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Creating insights into the vendor performance at Rodelta Pumps International by means of an interactive vendor rating dashboard

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RODELTA®

Management summary

Introduction

This research is a result of a bachelor assignment performed for my study at the University of Twente. For such a bachelor's assignment, a company is needed to execute the research which in this case is done at Rodelta Pumps International. Rodelta is a company that specialises in the designing and manufacturing of hydraulic pumps, and they are located in Almelo, the Netherlands.

Problem description:

The problem that they were facing which led to this research being conducted was the fact that they had problems with delivering contracts on time to their customers. This problem had its roots in a lot of different departments of Rodelta but for this research, the scope would lay on the Logistics/Purchasing department. Here the problem was mostly related to their vendors and the lack of insights into the performance of those vendors. Problems at this stage would of course transfer over during the rest of the business process and that is why this would be the main focus of this research. The core problem of this research would therefore be set as the following statement:

"There is a significant lack of overview of their vendors at Rodelta and their individual performance due to a lack of structure, data and transparency of information".

Main research question:

For this research, we set up a main research question that would be answered at the end of this research. The research question states: "How can the rate of on-time delivery of contracts be improved at Rodelta when looking at the performance of vendors?". This question could not be answered immediately and therefore there were sub-research questions set up to work towards this final answer. At the end of this research, the goal was to have answers to all these questions.

Approach:

The methodology used in this research was suited for the creation of an artefact that would solve the core problem. This methodology of choice is the Design Science Research Method. This methodology allows the researcher to follow a set of steps which will help the researcher build towards the final artefact. These steps are Identifying the problem, Defining objectives/solutions, Design and development, Demonstration, Evaluation and Communication.

For the first two steps of the DSRM, it was important to get a good understanding of the problem and the current situation at the company. This was done through observations on-site and the gathering of information through employees. The gathered information allowed for the creation of a BPMN that displayed an overview of the entire business process. After we had a clear overview we started by looking into the KPIs that were preferred by the company. This selection of KPIs was made after a selection method existing out of two

questionnaires that were used to incorporate the stakeholder's experience into the KPI selection process. After the company's preference was known we executed a literature search for possible new KPIs. This list that resulted from the literature review was also checked by the stakeholders based on relevance and preference.

The combination of the two final lists left us with the final selection of KPIs for this research.

-Delivery time
-Product quality
-Delivery conform to order
-Lead time
-Delivery quality
-Cost of product/Cost stability
-Compliance with SLA

This list was then ranked by the stakeholders based on their importance regarding vendor performance. The ranking was done by letting the stakeholders rearrange the final KPI selection in order of most relevant to least relevant. This information was then used to calculate the weights per KPI utilizing the Rank-Sum method. With these weights, it was possible to score the vendors based on their performance per KPI that was built up out of the different weighted scores per KPI. With the weights and KPIs in place, it was time to gather and extract the data from the two systems that are in use at Rodelta. One of those is the company's ERP system MKG where most of the information is stored and the other system is called Qooling which consists of the quality-related information. Once all of this data was extracted it was time to sort and filter this data in Excel until there were different organised datasets per KPI in place. This was the foundation for the prototype of the dashboard that was going to be built.

Before the prototype was made in the third step of the DSRM it was first important to get a good understanding of the different ways to design a dashboard and what certain points of attention should be taken into consideration when designing. After an academic literature search was completed, it was time to start making the prototype and using the different visualisation methods that came out of the literature. This resulted in a prototype that wade in the third step of the DSRM that still needed to be tested and revised, as would be done in the evaluation step of the DSRM. This was done by letting the stakeholder and a group of inexperienced test subjects test the prototype. Once they had tested it, they were able to give their feedback and were asked to fill in the User Experience Questionnaire. These feedback results allowed for the creation of an improved final dashboard which can be used to give the user clear insights into the individual performance of the vendors of Rodelta based on a refined list of KPIs.

Results and Recommendations:

This thesis is ended with some recommendations that came up during the execution of this research which can be used for future work on this topic. Below is a summarised list of these recommendations.

-Keep better track of data regarding the KPIs
-Assign people to the task of tracking and storing data
-Implement benchmark values in the dashboard to make it more accessible without experience of the subject
-Extending the scope by adding new KPIs into the dashboard

The result of the research is an interactive vendor rating dashboard (Figure 1) that can be used to assess the individual and combined performance of all the vendors at Rodelta Pumps International.

Figure 1: Final Dashboard

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Preface

Dear reader,

This thesis with the title '*Creating insights into the vendor performance at Rodelta Pumps International by means of an interactive vendor rating dashboard*' contains the research that I have performed over the course of multiple weeks. I have written this thesis as the graduation assignment for my bachelor's degree of the study Industrial Engineering and Management at the University of Twente. The research that was needed to be able to write this bachelor's thesis was conducted at Rodelta Pumps International. The execution of this research started off at the beginning of September 2023 and took up until the beginning of November 2023. However, the preparations for this research were already made during the 3rd academic quartile of the 2022-2023 year.

Firstly, I would like to thank everyone at Rodelta whom I met during my time there. Everyone was very welcoming and was interested in what my research was about. I want to thank my company supervisor Danny Engbers especially for the enjoyable time we spent together at Rodelta. There was always an informal vibe in the office and there was always room for questions. I also want to thank the people at Rodelta for the trust they had in me and letting me get to know more about the real working life outside of the research I was conducting.

Secondly, I want to thank my supervisor at the University of Twente Ipek Seyran Topan. She guided me through the whole process of this thesis and was always available for questions. She cleared up a lot of unknowns that I had at the beginning of this final study module and made working with her a very nice experience. I also want to thank my second supervisor Mahak Sharma who made herself available on short notice and has provided me with a lot of detailed feedback that helped me improve my thesis in the final stages.

Finally, I want to thank all my friends and family who supported me and believed in me during this research/graduation period.

Wessel van Dijk

Enschede, November 2023

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List of Abbreviations

BPMN: Business Process Modelling Notation
BOM: Bill Of Materials
ERP: Enterprise Resource Planning
FAT test: Factory Acceptance Test
ISO: International Standardization Organization
KPI: Key Performance Indicator
PI: Performance Indicator
AHP: Analytical Hierarchy Process
DSRM: Design Science Research Method
IT: Information Technology
JIT: Just In Time
ROI: Return On Investment
SMART: Specific, Measurable, Attainable, Relevant, Time-Bound
MCDM: Multi Criteria Decision Model
UEQ: User Experience Questionnaire
SLA: Service Level Agreement
VBA: Visual Basic for Applications

1) Introduction

For this thesis I have worked on a problem that was provided to me by Rodelta Pumps International regarding their current situation of their vendor management. Rodelta is a hydraulic pump manufacturer located in Almelo who has had struggles for the last 2 years with delivering their contracts on time. One of the reasons this keeps happening is their lack of insight into the individual performance of the vendors. This thesis will be aimed at understanding the problem, finding a solution to this problem and providing Rodelta with the additional recommendations.

1.1)   Background

Rodelta Pumps International is a Dutch pump manufacturing company based in Almelo that was founded in 1946 (called Delta Pompen at the time) because of the increased demand for pumps after the second world war. What first started with demand only from the agricultural market (see figure 1) soon grew to a lot of reasons/markets such as flood control, irrigation, drinking water, wastewater, pulp & paper, power, chemical, oil & gas and general industries. This resulted in the interest of Sulzer Pumps in 1970 who wanted to merge companies with Delta Pompen. This resulted in a complete transformation within the company and their facilities (see Figure 2). After another period of successful growth, the company was acquired in 2015 by a company called Kirloskar Pompen BV. They made sure that Rodelta was moved to a new modern location located in Almelo where it still is located to this day. Currently Rodelta has two pump families that are supplied to drinking water companies and the oil industry. Both of these markets have their own dynamics and they are the markets of Rodelta's main products.

Figure 2: Casting process at the beginning of Rodelta
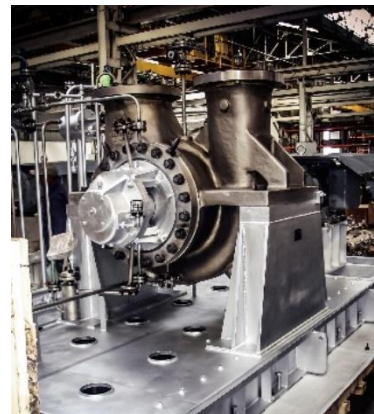
Figure 3: Current Rodelta product

1.2)   Motivation for research

Rodelta is a company which is very dependent on its vendors. Almost 70% of the end products of Rodelta come from different vendors who all perform at different levels. These performance levels are sometimes below expectations which causes problems for Rodelta along its business process.

This thesis will focus on the performance of strategic vendors that are currently being used at Rodelta Pumps International. Currently, the insights in the individual performance of the vendors are not optimal which stops Rodelta from getting a good understanding of which vendors are performing as they should and which vendors are performing below expectations. This is of course a problem that contributes to the bigger overlapping problem of not being able to deliver contracts on time.

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To sketch the problem that Rodelta is facing the following example is given. Rodelta has a certain standard product that is made out of 3 parts that are assembled in the order of XYZ. If then for some reason Rodelta receives good quality products from vendors X and Z that are delivered on time, but the vendor of product Y has had recurring problems with delivery time, then the entire production line is stalled because of this one underperforming vendor. This delay will then be transferred over to the next stages and will result in delayed overall delivery of the contract and/or higher inventories than expected because of the longer cycle time of the parts/raw materials. That is why this specific part of the business will be the main subject and focus of this research to try and find a fitting solution for this vendor performance problem.

From the research perspective of this thesis we hope to get a better understanding of the different factors that play a role in vendor management and in what ways the scientific literature and the implementation in practice differ from each other.

To conclude, this research is motivated by the need for improvement regarding the insights into vendor performance at Rodelta Pumps International. With these insights we hope to bring more clarity and information to the company that is needed to optimize the vendor performance management which would contribute to solving the main problem of the contracts not being delivered on time.

1.3) Problem description

The current situation regarding the overview of vendors and an insight into their individual performance is poorly defined. Rodelta knows about the main problem that is that the contracts of the last two years have not been delivered to the customer on time, but they have not been able to fix this problem because they are not sure how to solve this in the different sectors. Different parts of the business process have been marked as possible problem makers, and one of these is the problems regarding the vendors. The fact that they are struggling to meet the predetermined delivery times is of course not good and can cost them potential customers in the present but also in the future if competitors are not struggling with this same issue. This problem can also lead to other issues within the company because if there is already a problem at the beginning of the production line then this will inevitably show its result along the rest of the line which will result in extra delays, costs, uncertainties et cetera.

1.4) Problem identification

In this chapter, the problem that will be solved during this research will be identified using a problem cluster. After combining these problems with the stakeholder problems we can conclude that into a core problem and set our norm. This can then be compared to the reality of the current situation which will allow us to build our research around these differences.

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1.4.1) Problem cluster

The overarching problem at Rodelta has a lot of different causes spread throughout the business. This research focuses on the vendor management problem that they face which can be seen in Figure 4 and appendix A.
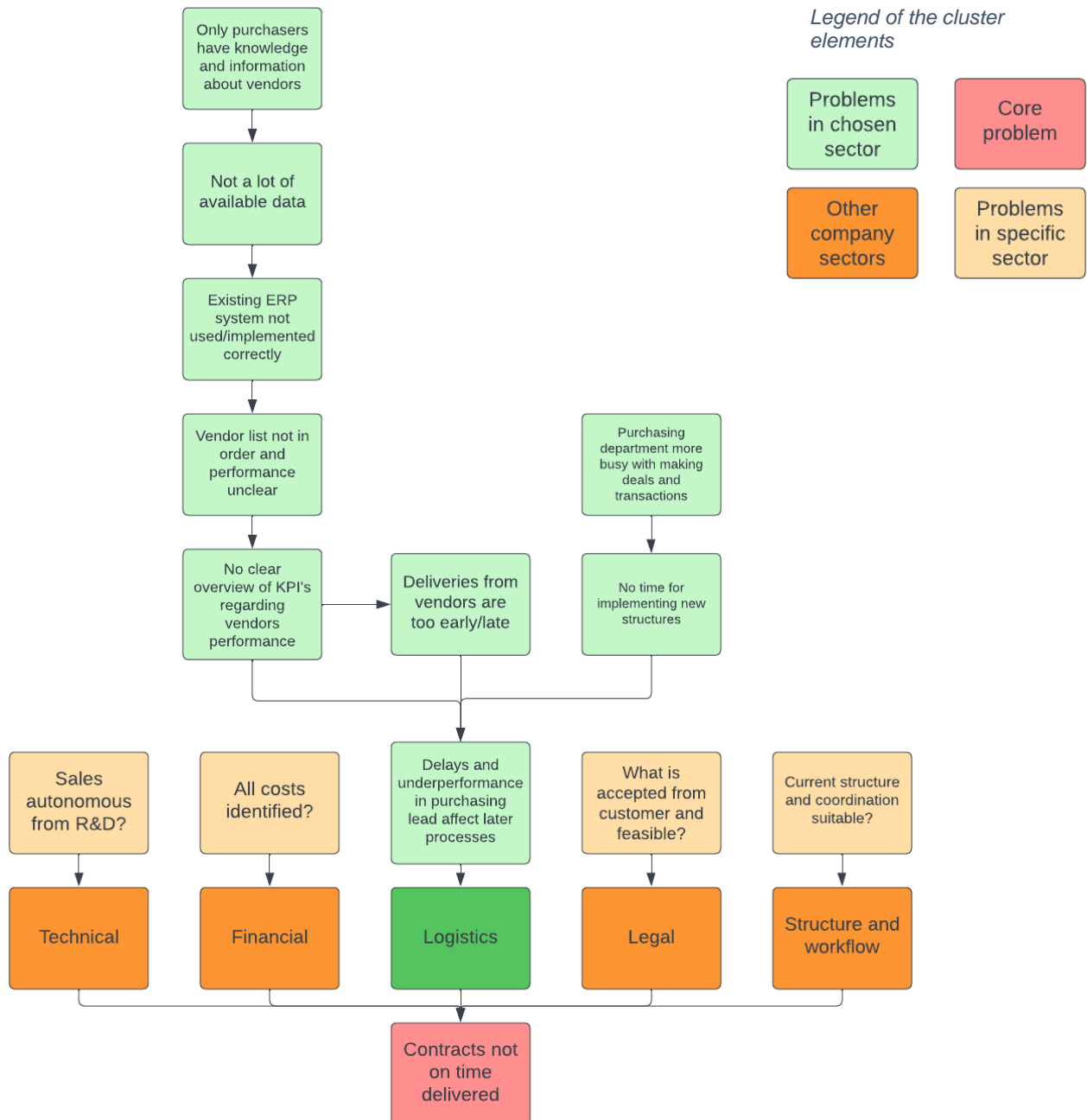
Figure 4: Problem cluster

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1.4.2) Reality

The current situation at Rodelta, also described as the current reality of the situation, is that the vendor management is not up to standard. The list of vendors is not clearly structured and the company does not have a good understanding of the insights in the performance of individual vendors. Also, a visualisation tool such as a dashboard is not yet in place. That is why this research starts off with a complete blank canvas.

To get a good understanding of the current reality of the situation within Rodelta a Business Process Modelling Notation (BPMN) flowchart has been made to globally visualise the business process from start to end and help solving the research questions mentioned in Chapter 1.7. This BPMN is depicted in Figure 5 below.
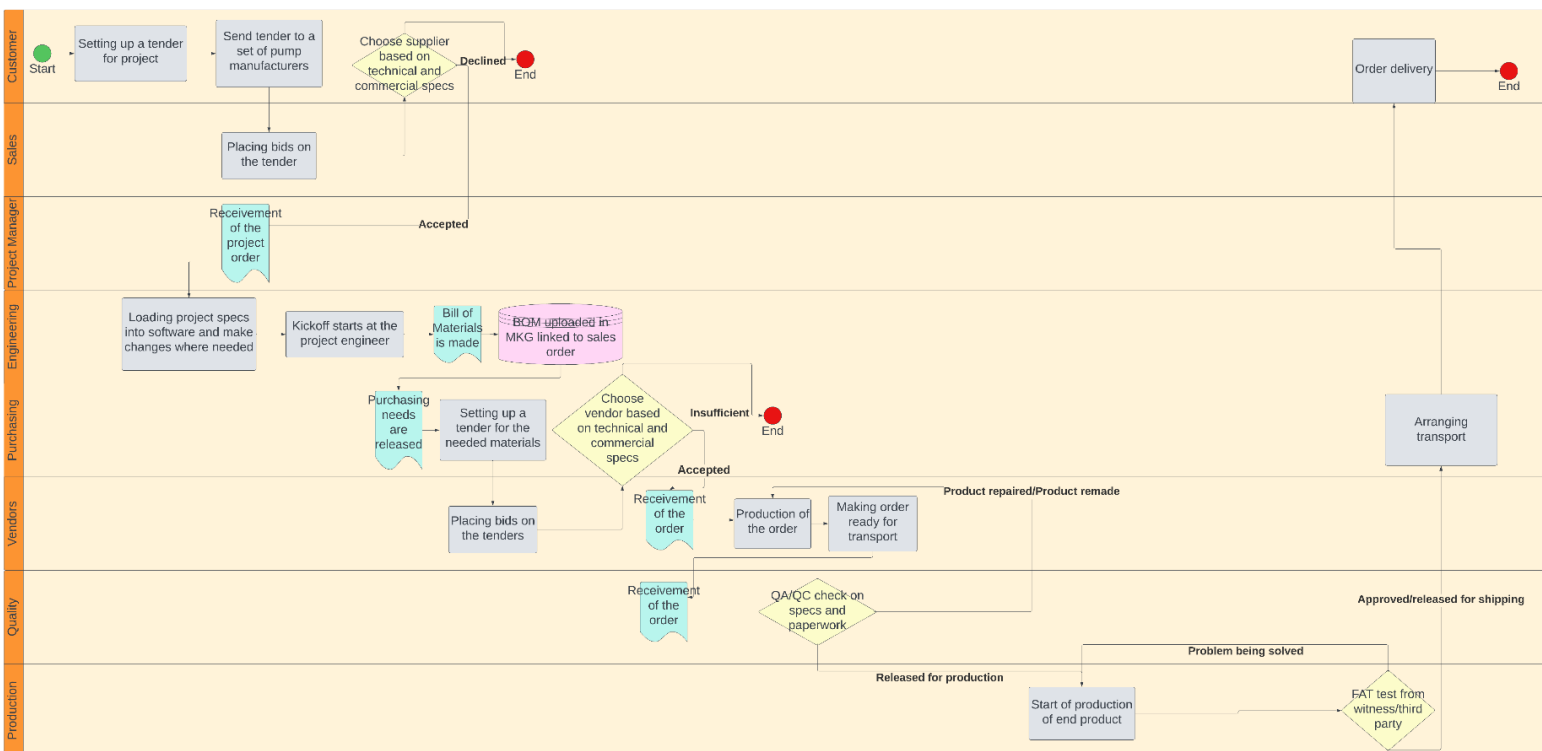
Figure 5: BPMN of Rodelta

The whole process starts with the customers of Rodelta who are looking for the suited pump manufacturer for their project. They do this by creating a so-called tender for the project. This tender can be seen as a contract that will be sent to multiple pump manufacturers which they will have the opportunity to place bids on. After the customer has considered all the bids from the manufacturer based on their bids and specifications they will accept one of the manufacturers to be their manufacturer for the specific project. This 'green light' will be received by the project manager of Rodelta which will in turn direct the engineering department to start setting up a Bill of Materials (BOM) based on the design that was made to fulfil all the specifications and needs of the customers project. When this BOM is finished it will be uploaded to the Enterprise Resource Planning (ERP) system of Rodelta called MKG. This will allow different departments to access the BOM, especially the purchasing department. The purchasing department will release the purchasing needs out of the BOM and will set up tenders for the needed materials and will spread these over different vendors, just like the customer did at the beginning of the BPMN. Once the purchasing department has

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decided which vendors will be contracted based on their tender bids the purchaser will send out orders to those specific vendors. These vendors will then start production of the order and after completion the transport will be arranged by either the vendor itself or the purchaser. Once the order is then received the quality department of Rodelta will check the order for possible failures in specs, failures in paperwork et cetera. Once all the parts are checked and approved the final stage of the process will happen and that is the production. The production department will assemble the final product and will test the product with a Factory Acceptance Test (FAT) test or a third-party test. If everything is approved, then the purchasing department will set up a transport for the final product to the customer.

Rodelta is buying around 60 to 70 percent of their order value externally. This means that the vendors that are used for these purchases are very important towards the performance of Rodelta itself. There are a couple of vendors that are critical to Rodelta but this number is limited. These vendors are known but not by everyone because there is not a lot of transparency around this subject. This holds for a lot of the information used in the purchasing department. Most of the information and knowledge comes from the experience of the purchasers themselves. This lack of transparency is only one part of the problem that they are currently experiencing regarding their vendor management.

Next to the problem about transparency they also face some problems with their lack of time and high workload. Currently the purchasing department is not focussing on every aspect that is related to vendor management. They are mostly focussed on the 'deal making' and the transaction process of the confirmed orders. There currently is no time to implement and adapt new structures to change the focus points of the purchasing department. The purchasing department is one of the main contributors to the company's profits and it is therefore very important that the performance of this department is up to standard and managed in the correct way. They try to take the needed measures and actions based on the ISO-norms but this is always done at the last minute. Especially during this period it is very hard for them to invest time into this problem because there have been a lot of retrenchments made by the directing board which results in a high workload per department as a result of less personnel.

There is no structural audit of vendors for Rodelta which means that there is currently no check on their vendors based on a certain set of criteria. This also means that they do not have a list of certain KPIs that they keep track of in terms of stored data. Therefore the transparency around the vendors, and their performance, within the purchasing department is poor and not a lot of data is available now. One of the problems that they face for example is that they do not have a consistent flow of incoming deliveries from their vendors. The deliveries are often too early or too late and this causes Rodelta to be unable to function optimally. These deliveries that are not on time make it also hard on the financial situation of Rodelta. This means that a lot of the time orders at the vendors are paid after some time which sometimes results in additional fines. Also, quality standards are not always met which result in unnecessary cost and/or delays.

The company also has a code of conduct which states the core principles of the company and in what ways they strive to uphold these principles. Here they also mention that they expect the third parties that they engage with, like their vendors, also uphold these principles. However, this code of conduct is currently not used when reaching out to vendors and contracting them so it is also not clear whether or not these third parties uphold these principles.

1.4.3) Norm

In this research we want to attain a systematic overview of the vendors of Rodelta together with informative performance metrics to help the stakeholders with vendor management and decision making. These performance metrics will be made with the use of key performance indicators (KPIs) that are formulated using academic literature and the experience from the stakeholders. The information based on the stakeholder's experience will be gathered through interviews and questionnaires and will then be combined with the information from the academic literature. This selection of KPIs will then be linked to the available data at the company around these performance indicators by setting up a data structure. This data structure will be the foundation for the interactive vendor rating dashboard that will help the company with the improvement of their vendor management and with the decision making that results from it. This dashboard can then be used to intervene on time if necessary and allows for a clear structured overview of the individual performance of the vendors of Rodelta per commodity.

1.4.4) Problem stakeholders

When looking at this problem we can see that there are a couple of people involved with this subject of vendor management. The main functions involved are the Purchase/Procurement manager and the Project Manager. This is because they are in direct contact with the vendors and their day-to-day work is closely related to the vendors and their individual performance. Next to them the Sales department and the board of directors are also connected in some way to this vendor problem, but they are not the main people involved.

These different functions within Rodelta will benefit the most from a fitting solution to the problem that they are currently facing regarding their vendor management. That is also why during this research they will be used as the research population for interviews and other ways of information gathering.

1.4.5) Core problem

The core problem that Rodelta is facing is that they cannot deliver their contracts on time to the customers due to a lot of problems spread throughout the business. For this research, the focus lies on the logistics side of the business. Here the problem is caused by a lack of overview of the vendors and their individual performance. This is because there is no structured way to keep track of the data and manage a set of KPIs to measure this performance. Therefore we can state the core problem as:

> "There is a significant lack of overview of the vendors at Rodelta and their individual performance due to a lack of structure, data and transparency of information".

