Tampere University of Applied Sciences

Description of the supply chain processes

Case: Dr. Födisch Umweltmesstechnik AG

Emmi Pietikäinen

BACHELOR'S THESIS
May 2021

Bachelor of Business Administration
International Business

ABSTRACT

Tampereen ammattikorkeakoulu
Tampere University of Applied Sciences
Bachelor of Business Administration
International Business

Emmi Pietikäinen
Description of the supply chain processes
Case: Dr. Födisch Umweltmesstechnik AG

Bachelor's thesis 61 pages, of which appendices 8 pages
May 2021

The purpose of this thesis was to describe the overall supply chain process and provide a clear structured document of the process flow. Main goal for the case company Dr. Födisch Umweltmesstechnik AG was to have process flowcharts updated. Secondary purpose was to create document with the supply chain process descriptions and based on the data, offer improvement suggestions. Theoretical framework explores the basic parts of the supply chain that are crucial for securing successful delivery to customers and ensure customer satisfaction.

The data were collected through interviews with company representatives from Dr. Födisch Umweltmesstechnik AG. Interviews were conducted via Teams and were recorded.

Results of the analysed data presents a clear picture of company's supply chain processes and shows how they are linked to other company operations. Flowcharts combined with the process descriptions offer insight into the processes of international manufacturing company operating in three continents.

Key words: supply chain, flowchart, process descriptions, dr. födisch umweltmesstechnik ag

CONTENTS

ABBREVIATIONS AND TERMS

CEMS	Continuous Emissions Monitoring System
Dr. Födisch UMT AG	Dr. Födisch Umweltmesstechnik AG
EPC	Engineering Procurement and Construction
FB 0032	Incoming goods inspection Document
FB 0034	Test equipment overview Document
FB 0036	Test data MCA 10 Document
FB 0047	Outgoing goods quality control Document
FB 0048	Supplier evaluation / Internal and external quality control and corrective actions Document
FB 0049	FAT Factory acceptance test Document
FB 7027	Order and technical requirement Document
ESI	Early Supplier Involvement
HWIR	MCA 10 analyzer Hot Wet with Infra-Red Components
JIT	Just-In-Time management
MCA 10	Multi component hot wet gas analyzer
PLC	Programmable Logic Controller
QAL1	Certified measuring- and evaluation system
VA 01	Main Flowchart of MCA 10 product flow
VA 02	Sales Flowchart
VA 03	Project management Flowchart
VA 04-02	Product process flow of MCA 10 Flowchart
VA 07	Material purchasing Flowchart
VA 07-01	Critical parts supplier selection Flowchart
VA 07-02	Non-critical parts supplier selection Flowchart

1 INTRODUCTION

Supply chain and its effective management is essential for any manufacturing company. Its functionality affects the whole productivity of the company and has an effect all the way to successful customer experience. Dr. Födisch Umweltmesstechnik AG is a German based company, which headquarters are located in Markanstädt near Leipzig. Dr. Födisch Umweltmesstechnik AG has years of experience in the field of process- and environmental (CEMS) engineering combined with profound knowledge of environmental legislation which enables ideal and customer customized solutions. Their success story is the Multi- component hot gas MCA 10 analyzer/system, which will be used as an example product throughout this supply chain description. Dr. Födisch Umweltmesstechnik AG will be referred in the text from here on as Dr. Födisch UMT AG.

The purpose of this thesis is to describe the overall supply chain process and provide a clear structured document of the process flow. Paper is done in cooperation with Dr. Födisch UMT AG which is providing professional aspect on supply chain management and insight on their processes. As one of the major outcomes of this research is to produce a comprehensive and updated flowchart of the supply chain process at Dr. Födisch UMT AG. Need for this update came from the company and the renewed flowcharts will come in use immediately during the spring. Secondary outcome is to provide report of improvement ideas and possibilities considering company's supply chain. Qualitative research method is used to conduct the interviews with the company representatives. The style of the research is descriptive.

Opportunity to observe closely the supply chain processes of an international manufacturing company became possible when author's contact person at Dr. Födisch UMT AG hinted that there was an opportunity to conduct this research with the company. Company was looking for an objective observer who could look the whole supply chain process form a new perspective. Thesis author is interested in pursuing a career in the supply chain management field and found studying and describing the whole process most satisfying. Author finds that this

paper will provide useful ideas for processes improvement and can act as a guideline for clarifying processes. Furthermore, author wishes that writing this research paper shows to future employers her interest and commitment towards the subject of supply chain management.

2 RESEARCH PLAN AND FRAMEWORK

2.1 Research Problem

There are two main purposes for this research paper. Main outcome of this research paper for the Dr. Födisch UMT AG is to have updated flowcharts of company's supply chain processes. Need for the updated flowcharts as previously mentioned is immediate since the company is missing comprehensive and clear flowcharts that can be presented for example to customers in audit situations. Also, it was pointed out by the company's Head of corporate communication, Quality manager and safety and environmental management Mrs. Gabriele Dietrich and Quality manager of the Analysis department and the head of the production planning and inventory control Mr. Peter Siebeneich, that they were completely lacking flowchart of their supplier selection process. This was added to the research project.

Secondary purpose for this research paper is to follow the path of their hot wet multi-component gas analyser MCA 10 through the supply chain in order to describe the process by using the newly created flowcharts and based on that information provide a reported document with improvement suggestions. Mrs. Dietrich also requested a general graphical presentation of the MCA 10 product flow through the company. Research is conducted together with Mrs. Dietrich, Mr. Siebeneich and from the sales department Sales Manager Mr. Thomas Lambertz and Sales Engineer Mrs. Tarja Geue-Niemi.

Supply chains importance cannot be undermined. Supply chains are becoming noticeably more complex than they previously were. Companies now deal with multiple tiers of suppliers, outsourced service providers, and distribution-channel partners. This complexity has evolved in response to changes in the way products are sold, increased customer service expectations, and the need to respond quickly to new market demands. (Hugos, 2018)

2.2 Case company: Dr. Födisch Umweltmesstechnik AG

Figure 1: Dr. Födisch Umweltmesstechnik AG headquarter. Picture from Dr. Födisch UMT AG's customer material

Dr. Födisch Umweltmesstechnik AG, celebrating this year its 30th anniversary of founding (1991), is focused on environmental and process measurement technology for gas components and monitoring air pollutants, dust, and flow. It operates on the fields of B2B, environmental technology and international sales. All departments: management board, manufacturing, maintenance and service, project management, administration, sales, research and development, and engineering are operated from the Markranstädt headquarters as figure 1 presents.

Dr. Födisch Umweltmesstechnik AG ideology and product range is strongly based on environmental values. The whole industrial field for which company is producing their devices and analysers is aiming for environmentally friendly solutions. For example, the Markranstädt factory is operational powered by solar panels. All production work can be carried out by utilizing this energy. Company also provides charging stations for electric and hybrid vehicles to its employees free of charge. Since its foundation in 1991, Dr. Födisch UMT AG has expanded abroad and widen its product range to cover not only analyzer integration but whole system cabinets as well. During the 30 years it has developed towards the Dr. Födisch Group it is today.

