective in the balanced scorecard. (Kaplan & Norton, 1999)

2.2   Key Performance Indicators

Depending on literature, the definition of key performance indicators varies (Pollock, 2007). How these measures are labeled varies as well, terms as key performance measure, performance measure, measure or metric are widely used, but essentially, they are referring to key performance indicators. For instance, in a balanced scorecard structure the term performance measure is commonly used. (Keyte, 2018)

Key performance indicators are measures used by managers to understand whether their business is going in the right or wrong direction (Marr, 2012). They provide information about the success or failure of a strategic objective over a specified time (Keyte, 2018). By using the right set of indicators, an accurate picture of the organization's performance will be provided and areas that need attention will be highlighted. (Marr, 2012)

The common idea in several literary works is that KPIs are a combined set of financial and non-financial metrics that give a clear view of how business is performing (Heesen, 2012; Kaplan & Norton, 1999; Marr, 2012; OSIsoft, 2007). David Parmenter (2015) on the other hand, has a slimmer definition of KPIs, arguing that KPIs only consist of non-financial metrics.

According to Parmenter, Kaplan and Norton's work has been a game changer and should be read by KPI teams. However, he has found that many balanced scorecard initiatives have failed. Therefore, Parmenter has developed a KPI methodology that he considers is underpinning the work of Kaplan and Norton. There are similarities between the two methodologies, such as emphasizing the importance of implementing strategy in a balanced way. (Parmenter, 2015)

There are also areas where the methodologies differ. One difficulty with the implementation of the balanced scorecard has been trying to determine which balanced scorecard perspective a performance measure belongs to. Frequently, staff members have faced issues with measures that seem to fit into more than one of the balanced scorecard perspectives. This usually stimulates drawn-out debates with unclear resolutions. In Parmenter's KPI methodology however, it is believed that a measure cannot fit neatly into one of the balanced scorecard perspectives. Instead, KPIs have a significant impact as they affect more than one of the perspectives. (Parmenter, 2015)

The point of view on performance measures also vary. According to Parmenter, performance measures should aid the workforce to focus on the critical success factors of the business.

Kaplan and Norton on the contrary consider that performance measures are primarily intended for monitoring the implementation of strategic initiatives. (Parmenter, 2015)

When commencing performance measure initiatives, Parmenter believes that finding the right performance measures can – and ideally should – be done in-house. The balanced scorecard approach however is rather complex, which has led to a major industry of software providers and balanced scorecard consultants. As implementation of the balanced scorecard usually is led by a consulting firm, there is a risk that the consultant is not involving the client's staff adequately in the project. Even though this approach has been proven to work in some cases, there have been many failures as well. It is more likely that staff is concerned about the change when led by a consultant, whereas with a project led by an in-house person, there is a higher probability that staff support it. (Parmenter, 2015)

One final difference is the amount of KPIs that are measured. In Parmenter's methodology, KPIs are well defined, whereas in the balanced scorecard KPIs are not clearly defined. Instead, all types of measures are called KPIs and are seen as important to the organization. This has led to a large number of KPIs being measured in the balanced scorecard while Parmenter is of the opinion that 10 KPIs or less are sufficient in a business. (Parmenter, 2015)

2.2.1   The great KPI misunderstanding

According to David Parmenter (2015) many organizations are working with the wrong measures, which of many are incorrectly termed as key performance indicators, KPIs. Based on his research, Parmenter has come to the conclusion that all performance measures cannot be considered as KPIs. As stated by Parmenter, there are four types of performance measures, which can be divided into two groups: result indicators and performance indicators. (Parmenter, 2015)

Result indicators are measures, where the result of the measure depends on more than one team's input. Since these measures are showing the result of combined teamwork, they are not that useful for management when attempting to fix a problem, since it is difficult to point out which teams were responsible for the performance, or lack of it. (Parmenter, 2015)

Performance indicators, on the contrary, provide clarity and ownership as they can be tied to a certain team or cluster of teams working closely together for a common purpose. With

performance indicators it is easier to pinpoint who is responsible for a certain performance as the responsibility only lies with one team. (Parmenter, 2015)

For both above-mentioned measure types, some measures are considered more important. To distinguish the more important measures from those of less importance, they are designated with the extra word "key". (Parmenter, 2015)

With this further breakdown, there are now two measures for each measure type:

1. Key result indicators, KRIs

    – Provide an overall summary of the performance of the organization.

2. Result indicators, RIs

    – Tell how teams are combining to produce results.

3. Performance indicators, PIs

    – Tell what teams are delivering.

4. Key performance indicators, KPIs

    – Tell how the organization is performing in their critical success factors. By monitoring them, it allows management to increase performance dramatically. (Parmenter, 2015)

2.2.2 KPIs versus KRIs

Key result indicators are measures that are commonly mistaken as key performance indicators. They can be both financial and non-financial measures. KRIs are useful for giving a clear picture of if the organization is travelling in the correct direction at the right speed. Moreover, they provide a good overview of the progress regarding the organization's strategy. They are easy to determine and are frequently reported to the board or governing body, generally reviewed monthly or quarterly. Nevertheless, they are reported too late to change direction, making them of little use for management. Additionally, they will not tell what needs to be done to improve results. (Parmenter, 2015)

With KPIs focus lies on the aspects of organizational performance that are considered being the most critical for the success of the organization, both currently and in the future.