1.5) Research goal

The goal of this research is to solve the core problem, which is stated in Chapter 1.4.5, by using the best-fitted solution. At the end of the research we want to have a final artefact which will help Rodelta with improving their current situation around vendor management. This artefact will be based around a compact selection of KPIs which is created using knowledge from academic sources, stakeholder experience and company preference. With this artefact it will be possible to manage the vendors based on their individual performance per KPI. This artefact will also include a scoring model that will display a ranking of the vendors to give a quick insight into who is underperforming for

example. At the end of this research we want to deliver this artefact together with some recommendations for possible short -and long-term future work based on the results that come out of this research. This will allow the company to improve the artefact in the future and will help them with the implementation of it in their company structure.

1.6) Research approach

The research will be focussed on finding a solution to the problem that Rodelta is currently facing regarding their vendors. This solution will be delivered in the form of a vendor performance management dashboard that will display the individual performance of vendors based on some predetermined KPIs. These KPIs will be selected based on knowledge gathered from academic sources and on the preferences from Rodelta themselves. The KPIs both based on gathered knowledge from academic sources and the suggestions from the company will be evaluated and given a weighted value. This weighted value will be determined by analysing the results of a survey that will be conducted with some of the company's experts based on the matter of vendor performance. After that the weighted values will be determined by making use of the Rank Sum Method or the Analytical Hierarchy Process (AHP) method. This choice will be based on the amount of KPIs that will be implemented in the dashboard. With the data from the survey and the chosen Multi-Decision-Making method the KPIs will be given their own weighted value which can then be used to compare the vendors and their individual performance with the use of the created dashboard.

1.7) Research questions

For this research, I have come up with a main research question and some sub-questions. These research questions will bring more structure to the research and divide the big overarching core problem into smaller manageable problems.

For this research, the main research question will be:

"How can the rate of on-time delivery of contracts be improved at Rodelta when looking at the performance of vendors?"

To help answer this main research question we have come up with a set of investigative sub-questions that will allow us to solve the main problem by gaining more knowledge in a step-by-step manner. These sub-questions, combined with a small explanation, are stated as follows:

1) What does the current situation look like at Rodelta regarding the insight in their vendor performance in terms of their ability to facilitate on-time deliveries?

This question helped to get a better understanding of the current situation at Rodelta and the way they are handling this part of the business. To help with the creation of this overview we made a BPMN which is depicted in Chapter 1.4.2. This then gave a good understanding of the possible problems that they are facing and gave insights into the methods that they use that do not seem to function properly. This was done by observing at the company itself and information gathered through interviews/asking questions.

2) What are certain KPIs that Rodelta prioritises regarding their vendor performance to improve their ability to facilitate on-time deliveries?

This question made sure that I took their personal preference and experience regarding the performance indicators into consideration and combined them with other important KPIs found during a literature review. This information was gathered through a set of interviews with the stakeholders and the solving of this question will be done in Chapter 2.2.

3) What are certain KPIs that are most important/influential regarding vendor performance based on existing literature to improve their ability to facilitate on-time deliveries?

This made sure that, next to the performance indicators preferred by the company, we would base the research on the most important and most frequently used performance indicators.

This also gave us more of an understanding of all the different KPIs and the different ways of evaluating them based on weighted values. From this literature search, a short list was created to be able to score the different vendors based on these most important performance criteria, which can be seen in Chapter 2.3.

4) Which visualisation methods are best fitted to improve vendor performance management and what are some recommendations for future improvement to improve the ability to facilitate on-time deliveries?

This question allowed me to gain knowledge about different display tools that can be used to display all the results gained from this research, see Chapter 2.6, and allow the company to base their decisions on these results. The layout is based on information gathered in a literature search and the user interaction is measured by surveys. To support these results a couple of recommendations are made on how to improve certain performance points. These recommendations can be used as managerial insights for the company to get a global idea of the possible solutions.

The design phase where all the display methods are combined is described in Chapter 3.

These questions are answered following the chosen methodology described in Chapter 1.8.

1.8) Methodology

The chosen research methodology for this specific problem will be the Design Science Research Method by Peffers, et. al (2007). This research methodology seemed most fitting for this specific research because it is aimed at the creation of a certain artefact which is based on existing and/or gathered data. Peffers, et. al (2007) described the DSRM as follows:

"Design science creates and evaluates IT artefacts intended to solve identified organizational problems. It involves a rigorous process to design artefacts to solve observed problems, to make research contributions, to evaluate the designs, and to communicate the results to appropriate audiences. Such artefacts may include constructs, models, methods, and instantiations. They may also include social innovations or new properties of technical, social, or informational resources; in short, this definition includes any designed object with an embedded solution to an understood research problem. Peffers, et. al (2007, p.49)"

The reason for the choice of the Design Science Research Method as our research methodology is based on the use scenario which is typical for the DSRM. This research aims to improve the ability of Rodelta to facilitate on-time deliveries to their customers by improving the current vendor

management. This will be done by the creation of an artefact which can be used to get insight into the individual performance of the vendors of Rodelta. Because we will be creating an artefact for a use scenario it seemed most fitting to utilize this methodology. As will be described in Chapter 1.8.1 this methodology helps the researcher with a step-by-step process through the research towards the final artefact that will be created.

1.8.1) Design Science Research Method

The DSRM exists out of a certain set of steps that guide the researcher through the process of finding a solution to the core problem. These steps can be seen in Figure 6 below.
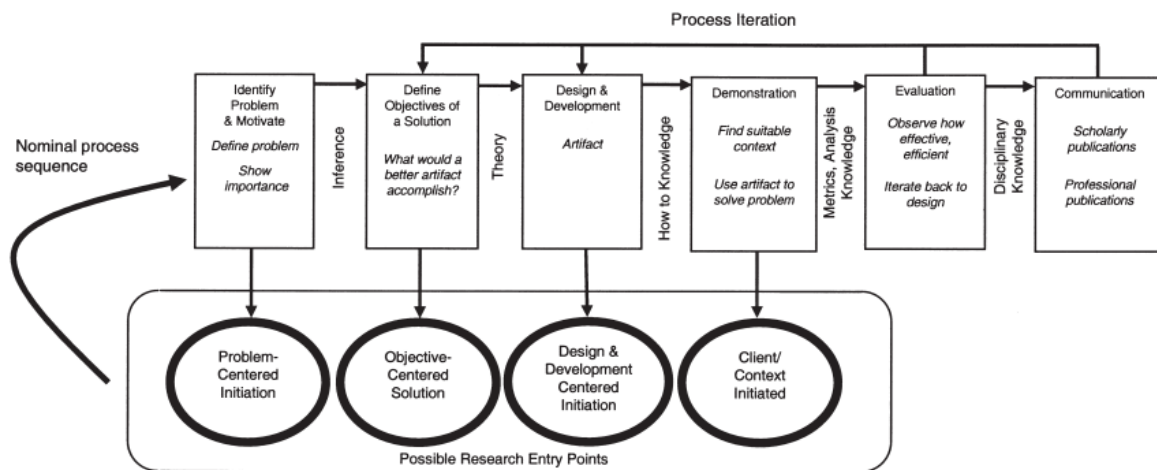
Figure 6: The DSRM process model

Note. From "A design science research methodology for information systems research" by Peffers, Ken & Tuunanen, Tuure & Rothenberger, Marcus & Chatterjee, S.. (2007). Journal of Management Information Systems. 24. 45-77.

The DSRM starts in the first step where the researcher needs to identify the problem and give a motivation for the research on this specific problem that justifies the value of an intended solution. Here it is useful to break the main identified problem down into several smaller discrete problems that make it easier for the solution to capture the complexity of the entire problem. In this step the researcher can show what the current knowledge is about the different problems and why the solution is therefore so important. This step of the DSRM will help solve the first sub-research question.

In this research the core problem is identified as: 'The company is unable to deliver contracts on time to their customers'. The underlying problems connected to this core problem are displayed in the problem cluster that is displayed in appendix A. Here the problem is divided into multiple sub-problems with each their own expertise within the business. For this research the focus lies on the logistics side of the problem and following the problem cluster we can see that the problem is a result of poor vendor management. This breakdown of the problem helps to get a grasp of the complexity of the problem and the solution that could be fitted for this problem. An improvement of the vendor management will most likely result in an improvement in the rate of on-time deliveries of contracts to customers.

For the second step of the DSRM the researcher is required to define the objectives of the research for a fitted solution to the identified problem that was determined in the first step of the DSRM. Here the choice needs to be made by the researcher whether the objectives will be qualitative ("a description of how a new artefact is expected to support solutions to problems not hitherto

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addressed") or quantitative ("terms in which a desirable solution would be better than the current ones") (Peffers, et. al (2007, p.55)). This step will help to answer the second sub-research question.

In this research the objectives will be the same as the norms that are described in the previous chapter. These objectives will be 'solutions' to the problems that they are facing right now in the 'reality'.

In this research the objectives will be partially quantitative and partially qualitative. This is because the company does not currently have such an artefact to help with the vendor management. Therefore the objectives will be describing the positive impact the artefact has on the problems but also how this situation with an artefact is better than the way that they are currently handling their vendor management.

In the third step of the DSRM will be the designing and development stage of the artefact. These artefacts can be in the form of constructs, models, methods and other designed objects that have a research contribution embedded in the design (Peffers, et. al (2007)). In this step of the DSRM the researcher will look at the functionality, the architecture and the creation of the artefact with the help and inspiration from knowledge gained through sources such as academic literature, stakeholders and other information sources that can play a role during the designing phase of the artefact. This step of the DSRM will help answer the second and third sub-research questions.

As for this research the artefact will be designed in the form of a dashboard displaying the predetermined KPIs. The design of the dashboard and the way the KPIs are set up will be based on the gathered knowledge from the academic sources and the results of the survey at the company itself. The end product should allow the researcher to make recommendations to the company based on the results of the dashboard.

For the fourth step of the DSRM the researcher will start with demonstrating the use of the artefact in practice. This can be done with a smaller part of the problem or a smaller part of the entire data. This allows the researcher to test the artefact and see if this result matches the intended solution. This step helps to answer the fourth sub-research question.

The artefact from this research will be tested by taking one or a couple of vendors to see if the dashboard results will allow the company to determine whether or not their vendors are performing as expected or if they are underperforming.

As the fifth step, the researcher will face the evaluation step. Here the results of the demonstration of the artefact will be compared to the objectives that were set during the second step of the DSRM. At the end of the evaluation step, the researcher will decide to cycle back to the third step of the DSRM to try and improve the design and effectiveness of the artefact. If there are no points for the researcher left to change/improve on the artefact, then the last step of the DSRM can be started. This way of evaluating the artefact will be closely matched during the execution of this research. This step also helps to answer the fourth sub-research question.

The sixth and last step of the DSRM is the communication step. Depending on the reason for research the researcher will communicate the results of the research to a certain relevant audience. In this case, the research will be done for educational purposes so the communication of the results of the research will be published in the form of this thesis. This will be done by going through the research from the beginning to the end as can be seen in the table of contents at the beginning of this thesis.

The way the researcher can make use of the DSRM can be versatile based on the way the researcher will approach the research problem. Examples given by Peffers, et. al (2007) are the problem-centred approach, the objective-centred solution, the design- and development-centred approach and the client-/contact-initiated solution. These different approaches to the research will determine whether the researcher starts the DSRM in steps 1,2,3 and 4 respectively.

In this research, the DSRM will be walked through from steps 1 to 6 to be able to show the entire process during this research and allow for a more complete report which is better fitted for the educational purpose of this thesis.

1.8.2) Research design

This research will be focussed on coming up with a solution for the research questions and therefore the main problem at Rodelta. The knowledge needed to answer these questions will be gathered in a couple of ways. These ways of gathering knowledge are by expert surveys at the company and by conducting a systematic literature review. The expert surveys will be used when there is data needed that is based on opinions, experience or preference and the systematic literature reviews will be used for all the other required knowledge such as understanding different decision-making methods or the use of different dashboarding software.

The research will be based on a set of data that was gathered over a period of time regarding the performance of the vendors of Rodelta. The performance will be measured using different predetermined KPIs from the literature and from the experts of the company. These performance indicators will then be given weights based on their importance. For this, a specific method will be researched in the literature review. Then with these weighted values and the data from the company, the researcher will be able to combine all of these factors into an interactive dashboard that allows for more insight into the performance of the vendors of Rodelta. So the deliverables in the end would be a list of weighted KPIs integrated in an interactive dashboard together with global recommendations based on the results that came from this research that can be used for future research.

For all of the research questions we made a breakdown of how we are going to form a plan and execute that plan to be able to answer all of these questions. This breakdown can be shown in table 1 on the next page. This breakdown from table 1 is made to help the researcher with solving the research questions step-by-step. First, we determined whether the type of research needed for the question was descriptive (describing a topic or phenomenon at hand) or exploratory (describing why a topic or phenomenon works the way it does). Then we determined the research population that we would be using to gather the information needed for the question. Then we determined the subject of the question and the research strategy that we would be using. This is either qualitative (using text, opinions from interviews) or quantitative (using numeral data to make predictions or identify patterns). Finally, the breakdown in table 1 shows in what way the data will be gathered and processed and a summary is given of the complete activity plan.

Table 1: Deconstruction of RQ's

How can the rate of on time delivery of contracts be improved at Rodelta when looking at the performance of vendors?							
Knowledge Problem	**Type of research**	**Research population**	**Subjects**	**Research strategy**	**Method of data gathering**	**Method of data processing**	**Activity plan**
What does the current situation look like at Rodelta regarding the insight in their vendor performance?	Descriptive	Rodelta	Rodelta Vendors	Qualitative	-Observation within the company -Conducting interviews/asking questions -Do work related tasks	-Summarize data on current situation -Visualize data from the interviews -Qualitative and quantitative	Getting acquainted within the company→Setting up interviews→Process the data→ Create an overview of current situation
What are certain KPI's that Rodelta prioritises regarding their vendor performance?	Descriptive	Rodelta and stakeholders	Vendors Performance indicators Employees Stakeholders	Qualitative (finding the KPI's)/Quantitative (gathering/processing KPI data)	-Conducting interviews with stakeholders/experts	-Make a selection of the found KPI's along with a detailed explanation -Qualitative and quantitative	Conducting interviews→ Summarise data and process into KPI selection→ explain choices and give definition
What are certain KPI's that are most important/influential regarding the vendor performance based on existing literature?	Descriptive	Literature	Vendors Performance indicators Literature	Qualitative (finding the KPI's)/Quantitative (gathering/processing KPI data)	-Literature search on academic sources	-Make a selection of the found KPI's along with a detailed explanation -Quantitative	Perform literature search→Filter through data→Summarise findings→add to the KPI selection list
Which methods are best fitted to display the vendor performance that is based on the determined KPI's and what are some recommendations for future improvement?	Explanatory	Rodelta and Literature	Rodelta Performance indicators Literature Dashboard User testing	Qualitative (finding methods) /Quantitative (implementing the data)	-Literature search -Conducting interviews to get an understanding of the preferences of the stakeholders -Measuring and collecting KPI data	-Choosing a layout and visualisation methods for the dashboard -Implement the data -Qualitative and quantitative	Perform literature search→Summarise findings→Set up interviews→Conduct interviews→ Implement findings to design a dashboard→Implement data into dashboard

2) Theoretical framework

In the first chapter the core problem has been identified and been categorised in different sub-problems regarding the different departments within the company. This was visualised in the problem cluster that is displayed in the appendix A. This research is focused on the logistics department of the company and therefore broken down further into multiple sub-problems that are purely related to the logistics department. This problem identification phase is part of the first step of the DSRM and will help us answer the first sub-research question.

2.1) Current problem situation

In this subchapter the first research question will be described and answered. This research question states: "*What does the current situation look like at Rodelta regarding the insight in their vendor performance in terms of their ability to facilitate on-time deliveries?*".

The current situation at Rodelta regarding their insights in their vendor performance is described by the employees as a blank canvas. Currently there is no such thing that exists which allows for a lot of freedom as a researcher. Because of some retrenchments that have been made lately there has been a decrease in the number of employees. This makes it that also in the logistics department there is a high workload. This makes it that there is no time left over to look into the vendor performance issue that is currently still in play. This means that a successful outcome of this research could result in a positive impact on the company which shows the importance of this research and is therefore also the motivation for this research.

The company currently has MKG as their ERP system. Within this ERP the employees can see the following information: Relations, Sales orders, Production orders, Engineering, Planning, Purchasing orders and some managing information. This means that there is a list of all the vendors and all the information that is needed from the start of the customer order. However, there is no information available about the performance of their vendor regarding different performance indicators. This however is something that the company is missing to be able to minimise the delays/faults during the order cycle and to be able to have a clear overview of the vendors performance which will help with the managing of the whole process.

2.2) Key Performance Indicator selection from the company

In this section we will discuss the second sub-research question "*What are certain KPIs that Rodelta prioritises regarding their vendor performance in order to improve their ability to facilitate on-time deliveries?*". The selection of KPIs will be made using data that is obtained through results of questionnaires that have been conducted with the stakeholders within the company regarding the performance and management of the vendors. Here we first made a list of possible KPIs that could be useful for the company based on personal knowledge and the problem description of the company. After the completion of this list it was assessed by the company stakeholders via a type of questionnaire. This was done by asking them whether a KPI was relevant or not for them along with an explanation based on their choice. The filled in questionnaire can be found in appendix F .

After the results of the questionnaire were in we could summarise the results and filter the initial list of KPIs into a shorter final list (Figure 7). This list states all the KPIs that Rodelta is currently interested in regarding their vendors and the way they perform in each of these categories.

This selection will be combined with the selection that came out of the literature search to form a final list of KPIs that can be used for the data that is needed for the dashboard. This final list will be described in Chapter 3.3.1.
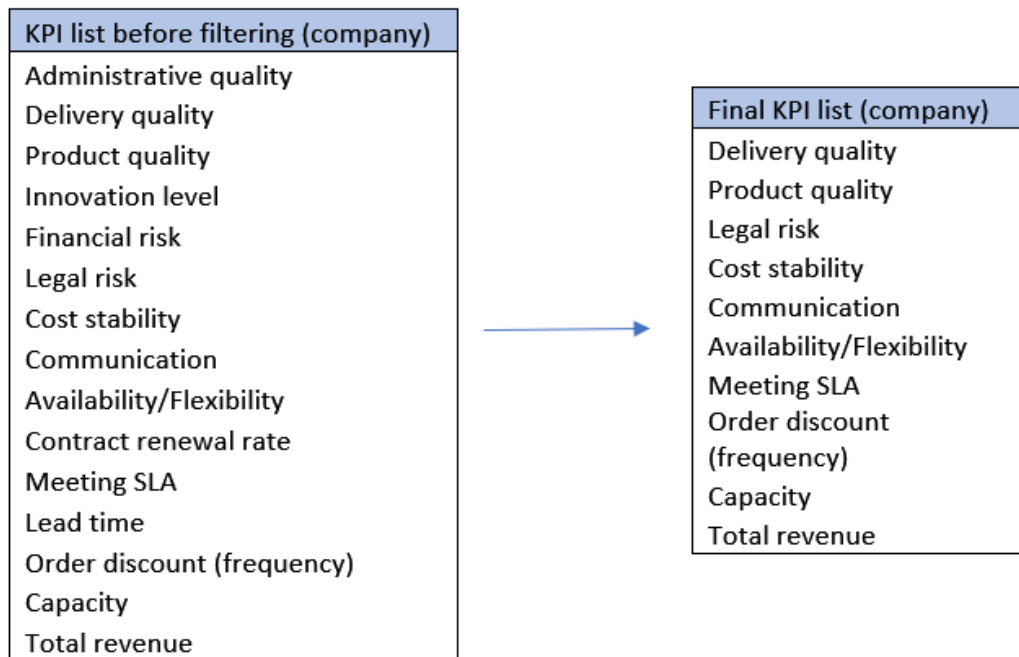
Figure 7: Company KPI selection after questionnaire from appendix F

2.3) Key Performance Indicator selection based on literature

This section will look into KPIs regarding vendor performance that were achieved after a systematic literature review which can be seen in appendix D This will give an answer to the third research question that states the following: "*What are certain KPIs that are most important/influential regarding the vendor performance based on existing literature in order to improve their ability to facilitate on-time deliveries?*".

When looking at all the aspects that arise when talking about vendor performance it is possible to make a big list with all types of different performance indicators. But not all of these performance indicators are relevant to every market and it is therefore better to narrow the list down to a set of the most important performance indicators. This process of narrowing down the list of PI's can be done in different ways. The most used ways to prioritise the PI's are looking at expert opinions, the number of citations in other research on the same topic and different multi-criteria decision-making models. During the literature search the following PI's were mentioned the greatest number of times and were valued as the most important (see Table 2).

Table 2:Descriptions of performance indicators (Govindan, K. et al., 2022)

Performance indicator	Description
Quality	The ability to deliver components that are free from defects in accordance with supplier quality agreement
Delivery	The ability to follow the predefined delivery schedule and on-time delivery reliability.
Cost	The final price of the components includes the processing cost, maintenance cost and warranty cost incurred by the supplier.
Flexibility	Level of responsiveness that allows the supplier to react in case of changes, whether predicted or unpredicted.

Because the selection of KPIs differs a lot per market, the choice is made to use the most used and important KPIs from the literature and then use the KPIs that came out of the company research as the indicators that are more market specific. That way the KPI list will be better suited for Rodelta because there is a balance between theory and practice and the expertise/preference of the company is taken into account during the KPI selection process.

This list of selected KPIs can be divided into different PI's (Performance indicators) that are more specific/detailed indicators that can measure the performance of a vendor very detailed in one specific category. The combination of all these PI's result in an overall summarised value that can be described as the KPI. These PI's were determined after the selection of KPIs was known which can be seen in Table 3 below.

Table 3: Combined KPI list

Key Performance Indicator	Performance Indicator
Quality	Product quality (Free of defects)
	Quality of compliance with contract
	Quality of the supplier-customer relationship
Delivery	Delivery time (Early/JIT/Late)
	Delivery quality (Damages during transport)
	Length of lead times
	Delivery is complete conform with order
Cost	Cost of the product (compared to past cost)
	Frequency of price changes
	Effect on the ROI (level of ROI by using this vendor)
Flexibility	Ability to react to order changes (quantity, date et cetera)
	Ability to handle late payments/payments in instalments
	Ability to accept orders with different capacities at an unspecified time

To make sure that the final list of KPIs from literature consist of good quality indicators we made use of the SMART-criteria (Z. Ishak, 2019) for KPIs. This business definition stands for Specific (does it define what is searched), Measurable (can you measure it), Attainable (is it in reach), Relevant (fits company goals) and Time-Bound (achievable in time). These different criteria help the researcher to filter down the list of KPIs into a selection that is of good quality and useful for the outcome of the research.

The KPI selection list that came out of the literature search will be tested following the SMART-criteria in the table below. In this test the PI's from which the KPI is made are taken into account while the KPI is evaluated (Table 4).

Table 4: SMART criteria for the list of KPIs from the literature search (Z. Ishak, 2019)

KPI	PI	Specific	Measurable	Attainable	Relevant	Time-bound
Quality						
	Product quality	✓	✓	✓	✓	✓
	Compliance with contract	✓	✓	●	✓	✓
	Customer-supplier relationship	●	●	✓	✓	●
Delivery						
	Delivery time	✓	✓	✓	✓	✓
	Delivery quality	✓	✓	✓	✓	✓
	Length of lead times	✓	✓	✓	●	✓
	Delivered conform with order	✓	✓	✓	✓	✓
Cost						
	Cost of product	✓	✓	✓	✓ / ●	●
	Frequency of price changes	✓	✓	✓	✓	●
	Effect on ROI	✓	✓	✓	✓	●
Flexibility						
	Ability to react on changes	✓	✓	✓	✓	●
	Ability to handle late payments	✓	✓	●	✓	●
	Ability to handle bigger capacity	✓	✓	✓	✓	✓

After the SMART-criteria selection we found that a couple of performance indicators score lower than the others. Here we draw the line by more than one doubt (depicted as: ●) per indicator which means we will exclude the indicators 'Customer-Supplier relationship' and 'Ability to handle late payments' from the list. The indicator 'Cost of product' is not per se decisive for the company in their vendor choice but it is a PI that can also be useful as an addition to the PI of 'Frequency of price changes'. That is why this PI will stay in the list.