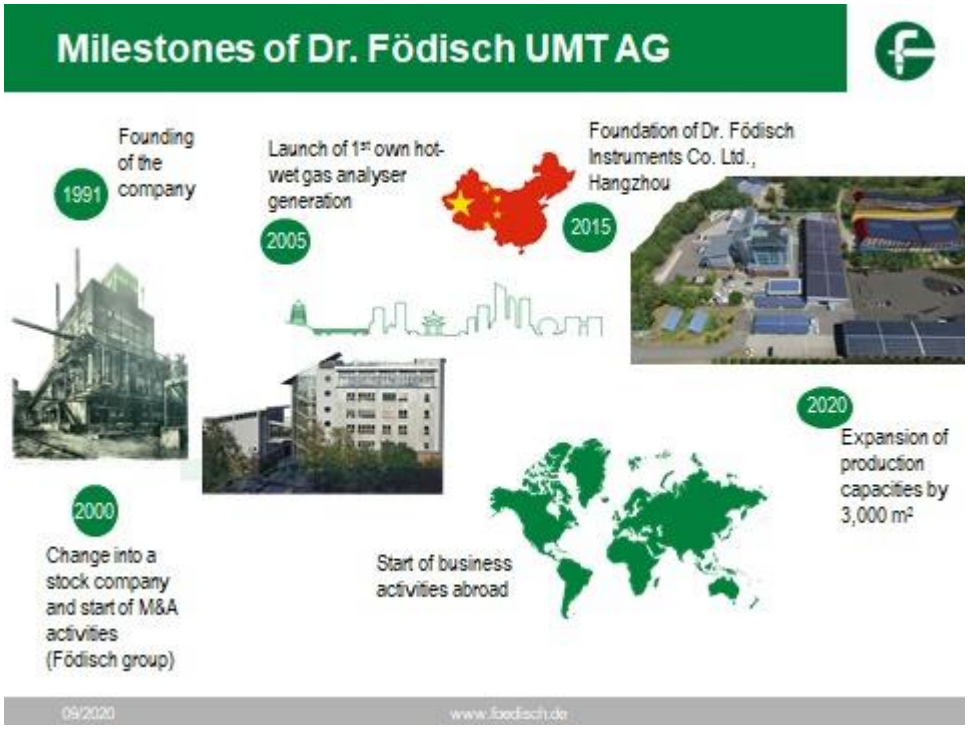


Figure 2: Milestones of Dr. Födisch UMT AG. Picture from Dr. Födisch UMT AG's customer material

Figure 2 and the following list present the milestones of Dr. Födisch UMT AG:

- 1991 Foundation of Dr. Födisch UMT Gmbh
- 1996-1998 Rebuilding and constructing the old facilities to new factory building
- 2000 Conversion to Dr. Födisch Umweltmesstechnik AG
- 2005 Launching of the 1st own hot-wet gas analyzer generation
- 2010 First service subsidiary opening in Norther Germany sales office.
- 2011 Rebuilding of industrial buildings including installation of technologies for energy and heat generation. Construction of a new building with offices, workshops; cafeteria and fitness room for the employees.
- 2015 Enlargement of product portfolio: smart sensor technology and foundation of the Dr. Födisch Instruments (Hangzhou) Co. LTD
- 2020 Starting construction for the new manufacturing hall for the gas analytics department.

The former 25-person-operation has developed to Dr. Födisch Group with about 250 employees governed by the Dr. Födisch Umweltmesstechnik AG as parent company (Dr. Födisch Umweltmesstechnik AG, 2020).

The clientele comprises for example of power plants, cement plants, waste incinerators, biomass plants and sewage sludge as well as plants for chemical and metallurgical industry. A wide service and maintenance network and on-call duties guarantees short and quick routes to customers nationwide and abroad. To ensure the success in the long run Dr. Födisch UMT AG emphasises innovations and the strategic cooperation with partners. Company has sales distributors in more than 18 countries: in Europe (two also in Finland), Asia, Middle East, Africa, South America, USA, and Canada. Measuring technology deliveries take always place from Markranstädt factory and thereby ensure the direct contact with the customer. (Dr. Födisch Umweltmesstechnik AG, 2020)

2.3 MCA 10 Multi-Component Hot Wet Gas Analyzer

Multi-component hot gas analyser / system or MCA 10 as referred from this point on, is the flagship product of Dr. Födisch UMT AG. According to material provided by Dr. Födisch UMT AG representatives, MCA 10 is an extractive measuring system for continuous emission measurement of pollutants in flue gas and for process control. The system design consists basically of three logic units: Multi component analyser MCA 10 HWIR (Hot Wet with Infra-Red Components), visualisation PC with user software and PLC for analyzer system. MCA 10 measuring methods are Bi-frequency (signal detection technique) measuring method, gas filter correlation and oxygen measurement. (Dr. Födisch Umweltmesstechnik AG, 2020) Single analyzer and analyzer installed in the system cabinet can be seen in the figure 3.

The method of hot-wet gas analysis is widely used for emissions and process measurement – in power plants, in waste incinerations, in paper, glass and cement industries and in many more. A partial flow of gaseous components is withdrawn by a sampling probe and sampling pipe and led to the analyzer cabinet. The sample gas is tempered at 185 °C for the whole gas path and monitored for flow and temperature. The multi-component analyzer is the heart of the hot-wet measuring system analysing simultaneously up to 12 gas components. (Dr. Födisch Umweltmesstechnik AG, 2020) Product is completely

designed and engineered by the company. Manufacturing takes place at Markranstädt headquarters in Germany and there are only few suppliers that can supply critical parts and components for MCA 10.

Figure 3: MCA 10 hot gas analyzer and MCA 10 installed in the cabinet. Picture from Dr. Födisch UMT AG's customer material

In the field of CEMS and process measurement, environmental laws and directives are defining the gas components to be measured and the measurements must be based on certificates and approvals. MCA 10 has type approval according to EN 15267-3, QAL1. Certificate confirms that a product meets defined criteria and defined safety-relevant aspects. The certificate specifies the basic principles according to which a product was tested. Corresponding test marks provide customers visible proof of quality to serve as a reliable decision-making aid when choosing a product. In a glance, recognized test marks are validation that product-specific quality has been checked by an independent third party. (TÜV Rheinland, 2021) It also ensures the consistency of manufacturing quality, due to the requirement of the certificate to always use the same manufacturing methods and same quality of parts.

2.4 Theoretical framework: Supply chain management

Supply chain management affects the whole functionality of the company such as Dr. Födisch UMT AG, and it is by definition: management of all activities, information, knowledge and financial resources associated with the flow and transformation of goods and services from the raw material supplier, component suppliers and other suppliers in such a way that the expectations of the end-users of the company are being met or surpassed (van Weele, 2018, p. 10). The goals of supply chain management are to reduce uncertainty and risk in the supply chain, thereby positively affecting inventory levels cycle time, processes and, ultimately, end-customer service levels (Chase, Aquilano, & Jacobs, 1998)

According to (Hugos, 2018) in order for a supply chain to support a product, it has to be moulded by the product design. The more flexible, responsive to changes and cost efficient the supply chain is, the more easily the product will succeed in its markets. Therefore, below it is described the main processes on the MCA 10 hot wet gas analyzer route from the incoming purchase order all the way from the sales department to the point when the product is leaving to the end customer. Processes relation to supply chain is also described.

2.4.1 Sales

Business to business (B2B) markets are characterized by often large and powerful buyers, purchasing predominantly for the furtherance of organizational objectives and in an organizational context using skilled/professional buyers. In B2B-selling sales department is the face of the company towards the potential customer (Jobber & Lancaster, 2015). It is often said that in B2C (Business to customer) selling customer can have strong connection with the product whereas in B2B connection is made with the salesperson. Marketing and selling in these markets are quite different from that encountered in B2C markets. Buyers are much more likely to negotiate on price. Delivery and service are particularly important. The salesperson is likely to be dealing with skilled negotiators and the process of buying, and hence selling, can extend over months (Jobber & Lancaster, 2015).

According to (Kotler & Gary, 2006) salespersons or department's primary goal is the acquisition of new customers and obtaining orders from them. Although much of their time is used in attending the old customers and building long-term customer relationships. Therefore, when talking about supply chain, sales department comes rarely first into mind. However, sales deals and orders obtained by the sales department sets in motion the next processes of supply chain.

Professional sales process consists of seven steps (Kotler & Gary, 2006):

1. prospecting and qualifying
2. pre-approach
3. approach
4. presentation and demonstration
5. handling objections
6. closing
7. follow-up

In B2B-selling rules are more formal than in B2C-selling where salesperson has more freedom with individual choices and selling strategies. Therefore, above mentioned sales process steps are mainly meant for B2B-selling. Below is shortly presented what each step includes.