According to Parmenter, KPIs are non-financial, monitored often – for instance 24/7, daily or weekly – and team based as they can be tied to a specific team or close cluster of teams working together. Furthermore, KPIs have significant impact, since they will affect one or more of the critical success factors and more than one balanced scorecard perspective. Finally, KPIs are simple in the sense that they are telling what action needs to be taken in a straightforward manner. (Parmenter, 2015)

Ideally, the number of measures required in an organization with over 500 full-time employees should not exceed the 10/80/10 rule, that is 10 KRIs, 80 RIs and PIs, and 10 KPIs. In many cases, fewer measures will be sufficient. For instance, for smaller organizations, the number of RIs and PIs are generally reduced, while the number of KRIs and KPIs remain about the same. (Parmenter, 2015)

2.2.3 Creating meaningful KPIs

As earlier mentioned, there are several definitions for KPI. The term is widely known in modern business, but when asking for an explanation of what a KPI really is, different definitions emerge. Often KPIs are overused and misunderstood, making them rather ineffective. (Bernard Marr & Co., 2018a) If not properly chosen, KPIs can make little or no difference to performance in the organization (Parmenter, 2015).

The identified organization's operational critical success factors should be the source of all performance measures that actually matter. In brief, critical success factors are about what the staff can do and should do inside the organization. It is a matter of operational issues or aspects that need to be done well day-in and day-out by the staff. Instead of picking out KPIs directly based on the strategy, begin with clarifying what the organization's operational critical success factors are. From that, measures that generate alignment to these operational critical success factors can then be determined. Figure 1 shows the relationship between strategy, critical success factors and KPIs. (Parmenter, 2015)
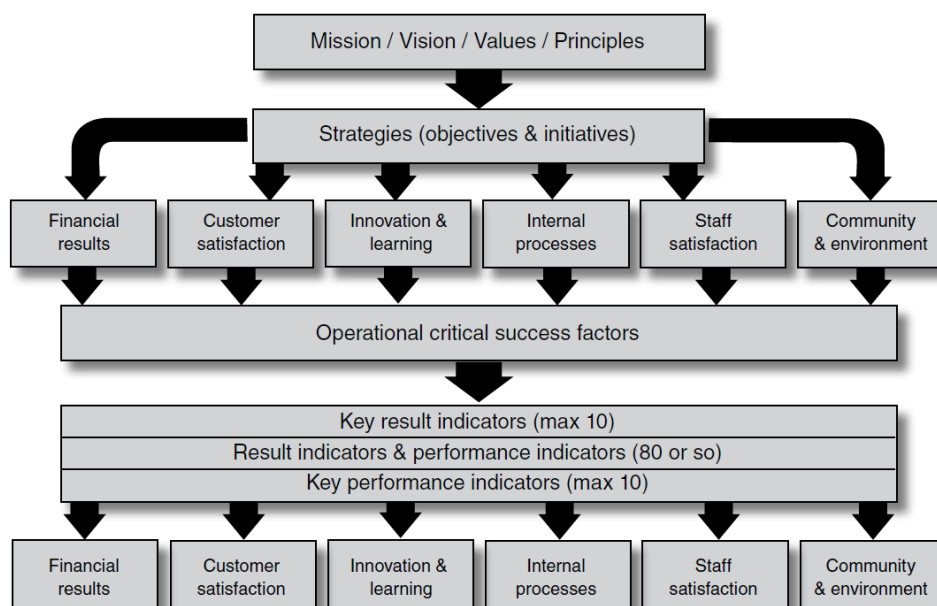
Figure 1 How strategy, critical success factors and performance measurements relate to each other (Parmenter, 2015, p. 165)

By creating performance measures from critical success factors, daily activities will be linked to the organization's strategy. According to Parmenter, the critical success factors are more fundamental than the organization's strategic initiatives, as many organizations are in fact able to succeed without a well-formulated strategy. (Parmenter, 2015)

Clive Keyte (2018) is instead referring to objectives. From set objectives, relevant KPIs can be created. When setting objectives, thought should be put on whether the objective will contribute to an overall strategy and whether the organization has any control over the objectives. For each objective the following questions should be considered: will it contribute to the strategy, will it make a difference, can the result be influenced to some extent and can it be measured? Once the objectives are refined in such a way that the answer to all, or most, of the questions is yes, relevant KPIs can then be identified from the objectives.

According to Bernard Marr, KPIs should be derived from key performance questions, KPQs. Marr states that strategy, if it is clear, acts as a starting point for creating appropriate KPIs. Based on strategy, KPQs should then be identified to make relevant and meaningful KPIs more obvious. (Bernard Marr & Co., 2018b) Essentially KPQs identify the questions we need answer to and provide guidance for developing meaningful performance indicators. Put simply, KPIs will help answer the KPQs. (Bernard Marr & Co., 2018c)

The idea behind these three above-mentioned approaches is essentially the same, the authors are simply using different terms and slightly different points of view when explaining how to find meaningful KPIs. From now on, the term critical success factor will be used in this chapter for going deeper into how to create KPIs.

When finding the organization's critical success factors, they should be limited to between five and eight. From these, all performance measures that really matter, the KPIs, will originate. Critical success factors should be worded in such a way that everyone can understand them. Furthermore, they should emphasize a precise operational activity, instead of being abstract statements that strategy often mainly consists of. Most organizations know their critical success factors, but few have actually worded them properly, segregated them from strategy, prioritized the success factors to find the critical ones and communicated them to staff to achieve full understanding and engagement. (Parmenter, 2015)

To identify the operational critical success factors, the first step is to review strategic documents within the organization as well as interview as many as possible within the organization for advice. These two activities should result in a list with SMART success factors, that is success factors that are specific, measurable, achievable, relevant and time sensitive. (Parmenter, 2015)