2.4) Key Performance Indicator ranking based on weighted values

These obtained KPIs can be given a weighted value based on their importance regarding the performance of the vendor. These weights can be retrieved from literature or calculated using certain multi-criteria decision-making models. One of the most used MCDM models is the Analytic Hierarchy Process (AHP) (S. Routroy, 2014). This method does however require a lot of calculation and data, especially when you are working with a large set of performance indicators. That is why we will most likely use the Rank Sum method because of its simplicity. After the determination of the weights for the performance indicators the researcher will have to implement these weights into a scoring model to be able to compare the different vendors with each other (B. Angrian, 2019)(Parthiban, 2012).

2.4.1) Analytical Hierarchy Process

The Analytical Hierarchy Process, created by Thomas L. Saaty in 1970, is a decision-making method that makes use out of pairwise comparisons between different attributes with respect to the end goal. This method is used to divide complex problems into smaller and more solvable problems[44]. This method is mainly applied in business decision-making but because of its flexibility and adaptability it can be a valuable tool in many other situation.

When the set of KPIs is a fairly small set it is possible to perform the AHP method to calculate the weights of the indicators. The Analytic Hierarchy Process model, better known as AHP, is a multi-criteria decision-making model designed to determine the weights of the different criteria. This method is based on the results of a pairwise comparison between the different performance indicators. These PI's are put into a pairwise comparison matrix to get the values needed to calculate the weights per PI. The results from the pairwise comparison matrix will then be normalised to get the normalised matrix of the comparison between the PI's. If then the arithmetic mean is taken from each row then the result will be the weighted value for the individual PI's. As mentioned, this method does take up a lot of data when there is a need to weight bigger lists of KPIs. That is why we also looked into other methods as mentioned in the next section.

2.4.2) The Rank Sum method

Because AHP will result in a very big and data intensive matrix calculation in the case of a higher number of KPIs it is also wise to look at other options. Some of the more well-known options are the rank sum method, TOPSIS, WPM (Hester, 2017). In case of a big set of KPIs we will make use of the

rank sum method combined with the preference of the stakeholders. This weighing method has been chosen due to its simplicity and low level of data intensity in case of 'a lot' of KPIs. This method follows a simple formula that can be seen as Equation 1.

This method used in '*A Method for Key Performance Indicator Assessment in Manufacturing Organizations*'(Hester, 2017) is based on the predetermined ranking of the KPIs by the stakeholders. After this ranking has been determined the formula can be calculated by filling in the formula. Here K stands for the total number of KPIs in the list and r_i is the number the set KPI has in the predetermined list. This short calculation will give the different weights for all the KPIs in the list that also includes the stakeholders opinion and expertise.

Because of the fact that this research contains a fairly large number of KPIs and the time of this research is limited we will be using the Rank Sum method as the method being used to generate our weighted values per performance indicator.

$$w_i = \frac{K + 1 - r_i}{\sum_{j=1}^{K} K + 1 - r_j}$$

<div align="right">(1)</div>

2.5) Key Performance Indicator ordering using a scoring model

After the weights of the different performance indicators have been determined the researcher can place these results into a scoring model. To do this the researcher needs to have a data set with the performance per vendor per specific PI. Then the researcher needs to make a scale based on the performance of the vendor regarding this PI, for example the degree in which a vendor is on-time with the delivery of their product. Very early or very late can then be given a score of [0 till 0,5], almost on-time can be given a score of [0,51 till 0,8] and just-in-time delivery can then be given a score of 1 for example. These scores will then be stored for all the PI's and will then each be multiplied by their own weighted value to create their end scores. This will allow the researcher to sort the vendors based on their overall performance score and give recommendations to the company. This way of scoring the vendors will allow the researcher to see where the vendors are underperforming based on the performance scores per PI.

When the data, after the appliance of the weights, per performance indicator is known we can then compare this with a certain threshold level. This level/value will be determined together with the company stakeholders and will allow the dashboard user to see when the vendor is underperforming in a certain area.
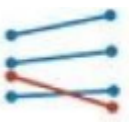
2.6) Visualisation of the Key Performance Indicators

"Data is just a collection of numbers until you turn it into a story" (A. Wood, 2021) is a saying that is also true in this research. Without a good visualisation method the raw data will be unclear and of way less use to the company. That is why it is important to choose the right visualisation method to the right type of dataset. This will allow the reader/user to understand the information that the data gives much more easily and quickly and will make comparisons with past/future data easier and decision-making easier.

In this research, there will be made use of a static visualisation approach (A. Wood, 2021) which means that the data that will be depicted in the end product will consist of diagrams and charts. However, these static visualisation methods will be based on a data set that can be changed in real-time. That means that when the dataset is changed or when extra data is added/deleted the visuals in the form of diagrams and charts will change accordingly.

There are a lot of different methods to visualise certain sets of data. S.D.H. Evergreen describes a set of different quantitative chart types in her book "Effective Data Visualization: The Right Chart for the Right Data"(S.D.H. Evergreen, 2019). In table 5 below some of these different options, that could be useful in this research, are depicted and shortly described.

Visualisation Method	Type of data
23% The big number	When the data value in question is an important single value
The Icon array	When the data visualised is about showing which part of a total number is meant. Such as showing that 3 out of 10 people are left-handed
The Pie chart	To show in what way the total is divided (percentage wise)
The Side-by-Side bar chart	This chart can be used to compare two different data values with each other. This can also be used to compare the difference between 2 data values over different periods.
Slopograph	This method can be used to compare different values and their change over time with each other.
The Benchmark line	This method can be used to show the data values over a longer period compared to a consistent benchmark value.
Bar/Column	This chart can be used to for example show the results of a survey and allows the reader to see the different scores.

The layout and the design of the dashboard will be tested on user-friendliness after completion by the stakeholders within the company. This will be done according to a User Experience Questionnaire (UEQ) (A. Hinderks, 2018). This questionnaire will let the user answer a couple of questions regarding the artefact that they are judging based on a scale ranging between two terms with opposite meanings. This data can then be implemented in the UEQ data analysis tool which will give a result showing the researcher where improvement can be made. The feedback data from that will be reimplemented into the dashboard and the process will be repeated until the final version can be realised.

3) Solution design

In this chapter we will go over the chosen solution design and what this will entail. After that the final list of KPIs will be discussed and the ranking/scoring procedure will be shown. When we have come to a finalised set of weights for the KPIs we will link these KPIs to a specific data visualisation method that is best suited for the type of data the KPI depicts. Lastly we will go over the determination of the layout of the solution and a walkthrough of the prototype. All of this will be done to answer the fourth sub-research question: "*Which visualisation methods are best fitted to improve the vendor performance management and what are some recommendations for future improvement in order to improve the ability to facilitate on-time deliveries?*".

3.1) Solution description

For this research the choice of artefact will be a dashboard that is ran from Microsoft Excel. A dashboard is a tool for companies/researchers to get a quick and clear overview of a set of data from different sources displaying different topics. As said in the article of K. Bugwandeen & M. Ungerer (K. Bugwandeen, 2019) a dashboard is an informative tool that can be used in organisations to translate and visualise their strategy into objectives, metrics and tasks for the organisation's employees. Another statement made states: "Dashboards should provide employees with the right information to optimise decisions, enhance efficiency, and increase profits.". In the case of this research's artefact the 'employees' will be the stakeholders which mainly is the Procurement manager. Things to look out for when designing/making a dashboard are that it may not be too complicated in use, does not take too long to update and that the layout/looks do not appeal to the users.

3.2) Dashboard design in categories

The design of a performance dashboard exists out of a couple of categories which are dashboard content, dashboard data analysis, dashboard visual effects, dashboard functionality and dashboard platforms. For the design of our dashboard we will go through these categories step by step explaining globally what is required to successfully design a dashboard.

Dashboard content

The contents of the dashboard should enable the user of the dashboard to overview the sets of data and it should allow them to accurately base their decision making on it. That is why this data should be displayed in a dynamic and interactive way in the form of relevant, accurate and timely KPIs (S. Malik, 2005). It is important that this KPI selection is made in consultation with the stakeholders/users of the dashboard. This will make sure that the selection is of value to their day-to-day work and is not unnecessarily large (M.K. Allio, 2012).

In our dashboard the KPI selection that was made out of the combination of the companies preference and the literature has been revised a final time by the stakeholders. This was done to eliminate the unnecessary KPIs so that we would be left with a selection of KPIs that are in direct connection to the stakeholders interest. This finalised list will be summed up and will be elaborated per KPI in Chapter 3.3.

Dashboard data analysis

In our dashboard the data will be analysed with the use of different methods displayed in visuals such as graphs and diagrams. These graphs and diagrams will be linked to a certain KPI that show a specific type of data where this graph/diagram is used for. The dashboard will also consist of options to drill down the data into user specific selection that can be inserted on the home screen of the dashboard itself. Apart from that the dashboard should display the analysed data in such a way that it is easy for the end user to understand and use, instead of having to execute a data analysis by themselves on the dashboard data because it is not specific enough. Another important factor of the dashboard is that when there is previous data available that there is the possibility to compare certain values with this historical data. This allows the user to see trends which will impact the way he/she is able to make decisions and act when necessary.

Dashboard visual effects

It is of course very important for a dashboard to be visually pleasing and easy to use. This can be achieved by implementing the house style and arranging the elements of the dashboard in a logical way for the user. The user interface should be clear and not too complex so that everyone is able to use it even when they do not understand the data that is being displayed. This is an important factor because when the stakeholders are not enjoying the use of the dashboard they will most likely stop using it. Furthermore it is important that the dashboard does not display too much numerous data as this can come over as overwhelming for the user and this can affect the correct interpretation of the user (M.K. Allio, 2012).

It is also important that the dashboard does not contain too much information at once. This is why the use of tabs and filters on the main screen allows the user to find the data that they want to view without having to look through the entire dashboard (W.W. Eckerson, 2011). It is also smart to use the instincts of the user when trying to show results like if something/someone is operating bad/mediocre/good. In this example, it can be handy to use the colours red/orange/green for these different statuses because those are the most instinctive colours for the user (U.C. Bititci, 2015).

Dashboard functionality

Here the most important part is that the user is satisfied with the look and feel of the dashboard and all the options that come with it. This can be ensured by engaging the stakeholders in the designing phase and letting them be the test persons of the prototypes. This way we can ensure that the dashboard will not have too many or too few functions and the user is happy with the way the dashboard looks and is in use.

Dashboard platforms

The platform that will be used for the dashboard in this research will be Microsoft Excel. This choice is made in consultation with the company's stakeholders. The reason that Microsoft Excel has been chosen is because it is free and familiar to use. This makes it more likely that the users will pick it up and it will cost the company no extra money. This last one is very important since they often struggle with getting the finances right for things such as orders and other expenses.

Summary of design idea

For this research, the aim is to implement all the KPIs from the final selection into an interactive performance dashboard which specifically measures the performance of the vendors. This will be done by filtering the data that is exported from the current ERP system and linking this to the performance indicators. These filtered datasets will then be linked to a main page where the dashboard will be displayed. Here a couple of filtering settings and tabs are available for the user to specify the data that is displayed. This dashboard will have the possibility to be updated when there is new data for the dataset available, like the performance data of a new month, with only a small input from the user. This will allow everyone to be able to use and understand the dashboard without needing to first get schooled on the use and functionalities of Excel and the dashboard. Also, the fact that the updating of the dashboard does not require a lot of steps allows for quick and easy use, which is important because the stakeholders already have a high workload.

3.3) Key Performance Indicators (KPI)

As mentioned in the previous chapter we revised the KPI list for the final time together with the stakeholders. This was done to make sure that the combination of the KPI selection of the literature and the KPI selection from the company was done correctly and that the final list of KPIs was fully in line with the interests of the stakeholders. This final revision is also to make sure that we do not have any unnecessary data displayed on the dashboard because as was described in chapter 3.2 it is unwanted to have too much (numerous) data in a dashboard that may lead to confusion. After the KPI selection has been described we will go over the ranking method and the way we will assign the weighted values to the KPIs.

3.3.1) Key Performance Indicator choice explanation and description

After the revision, a couple of the KPIs were left out of the final list which has resulted in the following list that is described below. Here we also elaborate on the measurability of these KPIs. This revision was done in consolidation with the stakeholders from the company utilizing two questionnaires. The first questionnaire showed all the possible KPIs from the literature search that the stakeholder could choose from and allowed for some feedback per KPI after the choice was made whether to use/not use the KPI. This questionnaire can be seen in appendix F. After this we also let them fill in the second questionnaire which showed a combined list of the results from the first questionnaire and the ideas that came from discussing KPI ideas with the stakeholders. This questionnaire can be seen in appendix G.

Product quality: The product is of the expected quality in terms of specifications like performance. This will be made measurable by tracking the number of times this is not the case. This total number can then be displayed along with a possibility to see it per specific order combined with a small description of what was wrong

Cost of product: The price of the product at the time of ordering (also allows for comparisons with historical data)
This will be made measurable by tracking all the different purchase prices per ordered article/product together with the date it was purchased on

Cost stability: The frequency of price changes (compared with historical data over a chosen period of time)
This will be made measurable by tracking the different prices per ordered article/product over different periods of time. Then that data can be analysed to see if there is a trend or if there are imbalances.

Delivery time: If the order is delivered too early, just-in-time or too late
This will be made measurable by tracking the agreed delivery date and time and the actual delivery date and time. This can then be turned into a figure that displays the average deviation of this agreed delivery date and can be compared to the other vendors.

Delivery quality: Number of times there are damages to the order during transport
This will be made measurable by tracking all the instances that this occurs and then note what was wrong/below standard. This total number can then be displayed along with a possibility to see it per specific order combined with a small description of what was wrong.

Lead time: The time it takes from placing the order till the order is delivered
This will be made measurable by tracking the date the order is placed and the date the order is delivered.

Delivery conform to order: The order is complete and exact (no missing pieces/parts, right sizes, right materials etc.)
This will be made measurable by tracking the number of instances this is not the case together with a description of what is wrong. This total number can then be displayed along with a possibility to see it per specific order combined with a small description of what was wrong.

Compliance with contract/Meeting SLA: The predetermined contracts and agreements have all been fulfilled (correct delivery date, price etc.)
This will be made measurable by tracking the number of instances this is not the case together with a description of what is wrong. This total number can then be displayed along with a possibility to see it per specific order combined with a small description of what was wrong.

3.3.2) Ranking and Weights

In this subchapter we will go over the method that was used to determine the weights per KPI out of the final selection. For this we said that we were going to use the Rank-Sum method because of the fact that the selection list of KPIs is pretty large. When we would use a weighing method like the AHP method it would take up a lot of data. This is seen as unnecessary in this case and that is why we have shifted to the Rank-Sum method. For this method there are only a couple of data elements needed, starting off with the stakeholders preference. For this we have conducted a verbal interview with the Procurement manager in which we asked him to rank the final 8 KPIs based on importance for his scope of work and what he thought was most important when looking at their vendor performance. This resulted in an ordered list with 8 KPIs, as seen in Table 6 below, which we could then use for the weight calculation part of the rank sum method.

Table 6: KPI list (ranked by stakeholder)

KPI	Stakeholder rank
Delivery time	1
Product quality	2
Delivery conform to order	3
Lead time	4
Delivery quality	5
Cost of product	6
Cost stability	7
Compliance with contract/SLA	8

$$w_i = \frac{K+1-r_i}{\sum_{j=1}^{K} K+1-r_j} \tag{1}$$

For this calculation we needed 2 parameters, namely the K (Total number of KPIs) and the r_i (The rank of the KPI after stakeholder interview). When applying the formula depicted as Equation 1 we get the weighted values per KPI as a result. An example of such a calculation can be seen in Equation 2. The complete results can be seen in Figure 8 below.

$$\frac{(8+1-2)}{\sum_{j=1}^{K} 8+1-r_j} = \frac{7}{(3+2+8+4+5+6+1)} = 0,24 \tag{2}$$

Figure 8: Rank Sum method on final KPI selection

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After these weights per KPI are known we can start to score them based on a chosen scoring method. This scoring method will differ per KPI since not every KPI is describing the same sort of information. That is why we cannot use the same scoring criteria for all the KPIs. The way of thinking will be the same but the application will depend on the type of KPI. As an example we made a visualisation of the calculation of the score for the 'Delivery time' KPI. This will not be visualised like this in the dashboard because these calculations will be made 'in the background'. The vendor will be scored on a scale from 0,00 to 1,00 based on the performance on the KPI. This score is based on their performance in comparison to the benchmark that is set in consultation with the company. Once this score has been determined the weighted factor will be applied to those scores which will leave us with the end score of the vendors for that specific KPI. This will then allow us to see the individual results per vendor but also the differences between the vendors from the same or other commodities. An example of such a calculation can be shown in figure 9 below.

KPI weight:	0,285714286			
Delivery time				
Date	Vendor	Delivery time	Score	Weighted score
01/01/2023	Test B.V.	Very early/Very late (>1 days off of the agreement)	0	0
02/01/2023	Test B.V.	Just-in-time (as agreed)	1	0,285714286
03/01/2023	Test B.V.	Almost on time (one day off of the agreement)	0,5	0,142857143
04/01/2023	Test B.V.	Just-in-time (as agreed)	1	0,285714286
05/01/2023	Test B.V.	Very early/Very late (>1 days off of the agreement)	0	0
06/01/2023	Test B.V.	Very early/Very late (>1 days off of the agreement)	0	0
				Final score
				71%

Figure 9: Example of a calculation of the score of the KPI delivery time with the use of fictive data. This process takes place in the background of the dashboard.

Here we first determine the condition that will make the KPI measurable, so in this example with the delivery time we make use of a selection menu with the choices "Very early/Very late", "Almost on time" and "Just-in-time". For all the other KPIs this will of course vary. In the final artefact, this will be done automatically when the data is put into the datasheet so that the user does not have to do this manually. These conditions are linked in hidden cells to a specific value within the scale of 0,00 to 1,00. In this case, those values were "0,00", "0,50" and "1,00" respectively. The user will fill in the condition of the vendor delivery (or automated in the final artefact) which will result in the corresponding score. This score is then multiplied by the weighted factor that is linked to the KPI in question, in this case 0,286, which results in the final score of the delivery time. These scores combined will result in a summarised total score that scores the vendor on this specific KPI. These different scores will be calculated for all of the KPIs and will in the end be combined into a final score/grade which will be visible on the dashboard. This allows the user to quickly see what the status is of the vendor that is being assessed. This score will not be on a certain scale but will show the difference in performance between the vendors via a ranking that is complemented with a colour condition connected to the final score.

For the other KPIs we will use different methods to score them because this is unique for every KPI.

- Product/Delivery quality/Delivery conform to order: we will take a look at the amount of reported quality issues per vendor and we can make this comparable to the total amount of orders that the company has placed at this vendor. Also we will use the cost per quality issue and the total value per vendor as a measurement for these KPIs. For both of these measurements it will hold that the higher the value (high cost/high issue %), the lower the score is on that KPI.
- Lead time: for this KPI we will look at the average time it takes from the point the order is placed at the vendor till the moment the delivery has been confirmed at the company. This will be scored based on the length of this lead time value, so the longer it takes the lower the score will be.
- Cost of product/Cost stability: these KPIs are measured by looking at the different prices per order and also the cost that are made per vendor from all the orders over a certain time period. This will not be added towards the score of the vendors because this is very dependent based on the number of orders and the type of product that are bought. You can compare a pen vendor to a jeweller for example, so that is why it is left out in the scoring.
- Compliance with contract/SLA: this KPI is made measurable by looking at the total amount of orders that are placed per vendor. Then we will look at the number of times that there were changes made to the contract or that there were deviations from it. This will then be converted into a percentage and that percentage will be calculated into the weighted score by multiplying it with the constant KPI weight.

3.4) Gathering and organising the data

After all the KPIs were determined it was time to export the available data out of the company's ERP system. Their ERP system called MKG has the option to export complete data sets per department in one so called 'dump'. This can be directly exported into one Microsoft Excel file which will then leave us with a raw dataset. This data set contains a lot of irrelevant and duplicate data that needs to be filtered out before we can proceed with the assigning of the data to specific datasheets per KPI. After the raw dataset had been trimmed down manually it was time to divide the different data columns over different Excel sheets that were specific to a certain KPI.

During this filtering and organising process it became clear that the company did not have all the data that was necessary for all of the predetermined KPIs. This will be taken into account when we will give our recommendation at the end of the research. For the explanation of the dashboard and its functionalities this should not be a problem because we could use a randomly generated data set for that purpose. This will allow the user to still understand the way of working with the dashboard and then the company can keep track of this data in the future and implement this correct data into the dashboard. However we did make separate datasheets for all of the KPIs so that it would only be a matter of pasting the data into the sheet and it would work. For the rest of the KPIs there was enough data available to analyse it and use these results to assess the KPIs. For the KPIs about the cost of the vendors of Rodelta it is smarter to combine the information into one graph because the data is correlated to each other and it would therefore be unnecessary to split them into two separate ones. Also when talking about the cost KPIs we will not be looking at a product specific cost but more per order because almost all of the orders at Rodelta are custom made to fit the customer's needs and therefore the vendors do not always supply the same parts.

The company has a lot of different vendors but for this research the scope of these vendors is limited. The set of vendors that will be used for this research are described in Table 7 below together with what kind of a supplier they are.

Table 7: Vendor selection

Vendor	Specialty/discipline
Mafoder	Castings
Christenhusz (NFGC)	Castings
Freeze cast	Castings
JSons	Castings
John Crane	Sealings
Eagle Burgmann	Sealings
WEG	Engines
Wilbers Werkstätten	Turning and milling parts
Burink Metaal	Turning and milling parts

These vendors were chosen because these are the most strategic and important vendors for Rodelta Pumps International. They are the cost drivers of most of their projects and they often make up 90 percent of the end product. That is why these vendors are very important for the performance of Rodelta themselves. In the dashboard, we will only use the data of these vendors but this can also be changed in the future if the company wants to use this dashboard for the entire vendor list after this research.

3.5) Visualisation of the data

In this chapter, we will go over the different chart types and graphs that will be used to visualise the data in the dashboard. After these different choices have been elaborated on we will then discuss the layout of the dashboard and explain the choices that are made in the process based on either literature or the preference of the company.

3.5.1) Charts and Graphs per Key Performance Indicator

When making a dashboard out of a lot of different data sets the data must be visualised correctly. This is very important because it will be the way the user will see the data and will use the data. When there are faults in the visualisation method that is used it can completely influence the decision of the user which can result in unnecessary mistakes. Therefore visualisation is key in the process of getting the message that comes from the data set correctly to the user. That is why dashboard designing is not as easy as it may seem on the first hand. According to Few, who is mentioned in the article of C.J. Costa and M. Aparício (C.J. Costa, 2019), there is a common list of pitfalls when designing a dashboard. The ones that are relevant to the visualisation methods by the

use of charts and graphs are: supplying inadequate context for the data, displaying excessive detail or precision, expressing measures indirectly, choosing inappropriate media of display, arranging the data poorly, ineffective highlighting what is important, misusing or overusing colour, designing an unappealing visual display. These factors will all be taken into account when choosing what types of visuals we will incorporate in the dashboard.