First step in the selling process is prospecting and qualifying. In practice this refers to identifying qualified customers. Often a salesperson must contact several possible qualified customers before obtaining even one sale. Main purpose for this step is to have gained a coherent list of customers that could be targeted. (Çağlıaltuncu, 2020). Furthermore, some customers are extremely active in their purchasing and contact a salesperson to tender their services or product.

Second step is referred to as "doing your homework" by (Schmitz, 2012). Also (Kotler & Gary, 2006) explain that a salesperson should learn as much as possible about the organization (what it needs, who is involved in the buying). This gives the salesperson a good impression to the customer and makes the approach much easier. The better salesperson familiarizes oneself to the

potential customer, the easier the actual approach or step three is to conduct with confident and professional manner.

When presenting the product to the customer, it is vital to tell the products “story” in the most appealing way. Customer benefits should be emphasized and the solutions that the product quotations clearly presented. (Kotler & Gary, 2006) If customer has reached out to the seller this stage might seem easy. Customer is already interested in seller’s product and therefore possibly more willing to buy the product. However professional purchasers always tender their purchases and seller must come across stronger and more professional than the competition.

Fifth step or handling objections is something every salesperson is bound to face. Customers rarely accept the quotation as it is without presenting some concerns of product or the price. Professional salesperson seizes this moment as an opportunity to create stronger image of one’s own company compared to competition. Salespersons should use a positive approach, seeks out hidden objections, ask the byer to clarify any objections, take objections as opportunities to provide more information, turn the objections into reason for buying (Kotler & Gary, 2006). Much is determined on the way salesperson handles the situation and how customer feels their problems and concerns are being noticed.

Closing and successful follow-up are steps, which every salesperson pursues to achieve. Here salesperson asks the customer for an order and potential customers becomes the customer. Agreement between the two parties is reached where one is providing the solution and the other is receiving it. (Çağlıaltuncu, 2020) Right after the closure, the salesperson should complete the details on delivery, buying terms, and all the related matters. Follow-up activities will definitely help solve after-sales problems and obtain a successful overall sales transaction (Kotler & Gary, 2006).

According to (Schmitz, 2012) salespersons or sales department all together should form a list of procedures that follow every closure. That helps them to be in line with company policies and can be customer specific. Ex-customer should be conducted from time to time. Furthermore, passively following ex-customers

and keeping up with the state of needs is an aiding action while contacting ex-customers.

2.4.2 Purchasing

Purchasing refers to all activities necessary to manage supplier relationships in a such a way that their activities are aligned with the company's overall business strategies and interests (van Weele, 2018, p. 10). Any company has the potential to professionalize their purchasing management however organizing all the elements involved in the process takes time and considerable effort from the company. Procedures differ according to field being operated in and according to companies even though they would be operating in the same industry. Primary task of purchasing is securing availability of required materials and services at consistent quality from reliable suppliers. Supplier selection or sourcing is a strategic operation belonging into purchasing operations. Supplier selection as an operation of its own will be discussed more in the next chapter.

There are many strategies on how to manage the purchasing processes. One of the most famous is Kraljic's portfolio approach also called the product matrix or supplier matrix. Originally it was introduced in an article "*Purchasing Must Become Supply Management*" that was published in Harvard Business Review in 1983. Portfolio suggests that products or suppliers can be divided in to four categories leverage, strategic, routine or bottleneck and managed according to their characteristics. Depending on the product segment of the portfolio the power relationship between buyer and supplier, the supply strategy will differ (van Weele, 2018, p. 177). Power relationship is presented in the figure 4.

Leverage product is a commodity that has alternative multiple sources available. In this market there is a high possibility for tendering, and it is buyers' markets. These products can be purchased in large volumes and the market situation enables aggressive sourcing by the buyer. Usually, a leverage product represents a relatively large share of the final product's cost price.

Strategic products often represent a large share of the product's cost price and are high-tech products often supplied according to customer specification. These

are parts that cannot be easily replaced in the short term without inflicting considerable costs to the company. Acquiring these products requires patience and long-term planning from purchasers. Strategic products are at the highest risks to cause serious price fluctuation due supplier's dominant positions in the markets.

Routine products are no interest to anyone, but they must be purchased. In practice most inventory items fall into this category such as cleaning materials and office and maintenance supplies. These products are a reason why purchasing is often seen as an administrative job (van Weele, 2018, p. 177).

Bottleneck products can only be obtained from one supplier. Therefore, supply has to be secured and purchasers must be always on the look for a new possible supplier. Although, suppliers are usually technological leaders of their industry and competition is often faced with large entry barriers. Markets tend to stay monopolistic.

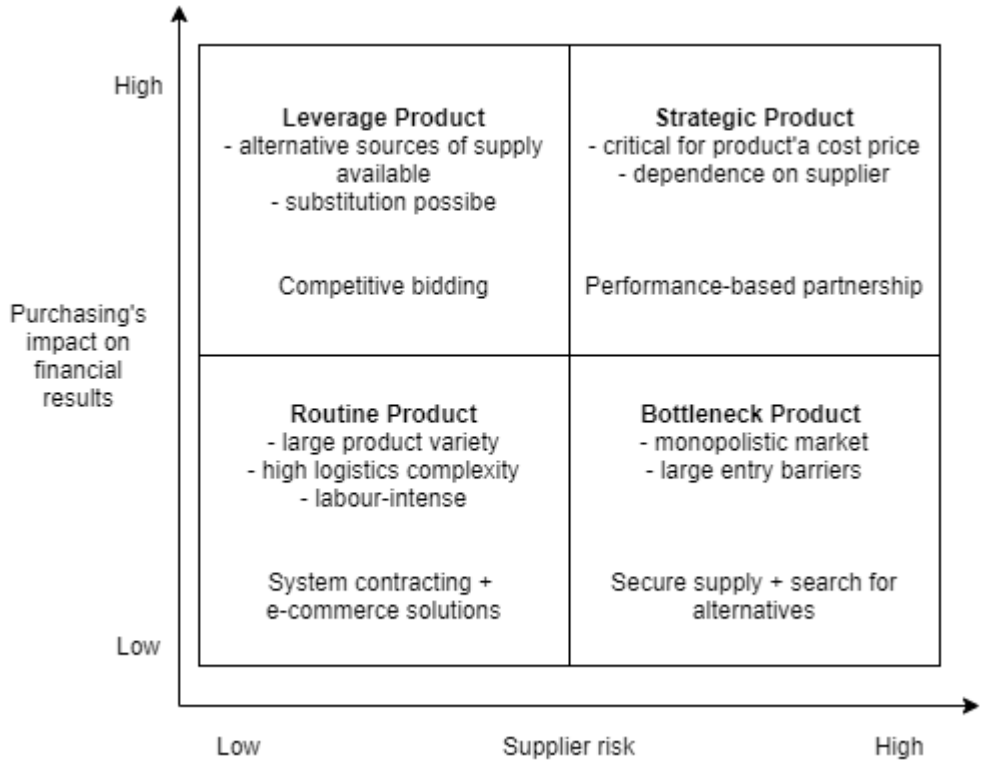


Figure 4: Product Portfolio by Peter Kraljic

Portfolio explains the financial impact of purchasing decisions in relation to supplier risk. To simplify: the higher the supplier risk is, the higher is the impact

financially. Companies should aim to balance the power relation between the buyer and the supplier. According to (van Weele, 2018) the strategic emphasizes should lay with the leverage and strategic products and companies should not waste so much energy on routine products.

Next will be presented the four basic supplier strategies that have been mentioned in the product portfolio. Identifying the category and the type of product and the type of supplier company has, helps to develop a strategic approach between the company and the supplier.

Of course, it is compelling to always have the upper hand on one's suppliers however that does not result necessarily into wanted outcome. All categories have a supplier strategy that has been redeemed suitable for the product and supplier it represents.