The next step is to identify the operational critical success factors from the list of SMART success factors. This can be done by using a "Sphere of influence" mapping process where all success factors are listed, on for instance a sheet of paper, and then looking at which success factors affect another success factor. By starting from one success factor, and asking, "Does it impact this success factor?" when looking at each other listed success factor, the sphere of influence will be identified. These relationships will be illustrated with arrows pointing in the direction of influence between the success factors. For some factors the relationships are two-way, in that case two arrows are drawn. (Parmenter, 2015)

From this mapping process the operational critical success factors can be identified: the success factors with most arrows pointing outwards are most likely to be operational critical success factors. It is however important to notice that the selection of critical success factors is a very subjective exercise and how useful the chosen critical success factors will be is highly dependent on the degree of analytical skill of those involved. Hence, the selection of critical success factors may vary depending on who is doing the mapping of the success factors. (Parmenter, 2015)

When critical success factors have been identified, they should be communicated to everyone concerned. By presenting the critical success factors and explaining why they are important, staff members can align their daily activities to them, maximizing their contribution. (Parmenter, 2015)

Once the critical success factors have been determined, it is time to find appropriate KPIs from the critical success factors. When much thought has been put into finding the critical success factors by fine-tuning the statements and making them easy to understand, it is easier to focus on finding good KPIs. (Parmenter, 2015)

Start by looking at one critical success factor and figure out the results that would be expected when the critical success factor is working correctly. Aim to find around four to five results for each critical success factor. From this, measures can be found by thinking of likely measures from each aspect. Questions such as "What would good performance look like?", "What measures would show this good performance best?", "What would poor performance look like?" and "What measures would give advance warnings of this negative performance" can be used to aid in finding powerful measures. Also think of whether the measures can be classified as past, current or future measures. Strive to have a good mix of the three. (Parmenter, 2015)

Once measures have been found, the following task is to find appropriate names for each measure and ascertain how they should be measured. After that, the KPIs should be identified from the set of measures. For each measure, check if the defined characteristics of a KPI are met. It is also important to think about the costs of gathering the measures, it is vital that the costs do not exceed the benefit derived from the measure. Finally, all KPIs should be tested to ensure that they are working as expected and that the desired behavioral outcome is as predicted. (Parmenter, 2015)

2.2.4 Struggles and things to be aware of

One common problem with key performance indicator or scorecard projects is that it can easily lead to a state of constant analyzation. The wish to develop a perfect set of KPIs can lead to the whole project being stalled in the design phase. (Brown, 2007) It is a rare achievement to get it right the first time, so to stay away from analysis paralysis a just-do-it culture should be established. With the just-do-it culture comes confidence in that we can do it and do not have to rely on experts to run the project. (Parmenter, 2015) With it also comes a realization that mistakes are a normal part of the design process and that the measures can

be tailored and improved at a later stage if they are found not to be useful. This approach will minimize the review and revision cycles in the design phase and help the design team to simply get on with the project. (Brown, 2007; Parmenter, 2015)

Another problem one might run into when designing performance measurements is that the measures have been designed in such a way that they are easy to manipulate, leading them to be useless for measuring the actual performance for the organization. This can occur when people get to choose their own performance metrics, as there is a tendency to want to pick measures that either make them look good or can be easily manipulated. (Brown, 2007)

However, measures can also unintentionally encourage negative behavior. As an example, Parmenter (2015) is mentioning a performance measure that was used by a city train service. They used an on-time measure that if not attained would result in penalties for the train drivers. Eventually the train drivers that were behind schedule learned that the measure could easily be manipulated by stopping at the top end of each station, which triggered a green light at the end of the platform, and then continue the journey without letting any passengers on or off. This resulted in a good on-time measure, but not so happy customers. Therefore, it is important for every performance measure to ascertain whether they can have a negative consequence or an unintended action that can lead to inferior performance and try to minimize them as much as possible. (Parmenter, 2015)

When getting started with trying to find and implement performance measurements, it is advised to start off small. By starting small, the project will be less overwhelming, which will give one the opportunity to learn how to do it well, without wasting an immense amount of time and effort. It is more important to learn and experience the proper way of measuring what matters rather than trying to measure everything and getting everyone involved right away. (Barr, 2010)

Once KPIs have been taken into use, it is also important to regularly review them. The reason for reviewing is to ensure that they are helping to make better decisions, which consequently improves performance. (Bernard Marr & Co., 2018b) A KPI can be relevant and powerful at the time of implementation, but over time it can gradually lose its impact (Heesen, 2012). Reviewing KPIs is therefore vital to ensure that time is not wasted on measuring indicators that are not contributing to improved operations. (Bernard Marr & Co., 2018b)

3 Method

When deciding on method to use, other bachelor theses were examined to get an idea of how the method usually is chosen. In many cases, the author of the thesis had apart from presenting relevant theory that would act as a foundation for the thesis, also researched different ways to, in the investigation part, gather data and presented them in the thesis. Based on that, the author then evaluated the different methods and reflected on which method would be most suitable for their assignment.

It is valid to choose method based on studying every possible way for investigating and gathering data, in order to find the most suitable method for one's assignment. However, based on the literary works studied regarding performance measurements and key performance indicators in particular, very specific methods are mentioned regarding finding useful measures and KPIs. Therefore, this thesis will not make a detour by presenting and assessing different methods for gathering data as a valid method is already clearly mentioned. In other words, the method chosen is based on gained knowledge from the theoretical framework.

Of the literary works examined, all are explaining how to find meaningful key performance indicators based on the scenario that creation and implementation of KPIs are to be carried out in the whole organization. In this thesis however, the project is limited to include the warranty process alone in the customer care department. Despite the difference in scale of the project, the theory still provides a good foundation on how KPI projects should be undertaken. Steps in the process that are found to be more suitable for large-scale projects can be modified if needed to better fit a project of a smaller scale.