Next to these pitfalls that we need to watch out for as stated in the article of C.J. Costa and M. Aparício (C.J. Costa, 2019) it also shows us a method to determine what type of visualisation method is suited for specific data. They designed a decision tree that gives the user a clear overview and step-by-step method of what to do with the data that they want to visualise in a tool such as a dashboard. This decision tree can be seen in Figure 10.
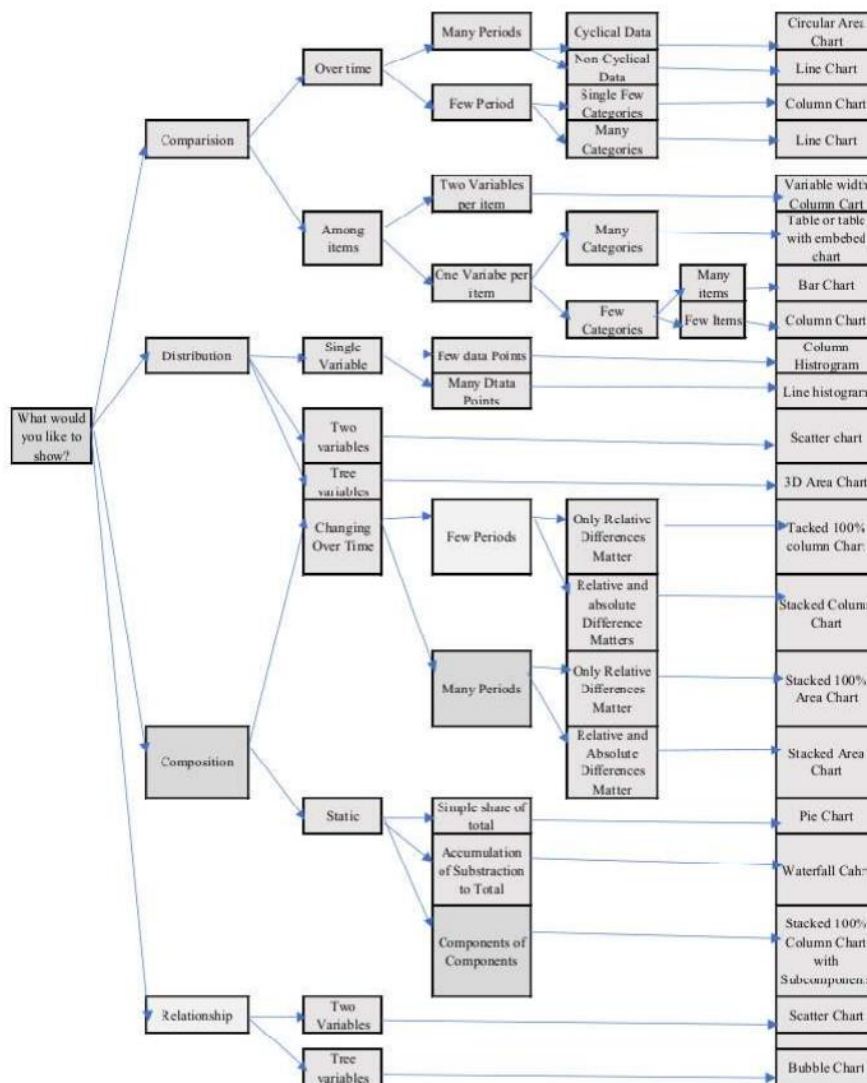
Figure 10: Decision tree for visualisation methods (C.J. Costa, 2019)

Note. From "Supporting the decision on dashboard design charts" by Costa, C. J., & Aparïcio, M. (2019). In Proceedings of 254th The IIER international Conference 2019 (pp. 10-15)

When following this decision tree and the information we gathered in Chapter 2.6 we can assign different visualisation methods to our list of KPIs. This can be seen in Table 8 below.

Table 8: Vendor selection

KPI	Visualisation method	Elaboration
Delivery time	Bar chart	Displays the different averages of the deviation of the agreed delivery dates and makes it easy to visualise
Product quality	Bar chart	Track the number of times the product is not up to standard displayed over a set time period
Delivery conform to order	Pie chart	Shows the distribution of the number of times the vendor has failed in comparison to the total orders/other vendors
Lead time	Side by side bar chart/grouped bar chart	Here the lead time per different period can be seen in comparison to the other vendors. This gives a nice and selected overview.
Delivery quality	Column chart	Show what part of the total is below the quality standards
Cost of product	Histogram	Shows a comparison of the price level over time
Cost stability	Line chart/trendline in histogram	Shows the frequency of changes over time. This can be combined with the histogram of the cost of the product.
Compliance with contract/SLA	The big number	Show the percentage the vendor has complied with the agreements
All KPIs combined	The big number	To visualise the overall performance of the vendor into a single grade

3.5.2) Dashboard layout

The layout of a dashboard can make or break the value that the artefact brings to the user. There are a lot of different ways to arrange a dashboard which all have different uses and impacts on the user. By looking through different literature sources we were able to get a good understanding of the way a layout should be made and what certain pitfalls are during the design of the layout.

As said in the article about dashboard design patterns there are a couple of different dashboard design categories. For this research we think it is best to make use of a screen fit dashboard design that exists out of multiple pages. These multiple pages will be formatted following a parallel structure which means that the different pages all have the same standardised layout but only different displayed information. As the type of layout we were most interested in the table layout principle combined with a navigation menu. This will allow for the user to get a nice and structured overview of the different data visualisations and will allow for a standardised look of the dashboard (Bach et al., 2023).

In the research about the intuitive use of user interfaces (Naumann et al., 2007) we saw that in most cases less is more. This means that it will benefit the user experience if the dashboard is not over complicated and is kept as consistent as possible in terms of layout and design. Also the use of flashy moving parts or animation in the dashboard need to be kept to a minimum because this can cause distractions when used too much. Other small details like using a standardised colour scheme, standardised fonts and semantic colours help with the quality of the user experience and the tight look of the artefact.

When looking at the options that come with the dashboard regarding the data we see that options like drilldowns and selective visualisation of the data (ways of parameterization) are big factors in terms of attributing to the user experience. These options are of great value to the stakeholders because it allows them to not only see the entire picture but also see the selective parts that the data set is built out of (Naumann et al., 2007).

3.6) Prototype walkthrough

After preparing and gathering enough information on dashboard making we started off with building the dashboard prototype. This began by setting up the different sheets that the Excel workbook would consist of. These different sheets are: *Dashboard, Contact, Help-info, Delivery time, Product quality, Delivery conform to order, Lead time, Delivery quality, Cost of product-Cost stability, Compliance with SLA and Grading.* After this basis structure was created we started by exporting the filtered data out of the raw data set into the correct sheets. Some of the data needed to be processed even more by means of calculations or links between different datasets. When the foundation for the dashboard was created it was time to start working on the interface of the dashboard, which can be seen in Figure 11.

Figure 11: Dashboard screenshot

Following the knowledge we gathered during the literature search we wanted to create a navigation system throughout the dashboard and put it in the most logical place to improve the user experience. In this case, we implemented this in the form of a navigation bar with simple icons on the left-hand side of the dashboard. When looking at the navigation bar (left side) we can see 4 different options to choose from. The first icon stands for the home page, the second icon stands for the data sheets behind the dashboard, the third icon stands for the contact information sheet and the fourth and final icon stands for the help-info sheet.

The home icon will send the user back to the dashboard and automatically refreshes the entire worksheet. This Excel macro is also linked to all the buttons on the datasheets that say "--> Dashboard". This is done to make sure that when the dashboard is used the data is completely up to date with possible changes and/or additions that were made by the user. The data icon is linked to a different Excel macro which will allow the user to easily navigate between sheets. When the icon is clicked a message box will appear in the form of a pop-up which will ask the user to choose out of the different datasheets that are linked to each of the KPIs (see Figure 12). Once the user has filled in their choice the program will automatically take the user to the correct datasheet. And as said each datasheet has its own home button that takes them back to the dashboard interface.
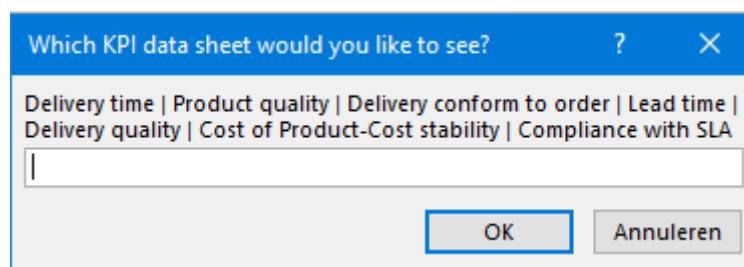
Figure 12: Datasheet navigation pop-up
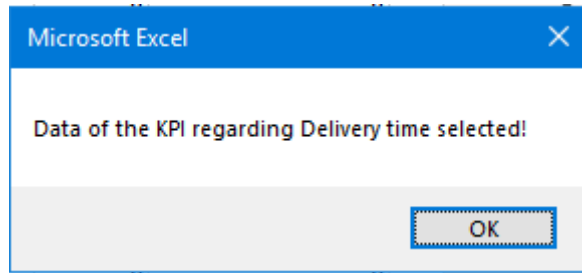
 The third icon is the contact button which will take the user to the contact information sheet. Here there is a list of all the vendors together with their addresses. Here it is possible to also add email addresses and telephone numbers but this is not of main concern for now. Then lastly, we have the help-info button which logically sends the user to the information sheet that contains a short introduction and explanation of what the dashboard is about and how it works.

Next to the navigation menu we of course have the dashboard itself. The dashboard is designed in such a way that everything is readable and that the information which is shown is not too overwhelming and distracting. Also there are no moving parts integrated in the dashboard because this would only decrease the quality of the user experience and would most likely be more distracting than helpful when using the dashboard. The colour scheme that was chosen is based on the company colours. Since this is only a prototype it is always subject to change but for now this colour scheme was used. In the colour scheme we made sure that the colours are slightly faded to make the dashboard easier to look at instead of having very vibrant colours which could work as a distraction.

The data that has been processed in the background of the dashboard is visualised in different types of graphs and other data visualisation methods. After having reviewed the data we came up with the following data that we wanted to visualise:

- Average deviation of the agreed delivery date in days (Delivery time)
- Lead time per chosen time period (Lead time)
- Compliance percentage with SLA per vendor (Compliance % with SLA)
- Cost of orders over time (Cost of product-Cost stability)
- Amount of quality issues per vendor (Product/Delivery Quality)
- Total cost because of quality issues per vendor (Product/Delivery Quality)
- Quality issue description per purchasing order number (Product/Delivery Quality)
- End score/ranking based on the total performance scored over all the KPIs (All KPIs)

All of the above have been visualised using the most fitting data visualisation method. This choice was based on the conclusion that came out of the literature study on the best ways to design and visualise an interactive dashboard (see Chapter 3.5).

All of the graphs that are shown on the dashboard have the option to filter the data in any way the user likes. This is because the data is visualised using the Pivot system of Microsoft Excel. For some of the graphs we have hidden these filtering features because it was of less use than with the others. This can be changed if the feedback shows that there is a need for these options. Next to the basic filtering options per graph we have also implemented a slicer and a timeline function. The timeline function is linked to the graph about lead time and allows the user to select a specific time period in days, weeks, months, quartiles and even years. Based on this selected period the graph will change automatically. Almost the same goes for the slicer but instead of being focussed on the time period

it is focussed on the vendors that are shown in the graphs about the number of quality issues and the costs that come with these quality issues. This slicer allows the user to select one or multiple vendors which will then automatically change both of the mentioned graphs that are linked to it. This function could also be applied to the whole dashboard but for two reasons this has not been done. Firstly because it would mean that all of the data should be stated in the same table on the same sheet. This will make it not possible to see the different datasheets per KPI and would result in a very large datasheet that is way less clear and organised. Secondly we decided not to implement this feature on the whole dashboard because it would become an unnecessary option from which the user experience would not benefit. From the literature study that was done on the way we could best visualise data one of the key things was that less is more in most cases. For this dashboard we think this also applies and therefore the option is left out.

When the user wants to know if there are any quality issues reported for specific purchasing order numbers we have also included a search bar in the dashboard. This search bar will check if the purchasing order number that has been filled in is reported in the quality data. If there is a match the dashboard will automatically return all the reported quality issue descriptions that are connected to the specific order number. If there is not a match the dashboard will simply return "No match".

When looking at the grading system we were able to calculate the scores of 4 different KPIs. This was because there was not enough specific data available to make all the KPIs measurable. Also, some of the vendors were missing data for some of the KPIs so these have been left blank. However, the 4 that were made measurable are also the ones that are of most value to the stakeholders. Also because we use an average of the total scores we can still make use of the vendors that do not have all the scores available. This grading system can always be expanded but then there first needs to be more detailed data available which we will elaborate more on in the chapter about recommendations. However, the scores that we did manage to calculate out of the available data were formatted in such a way that they will automatically be ranked from highest to lowest and will turn a specific colour (based on the semantic colour scheme) alerting the user of the status of their performance. This result will then be automatically published to the dashboard.

In the end, we had to merge some of the KPIs due to a lack of available data which resulted in an unclear separation of the data regarding different subjects. This was the case for the KPIs regarding the Costs and the Delivery/Product quality. This however does not matter much for the end result of the artefact since we merged these KPIs to create a more summarised indicator of the performance regarding these different performance characteristics. For the Cost KPIs it was more logical to merge them together because almost every order is unique because of the fact that the projects are almost always customer specific. Therefore it was better to merge the data into total order costs over time per vendor. For the Quality KPIs there was no distinct data for delivery and product quality. Because of this, it was better to merge them into one as a single quality indicator. This will be presented to the stakeholders during the evaluation phase of the research and will be changed or left as it is according to their preference.

To see if we have created a prototype that can be classified as a finalised artefact we can use the checklist created by M.K. Allio[36]. We will use this checklist to check if the artefact that we created is complete on the different aspects that are key for the creation of an effective dashboard.

This checklist can be seen in Figure 14 below (M.K. Allio, 2012).

Dimension	Description: in our organization, we have…	Status
Metrics	tightly aligned indicators/metrics with strategy; prioritized; balanced	
Audience	communicated who the dashboard is designd for, and how it's used	
Data Capacity	invested in data collection, infrastructure, analysis, management	
Stakeholders	involved key staff and stakeholders in metrics design & progress reporting	
Design	structured a succinct, accessible display; included management judgment	
Process	formalized key dashboard processes: when it's updated, presented, modified	
Accountability	assigned responsibility for managing dashboard content and process	
Effectiveness	used the dashboard to trigger strategic analysis, discussion, decisionmaking	

Figure 14: Checklist for completeness of a dashboard (M.K. Allio, 2012)

We will go through the list of dimensions one by one and will check our prototype per point to see if it is complete enough and ready for testing/feedback from the stakeholders.

- Metrics: The metrics were set up in consolidation with the stakeholders and therefore also with the strategy. Highlighted vendors are used as was asked by the stakeholders and are tightly aligned together with their accompanying data.
- Audience: The user of the dashboard is clearly known within the organisation and is also part of the group of stakeholders.
- Data capacity: The data capacity of the dashboard is big enough for the data that the organisation has on their vendors. There is however a slight lack in data that could improve the effectiveness of this dashboard. An example of such a problem is the lack of data for some purchasing orders/vendors. This can be improved by maintaining better records of their orders and consistently filling it into the tool/dataset.
- Stakeholders: All of the decisions that were made following the selection of KPIs for the artefact have been made in full consolidation with the stakeholders. In the evaluation phase, they will also be the main testing subjects that will be able to give feedback on the dashboard for any improved designs.
- Design: The design of the dashboard is made to be as simple as possible to ensure that every user can get the full potential out of the dashboard. The colour scheme used is in line with the colours of the company but we tried to tone the intensity of some of the colours down to avoid making the dashboard distracting.
- Process: This is something that still needs to be improved within the organisations. Because there is currently no such thing as a dashboard available/in use it will be key to formalise the use of this dashboard once it has been evaluated, improved and implemented.

- Accountability: This will also have to be done after the dashboard has been finalised. The dashboard uses a lot of different information that has been exported from the ERP system that the organisation uses. This makes it that multiple people are responsible for the updating of the data within the ERP system. The user (purchaser) of the dashboard will then be responsible for his/her own tasks of filling in data in the ERP and then also for the export/import of the data into the dashboards datasets.
- Effectiveness: This dimension of the dashboard will not be able to be answered at this stage in the research since the dashboard has not been implemented yet.

4) Evaluation of the artefact

With a finished prototype it is time to evaluate the artefact and see if there are any feedback points or any improvements that can be made. For the evaluation of this artefact we have chosen a couple of different methods. First of all we will check with the stakeholders what they think about the current prototype regarding things such as looks, understandability and usage. After this feedback has been collected we will test the artefact again. This time we will let the stakeholders and other test subjects try the artefact and after this testing period we let them fill in a questionnaire.

4.1.1) User Experience Questionnaire

This questionnaire was found during a study on literature about the different ways of testing user artefacts. We came by the User Experience Questionnaire (UEQ) by Andreas Hinkerk, Martin Schrepp and Jörg Thomaschewski[43]. As said by Hinkerk et al. *"The scales of the questionnaire cover a comprehensive impression of user experience. Both classical usability aspects (efficiency, perspicuity, dependability) and user experience aspects (originality, stimulation) are measured.".* The questionnaire is set up in a way where there is a scale of seven stages with on each end of the scale a term that is positive on one side and negative on the other, see Figure 15 below.
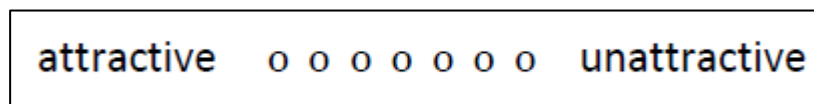
Figure 15: Example of a scale in the UEQ

This type of scale is applied to a list of different terms that can be used to describe the user experience of the artefact. This will score the artefact on 6 different categories: Attractiveness (Overall impression), Perspicuity (Easy to get familiar/understand), Efficiency (Tasks don't take unnecessary effort), Dependability (User feels in control), Stimulation (Motivation to use the artefact) and Novelty (Creativity/Innovative).

We will let our test subjects fill in this questionnaire after use and then we will transfer the collected data to the data analysis tool that is also provided by Hinkerk et al. (A. Hinkerk, 2018) as a complementary file. This data will be processed and visualised in different graphs which will allow the researcher to see where improvements can be made and what the error margins are based on the sample size and the fluctuation in answers. This data analysis tool also allows for a comparison between results which will be useful when we are going to compare the difference between the current prototype and the future improved version(s).

4.1.2) User Experience Questionnaire results

The most important results coming from the UEQ is the result from the stakeholder from the company since this tool will almost always be used by the stakeholder. We will conduct the UEQ two times with the stakeholder. The first time is after the prototype has been finished and the second time will be after the feedback has been implemented and changes have been made. This can be seen in Figure 16 and 17.

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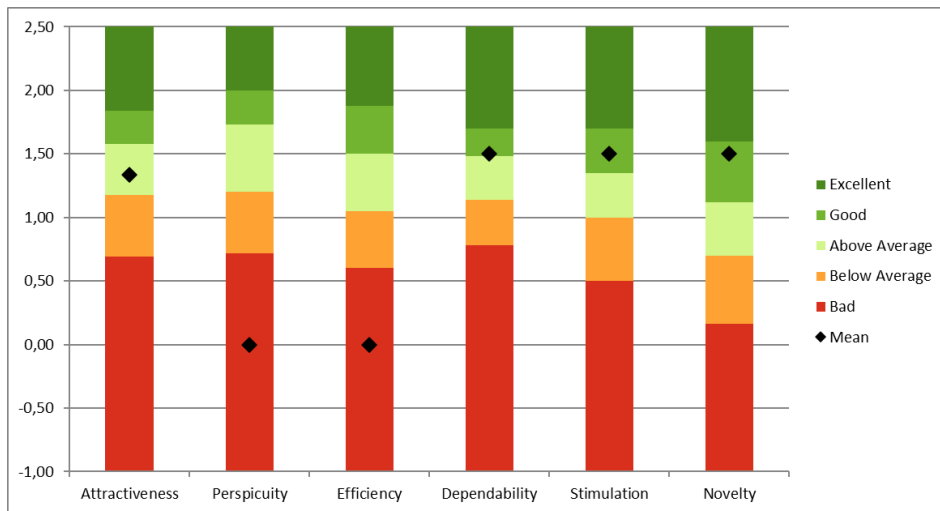
Figure 16: UEQ score of the stakeholders feedback
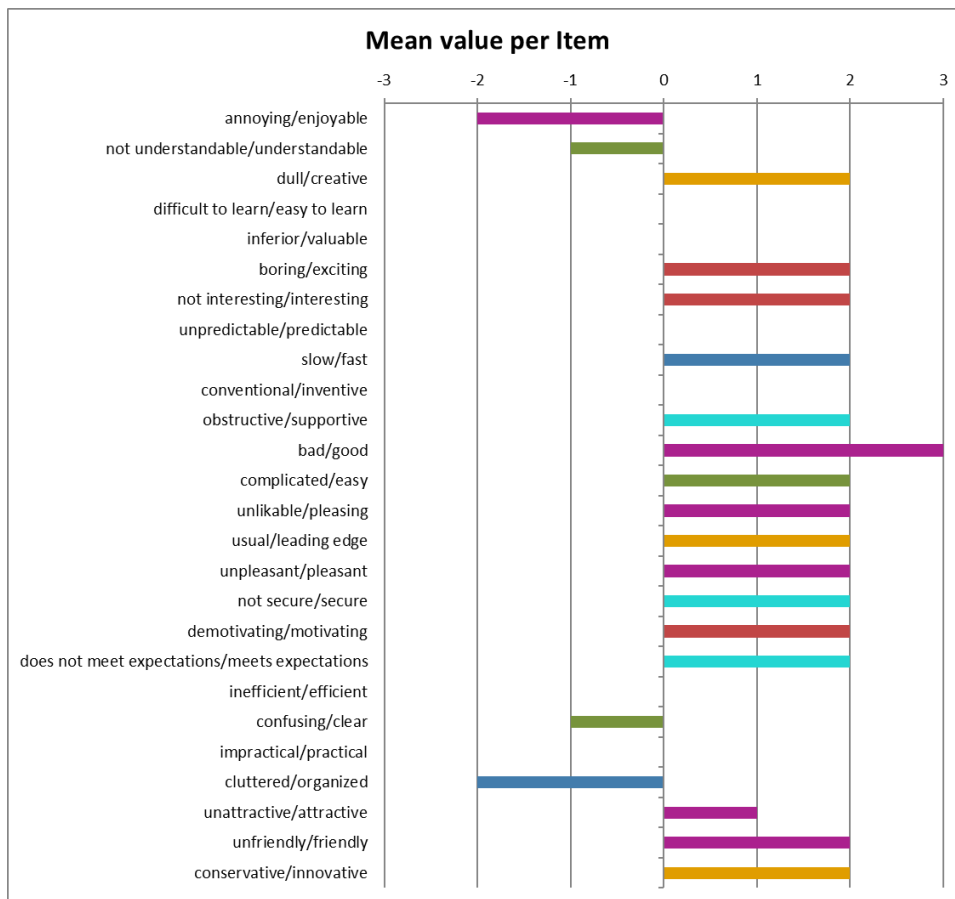
Figure 17: UEQ score per item from stakeholder input

From these results we can see that a couple of points are still scoring on the negative side of the scale which means that there are improvements to be made regarding those aspects. In Figure 16 we can see that the artefact lacks regarding Perspicuity and Efficiency. This correlates with the statistics that we can see in Figure 17 for the items that scored a minus or zero on the UEQ scale. Apart from these results the stakeholder was also asked to give additional feedback to better understand his experience using the artefact. Here the stakeholder said that the information that was displayed on the dashboard was very nice but that it was too messy and unorganised. This

caused distraction, a lack of enjoyment during use and low interest. The stakeholder would like to see a separation between different aspects of the dashboard to make the first impression clearer.