- Leverage supplier/product – Competitive bidding
- Strategic supplier/product – Performance-based partnership
- Routine suppliers/product – Category management
- Bottleneck suppliers/product – Securing continuity of supply

Competitive bidding is a common procurement practice that involves inviting multiple vendors or service providers to submit quotations for any particular material or service. Competitive bidding allows transparency, equality of opportunity and the ability to demonstrate that the outcomes represent the best value (GEP.com, 2021). Strategy is well applied with leverage products or suppliers which has high turnover.

Performance-based partnership is according to (van Weele, 2018) always targeted to create a participation based on pre-planned and mutually agreed cost and operational improvement targets. Together with the suppliers is often developed efficiency programmes that include cost reduction, quality improvement, process improvement and improved product development. All actions seek to develop a deeper buyer-supplier relationship that benefits both parties. Involving the supplier more closely to company's processes encourages them to stay loyal and develop their processes towards a common goal.

Category Management is a strategic approach to procurement where organizations segment their spend into areas which contain similar or related products enabling focus opportunities for consolidation and efficiency (Cips.org, 2021). Routine products and their supplier management requires a strategy that aims at reducing administrative and logistic complexity. Buyers must come up with a system that simplifies administrative routines by using for example electronic catalogues where order can be made directly from pre-selected supplier. (van Weele, 2018)

Bottleneck products/suppliers are the problem for any company. Buyer has little to no power over the supplier. Securing continuity of supply even at additional cost is necessary. At the same time efforts for finding new suppliers or products is (or should) be made in order to reduce the dependency on that one supplier. Paradox was summarized by (van Weele, 2018) when he stated that often costs involved in these actions exceed the obtained savings and therefore management has difficulties approving these actions.

Knowing in which category company's suppliers and purchased products belong to, steers the decision making towards right purchasing strategy. Usage of Kraljic's portfolio leads to differentiated purchasing strategies and points out the fact, that suppliers and products play different interest to the company.

2.4.3 Supplier Selection

Effective supplier selection management creates a strong base for efficient supply chain. (van Weele, 2018) defines supplier selection to be activities which pursue to select the best possible supplier for company's product including all the processes involving the selection process. Buying from the right supplier in the right time is essential for a manufacturing company. In this chapter the basic supplier selection process phases are introduced. Also, supplier selection is looked as a strategical operation that has effect on whole supply chain.

Supplier selection process is rather same in any business sector. The basic steps are similar regardless of the needed piece that is being purchased and the whole process can be divided in to 7 mains steps:

1. Gathering the supplier list
2. Screening of potential suppliers
3. Supplier bids
4. Supplier evaluation
5. Negotiation
6. Contracting and reviewing the decision
7. Supplier performance evaluation

Supplier list is usually already existing and can be obtained from example company's ERP-system or database unless the company in question is relatively new. Some companies are taking new suppliers on their supplier list based on other companies' recommendations or when visiting trade fairs. Second face is to shorten the list and eliminate suppliers that do not meet the criteria for the purchased piece or raw material. Based on supplier bids and their qualifications a decision is made, with whom to start negotiations, where is determined the details of the contract. The goal of a successful supplier selection is always to form a long-lasting relationship with the supplier and consider the supplier more as partner. Nature of the product also determines the nature of the relationship that the supplier is going to have with the purchasing company.

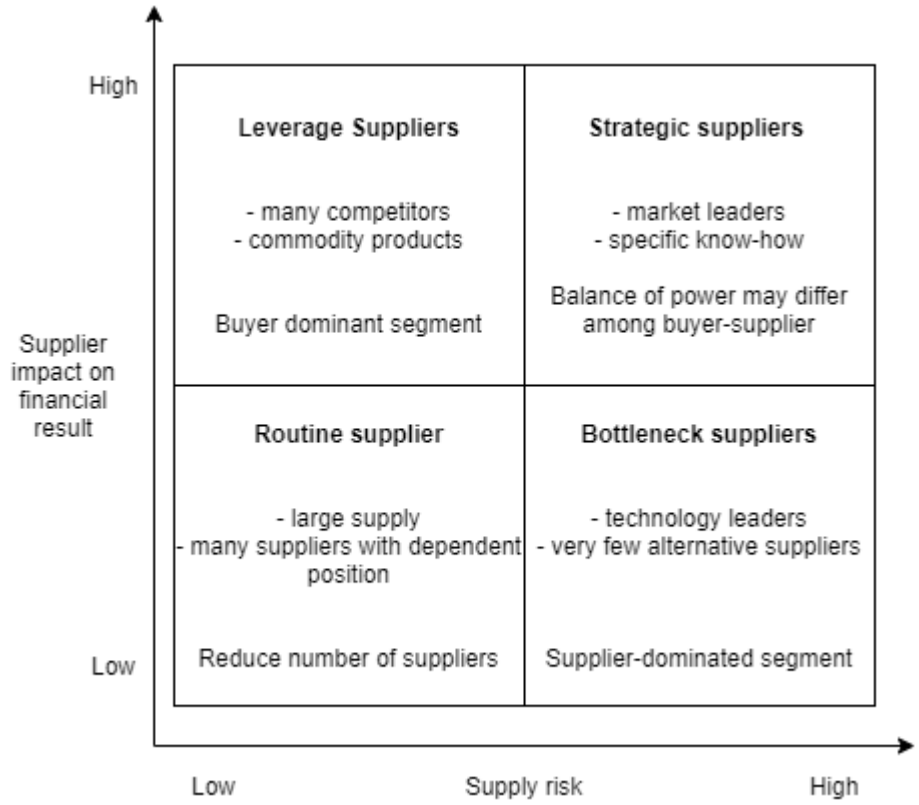


Figure 5: Supplier Portfolio by Peter Kraljic

Here is good to re-emphasise the importance of recognising the four groups of suppliers. On figure 5 is another version of the Kraljic matrix, this time concerning suppliers. It demonstrates power balance between different suppliers and the company and their position strategically. Traditional relationships between suppliers and purchasers tend to be antithetic, and generally depend on supply and demand to determine whether the supplier or purchaser is the dominant party. Under the supply chain environment, the relationship between suppliers and purchasers is changeable and available for selection (Chen, 2010).

Leverage suppliers are for commodity products and the competition is high. Buyer is extremely dominant in this segment. Supplier relationship is not balanced one and buyer can dictate the demands and supplier has no other alternative than to meet them.

Strategic suppliers represent market leaders who have the specific know-how on their segment. Supplied products cannot be easily replaced. This does not exclude competition but suppliers in this category are more likely to develop

“partnership relationship” over time. Buyer and supplier have a common interest maintaining a stable relationship.

Routine suppliers are dependent on the continuous orders of “everyday items”. Products supplied hold little value per item and competition keeps prices low and suppliers in a continuous movement. There is no time to form supplier relationship.

Bottleneck suppliers have a high advantage over the buyer since they are the technology leaders. On the market there are few if any other alternative suppliers that can supply their product. In some cases, company has only one supplier for one product and therefore the supplier can in worst case scenario increase prices, lack in customer service and have long delivery times without a fear of competitions.

Strategic supplier selection or sourcing is focused on TCO (Total Cost of Ownership) and always concentrated on long term result. TCO is defined as purchase price of an asset plus the costs of operation. Assessing the total cost of ownership represents looking at the bigger picture of what the product is and what its value is over time. (Investopedia.com, Total Cost of Ownership – TCO, 2020) Seeing the supplier selection as a continuous process rather than one-time project that is conducted together with the supplier provides significant advantages. According to (Kalliokoski, 2020) advantages gained from strategic supplier selection include costs savings, increase in quality, standardized pricing, operational efficiency, access to new suppliers and creating strong relationships with the already existing suppliers.