In order to find meaningful key performance indicators, focus first lied on finding the warranty process' critical success factors and from there then develop relevant KPIs. Information was gathered in two ways: through examining strategic documents and through conducting interviews.

After information had been gathered, it was analyzed. The answers from the different interviews were compared to each other as well as with what was found in the strategic documents. From that, viewpoints on strategy, areas that were mentioned as important, critical success factors and ideas on how to measure them were compiled to get a better overview of what kind of KPIs could be relevant to measure. From the analyzed data, relevant KPIs were eventually developed.

3.1 Interviews

During a meeting at ABB, suitable interview candidates were discussed and suggested. After the meeting, invitations were sent out and the interview outline was prepared. Depending on who was interviewed, the questions varied slightly to better suit the interviewee.

The interviewees have different positions at the company and work within different teams. They were chosen to get a broader understanding of what is important performance-wise and what could be useful to measure in the warranty process. By interviewing people outside of the warranty team, the desire was to receive valuable input that the warranty team otherwise might not think of. This is also justified in the examined literary works, as it is mentioned that asking for advice from other people within the organization when trying to find the organization's critical success factors and consequently KPIs, is essential.

In total eight people were interviewed split into six interview sessions, that is five one-on-one interviews and two group interviews with two participants.

The people interviewed were:

- Warranty Handling Specialists – 2 persons.

- Solutions and Support manager within Customer Care.

- Product Quality manager.

- Quality manager within Customer Care and Quality.

- Operations manager.

- Warranty customer from ABB switchgear factory – 2 persons.

The interviews were recorded so it would be easy to go back and listen to what was mentioned and compare the interviews with each other. To decrease the probability of the interviews not being recorded properly, two devices were used for recording. For five of the interviews the voice recording applications available on laptop and mobile phone were utilized. The interview with the ABB switchgear factory representatives however was held via Skype for Business and was recorded with the built-in recording feature available in the program.

3.2 Strategic documents

As mentioned in the theoretical framework, critical success factors can also be found through examining strategic documents. The strategic documents that were examined were found on the company's internal website. In addition to examining the documents for the reason to find critical success factors, they were also reviewed to verify that the interviewees opinions regarding objectives, mission and vision are not contradicting what is mentioned in the strategy. It was done to ensure that the key performance indicators, that will be derived from the critical success factors, will not encourage opposite performance of what is strived for in Distribution Solutions' strategy.

4 Results

In this chapter, the gathered data is summarized and analyzed. Based on the analyzed data, critical success factors will be presented. By further analyzing the critical success factors, relevant key performance indicators will finally be suggested.

4.1 Interview

Different languages were used during the interviews depending on who was being interviewed. Languages used were Finnish, English and Swedish. For practical reasons and to make the thesis coherent, citations from the interviews have been translated and will be presented in English.

4.1.1 Strategy within departments and teams

The Customer Care and Quality department of Distributions Solutions is in most cases not directly in touch with the end customers, instead communication is going through ABB channels. As their mission, they are striving to through the ABB channels around the world give prerequisites for them to handle their customers as good as possible.

The Customer Care department represents the customer contact when the customers need help, usually after having bought products from Distribution Solutions, but also when they have questions before purchasing. The main strategy is to give as good service as possible and have as satisfied customers as possible. What is important is that customers are satisfied

with the service, that they receive fast and professional answers on their questions as well as that the answers solve their problems.

The Quality department is investigating the faults found in the customers' defective products. For them it is important to discover the fault in the defective product and through that improve product quality. The Quality team itself does not make any changes but can bring up the matter to the R&D department. Apart from that, reports are also being made about the findings to the customer.

The warranty team's task is to take care of the customers' warranty orders and things that are related to that: "*we take care of the first step in the warranty process, starting the process and making it go on from there*". From the customer's perspective, they want a quick and reliable solution to their problems while from the factory's point of view cost-effectiveness also comes into picture – "*if you combine these two points of view, I would call it our vision*".

The Operations department is striving to deliver cost-effectively, with high quality and on time. The aim is to manufacture and deliver high-quality products that do not come back to Distribution Solutions as a warranty claim. Moreover, they are striving to keep the role as a world-class leader when it comes to delivering protection and control relays.

4.1.2   Areas considered important in warranty process

When asking about what areas or activities that are considered important in the warranty process, the most commonly mentioned areas were customer focus and customer satisfaction. It is about finding a fast and robust solution to the customer. It is important to get the correct unit or module, or getting the defective unit repaired rapidly, as the customer is having an interruption to their process. Furthermore, it is vital to get the initial faulty devices analyzed, preferably as fast as possible as well if the customer is asking for a root cause analysis.

Information-wise it is essential that all relevant information is present to get the process running: "*That all information is available as correct as possible from the beginning, what we need in order to solve it, without needing to ask for more information on several occasions. That I would say is the foundation.*" This concerns both information received from the customer as well as information internally – within the team and between teams.

To get the process running it is also important that the internal processes are working. The warranty handling cooperates with many departments and teams. Sometimes the processes can differ between the departments, so trying to find a common process together is essential.

From the warranty handling point of view, there are two main channels where warranty claims arrive: through the Business online, BOL, website and through email. In BOL, customers with access can place a warranty order themselves, whilst customers without access to BOL are contacting the warranty team through email. For the customers without access to BOL, the warranty handling specialist is placing the warranty order on their behalf in BOL. Priority-wise the cases arriving in BOL are the most important. As the customers themselves have inserted information to the system this part has to be effective and handled quickly. "*So first take care of BOL, then emails and such… Of course, all cases are significant in their own way, you cannot say that some issue does not belong to us. They do affect us in some way.*"

4.1.3   How critical success factors can be measured

By having asked questions about strategy and about areas or activities that are considered important in the warranty process, the aim was to get a conception of what the critical success factors are. To elaborate and make the matter clearer, the interviewees were asked how the mentioned critical success factors could be measured in order to be able to follow up the performance.