Next to the stakeholder's results we also conducted the UEQ with some other test subjects that would have no connection to the research at all. This was done to get a different view of the artefact by people that do not specifically understand what the dashboard should be telling. This would therefore create a subjective result based purely on the experience of unexperienced users. These results can be seen in Figure 18 and 19.
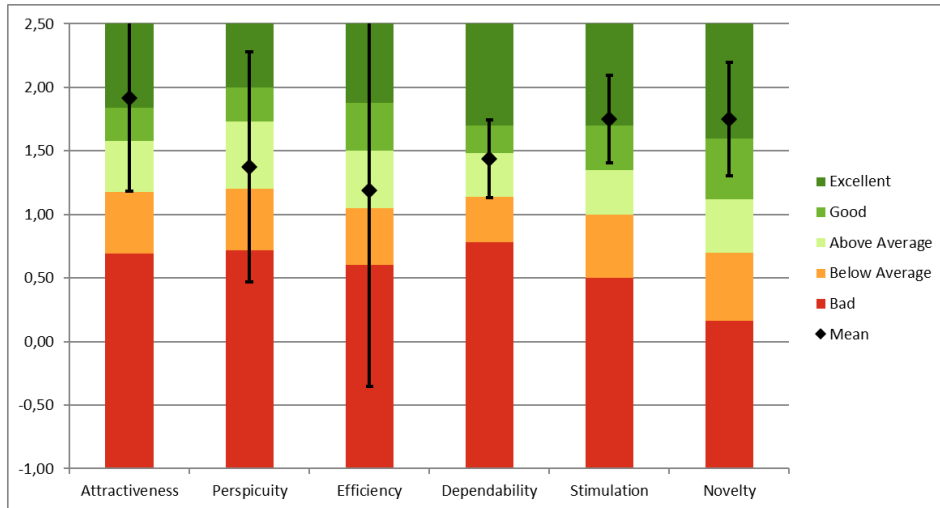
Figure 18: UEQ results from unexperienced test subjects feedback
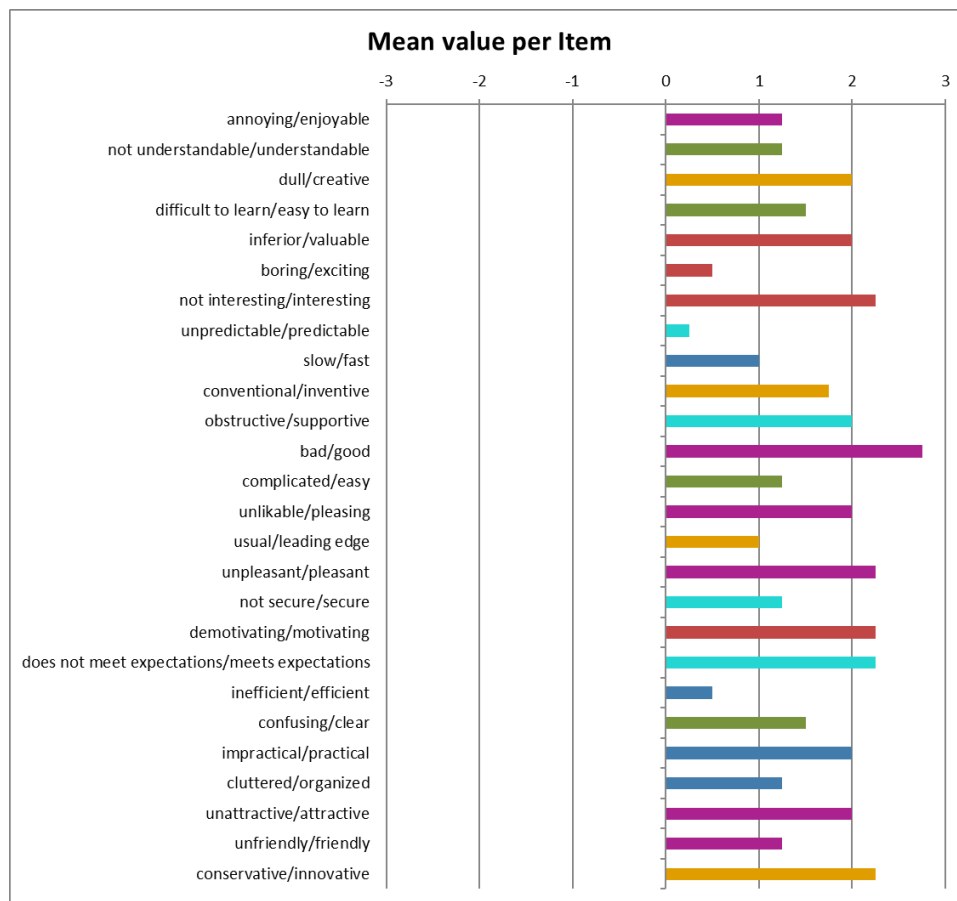
Figure 19: UEQ results per item for the unexperienced test subjects input

Here we can see that the results are more positive than with the results from only the stakeholder. This can be the result of the lack of experience around the subject making it that the test subjects miss some of the possible improvements. But something that we can take from this is that the overall looks and navigation of the dashboard are in good shape because there were no remarks made by the test subjects regarding this subject. Some of the test subjects did however make similar remarks about the busy layout as the stakeholder did. That is why this will definitely need to be changed in the improved design.

4.2) Improved designs

After some thorough testing of the dashboard we came across some faults in the VBA macros that had not been noticed before. One of these faults was connected to the search bar that is used to find descriptions of quality issues that are linked to the purchasing order number that was filled in. This feature of the dashboard worked fine until you searched for a purchasing order number that was connected to multiple quality issue descriptions. Then only the first one would show up inside the message box. In the new design we rewrote the code so that the VBA macro now creates a list of all of the descriptions that are linked to a unique purchasing order number and then it will display them under each other inside the message box and beginning with a "-" character to make the separation more visible to the user.

One of the most occurring remarks during the conducting of the UEQ was about the layout of the dashboard and that the data was displayed in a very busy way. This was improved by completely changing the layout of the dashboard and rearranging the graphs based on their data that they were visualising. We made a couple of different categories and separated them by adding extra borders in between those categories. Also we added big titles describing which category was depicted per section. These categories were Quality, Logistics, Cost and Performance. We also made sure that the colour scheme was consistent throughout the entirety of the dashboard. These changes did however make it that the dashboard was not visible on a full screen anymore which meant we needed to make the navigation menu a bit slimmer. This was no problem since there was enough margin left and in the end it made it look even better.

Some smaller points of feedback were related to the data that was depicted in the dashboard. Firstly the scores were displaying a lot of unnecessary decimals. This was also the case for the average delivery times. Another point o feedback was that the data labels in the pie chart about quality issues were unclear. The " ; " that was used as a separator sign was confusing for some of the test subject so we changed that to "…x = …" with the data on the spot of the dotted lines. This made it more clear and easier to understand for everyone. The last point of feedback was that there should be a " € " placed with all the graphs displaying costs.

After all the changes had been made following the feedback that was received we were able to settle on the final version of the artefact which can be seen in Figure 20 below.
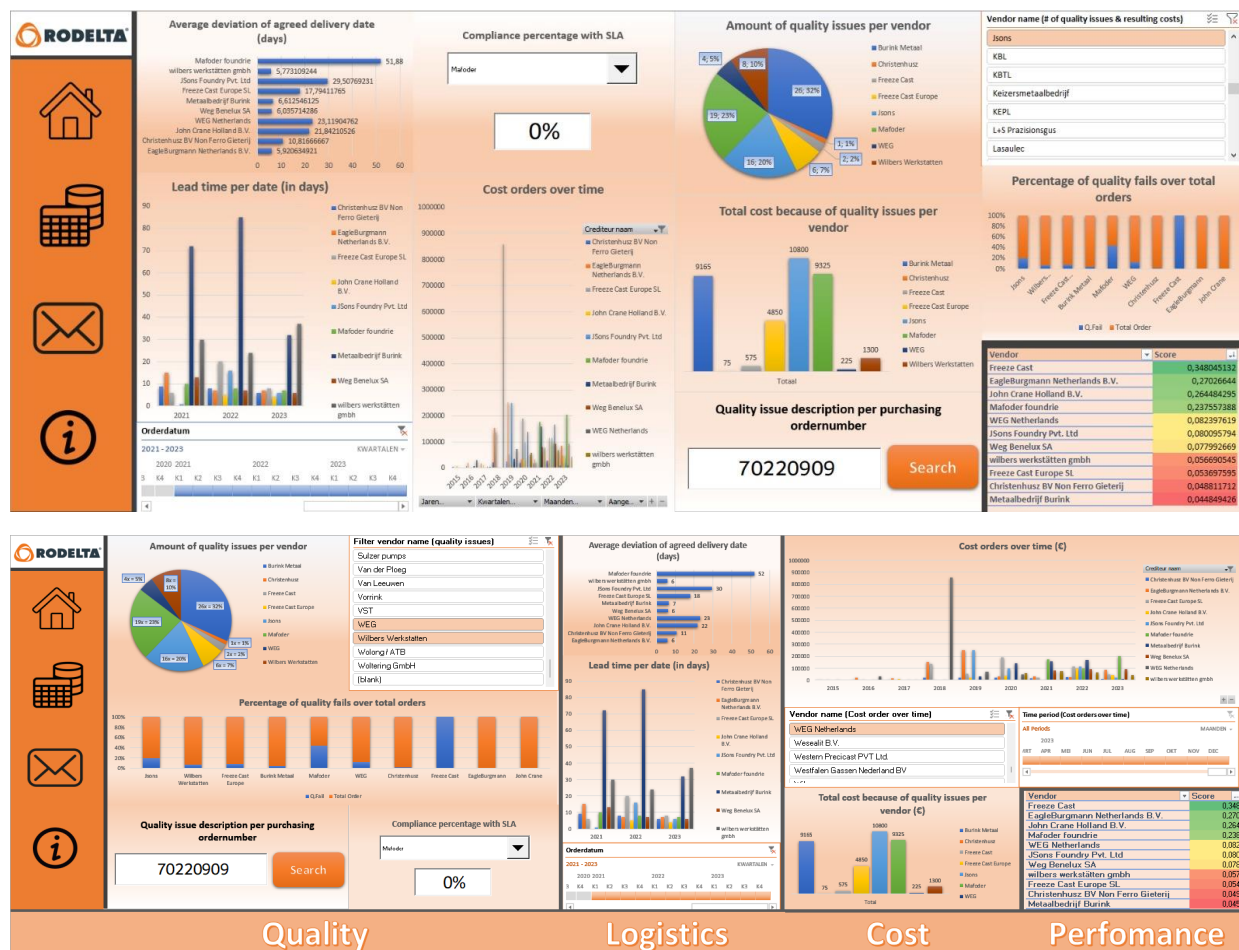
Figure 20: Final artefact after feedback and old prototype

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After the implementation of all the changes we let the same test subjects fill in the UEQ but this time with the final artefact as the tool they were testing. This resulted in the following results that can be seen in Figure 21 and 22 for the stakeholder and Figure 23 and 24 for the unexperienced test subjects.
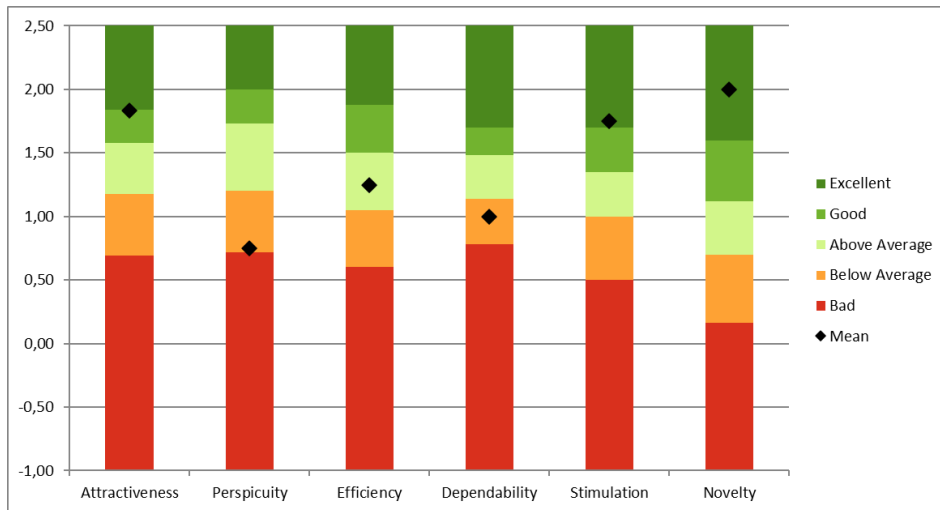
Figure 21: UEQ results from stakeholder feedback [final version]
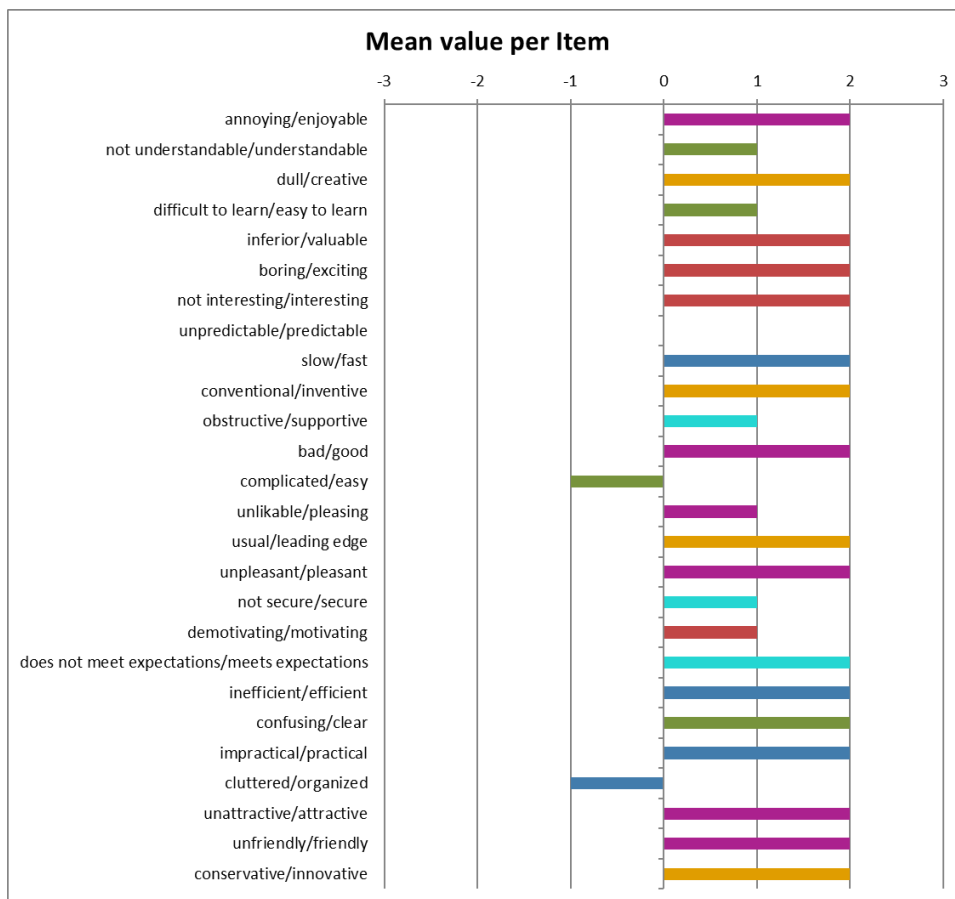
Figure 22: UEQ results per item for the stakeholder input [final version]
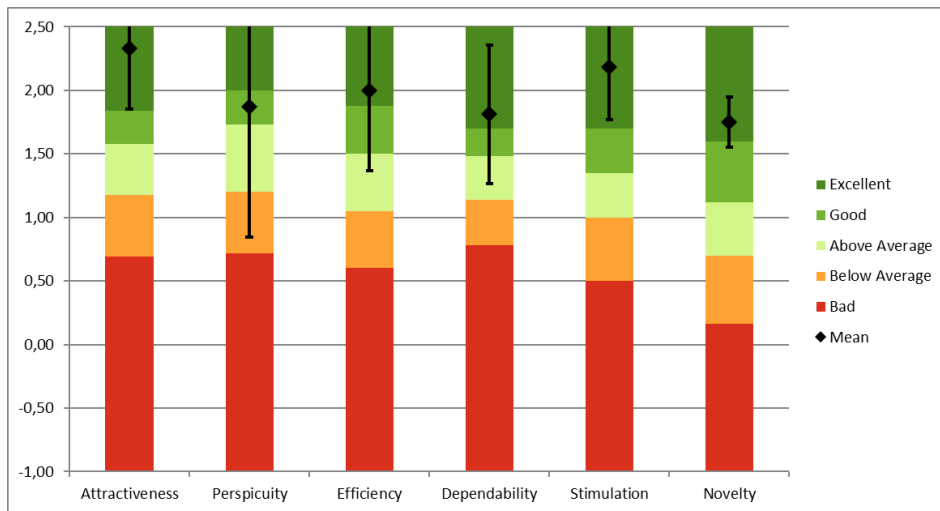
Figure 23: UEQ results from unexperienced test subjects feedback [final version]
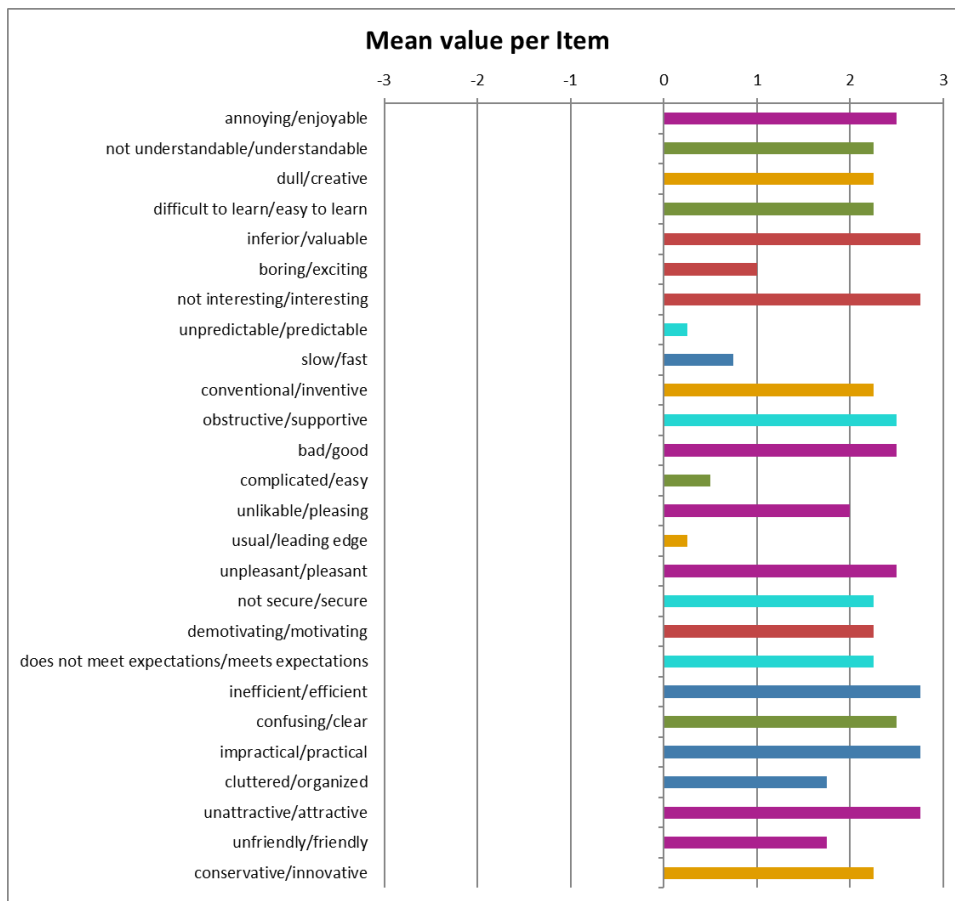
Figure 24: UEQ results per item for the unexperienced test subjects input [final version]

With these 2 results we can now take a look if the lower scoring points in the first UEQ are now improved after the changes that were made based on the received feedback. This comparison was done in the data analysis tool that came with the UEQ and these results are depicted in Figures 25 and 26 (Blue = Old version, Red = New version).
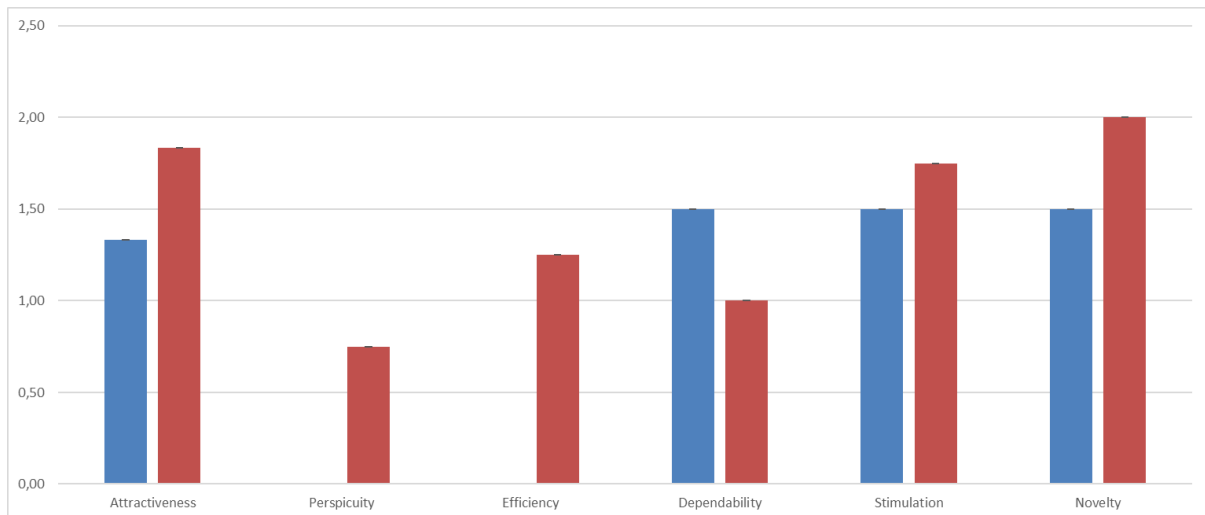
Figure 25: Comparison of the UEQ results from the stakeholder (Blue = Old version, Red = New version).
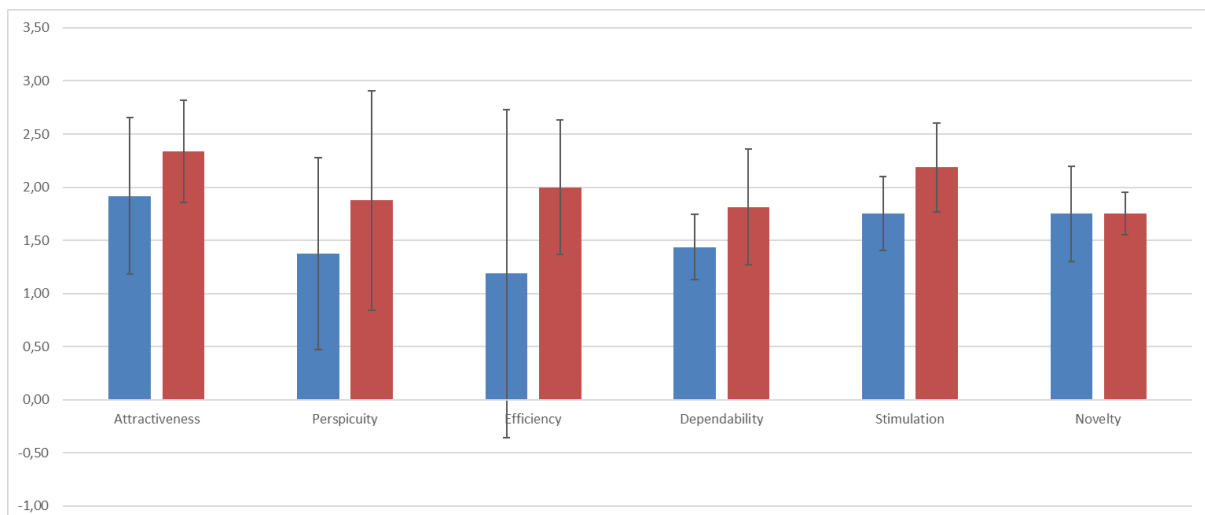
Figure 26: Comparison of the UEQ results from the unexperienced test subjects (Blue = Old version, Red = New version).

Here we can see that overall the artefacts have a higher score for the different categories. In some cases this is not the case when looking at the bar chart but this is a result of inconsistencies in the answers given, because everyone that filled in the UEQ the second time thought that the artefact was improved and that they had no feedback or tips for changes. Because the scale is fairly big and some of the items that are used in the scale are vaguely/not applicable to the artefact it can sometimes result in these inconsistencies in answers. That is why we asked for the additional feedback to be able to know whether or not we were dealing with such inconsistencies.