2.4.4 Manufacturing and Warehousing

According to (Jawalkar, 2016) manufacturing is defined as a core activity in an industry which involves conversion of raw material into finished good or product while always adding value to it. Manufacturing can be simplified to inputs and outputs. Inputs referring to raw materials or semi-finished products converted or processed by using technology to useful outputs. Output could be a finished

product or a semi-finished which requires further processing. Figure 6 below represents simplified manufacturing process.

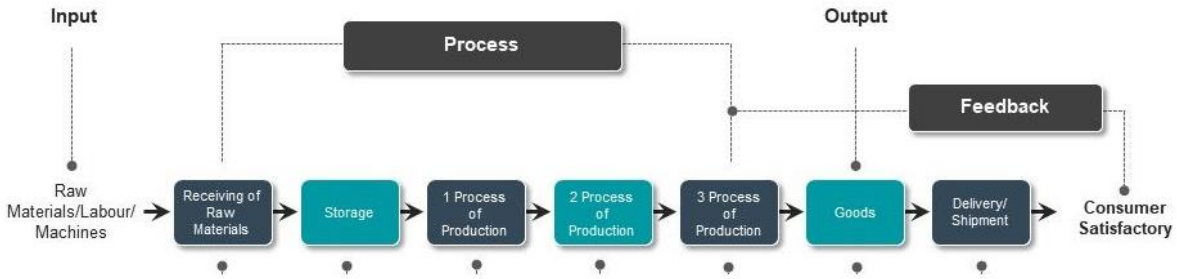


Figure 6: Basic manufacturing flowchart from slideteam.net

As the picture suggests, manufacturing could be described as a tunnel which all company efforts are passing through. Manufacturing is the reason and the cause for the company's operations and can rightly be called a core activity. Inputs are the work of sales and purchasing departments whereas outputs tie together logistic, warehousing, and sales again. Procedures within manufacturing process differ according to manufactures product, yet the starting point and the end goal are the same.

There are many manufacturing management styles and strategies. One of the most popular is Just-In-Time-management (JIT). The just-in-time (JIT) inventory system is a management strategy that aligns raw-material orders from suppliers directly with production schedules. Companies employ this inventory strategy to increase efficiency and decrease waste by receiving goods only as they need them for the production process, which reduces inventory costs. This method requires producers to forecast demand accurately. (Investopedia.com, Just in Time (JIT), 2021) JIT aims to improve work efficiency, release resources for other operations that require attention and constantly find hidden costs that are consuming the resources and money. JIT implies that nothing is produced if there is no demand (van Weele, 2018, p. 262).

JIT is a Japanese management philosophy which has been applied in practice since the early 1970s in many Japanese manufacturing organisations. It was first developed and perfected within the Toyota manufacturing plants by Taiichi Ohno

as a means of meeting consumer demands with minimum delays. Taiichi Ohno is frequently referred to as the father of JIT. Just-In-Time manufacturing has the capacity, when properly adapted to the organisation, to strengthen the organisation's competitiveness in the marketplace substantially by reducing wastes and improving product quality and efficiency of production. (IfM, 2016)

Warehouse operations have a huge financial impact to any supply chain. Efficiency and performance of the warehouse can either boost or break the delivery chain. Optimization of the warehouse processes can lead to increase in delivery performance, decreasing of the costs while at the same increasing customer satisfaction. (Soren, 2020) Soren describes the basic warehousing processes as follows:

- **Receiving** is the first warehouse process and one of the most crucial. It involves the transfer of responsibility for the goods to the warehouse.
- **Put-away** is the second warehouse process and is the movement of goods from the receiving dock to the most optimal warehouse storage location. For example, cross-docking can be used as an unloading method. It is defined as a practice in logistics of unloading materials from a manufacturer or mode of transportation directly to the customer or another mode of transportation, with little or no storage in between (Wikipedia, 2021).
- **Storage** is the warehouse process in which goods are placed into their most appropriate storage space. Storage space should be assigned according to the schedule when the goods are moving out.
- **Picking** is the warehouse process that collects products in a warehouse to fulfil customer orders. It is costliest process in the warehouse and optimizing this process will help reducing costs and increase warehouse efficiency. Using the right technologies gives a significant advantage to the successful optimization.
- **Packing** is the warehouse process that consolidates picked items in a sales order and prepares them for shipment to the customer. One of the primary tasks of packing is to ensure that damages are minimized from the time items leave the warehouse. Secondary tasks may include adding company logo or other packing materials.

- **Shipping** is the final warehouse process and the start of the journey of goods from the warehouse to the customer. Shipping is considered successful only if the right order is sorted and loaded, is dispatched to the right customer, travels through the right transit mode, and is delivered safely and on time.

Many of the world leading management styles whether it consider manufacturing or warehousing comes from Japan. It is important to acknowledge the cultural differences between Japan and European countries. In Japan it is not uncommon for work to take precedence over leisure. Even though for example Finnish and German employees are famous for their high work moral, a Japanese method cannot be implemented without cultural adaptation. Younger employees are no longer interested in manufacturing jobs because they are associated with the old lifestyle that is not seen to represent their identities or go along with their values. (Kapitan, 2019) Therefore, finding new workforce for manufacturing jobs is challenging.

In this age of liberalization and globalization, when the markets are becoming wider, the manufacturers are facing challenges to sell their products. Competitor's quote products at better prices, delivery, quality, and service in-order to remain competitive in the market. Competition enables customer wide choices; to pick from a range of products, where-as, at the same time it is a challenging activity for the company to match its competitor and deliver better products (Jawalkar, 2016).

2.4.5 Process Map

Process Map is planning and management tool that provides a visual description of the workflow. Map can also be called a flowchart and this term is being used during the thesis. Purpose of the flowchart is to present clearly who and what is involved in a process and what their functions are in it. Main goal is to improve efficiency and to provide tools to understand the whole process. (Lucidchart.com, 2021) Flowchart is simply defined as diagram that is presenting a process by using different symbols with information of the steps or sequences. Symbols are

linked together with arrows indicating the right direction of process flow. (Technopedia.com, 2021)

Flowcharts are a useful tool when processes must be explained to for example customers that are not familiar with the procedures beforehand or only have limited knowledge of the issues. Flowcharts also provide insight to company's processes for new employee. Especially with manufacturing companies' flowcharts improve the external and internal understanding of the operation and procedures inside the company. As an internal communication tool, they are valuable. When flowcharts present company's functions clearly and in a manner that is understood by everyone, it eliminates unnecessary communication and misunderstanding between different departments and increases productivity.

2.5 Data collection methods and timetable

In this chapter research process, timetable and data collection methods are introduced. Schedule for the research was short and compact. Author had set a timeline of about six-months for the project and that fitted Dr. Födisch UMT AG plans as well. During February topic was modified to fit company's purposes and March was dedicated to data collection and forming of the theoretical framework as well as preparing for the interviews. Skype meetings with the company representative Mrs. Geue-Niemi were held repetitively during the whole research process.

Interview with Mr. Siebeneich was held on April 1st. Topic of the almost two-hour interview was the supply chain and its different processes. Interviewees were asked to describe the overall supply chain process at Dr. Födisch UMT AG. Process descriptions were specified with follow-up questions. Present during the interview were also Mrs. Dietrich and Mrs. Geue-Niemi. Update interview with Mrs. Dietrich was kept on 22nd of April. On that interview next steps were determined and based on the discussion, final corrections to the flowcharts were made. Mr. Tom Lambertz was interviewed via Teams on 27th of April, concentrating on the sales aspect and company's overall view. Mr. Lambertz

offered an insight to company's history, values, and future goals. Mrs. Geue-Niemi was also present.

Primary task was to create updated flowcharts after the necessary information was gathered. Interviews and data collection were completed during April. Final versions of the flowcharts were submitted to the company at the beginning of May. Rest of the time was dedicated to analyzing the data, forming the descriptions and improvement ideas of the processes. Research paper was submitted for final evaluation in May.