Ideas mentioned were:

- Measure showing if any defect was found in the returned device after all, if the warranty claim was valid.

- Delivery time or delivery reliability for the sent warranty replacement unit.

- Delivery time or delivery reliability for reporting the root cause to the customer.

- Some measure that can help one plan resources needed.

- Response time.

- Feedback from the customers.

- How long a case has been in a work queue or in different stages.

Furthermore, the participants were asked if there are certain areas where it would be beneficial to have measures that could warn about negative performance in advance. Examples that were mentioned were measures that can show trends, for instance for different product groups, countries or regions, to easier identify if warranty claims are alarmingly increasing within a certain segment. Again, customer feedback was mentioned as a useful measure. By constantly getting feedback regarding customer satisfaction, you can through trends see if it is going in a positive or negative direction. Additionally, trends for the time it takes to close a case was mentioned to be useful for identifying negative performance and taking corrective action before the situation gets even worse:

"*If it takes longer and longer to get the solution or to close the cases, then we can assume that it affects how satisfied the customer is. You can get faster from only an indicator like that: you see that this is not some temporary negative peak, it is clear that it is taking longer and longer to get the cases closed, but we have not seen any feedback towards any negative trends in sales – then you can act*".

4.2   Strategy

When examining the strategic documents for Distribution Solutions as well as similar documents at a divisional level, it was found that what the interviewees had mentioned regarding strategy, mission, vision and so forth is in line with what is written in the strategic documents. The key focus areas mentioned are customer focus and quality. It is emphasized that the customer has to be at the center of all activities, that superior customer value should be provided and that everything that is done should be delivered with outmost quality.

Furthermore, simplicity is mentioned. To be able to focus on the above-mentioned areas it is important that the way of working together is simplified and that there is natural collaboration. All in all, it is about a strong service approach: customer first, quality always.

4.3   Critical success factors

From the gathered information, the following critical success factors could be identified:

- − Handle customers professionally in every aspect.

- − Deliver reliable solutions as quickly as possible.

- − Keep the work queues running smoothly.

– We finish what we start, within the team and between teams.

Handling customers professionally in every aspect is about having the customer to be the center of all activities. It is about delivering high quality answers, preferably as fast as possible, and making the customer feel like their issues are taken seriously.

Delivering reliable solutions as quickly as possible is strived for. However, notice that speed is not the only aspect that is important. What is even more vital is the quality on the solution, that the given solution to the customer is robust.

Moreover, it is essential that the work queues are running smoothly. No case should ideally have to wait for a long time to be handled. Above all, no case should be left unhandled in the queue. This brings us to the last critical success factor: we finish what we start, within the team and between teams. The warranty team should take care of incoming cases, starting the process by handling the case and making it go on from there. For the case to move forward in the process from there, they have to ensure that there is sufficient information available, so it does not end up between persons, being left unhandled somewhere else in the process. Throughout the process communication must work and relevant information must be available.

These critical success factors give an overview of the activities and aspects are important – activities and aspects that have to go well day-in and day-out in the warranty process. They explain what the staff can do and should do.

4.4   Key Performance Indicators

Based on the identified critical success factors and valuable input received from interviews and meetings, a total of seven key performance indicators came to mind. This chapter will present these seven KPIs that are believed to be relevant for the warranty process. Ideas on other measures that were considered, but eventually were found not to be suitable as KPIs will also be discussed.

4.4.1 Cases arrived today/Cases handled today

This first suggested key performance indicator: *cases arrived today/cases handled today*, shows the ratio between cases that have arrived in the warranty team's work queue today and cases that have been handled today. This KPI can be tied to the critical success factor *keep the work queues running smoothly,* as it gives an overview of the workload for the day as well as of the productivity within the warranty team for the day. It is not, however, showing the cases that are in the work queue but arrived yesterday or earlier. Therefore, to give a better overview of the actual situation, a measure showing cases that have arrived earlier should preferably be used together with this KPI.

4.4.2 Percentage of cases unhandled, received yesterday or earlier

The key performance indicator *% of cases unhandled, received yesterday or earlier*, can be used together with the previous mentioned KPI, to get an overall picture of the caseload. This KPI shows the proportion of the cases in the work queue that arrived yesterday or earlier. The KPI could be measured using the following equation:

$$\frac{\text{Cases in queue in total - Cases in queue that arrived today}}{\text{Cases in queue in total}} \qquad (1)$$

As mentioned in Chapter 4.3, it is important to keep the work queues running smoothly and to finish what has been started. No case should be left hanging in the queue for a long while, waiting to be handled. By using this KPI, it is easier to see how many of the cases have been waiting to be handled for some time and see if there is a trend; for instance, that cases tend to take longer than a day to handle.

4.4.3 Average time for case handling

Average time for case handling shows how long it generally takes for the warranty team to process a warranty claim. Time span for fetched data used in the key performance indicator could be within a day or even within a week. By using these time spans for measuring, the result for different time periods can be compared and possible ongoing trends can be observed. From that operations can be improved if necessary. For instance, if it for every week takes longer and longer for the warranty team to handle the incoming warranty cases,

the situation can further be examined. From there, action can be taken to improve the situation.