5) Conclusion and Discussion

In this final chapter we will look back at the research questions that we set up at the beginning of this research and give concluding answers for all of them. Next to those answers we will elaborate on them in Chapter 5.1 to give the reader a complete view of what has been achieved in this research and what steps were followed in the process. After this elaboration we will go over some limitations in Chapter 5.2 that we encountered during the research and give some recommendations in Chapter 5.3 accordingly. These recommendations are not only to help with solving the limitations but are also ideas for possible future work on this specific matter. In 5.4 we will shortly go over the contribution to theory and practise that this thesis has had.

5.1) Conclusion

To give concluding answer on our main research question we had made a couple of sub research questions that would help us to get there step by step. The first sub-question was "*What does the current situation look like at Rodelta regarding the insight in their vendor performance in terms of their ability to facilitate on-time deliveries?*". To answer this question we started researching the company and our focus was to gather as much information as possible about the current situation that the company was in. This was done through observations within the company and by asking questions to the stakeholders. This allowed us to set up a BPMN to make sure we had a good understanding of the entire business/production process that was going on at the company. During this period of gathering information we got to know that the research subject that we were focussing on in this research was still a 'blank canvas' which meant there was a lot of freedom but no foundation to build on. They did not have good insights in their vendor performance and something like a vendor rating tool was not in place.

After getting a good understanding of the current situation at Rodelta regarding the research subject we started off with answering the second question which was: "*What are certain KPIs that Rodelta prioritises regarding their vendor performance in order to improve their ability to facilitate on-time deliveries?*". This question required us to get the preference and expertise opinion of the stakeholders to assess which KPIs could be useful during our research and would improve the quality of our final product. To get this information we made 2 different questionnaires which can be seen in appendix F and G. We used these questionnaires to first understand which KPIs were relevant to the research subject in the eyes of the company and the second questionnaire was used to filter down this list into a more compact KPI selection that would consist of only the most important KPIs. The reason for this more compact list of KPIs was that we did not want to make the research data that was needed to large because we only have limited amount of time. Secondly we did not want a list with too many unnecessary KPIs because this could only lead to confusion and would not benefit towards the quality of the end product.

After the KPI selection process from the company it was time to go and search for more KPIs that could be added to this selection. This would help us answer the third research question which states: "*What are certain KPIs that are most important/influential regarding the vendor performance based on existing literature in order to improve their ability to facilitate on-time deliveries?*". This was done through a literature search that was conducted over multiple academic databases. From this extensive search we came up with a second selection of KPIs which we would then present to the company stakeholder. After the KPIs were presented we deleted all the duplicates and formed one list of possible KPIs and let the company stakeholder rank them and filter out any that were not applicable enough. This list can be seen in appendix G and resulted in our final list of KPIs that were

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mentioned in Chapter 3.3.1. With this clear selection we could focus on the data that needed to be required for these given KPIs.

For the last sub-research question we needed to find an answer to the question: "*Which visualisation methods are best fitted to improve the vendor performance management and what are some recommendations for future improvement in order to improve the ability to facilitate on-time deliveries?*". This meant we had to do another literature search to find different displaying/visualisation methods for our KPIs and the accompanying data. This resulted in a list of different visualisation methods fitted to all of the different KPIs based on the type of data that we would be able to measure. The way that we wanted to visualise/display the entirety of the data was already set from the beginning as an interactive dashboard since that is what the company's preference was. When the prototype was finished we put the artefact through different methods of testing with one of the methods being the UEQ. These types of checks gave us some feedback and improvement points which we could then implement into the improved designs to end up with the final product.

These different answered questions make it possible for us to answer the final research question which states: *"How can the rate of on-time delivery of contracts be improved at Rodelta when looking at the performance of vendors?".* This can be done by getting a good understanding of the company and the business process to be able to come up with suited KPIs. This KPI selection will be formed by adding indicators found in academic literature and indicators that seem valuable to the experienced stakeholders. Once the KPI selection is filtered and finalised it is time to start gathering the needed data and making sure all of it is stored and sorted clearly. When the data has all been stored correctly it is time for the final step which is visualising the data and showing different analyses to help the user during their decision-making process. By making it possible for the user to see where certain vendors are underperforming they can quickly act on it which will result in an improvement of the business process. This will then also help improve the on-time delivery of the contracts since the mistakes/underperformance can now be spotted earlier in advance and the user can then directly be linked to the right information.

5.2) Discussion

The research problem that we had at the beginning of this research, regarding the lack of insight into the performance of the vendors of Rodelta, has been solved step-by-step as described in Chapter 5.1. But during the solving of this problem, some things could have been done differently. In this chapter, we will go over these different ways of executing this research and we will go over the limitations that came up during the research itself.

If we go through the research, starting from the beginning, we could have been better prepared for the data gathering for the selection of KPIs. Because of the large amounts of data, it is smart to first set up a structure where the data can be stored after it has been exported. This will make organising and filtering the data easier for the researcher and will save time compared to when you would not have made a data structure. Another part of the research that we could have done differently is the incorporation of the stakeholder preference during the making of the KPI selection. In this research, the stakeholders were asked twice to give their opinion on the KPI list which in hindsight could have been done in just one time. The reason for it being done twice in this research is because we did not know how big the selection would be after doing a literature search for it. Because the selection came out bigger than expected we thought it necessary to filter down the list for a second time. The last thing that we could have done differently was the testing of the prototype by inexperienced test

subjects. In this research, the group of test subjects consisted of 5 people. The accuracy of the results could have been better if the research population would have been bigger. At the time this was not done so this is something to keep in mind for future research.

There were multiple factors and decisions that were made during the research that led to various points of discussion. These points of discussion were mostly related to limitations that were encountered during the research, and the decisions that were made at the time to handle them. These limitations all had to do with the data gathering and availability of all the needed data. The first point of discussion is related to the data storing structure that is in place at the company. At the company, most of the data was stored in one place, which was the ERP system. However, this system only allowed the user to export the data in large dumps based on the data labels that were given to the specific data. This meant that it took unnecessary time to select the right data from the source because after the export was finished you still had to sort it all out. The data was labelled with small descriptions that sometimes did not give a good understanding of what the dataset it entailed. Another limitation was that the data of some of the KPIs was missing or was not complete. This made it hard to automate the dashboard and the calculations done in the background during the data analysis and the scoring of the vendors.

Apart from the fact that some of the data was incomplete and unclear, it was also a limitation that some of the data was stored in a different system. This was the case for the information about the quality of the orders. This meant I needed to get this information from another system and combine the data with the rest of the data set.

The last limitation was that some of the data that was needed was badly updated. This meant that in some cases there was data up until a certain point in the past or only after a certain point in time. This also meant that we needed to change the way of calculating and analysing some of the data.

5.3) Recommendations and future work

The first recommendation for the company is to keep better track of the data that is needed to track the selected KPIs. If this is done regularly it is not a lot of work and the quality of the dashboard experience benefits immensely from this. Next to keeping the data up to date, it is important to use a structure for the exported data, for example the one that was used in this research. This makes the processing of the data dumps easier, clearer and less time consuming.

Something that goes hand in hand with the previous recommendation is that it would be good to assign certain people to the tasks of keeping the data up to date. This can be done by one person or multiple depending on the workload. These people will be responsible for the end data but this will also mean that every department that adds new data into the ERP system needs to keep this up to date, otherwise the end data will still lag behind even though everything is processed.

Another recommendation that can maybe be work for the future is the implementation of benchmarks inside the dashboard. Right now the dashboard does score the vendors on their performance on the KPIs but this is not visualised in all the graphs on the main interface. That means that apart from the scores on the main dashboard there are no benchmarks visible. For now, this is not a problem since the stakeholder and main user of this dashboard has enough experience to know what values are underperforming or are standing out. When the company might want to use this tool in other departments of the company then it might be a useful addition to also visualise benchmarks on the main interface of the dashboard. This will then allow inexperienced users to be able to make a fitting decision based on the displayed analysed data.

The last recommendation for any future work will be to expand the selection of KPIs. For this research, we have gathered a lot of possible KPIs but due to a limited period we decided to narrow down our selection of KPIs. This was done by filtering down the list based on the preference of the stakeholder which left us with a compact list. However, to make the dashboard capable of analysing even more of the vendor performance it could be a possibility in the future to add more KPIs to it. This will of course result in an expansion of the dashboard which could be questioned if this is wanted by the company or not. That will be something that they can decide internally to see if there is a need for this and act accordingly.

5.4) Contribution to theory/practice

The result of conducting this research led to the creation of the interactive dashboard which is shown in Chapter 4.2. This dashboard can be used by the company and possibly be improved/expanded in the future if they decide to start implementing it in their company infrastructure. Next to that, this thesis has contributed to practice by clearing up small problems at the company during my time there and offering a new scientific view on the day-to-day work at Rodelta. This research does not contribute a bunch to the existing scientific theory since we used a combination of already existing methods to help build a customized solution for this specific company. The contribution that this thesis has to the theory will mostly consist of the combination of theory and practice and the new insights/changes this gave regarding the existing theory of this subject.

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Appendix

A) Problem Cluster

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B) Business Process Modelling Notation

BPMN swimlanes (top to bottom): Customer, Sales, Project Manager, Engineering, Purchasing, Vendors, Quality, Production.

- Customer: Start → Setting up a tender for project → Send tender to a set of pump manufacturers → Choose supplier based on technical and commercial specs → Declined → End; Order delivery → End
- Sales: Placing bids on the tender
- Project Manager: Receivement of the project order; Accepted
- Engineering: Loading project specs into software and make changes where needed → Kickoff starts at the project engineer → Bill of Materials is made → BOM uploaded in MKG linked to sales order
- Purchasing: Purchasing needs are released → Setting up a tender for the needed materials → Choose vendor based on technical and commercial specs → Insufficient → End; Accepted; Arranging transport
- Vendors: Placing bids on the tenders → Receivement of the order → Production of the order → Making order ready for transport → Product repaired/Product remade
- Quality: Receivement of the order → QA/QC check on specs and paperwork; Approved/released for shipping
- Production: Released for production → Start of production of end product → FAT test from witness/third party → Problem being solved

C) Research Questions worked out

How can the rate of on time delivery of contracts be improved at Rodelta when looking at the performance of vendors?							
Knowledge Problem	Type of research	Research population	Subjects	Research strategy	Method of data gathering	Method of data processing	Activity plan
What does the current situation look like at Rodelta regarding the insight in their vendor performance?	Descriptive	Rodelta	Rodelta Vendors	Qualitative	-Observation within the company -Conducting interviews/asking questions -Do work related tasks	-Summarize data on current situation -Visualize data from the interviews -Qualitative and quantitative	Getting acquainted within the company→Setting up interviews→Process the data→ Create an overview of current situation
What are certain KPI's that Rodelta prioritises regarding their vendor performance?	Descriptive	Rodelta and stakeholders	Vendors Performance indicators Employees Stakeholders	Qualitative (finding the KPI's)/Quantitative (gathering/processing KPI data)	-Conducting interviews with stakeholders/experts	-Make a selection of the found KPI's along with a detailed explanation -Qualitative and quantitative	Conducting interviews→ Summarise data and process into KPI selection→ explain choices and give definition
What are certain KPI's that are most important/influential regarding the vendor performance based on existing literature?	Descriptive	Literature	Vendors Performance indicators Literature	Qualitative (finding the KPI's)/Quantitative (gathering/processing KPI data)	-Literature search on academic sources	-Make a selection of the found KPI's along with a detailed explanation -Quantitative	Perform literature search→Filter through data→Summarise findings→add to the KPI selection list
Which methods are best fitted to display the vendor performance that is based on the determined KPI's and what are some recommendations for future improvement?	Explanatory	Rodelta and Literature	Rodelta Performance indicators Literature Dashboard User testing	Qualitative (finding methods) /Quantitative (implementing the data)	-Literature search -Conducting interviews to get an understanding of the preferences of the stakeholders -Measuring and collecting KPI data	-Choosing a layout and visualisation methods for the dashboard -Implement the data -Qualitative and quantitative	Perform literature search→Summarise findings→Set up interviews→Conduct interviews→ Implement findings to design a dashboard→Implement data into dashboard

D) Systematic Literature Review

1. definition of the **knowledge problem/research question**

One of the key elements of this research are the KPIs that will be used in the dashboard to measure and display the performance of the vendors. Therefore the knowledge problem chosen for this SLR will be:

"What are certain KPIs that are most important/influential regarding the vendor performance based on existing literature?"

This question will be applied for the market that my company is functioning in. This is the market for hydraulic pump design/manufacturing. With the use of this question the goal is to get to know more about the different kinds of KPIs and the ways other comparable researchers use these in their research.

2. defining the **inclusion and exclusion criteria** to determine what will be included in the review (and why)

Inclusion criteria	Why?
English or Dutch language	I am fluent/as good as fluent in both these languages which is needed to be able to fully understand the academic source.
Subject area of business, management and accounting	These are academic sources that are in the same field/discipline as my study programme IEM.
Included terms: KPI, Key Performance Indicator, vendor, supplier	These are relevant terms connected to the knowledge question that is being researched.

Exclusion criteria	Why?
Sources older than 10 years	To keep the sources that are most up to date and therefore more likely to be relevant. 10 years is often used as a rule of thumb based on information found online. It is also roughly the time when KPI powered dashboard software like PowerBI started.
Sources behind paywall	There is no budget for this research so only sources accessible via the UT or open access will be used.

3. identification of the most relevant **academic databases** and other sources to search in (and why)

Database used	Why?
Scopus	One of the most used and important databases during the IEM programme and therefore also familiar in use, peer reviewed.
Business Source Elite	Business focussed; peer reviewed.

4. describing the **search terms** and how they were structured for different databases and sources (in other words, your search strings or queries)

Scopus:

Search string	Date of search	Scope	# of results	# of relevant sources
TITLE-ABS-KEY ((*kpi* OR *"key performance indicator"*) AND (*supplier* OR *vendor*)) AND (LIMIT-TO (SUBJAREA , *"BUSI"*)) AND (LIMIT-TO (PUBYEAR , *2022*) OR LIMIT-TO (PUBYEAR , *2021*) OR LIMIT-TO (PUBYEAR , *2020*) OR LIMIT-TO (PUBYEAR , *2019*) OR LIMIT-TO (PUBYEAR , *2018*) OR LIMIT-TO (PUBYEAR , *2017*) OR LIMIT-TO (PUBYEAR , *2016*) OR LIMIT-TO (PUBYEAR , *2015*) OR LIMIT-TO (PUBYEAR , *2014*) OR LIMIT-TO (PUBYEAR , *2013*))	19-04-2023	Title, abstract, keywords	73	13
TITLE-ABS-KEY ((*kpi* OR *"key performance indicator"*) AND (*supplier* OR *vendor*) AND (*management* OR *purchasing* OR *decision*)) AND (LIMIT-TO (SUBJAREA , *"BUSI"*)) AND (LIMIT-TO (EXACTKEYWORD , *"Key Performance Indicators"*) OR LIMIT-TO (EXACTKEYWORD , *"Decision Making"*) OR LIMIT-TO (EXACTKEYWORD , *"Performance"*)) AND (LIMIT-TO (PUBYEAR , *2022*) OR LIMIT-TO (PUBYEAR , *2021*) OR LIMIT-TO (PUBYEAR , *2020*) OR LIMIT-TO (PUBYEAR , *2018*) OR LIMIT-TO (PUBYEAR , *2017*) OR LIMIT-TO (PUBYEAR , *2016*) OR LIMIT-TO (PUBYEAR , *2015*) OR LIMIT-TO (PUBYEAR , *2014*) OR LIMIT-TO (PUBYEAR , *2013*))	19-04-2023	Title, abstract, keywords	25	5

TITLE-ABS-KEY (*"supplier performance"* AND (*kpi* OR *"key performance indicator"*) AND *decision*)	19-04-2023	Title, abstract, keywords	6	2
ABS (*"performance indicator*"* AND *vendor* OR *supplier* AND *determine* AND *best*)	19-04-2023	Abstract	8	1
ABS ("vendor management" AND kpi OR 'selection AND criteria' OR performance)	19-04-2023	Abstract	5	1

Business Source Elite:

Search string	Date of search	Scope	# of results	# of relevant sources
Key performance indicator AND vendor management OR supplier management AND evaluating supplier performance	19-04-2023	Keywords supplied by author	176	6

5. a flowchart, list, or table with the **number of search results found** (per source), the **number of duplicates**, and the **final set of articles included** (including a brief explanation of how you screened them)

The relevant articles were screened by globally reading through them to see if the article was useful for this research. For 10 of the found articles the information in those articles was either not relevant for this research question or was giving information on the same subjects as other found articles but then of inferior quality. Some of the articles were behind a paywall and therefore left out of the literature search. After some of the global reading I also checked the references of articles which got my interest. With the use of the snowballing technique I was able to find 3 more articles that consisted of useful information. This left me with a total of 10 articles to read and evaluate.

Total amount of articles	293	28
Duplicates	7	7
Paywall	4	4
Not relevant after reading	8	8
Total after screening	272	7
Total after snowball technique	277	12

6. a **conceptual matrix** listing the selected articles for review, with their core topics or findings, organised along concepts (for inspiration, see <u>microlecture B2-6Links to an external site.</u>)

After reading all the 12 sources I was able to sort them into different categories based on the findings I was able to do during the reading. In this table below the articles will be named and followed with the type of subject that they discuss and the findings that I have gotten from those articles. The sources will be displayed as the number that corresponds with the order of the sources mentioned above.

Source	Topic/subject	Findings
B. Angrian, 2019	KPIs for vendor/supplier management	The most popular KPIs for vendor selection are quality, delivery, price/cost, manufacturing capability, service, management, technology, research and development, finance, flexibility, reputation, relationship, risk, and safety and environment
D. Aditi Kannan, 2022	KPIs for vendor/supplier management	KPIs for vendor evaluation can be: price, quality, delivery (time), technical capability, flexibility, financial position, location, reputation (in market)
K. Romule, 2020	KPIs for vendor/supplier management	This study shows a list of performance measures and after an assessment of all these supplier performance indicators they came up with a list of 5 of the most important indicators. This study also mentions being one of the first to incorporate the suppliers view in the assessment of the KPIs.
M. H. Abolbashari, 2018	KPIs for vendor/supplier management	List of possible procurement KPIs together with a description and similar KPIs. Also the KPIs are evaluated by experts and the most important ones are filtered.
S. Routroy, 2014	KPIs for vendor/supplier management	Performance indicators that are linked to certain critical

		success factors and they get evaluated by the AHP method
K. Govindan, 2023	KPIs for vendor/supplier management	List of KPIs along with description and sources that go more in depth on this KPI.
P. Parthiban, 2013	KPIs for vendor/supplier management	List of KPIs created by opinions from industry experts, literature review.
M.N. Kasirian, 2013	KPIs for vendor/supplier management	KPIs for vendor evaluation and also the correlation between these KPIs.
P. Dutta, 2022	KPIs for vendor/supplier management	List of criteria used in DEA method to evaluate the supplier performance.
H. Kaur, 2016	KPIs for vendor/supplier management	List of performance indicators with the number of citations is other research and ranked on importance based on expert surveys.
N. Jain, 2020	KPIs for vendor/supplier management	List of sustainability criteria for supplier selection along with extra sources per criteria.
P. Parthiban, 2012	KPIs for vendor/supplier management	List of KPIs based on literature review and opinions from industry experts.
B. Angrian, 2019	Weight determination for KPIs	Weights can be given to the KPIs according to existing literature and then be scored using a points system.
D. Aditi Kannan, 2022	Weight determination for KPIs	Weights can be determined using methods like the Best-worst method. MACROS is a method that can be used to prioritise the weights.
6	Weight determination for KPIs	Using the Best-worst method they give the KPIs their own weighted value.
7	Weight determination for KPIs	Modified ISM model used for the determination of the weights.
10	Weight determination for KPIs	List of weights per KPI by use of DEMANTEL analysis.

12	Weight determination for KPIs	MISM-AHP hybrid is used to determine the weights per criteria. Also the different performance indicators are compared with each other to generate alternative priority weights.
4	Models to evaluate the vendors based on their KPIs	A comparison between all the possible methods, such as AHP, DEA and Bayesion Network.
5	Models to evaluate the vendors based on their KPIs	Explanation and use of the AHP method on a set of performance indicators for suppliers/vendors.
6	Models to evaluate the vendors based on their KPIs	Explanation and use of TODIM decision making model to evaluate the weighted KPIs
7	Models to evaluate the vendors based on their KPIs	AHP and a sensitivity analysis is used to evaluate the performance indicators.
8	Models to evaluate the vendors based on their KPIs	AHP, ANP and TOPSIS model explained.
9	Models to evaluate the vendors based on their KPIs	TOPSIS, AHP, ANN, and ANP are described. Also different types of DEA are explained.
10	Models to evaluate the vendors based on their KPIs	Multi-criteria decision-making models are mentioned and referenced.
11	Models to evaluate the vendors based on their KPIs	Fuzzy Interference System used to evaluate different supplier performance indicators per category such as economic, environmental and social.

Final version

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Contact tab

Vendor	Address
ARSOPI industrias Metalurgicas Arlindo	ARSOPI industrias Metalurgicas Arlindo S. Pinho Lda P.O. Box 10 3730-954 VALE DE CAMBRA Portugal
Kuipers Air & Sea BV	Kuipers Air & Sea BV munsterstraat 18 7575 ED OLDENZAAL
GMG GussTec GmbH	GMG GussTec GmbH Leibnizstraße 65 07548 GERA DEUTSCHLAND
Hydrobolt Limited	Hydrobolt Limited Global Service Centre Monmore Business Park WV2 2EE WOLVERHAMPTON Dixon Street GREAT BRITAIN
Rubix	Rubix Josink Hofweg 18 7545 PP ENSCHEDE
GMA-Holding BV	GMA-Holding BV Enschedesestraat 218 A 7552 CL HENGELO
Pritech	Pritech Opaalstraat 3 7554 TS HENGELO
NPL machinefabriek	NPL machinefabriek Hassinkweg 8 a 7556BV HENGELO
Metaalbedrijf Burink	Metaalbedrijf Burink Hamburgstraat 14 7575EG OLDENZAAL
Voskamp Industrietechniek B.V.	Voskamp Industrietechniek B.V.
Gelria Pakking B.V.	Gelria Pakking B.V. Postbus 3955 7500 DZ ENSCHEDE
Freeze Cast Europe SL	Freeze Cast Europe SL Calle Roble 101 E40140 POLIGONO INDUSTRIAL NICOMEDES CARCIA SPAIN
wilbers werkstätten gmbh	wilbers werkstätten gmbh Luxemburger Str 61 48455 BAD BENTHEIM DEUTSCHLAND
Rathi Europe GmbH	Rathi Europe GmbH Im Wied 2 32683 BARNTRUP DEUTSCHLAND
EagleBurgmann Netherlands B.V.	EagleBurgmann Netherlands B.V. Koningsschot 9 3905 PP VEENENDAAL
Weg Benelux SA	Weg Benelux SA Rue de l'Industrie 30 D B-1400 NIVELLES BELGIE
Schipper	Schipper Postbus 214 7640 AE WIERDEN
Mafoder foundrie	Mafoder foundrie 9 km route d'El Jadida. Lissasfa20190CASABLANCAMarokko
Satink Hengelo B.V. Stralen & Conservere	Satink Hengelo B.V. Stralen & Conservere Postbus 771 7550 AT HENGELO OV
Verspaning Service Twente B.V.	Verspaning Service Twente B.V. Turbinestraat 6 7556 RB HENGELO
Christenhusz BV Non Ferro Gieterij	Christenhusz BV Non Ferro Gieterij Parelstraat 12 7554 TM HENGELO
Dover precision	Dover precision 543 Calder Street G42 0PT GLASGOW UNITED KINGDOM
Bureau Geluid nl vof	Bureau Geluid nl vof Sint Gerlach 47 6301 JA HOUTHEM-VALKENBURG AAN DE GEUL
John Crane Holland B.V.	John Crane Holland B.V. Postbus 244 2990 AE BARENDRECHT
TECHNIPARTS B.V.	TECHNIPARTS B.V. Rondweg 26 8091XB WEZEP (ZWOLLE)
JSons Foundry Pvt. Ltd	JSons Foundry Pvt. Ltd Mr S Jadhav G-13, G-2/B, G-12/1. M.I.D.C. SANGLI, 416 436 MAHARASHTRA INDIA
KOLIN-KALYON Joint Venture	KOLIN-KALYON Joint Venture
SPM Instrument BV	SPM Instrument BV Postbus 86 5150 AB DRUNEN
Delta Seal Alliance Co. LTD	Delta Seal Alliance Co. LTD 86 Map Ya Road, Map Ta Phut 21150 MUANG, RAYONG Thailand
Domsel AG	Domsel AG Horbacher CH-3706 LEISSIGEN
Woerner Smeersystemen B.V.	Woerner Smeersystemen B.V. Nijverheidsweg 73 3771 ME BARNEVELD
Kistenmakerij Twente	Kistenmakerij Twente Gildestraat 9 7622AZ BORNE
RAJAPACK	RAJAPACK Minervum 7439 C-D 4817ZG BREDA
Sietzema Techniek	Sietzema Techniek T.a.v. dhr. S. Sietzema De Werf 42 8401 JE GORREDIJK
Pultrum Rijssen BV	Pultrum Rijssen BV
Kirloskar Brothers Limited	Kirloskar Brothers Limited Yamuna, Baner Pune PUNE 411045 INDIA
Rhenus Logistics	Rhenus Logistics Eektestraat 2 7575 AP OLDENZAAL

→Dashboard

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Introduction tab

Introduction/Information on the Vendor Rating Dashboard:

Welcome to the vendor rating dashboard of Rodelta Pumps International BV. This dashboard will allow the user to analyse the data around the vendors in an interactive way and will create a clear and structred overview of the current situation.
The dashboard is divided into a navigation side and a data analysis side. When looking at the navigation bar (left-side) we can see 4 different options to choose from. The first icon stands for the home page, the second icon stands for the data sheets behind the dashboard, the third icon stands for the contact information sheet and the fourth and final icon stands for the help-info sheet that we are currently on.