Data for the thesis were collected through personal interviews with couple of key employees in Dr. Födisch UMT AG. Qualitative research method was used to conduct this research because it is primarily exploratory research and that settled in with general purpose of this research. Qualitative research method is mostly used to understand reasons, opinions, motivations and in this case processes. It also dives deeper into the problem. (DeFranzo, 2020) Interviews were held via Teams and Skype since the interviewees are living in Germany and the interviewer in Finland. Due the Covid-19 pandemic interviewer was unable to travel abroad and conduct the interviews in person. Visit to the company premises was requested by the company but due the current situation unfortunately had to be cancelled.

Interviews were chosen as the selected data collection method because of their interactive nature. While interviewing face-to-face it is easier to present follow-up questions and dive deeper on the subject. Recording the meetings ensured the possibility to recheck the spoken subjects. Since this paper considers the whole supply chain process at Dr. Födisch UMT AG, interviews are the most effective way to research the overall process and its functions. Naturally, the process required more planning since the interviews were held via Teams. When the normal face to face interaction can be interrupted due possible technical difficulties, it can be difficult to get the interviewee or the interviewer to regain focus and answering flow. Interviews were by style unstructured and could as well be referred to as "guided conversations". (McNeill, 1985)

Researchers, who take a unilingual English-dominated approach to cross-cultural interviewing, often assume that employees of international companies are fluent in English regardless of their nationality (Rebecca & Welch, 2004, p. 233). Respondents at the Dr. Födisch UMT AG speak English but the interview subject considers rather technical terms, some which can be difficult to explain in a foreign language and therefore as a common curtesy and due the interviewers lack of knowledge in technical German vocabulary, Mrs. Geue-Niemi was present the duration of all the interviews to act as a translator when needed. This was also done to prevent misunderstandings and get as validated data for the thesis as possible. Interviews were held mainly in German.

3 DATA ANALYSIS AND THE DESCRIPTION OF THE PROCESSES

In this chapter the interview results are presented. Interviews were conducted as a dialog between company representatives Mr. Siebeneich, Mrs. Dietrich, Mr. Lambertz, Mrs. Geue-Niemi and the interviewer. The results are in a form of description of the supply chain path considering Dr. Födisch UMT AG's hot wet gas analyzer MCA 10. Supply chain path is divided into smaller parts that simplify the description process and make them fit better for the company's actual supply chain procedures. Interviews were recorded and were also used to create the remodelled flowcharts.

Next is presented the process of updating the flowcharts and the need for the update is explained. New flowcharts are also used to support the process descriptions of the company's supply chain later in the chapter. On chapter 4 will be presented improvement ideas that have come up during the research project and solutions suggestions for the Dr. Födisch UMT AG to implement. Lastly chapter 5 concludes the whole process.

3.1 Updating the flowcharts

As a part of this research project company's process flowcharts were updated to meet customer requirements and company's own needs. During customer meetings, company had received comments and critic towards their already existing flowcharts. Flowcharts were said to be lacking information and unclear to follow by the customers. Therefore, updating and modernizing the flowcharts was assigned by the company as a part of this descriptive research project. Since the purpose of the thesis is to describe the supply chain process of Dr. Födisch UMT AG, remodelling the flowcharts allowed the author to study deeper their processes and fully understand the product process flow of MCA 10.

After discussions with the company representatives, it became clear that some of the processes were not described detailed enough or at all in the flowcharts. For that reason, below is presented all updated and newly created flowcharts in a numerical order. Completely new flowcharts are bolded.

- **Graphic description of MCA 10 process**
- **VA 01 Main flowchart of MCA 10 product flow**
- VA 02 Inquiry/Quotation/Order
- VA 03 Project management
- VA 04-02 Single analyzer/system product management
- VA 07 Material purchasing
- **VA 07-01 Critical parts supplier selection**
- **VA 07-02 Non-critical parts supplier selection**

The purpose of the graphic description of MCA 10 process is to provide an overall view of the product flow containing all flowcharts. Graphic description serves as an introduction to company processes that can be presented for example during first customer audits. Since flowcharts VA 03 and VA 04-02 both lay out the MCA 10's product path, through different customer request, one combined flowchart was created. It was important to create VA 01 to combine the main process flow charts VA 04-02 and VA 03 in order to have both product paths on the same paper for Dr. Födisch UMT AG employees to understand and to share with the customers. Flowchart presents the process flow of a single analyzer/single system (analytics department VA 04-02) and links it together to the overall projects with the project management (VA 03.

Supplier selection process was only mentioned in flowchart VA 07 Material purchasing even though it is a highly important process in the manufacturing of MCA 10 and should be documented in detail. Therefore, two completely new flowcharts were created, in the request of Mr. Siebeneich and Mrs. Dietrich. One for critical parts (VA 07-01) and the other for non-critical parts (VA 07-02). All remodeled and newly created flowcharts can be found in the appendices. During the next chapter, parts of the flowcharts are being used to elaborate the product patch of MCA 10.

3.2 Supply chain path of MCA 10

3.2.1 Sales

MCA 10's path through the supply chain starts with the sales department receiving an invitation of tender, inquiry from the customer. The whole sales process is pictured in the flowchart VA 02 that can be found in the appendices. Inquiry can come directly from the end customer, abroad partners or from EPC as a part of tendering. EPC or Engineering, procurement, and construction contracts are the most common form of contract used to undertake construction works by the private sector on large-scale and complex infrastructure projects. Under an EPC contract a contractor is obliged to deliver a complete facility to a developer who need only turn a key to start operating the facility, hence EPC contracts are sometimes called turnkey construction contracts (Wikipedia.com, 2021). Customers inquiring about Dr. Födisch UMT AG's product through EPC are usually more interested in the price of the sales than end customers that consider total cost of ownership while entering their inquiry.

All incoming customer inquiries and tenders will be checked and forwarded to the sales department. Inquiry is reviewed and a decision whether it is doable or not, is made. Management, R&D department, or engineering department is consulted if needed. Before submission additional information from the customer might have to be asked. The data collection for the dust measuring devices and analysis projects is carried out by means of questionnaires. This leads to termination or acceptance of the inquiry, depending on customer's specifications. Rejection with a reason for it, is sent to the customer if no quotation can be submitted.

After comprehensive overview, sales department assigns a quotation number to each quotation including the cost center number. With the given quotation number salesperson is able to access the document's information during and after the sales process if needed. Quotations are stored in ERP-system and are also stored in manual folders with the signature of the responsible salesperson. Especially when referring to older quotations, information can often be found only in the paper folders leaving the electronic version lacking. Next step in the sales process is price calculations as can be seen from the figure 7.