4.4.4 Requested on-time delivery, ROTD

As earlier mentioned, on-time delivery is already being measured by the warranty team. By also measuring requested on-time delivery, ROTD, the warranty team would be able to ascertain how good they are at delivering the warranty solution according to the customer's request regarding delivery date. This key performance indicator is giving a hint regarding the level of customer satisfaction, as it can be assumed that the ability to deliver according to customer request is affecting customer satisfaction in a positive way. When the critical success factors *handle customers professionally in every aspect* and *deliver reliable solutions as quickly as possible* are working correctly, a good result on ROTD can be expected.

4.4.5 Percentage of units with good fault description

When placing a warranty order, the customer can request for a root cause analysis, RCA, to be made by the quality team for the defective unit. There are many different factors that affect how long it takes to find the root cause; sometimes finding the root cause takes a couple of weeks, sometimes a couple of months, sometimes the fault cannot be replicated and is not found at all.

One factor that is affecting how fast the root cause can be identified is the customer's given fault description of the defective unit. If the customer is giving a very in-depth description of the fault – what it looked like, what happened and in what environment the product was operating in – it is easier for the quality team to know where to begin with the analysis as the description can give a hint on where the fault possibly can be. If the fault description on the other hand is too generic, for instance simply "relay is not working", it is hard to know where to begin, which can lead to a prolonged analysis process.

If the quality team could evaluate the given fault description and rate it in terms of how helpful it was for finding the root cause during analysis, it could hopefully improve the quality of the fault descriptions received from the customers. This is the main idea behind the suggested key performance indicator *% of units with good fault description*. If quality of information is improved, the RCA process could go faster, which eventually would lead to happier customers as they are receiving the RCA reports quicker.

4.4.6 Percentage where first warranty solution solved the issue

When processing a warranty claim from the customer, the aim is to deliver a reliable solution right away. Sometimes however, this is not achieved. It might be that it sounded like the issue could have been solved by replacing a certain module in the product, but after replacement, the issue still has not been solved. In those cases, additional modules, or even completely new products have to be sent to the customer to solve the issue. The KPI *% where first warranty solution solved the issue* would show how often the warranty team is able to provide a reliable solution that solves the customer's problem on the first try.

4.4.7 Percentage of claims where warranty replacement was valid

In general, for any kind of product, there are instructions available that explain how the product is supposed to be used in a proper way. Limitations regarding the operating environment, where it can be used, can also be mentioned for the product. Any fault that has occurred outside of these instructions and conditions is therefore not covered by warranty.

When the customer has received a replacement product under warranty, they must return the defective product for technical analysis, where warranty validity will be verified. The idea with the key performance indicator *% of claims where warranty replacement was valid* would be to show how many of the received warranty claims actually were covered by warranty. Additionally, it would give an overview of how good the warranty team is att providing cost-efficient solutions to the customer. To make this KPI even more extensive, there could be four categories measured. The KPI would then show the ratio between:

1. Yes, fault is covered by warranty.

2. Fault is covered by warranty, but better solution would have been available.

3. No, failure originated from conditions or actions not covered by warranty.

4. Fault was not found. Uncertain if warranty was valid.

The first category shows the amount of cases where warranty was valid. The second category shows the amount of cases where warranty was valid as well but a better solution for the issue would have been available. For instance, for a warranty case the provided solution was to send a completely new relay to the customer, however, during analysis of the defective relay it was found that it would have been enough to only replace a faulty module within the relay.

The third category shows the amount of cases where the failure originated from conditions or actions not covered by warranty. The fourth category shows the amount of cases where fault was not found. This should be excluded from the category where the case was clearly not covered by warranty as it is hard to determine if they are covered by warranty or not. Only because no fault is found in the customer's unit, the fault can still have been present at customer site. It might be that the fault was temporary, or that it is a fault that is recurring now and then but not showing at the moment. Therefore, it is better to have fault was not found as a separate category to give a more accurate picture.

4.4.8 Key Performance Indicator matrix

Table 1 illustrates the key performance indicators in a matrix, where they are ranked based on how easy it would be to gather data and how powerful the KPI could be when used. The powerfulness of the KPI and ease of data collection are measured on a scale from 1-5: 1 being not that powerful/not that easy and 5 being very powerful/very easy. The KPIs have been numbered, as seen to the right of the matrix, to better fit into the cells of the matrix.

Table 1 Matrix comparing powerfulness against how easy data can be gathered for the KPIs

		Powerfulness of KPI				
		1	2	3	4	5
How easy gathering data	1					
	2			5		
	3					6
	4					7
	5			1,4	2,3	

#	Key Performance Indicator
1	Cases arrived today/cases handled today
2	% of cases unhandled, received yesterday or earlier
3	Average time for case handling
4	Requested on-time delivery, ROTD
5	% of units with good fault description
6	% where first warranty solution solved the issue
7	% of claims where warranty replacement was valid

For the KPIs numbered 1-3, the data needed is quite simple as it is about time and date. This kind of data should already be available in the system. There should be a recorded time and date for when the case arrived and for when the case has been processed. The powerfulness of the KPIs should be quite good as well, as these measures are current measures. With current measures, action that is taken will affect the measure immediately.

For KPI number 4, *requested on-time delivery* – which is a past measure – it might be difficult to take action that would improve the measure drastically, as there are many people involved in the process that can affect the delivery time. What the warranty team can try to

do for increasing the performance of ROTD is to inform people within the process that cases with requested delivery date should be prioritized if possible. This can improve the performance, but at times it might be impossible to get the product delivered any faster despite trying to speed up the process. Regarding possibility to measure, as on-time delivery is already being measured in the warranty process, ROTD should also be quite easy to collect data to and measure. For warranty cases there is a field for requested delivery date available, that can be filled if the customer has a request on delivery date.