The navigation buttons like the home, contact and help-info buttons are pretty self explanatory but for the data sheets it is good to understand what to do. The dashboard is built on different datasheets that are liked to a main KPI. These KPI's will be shown in a pop-up menu once you have clicked on the navigation button for the datasheets. Here you need to fill in the name of the data that you want to see and it will automatically take you to the correct infromation.

When we look at the dashboard itself we see different types of information that is visualised in different ways. All of the visualisation method have their own filtering system to allow the user to selectively search for the data that is needed. These filtering mechanisms can relate to the vendor that is displayed and/or the time period that is displayed. The dashboard also offers the option to se the in depth description of certain purchasing orders that have reported quality issues.

The dashboard is fully automated wich means that when there is new data the user can just replace/add the new data to the right datasheet and then the dahboard will do the rest.

For this dashboard the following KPI's have been used:

Product quality: The product is of the expected quality in terms of specifications like performance
Cost of product: The price of the product at the time of ordering (also allows for comparisons with historical data)
Cost stability: The frequency of price changes (compared with historical data over a chosen period of time)
Delivery time: If the order is delivered too early, just-in-time or too late
Delivery quality: Amount of times there are damages to the order during transport
Lead time: The time it takes from placing the order till the order is delivered
Delivery conform to order: The order is complete and exact (no missing pieces/parts, right sizes, right materials etc.)
Compliance with contract/Meeting SLA: The predetermined contracts and agreements have all been fulfilled (correct delivery date, price etc.)

Some of these KPI's have been mended together to create a better overview of the total picture instead of keeping it very detailed. This was done to make sure the user is not overwhelmed with to much data on the dashboard interface. Still this data is available but the on the back side of the dashboard in the datasheets.

→Dashboard

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Datasheets and scoring sheet

Inkooporder	Crediteur	Leverdatum (afges	Bevestigde leverdatu	Crediteur naam	Deviation of agre	Score	Weighted score
70200010	5005	29/07/2020	?	ABB	?	0	0
70190308	5005	25/09/2019	25/10/2019	ABB	30	0	0
70180362	5018	27/07/2018	?	Bennink & Ten Cate Heerenveen	?	0	0
70190028	5025	22/03/2019	29/03/2019	EagleBurgmann Netherlands B.V.	7	0	0
70190420	5050	20/09/2019	?	Flender B.V.	?	0	0
70170044	5066	17/02/2017	21/02/2017	Eriks gasket technology B.V.	4	0,5	0,142857143
70230594	5110	30/08/2023	?	SPM Instrument BV	?	0	0
70220782	5117	02/12/2022	02/12/2022	Verspaning Service Twente B.V.	0	1	0,285714286
70210609	5117	07/01/2022	07/01/2022	Verspaning Service Twente B.V.	0	1	0,285714286
70200342	5117	21/04/2020	21/04/2020	Verspaning Service Twente B.V.	0	1	0,285714286
70181228	5117	11/01/2019	?	Verspaning Service Twente B.V.	?	0	0
70181230	5117	11/01/2019	?	Verspaning Service Twente B.V.	?	0	0
70181214	5117	19/12/2018	?	Verspaning Service Twente B.V.	?	0	0
70181187	5117	18/01/2019	?	Verspaning Service Twente B.V.	?	0	0
70181176	5117	07/12/2018	?	Verspaning Service Twente B.V.	?	0	0
70181177	5117	07/12/2018	?	Verspaning Service Twente B.V.	?	0	0
70181126	5117	14/12/2018	?	Verspaning Service Twente B.V.	?	0	0
70181117	5117	07/12/2018	?	Verspaning Service Twente B.V.	?	0	0
70181105	5117	19/11/2018	?	Verspaning Service Twente B.V.	?	0	0
70181063	5117	30/11/2018	?	Verspaning Service Twente B.V.	?	0	0
70181065	5117	07/12/2018	?	Verspaning Service Twente B.V.	?	0	0
70181070	5117	07/12/2018	?	Verspaning Service Twente B.V.	?	0	0
70181071	5117	07/12/2018	?	Verspaning Service Twente B.V.	?	0	0
70181047	5117	12/12/2018	?	Verspaning Service Twente B.V.	?	0	0
70181049	5117	14/11/2018	?	Verspaning Service Twente B.V.	?	0	0
70181050	5117	28/11/2018	?	Verspaning Service Twente B.V.	?	0	0
70181052	5117	28/11/2018	?	Verspaning Service Twente B.V.	?	0	0
70181044	5117	14/11/2018	?	Verspaning Service Twente B.V.	?	0	0
70180994	5117	21/11/2018	?	Verspaning Service Twente B.V.	?	0	0
70180995	5117	28/11/2018	27/11/2018	Verspaning Service Twente B.V.	-1	0,5	0,142857143
70181002	5117	09/11/2018	?	Verspaning Service Twente B.V.	?	0	0
70180945	5117	13/11/2018	?	Verspaning Service Twente B.V.	?	0	0
70180937	5117	22/11/2018	?	Verspaning Service Twente B.V.	?	0	0
70180917	5117	29/10/2018	?	Verspaning Service Twente B.V.	?	0	0
70180913	5117	22/10/2018	29/10/2018	Verspaning Service Twente B.V.	7	0	0
70180904	5117	02/11/2018	?	Verspaning Service Twente B.V.	?	0	0
70180861	5117	17/10/2018	?	Verspaning Service Twente B.V.	?	0	0

Totaal scor	Aantal vermeldingen	Avg score	Avg delivery da	Crediteur	Bedrijfsnaam
3,857142861	63	0,06122449	5,920634921	5025	EagleBurgmann Netherlands B.V.
5,000000005	60	0,083333333	10,81666667	5031	Christenhusz BV Non Ferro Gieterij
2,000000002	38	0,052631579	21,84210526	5072	John Crane Holland B.V.
1,571428573	42	0,037414966	23,11904762	5232	WEG Netherlands
1,857142859	28	0,066326531	6,035714286	5587	Weg Benelux SA
4,142857147	542	0,007643648	6,612546125	5801	Metaalbedrijf Burink
0,714285715	68	0,010504202	17,79411765	6278	Freeze Cast Europe SL
2,85714286	65	0,043956044	29,50769231	6360	JSons Foundry Pvt. Ltd
8,857142866	119	0,074429772	5,773109244	6410	wilbers werkstätten gmbh
0	25	0	51,88	6499	Mafoder foundrie

Average deviation of agreed delivery date (days)

Company	Value
Mafoder foundrie	51,88
wilbers werkstätten gmbh	5,773109244
JSons Foundry Pvt. Ltd	29,50769231
Freeze Cast Europe SL	17,79411765
Metaalbedrijf Burink	6,612546125
Weg Benelux SA	6,035714286
WEG Netherlands	23,11904762
John Crane Holland B.V.	21,84210526
Christenhusz BV Non Ferro Gieterij	10,81666667
EagleBurgmann Netherlands B.V.	5,920634921

→Dashboard

Inkooporder	Sales nr	Production nr	Date of creation	Crediteur	Kind of NCR	Related dep	Observation during	Major/	Description short	Description long	Risk category	Cost	Lot size	Number of rejects	hulp co
70220680	30220089	60220084	05-05-2023	Jsons	Casting	Engineering	IKG		Bearing cover DE com	1)The two semi-circular recesses are too deep, so		1000	4	4	1
70220909	30220158	60220146	17-03-2023	Wilbers W	Finishing	Purchase	Final inspection		Lagerstoel complete n	Inkoop heeft lagerstoel niet besteld inclusief prin		350	1	1	1
70220909	30220158	60220146	10-03-2023	Wilbers W	Dimension dev	Purchase	IKG		Motorstoel compleet	Er zijn geen kottervlakken aangebracht waardoor		75	1	1	1
70220352	30220025	60220018	08-03-2023	Freeze Cast	Delivery	Production			Machined impeller	Not all examinations have been carried out of the		4000	2	2	1
70220347	30210150	60210097	28-02-2023	Burink Met	Miscellaneous	Purchase	Production		Dichtingsringen	De huisdichtings ringen zijn niet geleverd met NA		650	4	4	1
70220351	30220025	60220018	16-02-2023	Jsons	Casting	Purchase	Production		Pumpcasing complete	During the hydrostatic test, it appears that the pu		1750	2	1	1
70220406	30220065	60220058	01-02-2023	Mafoder	Design	Engineering	IKG		SPP 25-30 pomp met	Er zijn geen kottervlakken aangebracht achter de		75	1	1	1
70220406	30220065	60220058	01-02-2023	Mafoder	Finishing	Purchase	IKG		Pumpcasing, bearing	1) In the bearing housing there is a deep groove i		500	5	3	1
70220612	30220112		13-12-2022	Burink Met	Miscellaneous	Purchase	IKG		Slijten ringen waaier	1) De waaierdichtings ring is gehard i.p.v . huisdi		75	2	2	1
70220730	30210150	60210096,6	06-12-2022	Wilbers W	Dimension dev	Purchase	IKG		Sole plate 6006838 re	Leverancier is vergeten om de M16 tap gaten t.b.v		75	4	4	1
70220570	30220111		16-11-2022	Burink Metaal		Purchase	IKG		Pompas compleet ma	Spiebaan is aan 1 zijde van pompas te lang 40mr		75	1	1	1
70210809	30210120	60210073	04-11-2022	Mafoder	Casting	Purchase	Production		Pumpcasing complete	During the hydrostatic test of the pump casing, th		1250	2	1	1
70220270	30220041		28-10-2022	Jsons		Purchase	IKG		Various deviations pu	1) Stuffingbox covers 4 pieces d Kwaliteit		1500			1
70210809	30210120	60210073	19-10-2022	Mafoder	Miscellaneous	Purchase	IKG		Pumpcasing NS6210	1) The gasket surface between the pumpcasing to		1500	2	2	1
70220473	30220064	60220060	18-10-2022	Burink Met	Miscellaneous	Purchase	IKG		Impeller wearring en	De impeller wearring en throat bush zijn niet geh		75	2	2	1
70220157	30210147	60210099	13-10-2022	Mafoder	Dimension dev	Purchase	Production		Pumpcasing machine	The tapped holes M20 (20 times) are placed on th		75	1	1	1
70220157	30210147	60210099	13-10-2022	Mafoder	Dimension dev	Purchase	Production		Pump cover machined	Tapped holes M12 (6 times) are probably made i		75	1	1	1
70220272	30220041		20-09-2022	WEG	Miscellaneous	Purchase	IKG		E-Motor	De motoren voldoen niet aan de spec.PD-220041		75	7	7	1
70220261	30220011	60220007	13-09-2022	Burink Met	Dimension dev	Purchase	IKG		Pompas	DE spiebaan die is aangebracht in de pompas is :		75	3	1	1
70220261	30220011	60220007	13-09-2022	Burink Met	Finishing	Purchase	IKG		Shaft sleeve	De boring aan de zijde van de o-ring groef is klei		75	3	1	1
70220222	30220011	60220007	06-09-2022	Mafoder	Casting	Purchase	IKG		Compleet machined Ir	Inside Intermediate Piece there is a lot of bras (s		450	3	3	1
70220384	30210104	60210065	06-09-2022	Mafoder	Dimension dev	Purchase	IKG		Pumpcasing machine	There are 12 tapped M16 holes instead of 8 tapp		350	1	1	1
70220510	30220041	60220031	19-08-2022	Burink Met	Damage	Purchase	IKG		Impeller machined	De ontlastgaten zijn in de schoepen geboord hier		1500	1	1	1
70210809	30210120	60210073	19-08-2022	Mafoder	Casting	Purchase	Production		Pumpcasing machine	Pumpcasing is leaking during hydrostatic test at		500	1	1	1
70210809	30210120		01-06-2022	Mafoder	Dimension dev	Purchase	IKG		Various castings	1) Grinding has been done again after machining		150			1
70210809	30210120	60210073	01-06-2022	Mafoder	Dimension dev	Purchase	IKG		Motorstool	The tapped holes and through holes in the top an		350	2	2	1
70210809	30210120	60210074	01-06-2022	Mafoder	Dimension dev	Purchase	IKG		Pump feet	All spotfacings are missing.		750	2		1
70210809	30210120	60210073	01-06-2022	Mafoder	Casting	Purchase	IKG		Pump foot	An inflow shot is missing. see pictures attached.		75	2	2	1
70220353	30220013	60220011	23-05-2022	Burink Met	Dimension dev	Purchase	IKG		Waaier compleet bew	Van 1 waaier is de boring na het aanbrengen na		1500	2	2	1
70210635	30210098	60210059	17-05-2022	Mafoder	Casting	Purchase	Production		Pumpcasing NS	Pump casing is leaking during hydrostatic test se		750	2	1	1
70220177	30210083	60210050	28-03-2022	Burink Met	Dimension dev	Purchase	IKG		Waaier	1) De waaiers zijn niet voorzien van een radius R		250	3	3	1
70210640	30210104		17-03-2022	Mafoder	Casting	Purchase	Production		Pumpcasing	During the hydrostatic test it appears that the pu		750	7	7	1
70210640	30210104		01-03-2022	Mafoder	Design	Engineering	Production		Pompvoet/pomphuis	De pompvoet heeft op steekcirkel 530 mm 8 gater		900			1
70210640	30210104		23-02-2022	Mafoder	Dimension dev	Purchase	IKG		Pumpcasing machine	The inside of the pump casing on the left-hand si		0	6	6	1
70210817	30210120		04-02-2022	Burink Met	Dimension dev	Purchase	IKG		Huisdichtingsring tek	1) De huisdichtings ringen zijn volgens tekening :		0			1
70210501	30210094	60210047	01-02-2022	Mafoder	Dimension dev	Purchase	IKG		Discharge casing LS 6	1) The discharge casing is machined according d		75	1	1	1
70220002	30210104	60210066	26-01-2022	Burink Metaal		Purchase	IKG		Boring waaier 45H7	De penkaliber 45H7 past niet na het aanbrengen		75	2	2	1
70220001	30210104		26-01-2022	Burink Met	Dimension dev	Purchase	IKG		Boring waaier	De penkaliber 45H7 past niet na het aanbrengen		75	3	3	1
70220006	30210093	60210058	26-01-2022	Burink Met	Dimension dev	Purchase	IKG		Boring waaier	De penkaliber 25H7 past niet na dat de spiebaan		75	1	1	1
70210787	30210104	60210063	17-12-2021	Burink Met	Dimension dev	Purchase	IKG		Waaiers	De spiebanen die aangebracht zijn door Burink zi		75	4	4	1
			17-12-2021	Burink Met	Dimension dev	Purchase	IKG			De spiebaan die is aanbracht ziet er niet uit en de		75			
	30210066		16-12-2021	Mafoder	Miscellaneous	Purchase	IKG		Stuffing box cover dw	1) Threaded hole 1/2" drain in stuffing box cover		750	8	8	1

Som van hulp constant

Totaal
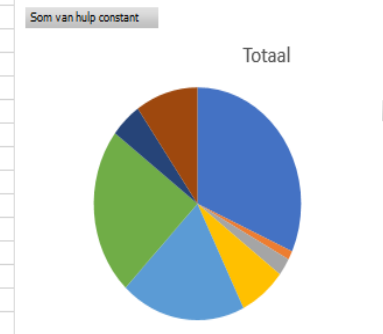
Kolomlabels

	Burink Metaal	Christenhusz	Freeze Cast	Freeze
Som van Cost	9165	75	575	
	0,252375052	0,00206526	0,0158337	
	0,747624948	0,99793474	0,9841663	

kpi score

| | 0,180461194 | 0,2408808 | 0,2375574 | |

→Dashboard

Van Dijk, W.M. (Student - BSc IEM) | UNIVERSITY OF TWENTE.

Inkooporder	Sales nr	Production n	Date of creation	Crediteur naam	Kind of NCR	Related department	Observation durin	Major/	Descrip	Descrip	Risk cat	Cost	Lot size	Numbe	hulp co
70220680	30220089	60220084	05-05-2023	Jsons	Casting	Engineering	IKG		Bearing cc	1)The two semi-circu		1000	4	4	1
70220909	30220158	60220146	17-03-2023	Wilbers Werkstatten	Finishing	Purchase	Final inspection		Lagerstoe	Inkoop heeft lagerst		350	1	1	1
70220909	30220158	60220146	10-03-2023	Wilbers Werkstatten	Dimension deviatic	Purchase	IKG		Motorstoe	Er zijn geen kottervl:		75	1	1	1
70220352	30220025	60220018	08-03-2023	Freeze Cast Europe	Delivery	Purchase	Production		Machined	Not all examinations		4000	2	2	1
70220347	30210150	60210097	28-02-2023	Burink Metaal	Miscellaneous	Purchase	Production		Dichtingsr	De huisdichtings ring		650	4	4	1
70220351	30220025	60220018	16-02-2023	Jsons	Casting	Purchase	Production		Pumpcasi	During the hydrostat		1750	2	1	1
70220406	30220065	60220058	01-02-2023	Mafoder	Design	Engineering	IKG		SPP 25-30	Er zijn geen kottervl:		75	1	1	1
70220406	30220065	60220058	01-02-2023	Mafoder	Finishing	Purchase	IKG		Pumpcasi	1) In the bearing hou		500	5	3	1
70220612	30220112		13-12-2022	Burink Metaal	Miscellaneous	Purchase	IKG		Slijten rin	1) De waaierdichting		75	2	2	1
70220730	30210150	60210096,6	06-12-2022	Wilbers Werkstatten	Dimension deviatic	Purchase	IKG		Sole plate	Leverancier is verget		75	4	4	1
70220570	30220111		16-11-2022	Burink Metaal		Purchase	IKG		Pompas cc	Spiebaan is aan 1 zij		75	1	1	1
70210809	30210120	60210073	04-11-2022	Mafoder	Casting	Purchase	Production		Pumpcasi	During the hydrostat		1250	2	1	1
70220270	30220041		28-10-2022	Jsons		Purchase	IKG		Various de	1) Stuffing Kwaliteit		1500			1
70210809	30210120	60210073	19-10-2022	Mafoder	Miscellaneous	Purchase	IKG		Pumpcasi	1) The gasket surface		1500	2	2	1
70220473	30220064	60220060	18-10-2022	Burink Metaal	Miscellaneous	Purchase	IKG		Impeller v	De impeller wearrin		75	2	2	1
70220157	30210147	60210099	13-10-2022	Mafoder	Dimension deviatic	Purchase	Production		Pumpcasi	The tapped holes M:		75	1	1	1
70220157	30210147	60210099	13-10-2022	Mafoder	Dimension deviatic	Purchase	Production		Pump cov	Tapped holes M12 (6		75	1	1	1
70220272	30220041		20-09-2022	WEG	Miscellaneous	Purchase	IKG		E-Motor	De motoren voldoer		75	7	7	1
70220261	30220011	60220007	13-09-2022	Burink Metaal	Dimension deviatic	Purchase	IKG		Pompas	DE spiebaan die is a:		75	3	1	1
70220261	30220011	60220007	13-09-2022	Burink Metaal	Finishing	Purchase	IKG		Shaft slee	De boring aan de zij		75	3	1	1
70220222	30220011	60220007	06-09-2022	Mafoder	Casting	Purchase	IKG		Compleet	Inside Intermediate		450	3	3	1
70220384	30210104	60210065	06-09-2022	Mafoder	Dimension deviatic	Purchase	IKG		Pumpcasi	There are 12 tapped		350	1	1	1
70220510	30220041	60220031	19-08-2022	Burink Metaal	Damage	Purchase	IKG		Impeller r	De ontlastgaten zijn		1500	1	1	1
70210809	30210120	60210073	19-08-2022	Mafoder	Casting	Purchase	Production		Pumpcasi	Pumpcasing is leakir		500	1	1	1
70210809	30210120		01-06-2022	Mafoder	Dimension deviatic	Purchase	IKG		Va	nding has been		150			1
70210809	30210120	60210073	01-06-2022	Mafoder	Dimension deviatic	Purchase	IKG		Motorstoc	The tapped holes an		350	2	2	1
70210809	30210120	60210074	01-06-2022	Mafoder	Dimension deviatic	Purchase	IKG		Pump fee	All spotfacings are m		750	2		1
70210809	30210120	60210073	01-06-2022	Mafoder	Casting	Purchase	IKG		Pump foo	An inflow shot is mis		75	2	2	1
70220353	30220013	60220011	23-05-2022	Burink Metaal	Dimension deviatic	Purchase	IKG		Waaier co	Van 1 waaier is de bc		1500	2	2	1
70210635	30210098	60210059	17-05-2022	Mafoder	Casting	Purchase	Production		Pumpcasi	Pump casing is leakir		750	2	1	1
70220177	30210083	60210050	28-03-2022	Burink Metaal	Dimension deviatic	Purchase	IKG		Waaier	1) De waaiers zijn nio		250	3	3	1
70210640	30210104		17-03-2022	Mafoder	Casting	Purchase	Production		Pumpcasi	During the hydrostat		750	7	7	1
70210640	30210104		01-03-2022	Mafoder	Design	Engineering	Production		Pompvoet	De pompvoet heeft		900			1
70210640	30210104		23-02-2022	Mafoder	Dimension deviatic	Purchase	IKG		Pumpcasi	The inside of the pu		0	6	6	1
70210817	30210120		04-02-2022	Burink Metaal	Dimension deviatic	Purchase	IKG		Huisdichti	1) De huisdichtings r		0			1
70210501	30210094	60210047	01-02-2022	Mafoder	Dimension deviatic	Purchase	IKG		Discharge	1) The discharge casi		75	1	1	1
70220002	30210104	60210066	26-01-2022	Burink Metaal		Purchase	IKG		Boring wa	De penkaliber 45H7		75	2	2	1