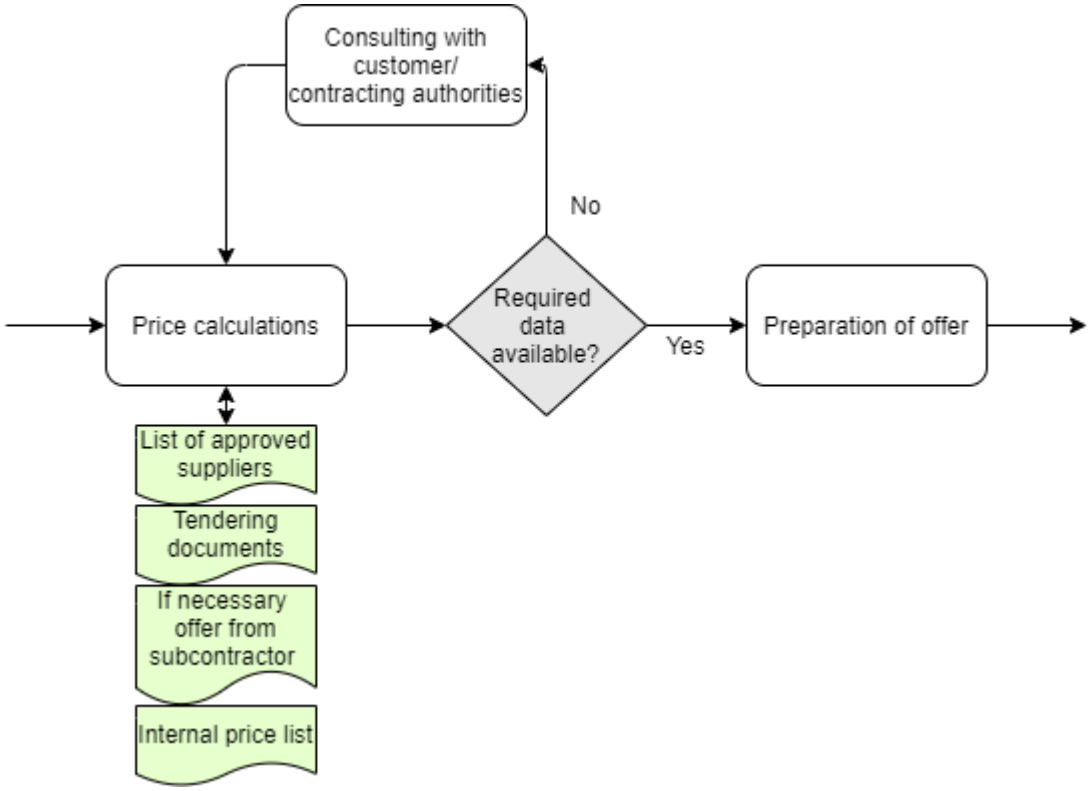


Figure 7: VA 02 Inquiry/Quotation/Order: Inquiry process and price calculations

All relevant initial data are included in the quotation calculation. Customer is contacted if they have failed to submit all needed data for the calculations. All acceptance and communication in relation to the customer is recorded and documented. Price calculations and the discussion with the customer presents an opportunity for additional sales and the possibility to make correction in the calculations. A quotation from the subcontractors will be secured already in the early stage for the larger orders. The quotation is created after the calculations are finished. When processing the quotations, the customer requirements and regulatory and legal requirements are considered. Quotation is checked together with the management and is approved by their signature before sending it to the customer.

Sales department send the quotation to the customer and takes care of the order follow-up. This means inquiring from the customer the status of the ongoing project. Purpose is to determine whether customer is going to place an order or not. Quotation is saved in the quotation folder if customer does not place an order with the written rejection or documentations of the cancellation by phone. Failed

quotations are being stored for traceability reasons. From there can be seen what could have been done differently. When a customer places an order, a quotation is assigned an order/project number. Order is overviewed and sent to either analytics or project department. Depending on the customer application MCA 10's product flow realization follows either the VA 04-02 single analyzer/single system product management flowchart or the VA 03 Project management flowchart also including implementation of other devices for example dust, flow or container.

3.2.2 Supplier selection and purchasing

Being the flagship product of their company and protected by the QAL1 certificate, MCA 10 is a heavily regulated product to manufacture and requires high commitment to quality standards from the suppliers. MCA 10 includes parts that can be described as critical. There is not a clear academic definition for what is meant by a critical part, but with MCA 10 the critical parts are the key components. Supply of the parts is not always certain. It is crucial to have a supplier that can supply parts according to the quality standards and are compatible with the QAL1 approved system cabinet.

Whether the part is critical or non-critical, selection process follows traditional path but with critical parts process has some limitations. Next will be described supplier selection process for critical parts. Process for non-critical parts is same but not as regulated. Comparison will be made alongside the description. Flowcharts for both parts (VA 07-01 Critical parts and VA 07-02 Non-critical parts) are added in the appendices.

In some cases, critical parts are being purchased in large quantities because, Dr. Födisch UMT AG does not have in some cases a secondary supplier for them. One-year buffering inventory shall be maintained which means for example keeping total of 100 units of a certain critical part in stock. Parts are stored because they are used for orders covering the sales for the year and as spare parts in case of a failure is detected or reported by a customer. Purchasing takes this into account when planning purchasing strategy.

Critical and non-critical parts are purchased when stock levels decrease below predetermined level defined by manager, which is carried out in company's ERP system. New supplier must be selected, if supplier for the critical parts is unable to deliver the needed amount or they have changed their product. When suppliers change their product there is a risk that the product or offered substitute will no longer be compatible with Dr. Födisch UMT AG's final product. Development department at Dr. Födisch UMT AG starts planning for a possible replacement for the part, considering the QAL1 requirements, when there are continuous availability problems with existing supplier, or the part is not available in the open markets. Figure 8 shows the beginning of the supplier selection process for critical parts at Dr. Födisch UMT AG.

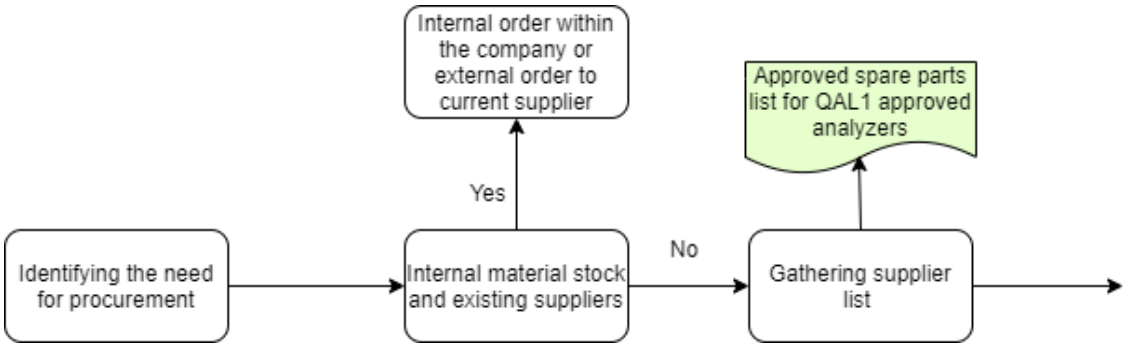


Figure 8: VA 07-01 Critical parts supplier selection: Beginning of the process

Process for supplier selection, whether it is for critical or non-critical part, begins by identifying the need for material procurement. ERP-system alerts what part is below appropriate stock level and sets the process in motion. Primary source for parts in all cases is internal material stock. Purchasing process is transferred to the manufacturing department and an internal order is placed if a part can be acquired internally or from already existing supplier.

When a part cannot be acquired internally or from an existing supplier, a list of suppliers is gathered. By using the already existing supplier database and comparing it to the approved spare parts list, it is determined which supplier could deliver the required product. Project engineer/managers can however submit suggestions to sales or to executive management for orders concerning suppliers which are not yet in the approved supplier list. When gathering the supplier list, most important requirement is that supplier can ensure the compatibility with QAL1 certificated system cabinet. These requirements are valid for critical and

non-critical parts. Figure 9 continues the supplier selection processes by showing the decision-making process.

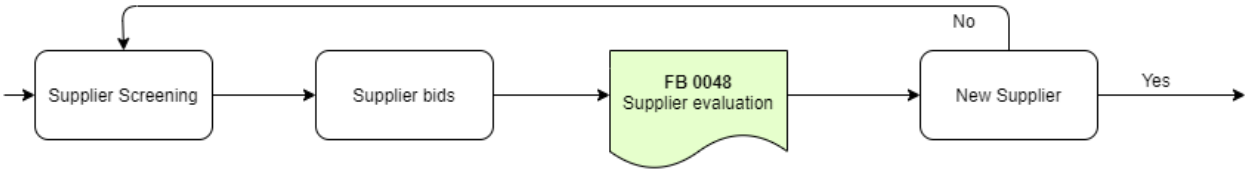


Figure 9: VA 07-01 Critical parts supplier selection: Choosing the supplier

After the suppliers have been selected from the list, the screening begins. Suppliers are pre-evaluated according to previous experiences and database information. Characteristics of the part determines how suppliers are contacted. The more important the part is the more detailed requirements are being set to the suppliers.