KPI number 5, *% of units with good fault description*, is the trickiest to measure. First off, the measure would be based on subjective data as it is up to the person who has analyzed the product to determine whether the fault description was helpful or not. This kind of data is not collected at the time but should not be difficult to start collecting. However, it can be difficult to define what a good fault description is, where is the line drawn between good and bad? This must be clearly defined in order for the measure to give an accurate picture. The possibility of affecting the performance of the measure can be quite low, considering that the fault description from the customer would have to be improved. Then again, if the KPI is showing a low percentage of good fault descriptions, it might be that the disposition of the fault description form has to be improved to get more in-depth information. To some extent, it is possible to improve the quality of received fault description, but ultimately, it is the customer's responsibility to provide it.

For KPI number 6, *% where first warranty solution solved the issue*, the idea is to compare the amount of cases where it was enough to deliver a solution once to the cases where several orders have been added to the case afterwards. It is possible at the time to add new products to the same warranty case if more parts or products are needed to solve the issue, so additional sent parts can be linked to the same case.

The easiest way to measure this KPI would perhaps be to include a checkbox that could be ticked in the case if the first warranty solution did not solve the problem. If such an option was available, it should be easy to collect the data. How easy it is to implement this option is however a different question. Probably it would be most suitable to have the option available in SAP. However, changes in SAP can be difficult to do and take a while to roll out. A quicker option would be to have an excel spreadsheet, where cases that were not solved by the first warranty solution could be put in manually.

If the KPI is working as intended, it should be powerful. If the KPI is showing a bad result, it might be that there is a training need within the warranty team, a need to improve the process or it can be because of a batch defect with the sent warranty replacement products.

For KPI number 7, *% of claims where warranty replacement was valid*, several data options will be compared to each other. The easiest way to gather the data would be to have some kind of drop-down menu, where the appropriate warranty validity option could be chosen for the faulty product after it has been analyzed. For warranty cases at the moment, the warranty team receives information about whether the faulty unit was covered by warranty after it has gone through technical analysis. A possibility would be to incorporate the four suggested data categories, or answer options, at this stage. Instead of only being able to inform about if the product was covered by warranty or not, information about whether a better solution would have been available or if the fault could not be found could also be provided. This KPI should be powerful if working correctly, as it should clearly show if there are areas that could be improved, regarding for instance cost-effectiveness.

Based on the matrix, it looks like the KPIs *% of cases unhandled, received yesterday or earlier*, *average time for case handling* and *% of claims where warranty replacement was valid* are the ones that could be most useful. The rest of the KPIs are quite highly ranked as well, the only one that really stand out is *% of units with good fault description*, which seem to be both hard to measure correctly and act upon if the KPI is showing a bad result.

4.4.9 Measures that did not make the cut

Initially, two other measures came to mind as being suitable key performance indicators: *average first response time* and *customer satisfaction*. After having analyzed for instance the relevance and the impact these measures would have, among others, they were nevertheless not considered critical enough for being considered as key performance indicators.

The idea behind the measure *average first response time* was to be able to track how fast the warranty team are on average to provide a first response to the customer's issue or question. Naturally, it can be assumed that customer satisfaction might decrease if the customer must wait for a long time before receiving a reply to their first sent message. One flaw with this measure however is that it can be easily manipulated.

It is essentially possible to send whatever kind of reply to the customer to make the indicator show that the response time is good. If only focusing on trying to make the indicator look

good and not making an effort to provide answers that are of value to the customer, the indicator will most likely give an inaccurate picture of the performance seen from the customer satisfaction point of view. A reply such as "thank you for your message, we will get back to you" might make the customer pleased to know that their message has reached the correct email address. Besides that, it does not actually give the customer any kind of valuable information. Only thing they know is that someone will be in touch, but when? These kinds of reply can decrease the customer satisfaction as they are not actively doing anything to make the matter move forward.

Furthermore, the possibility to actually measure this indicator seems tricky at the moment. As mentioned earlier, all warranty cases are generally being processed at the Business Online website. The communication on the other hand, is managed via email and is not physically linked to the warranty cases in BOL. Therefore, it would be hard to distinguish between which emails are counted as "first reply emails" and which emails are not.

For the measure to work, there has to be proper ground rules set within the team regarding first time responses, to minimize possible manipulation of the indicator. Further the case handling platform would need to be developed so that all communication could be linked to the case. By doing so, it should be easier to gather the correct data for the indicator.

Customer satisfaction as a key performance indicator was also considered. However, there are many challenges with gathering feedback from the customers, which can lead to the indicator showing an inaccurate result compared to reality.

Additionally, it can be argued whether customer satisfaction as a measure can be counted as a KPI. One of the characteristics for a KPI, as mentioned in literature, is that it is measured frequently. Usually that is not the case when gathering information about customer satisfaction. In general, information might be gathered once, or a couple times a year. If gathered more frequently, for instance weekly or monthly, the customers are less likely to answer – at least more than once – as it takes a lot of their valuable time. So already from that aspect, a measure showing customer satisfaction cannot be considered as a KPI. If looking at the definition for key result indicators, it might even suit better in that category, as KRIs are reported too late to change direction. Depending on the quality and amount of data that is gathered, it might not even tell what needs to be done to improve the result.

Reliability of the data gathered through the customer satisfaction survey is also difficult to assess. As customer satisfaction surveys are optional to answer, it is impossible to know

what kind of people choose to answer the survey. Is it a specific group of people or is it random? It might be that only dissatisfied customers bother to answer, or the other way around, which can give an inaccurate picture of the performance.