→Dashboard

Inkooporder	Crediteur	Orderdatum	Leverdatum (afgesproken)	Bevestigde leverdatum	Crediteur naam	Lead time	Score	Weighted score		Totaal score	Aantal vermeldir	Average lead tim
70230645	6462	26/09/2023	22/01/2024 ?		ARSOPI industrias Metalurgicas Arlindo	Incomplete data	0	0		0	0	N/A
70230646	6411	26/09/2023	27/09/2023 ?		Kuipers Air & Sea BV	Incomplete data	0	0		0	0	N/A
70230647	6529	26/09/2023	04/12/2023 ?		GMG GussTec GmbH	Incomplete data	0	0		0	0	N/A
70230642	5373	25/09/2023	27/09/2023 ?		Hydrobolt Limited	Incomplete data	0	0		0	0	N/A
70230643	6290	25/09/2023	02/10/2023 ?		Rubix	Incomplete data	0	0		0,08064516	35	
70230644	5604	25/09/2023	04/10/2023 ?		GMA-Holding BV	Incomplete data	0	0		0	0	N/A
70230639	5676	20/09/2023	22/09/2023	06/10/2023	Pritech	16	0,75	0,120967742		0	0	N/A
70230640	6568	20/09/2023	27/09/2023 ?		NPL machinefabriek	Incomplete data	0	0		0	0	N/A
70230641	5801	20/09/2023	10/01/2024 ?		Metaalbedrijf Burink	Incomplete data	0	0		0	0	N/A
70230634	5801	19/09/2023	13/12/2023 ?		Metaalbedrijf Burink	Incomplete data	0	0		0	0	N/A
70230635	5676	19/09/2023	17/01/2024 ?		Pritech	Incomplete data	0	0		0	0	N/A
70230636	5801	19/09/2023	10/01/2024 ?		Metaalbedrijf Burink	Incomplete data	0	0		0	0	N/A
70230637	5437	19/09/2023	20/09/2023 ?		Voskamp Industrietechniek B.V.	Incomplete data	0	0		0	0	N/A
70230630	6290	18/09/2023	18/10/2023 ?		Rubix	Incomplete data	0	0		0	0	N/A
70230631	5676	18/09/2023	10/01/2024 ?		Pritech	Incomplete data	0	0		0	0	N/A
70230632	5676	18/09/2023	21/02/2024 ?		Pritech	Incomplete data	0	0		0	0	N/A
70230633	5566	18/09/2023	07/02/2024 ?		Gelria Pakking B.V.	Incomplete data	0	0		1,53225807	125	
70230629	6278	15/09/2023 ?	?		Freeze Cast Europe SL	Incomplete data	0	0		0	0	N/A
70230623	6410	14/09/2023	24/01/2024 ?		wilbers werkstätten gmbh	Incomplete data	0	0		0	0	N/A
70230624	5801	14/09/2023	29/11/2023 ?		Metaalbedrijf Burink	Incomplete data	0	0		0	0	N/A
70230625	6382	14/09/2023	31/01/2024 ?		Rathi Europe GmbH	Incomplete data	0	0		0	0	N/A
70230626	5025	14/09/2023	31/01/2024 ?		EagleBurgmann Netherlands B.V.	Incomplete data	0	0		1,25	63	
70230627	5587	14/09/2023	14/02/2024	16/02/2024	Weg Benelux SA	155	0	0		0	0	N/A
70230628	6353	14/09/2023	20/09/2023 ?		Schipper	Incomplete data	0	0		0	0	N/A
70230622	6410	13/09/2023	13/09/2023 ?		wilbers werkstätten gmbh	Incomplete data	0	0		0	8	
70230616	6529	12/09/2023	20/11/2023	20/10/2023	GMG GussTec GmbH	38	0	0		0,32258065	60	
70230617	5801	12/09/2023	15/09/2023 ?		Metaalbedrijf Burink	Incomplete data	0	0		0	0	N/A
70230618	5801	12/09/2023	15/09/2023 ?		Metaalbedrijf Burink	Incomplete data	0	0		0	0	N/A
70230619	6462	12/09/2023	20/11/2023 ?		ARSOPI industrias Metalurgicas Arlindo	Incomplete data	0	0		0	0	N/A
70230620	6278	12/09/2023	27/11/2023 ?		Freeze Cast Europe SL	Incomplete data	0	0		0,36290323	14	
70230621	6499	12/09/2023	24/01/2024 ?		Mafoder foundrie	Incomplete data	0	0		0,12096774	3	
70230612	5354	11/09/2023	20/09/2023 ?		Satink Hengelo B.V. Stralen & Conservere	Incomplete data	0	0		0,76612903	14	
70230613	5117	11/09/2023	13/09/2023 ?		Verspaning Service Twente B.V.	Incomplete data	0	0		0	0	N/A
70230614	5801	11/09/2023	23/10/2023	23/10/2023	Metaalbedrijf Burink	42	0	0		5,52419356	199	
70230615	5031	11/09/2023	01/11/2023 ?		Christenhusz BV Non Ferro Gieterij	Incomplete data	0	0		0	0	N/A
70230611	6462	08/09/2023	04/12/2023	04/12/2023	ARSOPI industrias Metalurgicas Arlindo	87	0	0		0	0	N/A
70230607	5117	07/09/2023	06/11/2023	06/11/2023	Verspaning Service Twente B.V.	60	0	0		0	0	N/A

→Dashboard

Inkooporder	Sales nr	Production	Date of creation	Crediteur naam	Kind of NCR	Related depart	Observation durin	Major/	Descrip	Descrip	Risk cat	Cost	Lot size	Numbe
70220680	30220089	60220084	05-05-2023	Jsons	Casting	Engineering	IKG		Bearing cc	1)The two semi-circu		1000	4	4
70210809	30210120	60220073	04-11-2022	Mafoder	Casting	Purchase	Production		Pumpcasi	During the hydrostat		1250	2	1
70210809	30210120	60220073	19-10-2022	Mafoder	Miscellaneous	Purchase	IKG		Pumpcasi	1) The gasket surface		1500	2	2
70220270	30220041		28-10-2022	Jsons		Purchase	IKG		Various de	1) Stuffing Kwaliteit		1500		
70220909	30220158	60220146	17-03-2023	Wilbers Werkstatten	Finishing	Purchase	Final inspection		Lagerstoe	Inkoop heeft lagerst		350	1	1
70220406	30220065	60220058	01-02-2023	Mafoder	Design	Engineering	IKG		SPP 25-30	Er zijn geen kottervla		75	1	1
70220730	30210150	60210096,6	06-12-2022	Wilbers Werkstatten	Dimension devia	Purchase	IKG		Sole plate	Leverancier is verget		75	4	4
70220909	30220158	60220146	10-03-2023	Wilbers Werkstatten	Dimension devia	Purchase	IKG		Motorstoe	Er zijn geen kottervla		75	1	1
70220612	30220112		13-12-2022	Burink Metaal	Miscellaneous	Purchase	IKG		Slijten rin	1) De waaierdichting		75	2	2
70210809	30210120		01-06-2022	Mafoder	Dimension devia	Purchase	IKG		Various ca	1) Grinding has been		150		
70220222	30220011	60220007	06-09-2022	Mafoder	Casting	Purchase	IKG		Compleet	Inside Intermediate		450	3	3
70220157	30210147	60210099	13-10-2022	Mafoder	Dimension devia	Purchase	Production		Pumpcasi	The tapped holes M2		75	1	1
70220157	30210147	60210099	13-10-2022	Mafoder	Dimension devia	Purchase	Production		Pump cov	Tapped holes M12 (6		75	1	1
70220510	30220041	60220031	19-08-2022	Burink Metaal	Damage	Purchase	IKG		Impeller r	De ontlastgaten zijn		1500	1	1
70220570	30220111		16-11-2022	Burink Metaal		Purchase	IKG		Pompas co	Spiebaan is aan 1 zijd		75	1	1
70220261	30220011	60220007	13-09-2022	Burink Metaal	Dimension devia	Purchase	IKG		Pompas	DE spiebaan die is aa		75	3	1
70210809	30210120	60210073	19-08-2022	Mafoder	Casting	Purchase	Production		Pumpcasi	Pumpcasing is leakir		500	1	1
70220272	30220041		20-09-2022	WEG	Miscellaneous	Purchase	IKG		E-Motor	De motoren voldoer		75	7	7
70210640	30210104		23-02-2022	Mafoder	Dimension devia	Purchase	IKG		Pumpcasi	The inside of the pu		0	6	6
70220384	30210104	60210065	06-09-2022	Mafoder	Dimension devia	Purchase	IKG		Pumpcasi	There are 12 tapped		350	1	1
70220473	30220064	60220060	18-10-2022	Burink Metaal	Miscellaneous	Purchase	IKG		Impeller v	De impeller wearrin		75	2	2
70220261	30220011	60220007	13-09-2022	Burink Metaal	Finishing	Purchase	IKG		Shaft slee	De boring aan de zijd		75	3	1
70210809	30210120	60210073	01-06-2022	Mafoder	Dimension devia	Purchase	IKG		Motorstoe	The tapped holes an		350	2	2
70210809	30210120	60210074	01-06-2022	Mafoder	Dimension devia	Purchase	IKG		Pump fee	All spotfacings are m		750	2	
70210809	30210120	60210073	01-06-2022	Mafoder	Casting	Purchase	IKG		Pump foo	An inflow shot is mis		75	2	2
70210640	30210104		17-03-2022	Mafoder	Casting	Purchase	Production		Pumpcasi	During the hydrostat		750	7	7
70210635	30210098	60210059	17-05-2022	Mafoder	Casting	Purchase	Production		Pumpcasi	Pump casing is leakir		750	2	1
70201007	30200116	60200102	02-07-2021	WEG	Miscellaneous		Client		E-Motor L	Motor maakt een ge		75	4	1
70220353	30220013	60220011	23-05-2022	Burink Metaal	Dimension devia	Purchase	IKG		Waaier co	Van 1 waaier is de bo		1500	2	2
70220177	30210083	60210050	28-03-2022	Burink Metaal	Dimension devia	Purchase	IKG		Waaier	1) De waaiers zijn nie		250	3	3
70210640	30210104		01-03-2022	Mafoder	Design	Engineering	Production		Pompvoet	De pompvoet heeft		900		
	30200116	60200102	01-07-2021	Wilbers Werkstatten	Dimension deviation		Client		Manomet	Bij deze de foto's va		500	4	4
70210817	30210120		04-02-2022	Burink Metaal	Dimension devia	Purchase	IKG		Huisdichti	1) De huisdichtings r		0		
70210501	30210094	60210047	01-02-2022	Mafoder	Dimension devia	Purchase	IKG		Discharge	1) The discharge casi		75	1	1
70210469	30210066	60210034	25-10-2021	Burink Metaal	Damage	Assembly	Production		Asbus 2-L	Tijdens de montage		425	1	
70220002	30210104	60210066	26-01-2022	Burink Metaal		Purchase	IKG		Boring wa	De penkaliber 45H7		75	2	2
70220001	30210104		26-01-2022	Burink Metaal	Dimension devia	Purchase	IKG		Boring wa	De penkaliber 45H7		75	3	3

→Dashboard

Inkooporder	Crediteur	Aangemaakt op	Regel totaal	Betalingscond.	Crediteur naam
70230645	6462	26/09/2023	€ 3.200,00	26	ARSOPI industrias Metalurgicas Arlindo
70230646	6411	26/09/2023	€ 375,00	12	Kuipers Air & Sea BV
70230647	6529	26/09/2023	€ 1.373,27	0	GMG GussTec GmbH
70230642	5373	25/09/2023	€ 889,76	5	Hydrobolt Limited
70230643	6290	25/09/2023	€ 6,12	5	Rubix
70230644	5604	25/09/2023	€ 0,00	5	GMA-Holding BV
70230639	5676	20/09/2023	€ 524,44	5	Pritech
70230640	6568	20/09/2023	€ 0,00	0	NPL machinefabriek
70230641	5801	20/09/2023	€ 0,00	5	Metaalbedrijf Burink
70230634	5801	19/09/2023	€ 0,00	5	Metaalbedrijf Burink
70230635	5676	19/09/2023	€ 61,48	5	Pritech
70230636	5801	19/09/2023	€ 0,00	5	Metaalbedrijf Burink
70230637	5437	19/09/2023	€ 0,00	5	Voskamp Industrietechniek B.V.
70230630	6290	18/09/2023	€ 0,00	5	Rubix
70230631	5676	18/09/2023	€ 26,21	5	Pritech
70230632	5676	18/09/2023	€ 459,99	5	Pritech
70230633	5566	18/09/2023	€ 0,00	5	Gelria Pakking B.V.
70230629	6278	15/09/2023	€ 3.540,00	0	Freeze Cast Europe SL
70230623	6410	14/09/2023	€ 0,00	5	wilbers werkstätten gmbh
70230624	5801	14/09/2023	€ 0,00	5	Metaalbedrijf Burink
70230625	6382	14/09/2023	€ 338,60	45	Rathi Europe GmbH
70230626	5025	14/09/2023	€ 0,00	5	EagleBurgmann Netherlands B.V.
70230627	5587	14/09/2023	€ 18.900,76	5	Weg Benelux SA
70230628	6353	14/09/2023	€ 61,60	5	Schipper
70230622	6410	13/09/2023	€ 0,00	5	wilbers werkstätten gmbh
70230616	6529	12/09/2023	€ 741,61	0	GMG GussTec GmbH
70230617	5801	12/09/2023	€ 0,00	5	Metaalbedrijf Burink
70230618	5801	12/09/2023	€ 0,00	5	Metaalbedrijf Burink
70230619	6462	12/09/2023	€ 550,00	26	ARSOPI industrias Metalurgicas Arlindo
70230620	6278	12/09/2023	€ 2.900,00	0	Freeze Cast Europe SL
70230621	6499	12/09/2023	€ 11.285,66	5	Mafoder foundrie
70230612	5354	11/09/2023	€ 295,00	5	Satink Hengelo B.V. Stralen & Conservere
70230613	5117	11/09/2023	€ 291,00	5	Verspaning Service Twente B.V.
70230614	5801	11/09/2023	€ 380,00	5	Metaalbedrijf Burink
70230615	5031	11/09/2023	€ 0,00	5	Christenhusz BV Non Ferro Gieterij
70230611	6462	08/09/2023	€ 4.500,00	26	ARSOPI industrias Metalurgicas Arlindo
70230607	5117	07/09/2023	€ 361,00	5	Verspaning Service Twente B.V.

Bedrijfsnaam	Crediteur	Totale uitgave	Aantal orders
Fluiconnecto B.V. by Manuli	5001	€ 0,00	0
A&M Consultancy & Investments	5002	€ 0,00	0
TeleSpectrum Telecommunicatie BV	5003	€ 0,00	0
AB Software Consultancy	5004	€ 0,00	0
ABB	5005	€ 1.251.838,38	35
Abird Industrial Rental Services	5006	€ 0,00	0
AKD Prinsen Van Wijmen	5007	€ 0,00	0
Allweiler AG	5008	€ 0,00	0
Allweiler Pumps Benelux	5009	€ 0,00	0
American Express	5010	€ 0,00	0
Amida Service	5011	€ 0,00	0
Ashworth Jonge Poerink BV	5012	€ 0,00	0
Atlet BV	5013	€ 0,00	0
BCS HRM en Salarisadministratie	5014	€ 0,00	0
Baan Twente B.V.	5015	€ 0,00	0
Beltman Mechanisering BV	5017	€ 0,00	0
Bennink & Ten Cate Heerenveen	5018	€ 314.394,65	125
Berco & Telva	5019	€ 0,00	0
Angst + Pfister	5020	€ 0,00	0
Boekholt aandrijftechniek	5022	€ 0,00	0
Bouwbedrijf Exterkate Borne BV	5024	€ 0,00	0
EagleBurgmann Netherlands B.V.	5025	€ 624.923,84	63
Cantorclin	5028	€ 0,00	0
Centraal Beheer Achmea	5029	€ 0,00	0
Ceratec Technical Ceramics BV	5030	€ 15.085,00	8
Christenhusz BV Non Ferro Gieterij	5031	€ 132.755,46	60
Debitel Nederland BV	5032	€ 0,00	0
Design Solutions BV	5034	€ 0,00	0
DHL International B.V.	5035	€ 0,00	0
Dichtomatik B.V.	5036	€ 565,12	14
Econosto Nederland	5037	€ 2.449,00	3
Elcas BV	5038	€ 6.143,33	14
GDF Suez Energie Nederland B.V.	5039	€ 0,00	0
Eriks BV	5040	€ 147.990,13	199
Ernst & Young Accountants	5041	€ 0,00	0
Enexis BV	5042	€ 0,00	0
Essent Kabelcom B.V.	5043	€ 0,00	0

Som van Regel totaal	Kolomlabels	
Rijlabels		Christenhusz BV Non Ferro Gieterij
⊞2015		4108,89
⊞2016		7115,67
⊞2017		1286,44
⊞2018		23013,45
⊞2019		24120,75
⊞2020		19690,13
⊞2021		16207,69
⊞2022		27394,94
⊞2023		9817,5
Eindtotaal		132755,46

Som van Regel totaal

1000000

900000

800000

700000

600000

500000

400000

Crediteur naam
- Christenhusz BV Gieterij
- EagleBurgmann B.V.
- Freeze Cast Eur
- John Crane Holl
- JSons Foundry
- Mafoder found

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Inkooporder	Crediteur	Wijziging tov bestelopdracht (vanuit Rodelta)	Crediteur naam	Vendor compliant with co
70230626	5025	no	EagleBurgmann Netherlands B.V.	
70230616	6529	yes	GMG GussTec GmbH	
70230591	6462	no	ARSOPI industrias Metalurgicas Arlindo	
70230092	5093	yes	Graveertechniek Nederland	
70220798	6305	yes	Electromach B.V.	
70220315	6157	yes	ARENDS houten-emballage	
70220242	6404	yes	James Walker Benelux B.V. **	
70220190	5040	no	Eriks BV	
70220097	5093	yes	Graveertechniek Nederland	

Crediteur	Bedrijfsnaam	Compliance % Rod	Compliance %	Aantal vermeld	aantal yes rod	aantal yes ve	weighted score
5025	EagleBurgmann Netherlands B.V.	12,70%	0	63	55	0	0
5031	Christenhusz BV Non Ferro Gieterij	8,33%	0	60	55	0	0
5072	John Crane Holland B.V.	10,53%	0	38	34	0	0
5587	Weg Benelux SA	14,29%	0	28	24	0	0
5801	Metaalbedrijf Burink	5,17%	0	542	514	0	0
6278	Freeze Cast Europe SL	8,82%	0	68	62	0	0
6360	JSons Foundry Pvt. Ltd	4,62%	0	65	62	0	0
6410	wilbers werkstätten gmbh	8,40%	0	119	109	0	0
6499	Mafoder foundrie	12,00%	0	25	22	0	0

→Dashboard

	Del. Time	Prod. Qual	Lead time	SLA compl.
EagleBurgmann Netherlands B.V.	0,06122449	1	0,01984127	0
Christenhusz BV Non Ferro Gieterij	0,083333333	0,240880798	0,005376344	0
John Crane Holland B.V.	0,052631579	1	0,005305603	0
WEG Netherlands	0,037414966	1	0,00672043	
Weg Benelux SA	0,066326531	0,239883775	0,005760369	0
Metaalbedrijf Burink	0,007643648	0,180461194	0,007142007	0
Freeze Cast Europe SL	0,010504202	0,209142227	0,00711575	0
Freeze Cast		0,237557388		
JSons Foundry Pvt. Ltd	0,043956044	0,169593642	0,001240695	0
wilbers werkstätten gmbh	0,074429772	0,232738443	0,013214963	0
Mafoder foundrie	0	0,179397703	0	0

Score	Vendor
0,27026644	EagleBurgmann Netherlands B.V.
0,082397619	WEG Netherlands
0,264484295	John Crane Holland B.V.
0,348045132	Freeze Cast
0,077992669	Weg Benelux SA
0,048811712	Christenhusz BV Non Ferro Gieterij
0,056690545	wilbers werkstätten gmbh
0,237557388	Mafoder foundrie
0,053697595	Freeze Cast Europe SL
0,080095794	JSons Foundry Pvt. Ltd
0,044849426	Metaalbedrijf Burink

→Dashboard

Beoordeling en selectieproces van de performance indicatoren

Hieronder staan een aantal performance indicatoren, incl. definitie, die wellicht van toepassing kunnen zijn voor de vendor rating tool. Deze lijst is samengesteld d.m.v. een systematic literature review (SLR) maar hierin is nog niet de voorkeur en ervaring van de stakeholders meegenomen, dus vandaar dit beoordelings/selectie formulier.

Mijn vraag is of u hieronder kan laten weten of de KPI wel of niet relevant is in uw ogen en waarom wel/niet. Ook is er onderaan het formulier nog ruimte voor eventuele eigen toevoegingen die nog niet in de lijst vermeld waren maar wel relevant zijn in uw ogen.

Administrative quality: *Frequentie van het aantal fouten in het papierwerk van de leverancier*

- ☐ Wel relevant   Toelichting:
- ☐ Niet relevant

Delivery quality: *Frequentie van het aantal fouten/schade bij de levering van/aan het product*

- ☐ Wel relevant   Toelichting:
- ☐ Niet relevant

Product quality: *In hoeverre de goederen aan de eisen voldoen (conform met de order)*

☐ Wel relevant   Toelichting:

☐ Niet relevant

Innovation level: *Denk aan lageren kosten d.m.v nieuwe designs/productie methodes*

☐ Wel relevant   Toelichting:

☐ Niet relevant

Financial risk: *Financiële situatie van de leverancier (in hoeverre ze late betalingen kunnen hebben/permitteren bijvoorbeeld)*

☐ Wel relevant   Toelichting:

☐ Niet relevant

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Legal risk: In hoeverre de leverancier zich aan de wetten/regels houdt

☐ Wel relevant   Toelichting:
☐ Niet relevant

Cost stability: *Frequentie van het aantal prijsveranderingen over een bepaalde tijdsperiode*

☐ Wel relevant   Toelichting:
☐ Niet relevant

Communication: *De reactietijd van de leverancier vanaf het moment van contact zoeken*

☐ Wel relevant   Toelichting:
☐ Niet relevant

Availability/Flexibility: *In hoeverre ze capabel zijn om zich aan te passen zoals in het geval van een verandering in een order et cetera*

☐ Wel relevant   Toelichting:

☐ Niet relevant

Contract renewal rate: *Aantal keer dat de leverancier is gecontracteerd (geeft aan of er een positieve relatie is met de leverancier)*

☐ Wel relevant   Toelichting:

☐ Niet relevant

Meeting the SLA (Service Level Agreement): *In hoeverre de leverancier nakomt wat er is afgesproken (zonder veranderingen of te kort komingen)*

☐ Wel relevant   Toelichting:

☐ Niet relevant

Lead time: *Tijd die het kost vanaf de orderbevestiging tot de levering van het product/product klaar is voor transport*

    ☐ Wel relevant   Toelichting:

    ☐ Niet relevant

Order discount: *Frequentie van kortingen aan de hand van bulk orders/vroege betalingen et cetra (wellicht ook hoogte van de kortingen hierin meenemen)*

    ☐ Wel relevant   Toelichting:

    ☐ Niet relevant

Capacity: *In hoeverre de leverancier de grootte van de orders aan kan (of dat sommige grote orders moeten worden verdeeld over kleine orders)*

    ☐ Wel relevant   Toelichting:

    ☐ Niet relevant

Opmerkingen en eigen inbreng

Geen opmerkingen, QLTC-punten zijn allemaal behandeld

Dit is de lijst van KPIs waar ik nu mee ben overgebleven na het literatuuronderzoek en de vragenlijsten. Nu is mijn vraag welke jij graag terug wilt zien in het dashboard? Als je ze allemaal terug wilt zien vink dan dit vakje aan:

In het geval dat je bepaalde KPIs niet op het dashboard wilt zien mag je ze hieronder doorstrepen.

Product quality (right specs like looks and performance etc.)

Compliance with contract/SLA (delivery date, price etc.)

Delivery time

Delivery quality (amount of times there is damage during transport)

Length of lead times

Delivered conform with order (no missing pieces

Cost of product (compared to historical data)

Cost stability (Frequency of price changes)

Effect on ROI/ total revenue (compared to historical data)

Ability to react on changes (time)

Ability to handle bigger capacity (max capacity order)

Communication time (how long does it take for them to respond)

Frequency of order discounts

Alvast bedankt!