Apart from these two above-mentioned measures, there were a couple of other measures that were suggested during the interviews as possibly being useful for the warranty process. Mainly they were about measuring certain scenarios or things by segments, for instance by product group, country or region. As an example, a measure showing the amount of warranty claims that arrive for a specific product could be useful. By monitoring by product, it is easier to notice trends, such as if warranty claims are increasing for a certain batch and take preventive action before the situation gets worse.

Another example for segment measures is incoming warranty claims from a certain customer or customer segment. Imagine that there is a scenario where a customer is constantly getting the same fault on a certain type of product and is creating new warranty claims for each of them. Other customers or customer segments however do not seem to experience the same issues. Measures based on customer segments could identify these kinds of issues at an early stage and the problem could be investigated further.

These kinds of measures can definitely be valid to measure as they can provide valuable information and be useful for improving operations and performance. However, such measures do not count as key performance indicators. If going back to what is mentioned in literature, KPIs focus on the aspects of organizational performance that are considered being the most critical for the success of the organization. Furthermore, they should be few in number, no more than 10. If measures for different product groups, regions or customers were to be considered as KPIs, it would be difficult to keep the amount of KPIs under 10. Instead these types of measures would fall into the performance indicator category, which still are important and useful measures, but not as crucial as key performance indicators.

5 Conclusion

The purpose of this thesis was to investigate how to set up different key performance indicators, that could be used in the warranty process. The examined literary works were very helpful for identifying a proper course of action for finding meaningful KPIs. As earlier mentioned in the method-chapter, all the literary works examined were explaining how to find meaningful KPIs based on the scenario that KPIs were meant to be set up for a whole

organization, which was not the case for this thesis. Despite that, the described method for finding KPIs seemed to be applicable for this assignment although the project was of smaller scale.

Overall the fundamental steps for finding KPIs were followed. One smaller step of the method mentioned in literature was however omitted: the sphere of influence mapping process used to sort out the critical success factors from all identified success factors. This step seems to be useful when many success factors have been identified, for instance 20 or more, which can be expected for an organization-wide KPI project. In such cases it can be hard to decide which of the success factors are the most critical without looking at the sphere of influence for each success factor. In this thesis however, the identified critical success factors were few and therefore this step did not seem to be relevant.

Based on the theoretical framework and gathered information from strategic documents and interviews, I have been able to propose seven different KPIs that can be of use for the warranty process. What is now left for the warranty team is practical implementation of the KPIs and to test if they are working as intended. Implementation-wise I would suggest starting off small, by implementing only a few of the proposed KPIs rather than implementing all at once.

5.1   Challenges

This assignment has been interesting as well as challenging. At first it was difficult to find literature about key performance indicators, which was quite surprising as KPIs seem to be a commonly known concept among people. It turned out that literature is available, but many authors use different terms for describing the concept. Terms such as key performance measure, performance measure or metric are commonly used instead of talking about key performance indicators. Once I realized this, much useful information about the topic was found, that acted as a solid foundation for the assignment.

In the beginning I had some difficulties with trying to find KPIs that would be considered relevant. What helped me the most was definitely the valuable input received from the interviews, combined with the theoretical foundation achieved from literature. As mentioned in the theory-chapter, it is difficult and a rare achievement to find powerful KPIs and to get it right the first time. I agree that it is a challenging task and I would advise to have the just-do-it mindset to get the project moving forward. It is good to have in mind that the first suggested KPIs can be modified if it turns out that they do not to work as intended.

5.2   Proposals for further research

As this thesis did not address practical implementation of key performance indicators, I would first and foremost propose further study to be done about this topic. As implementation is not a trivial matter, research on the topic can help the implementation go more smoothly and make it less time-consuming.

Once the KPIs have been successfully implemented, I would suggest that they should be reviewed periodically to ensure that they are helping to improve performance. It should be examined whether the measures still have the KPI characteristics and can be considered as KPIs. As mentioned in the theory-chapter, KPIs can gradually lose impact over time. If strategy, objectives and critical success factors change over time, it might be that some measures are no longer considered important enough to count as a KPI. By reviewing them periodically, improvements to the set of KPIs can be made, to ensure that they are contributing to continuous improvement of operations.

Moreover, this thesis main focus was to find useful key performance indicators. However, in the theory-chapter other types of indicators that are useful to measure and monitor within the organization were also mentioned: performance indicators, result indicators and key result indicators. It was mentioned that an organization ideally should have no more than 10 KPIs, 80 PIs and RIs, and 10 KRIs. As further research I would suggest studying these measures as well and see if they could be implemented to get an extensive picture of the overall performance and progress.

5.3   Final conclusion

The aim of the thesis was to find areas within the warranty process that need measurements and define a way to measure them. All in all, I would say that the aim was reached: this thesis resulted in a suggested set of relevant and meaningful key performance indicators.

As testing of the suggested KPIs was excluded from this thesis, it is of course difficult to determine the powerfulness of the KPIs. As there is not a specific set of KPIs that works for everyone, it is hard to know how meaningful, useful and powerful a measure is without testing it in practice. Nevertheless, I think the proposed set of KPIs acts as a good starting point for the warranty team when it comes to wanting to get better on measuring and tracking the warranty process' performance.

All in all, this has been a challenging but valuable experience. It has been interesting to learn more about performance measurement and the challenges with them. From the interviews I gained a lot of valuable input. It was interesting to hear opinions and ideas from people that have different positions and work in different teams as they all have a slightly different perspective on things. This has given me a broader perspective as well on the matter. Lastly, I would like to thank ABB Oy, Distribution Solutions for the given assignment and for the help I have received during my research.

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