Suppliers are presented with one of the following types of inquiries depending on the part.

1. Normal inquiry
2. Inquiry with a set of drawings. Supplier must manufacture the part based of these drawings.
3. Inquiry with a set of drawings. Supplier must manufacture the part based on these drawings and send back a sample piece for evaluation.

Suppliers are qualified to participate the bidding, if they can follow the drawings or/and produce a sample piece that has been evaluated and tested suitable. However, possibility for supplier tendering with critical part suppliers is rarely possible since options are limited. Here supplier selection for non-critical parts differs from the critical parts due the fact that tendering is widely possible and even recommended for the non-critical parts. When looking at non-critical part and critical part suppliers at Dr. Födisch UMT AG, they can be placed in Kraljic supplier portfolio (figure 5). To generalize, it can be said that non-critical part suppliers are leverage suppliers and critical part suppliers bottleneck suppliers. Therefore, bidding differs in these two categories due their strategical nature. One

is suitable for competitive bidding and with the others securing continuous supply is the most important factor as discussed in chapter 2.

When all suitable suppliers have attended bidding, a selection is made based on availability, reliability, and quality. Criteria for non-critical suppliers is more concentrated on price, availability, flexibility, and the reputation of the supplier. Both supplier categories are being evaluated by company's form FB 0048. After supplier has passed all the evaluations and quality controls, supplier selection is submitted to CEO or Sales Manager for an approval. Supplier is added to the list of approved suppliers and the process continues to negotiations if management complies with the decision. Otherwise, the whole process is restarted from supplier screening.

Figure 10: VA 07-01 Critical part supplier selection: Concluding the process

Figure 10 presents the end of the critical part and non-critical part supplier selection flowchart and shows how the process is concluded. Negotiations are being held according to normal procedures between the company and the chosen new supplier. Discount negotiations must be conducted with the manufacturer or supplier before ordering if those have not already been agreed. Negotiations are being held between two or three best ranked suppliers if the supplier in question is for non-critical part. Bottleneck suppliers tend to have more influence over the company in these negotiations than desired. Then again, with leverage suppliers the dominant party is undeniably the buyer. After contracting and when supplier has delivered their first patch, suppliers' performance is evaluated. Document FB 0048 Supplier evaluation is being utilized throughout the process for non-critical and critical part suppliers. Evaluation form is already mentioned in the figure 6.

Purchasing is primarily carried out through the sales department by acceptance of the management for devices/systems and maintenance/services. Analytics, R&D, and engineering department purchase themselves in their respective

areas, however not all employees with contact to customers are allowed to carry out their purchasing process. Dr. Födisch UMT AG does not have a centralized purchasing process for all its departments. Each project engineer/manager is self-responsible for sourcing the required project materials. Except the standard and small materials which will be purchased by each individual department production manager. All other materials, which has a quality-relevant influence on company's services, facilities, devices, etc. will only be purchased by the manufacturers or suppliers, whose quality have been confirmed. For that, supplier data files are kept in the ERP which can only be operated by production planning and management.

Next description follows the path of material purchasing after supplier selection has been made or supplier has been chosen from the database. Order documents are created with specification's details and the quality-relevant requirements including the reference to discount agreements, after which the order is placed. The orders contain at least the following information:

- Exact material description and technical material data
- Exact description of the scope of services
- Technical specifications, including delivery standards, quality, environmental and safety requirements
- Quantity of items and packaging

If any changes are made to the already stored documents with the reference number, they are checked and approved. They are made available and sent to the supplier. Figure 11 begins to describe the material purchasing process.

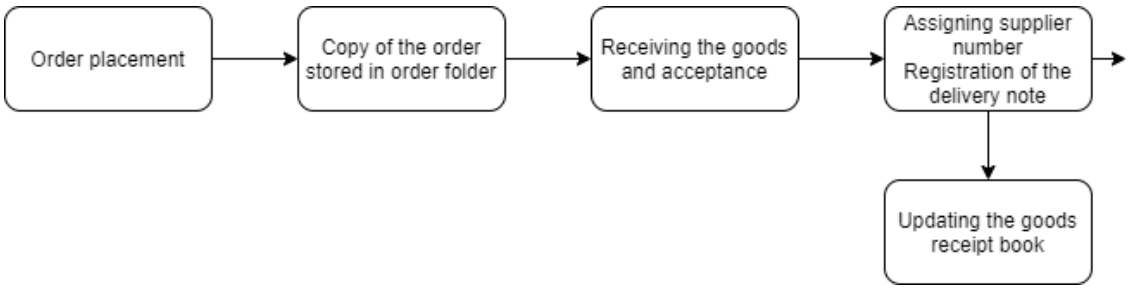


Figure 11: VA 07 Material Purchasing: Order placement and receiving of the goods

Order to the selected or already existing supplier is placed by the corresponding purchasing department and the order is stored on the order folder. Order has to be submitted to CEO or Sales Manager for approval, if total order value exceeds the agreed amount of 200€. The acceptance of goods takes place in one joint centre. All incoming goods are checked for intactness and damages by the warehouse management and the accuracy of the information is checked. After the goods are received the delivery note number is assigned. Using the number purchaser or relevant employee can access the files. Delivery note is registered, and the goods receipt book is updated. Project description and the customer information can be seen on the delivery note. Updating the goods receipt book is not automated or linked with the ERP-system and information is stored in a physical book that must be filled manually.

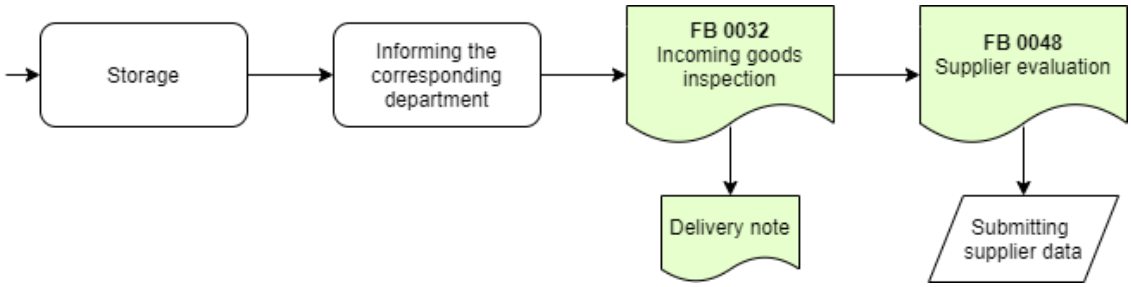


Figure 12: VA 07 Material Purchasing: Order handling and supplier evaluation

The goods are assigned to the storage area. Storage bins are set up for larger projects to have all deliveries belonging to the project together. Department that has made the purchasing order is being informed after the goods have been received and stored as can be seen from the figure 12. The delivery note remains with the goods until the corresponding department has carried out the incoming goods inspection and has confirmed the correctness of the delivery on the delivery note. The delivery note is then filed at secretariats office in the delivery note folder. Goods are being subjected to inspection and for critical parts company uses the form FB 0032 Incoming goods inspection. Supplier evaluation is being done by using the form FB 0048 Supplier evaluation, that has been previously mentioned. Suppliers' information is submitted to the database when inspection and evaluation has been found satisfactory.

3.2.3 Manufacturing and warehousing

Manufacturing process of the MCA 10 takes place at the company premises at headquarters in Markranstädt. After the sales department has secured a customer order, a process method for the order is determined by the Sales Manager. Whether the order is for a single analyzer/system or it is for a complete system with more devices such as dust or flow monitoring device determines which flowchart to follow:

- VA 04-02 Single analyzer/system product management or
- VA 03 Project management

This process description follows the path of a single MCA 10 hot wet gas analyzer and therefore next will be presented the processes of the flowchart VA 04-02 that describes MCA 10's product flow through the company. Both complete flowcharts can be found in the appendices.

Gas analysis department manufactures all MCA 10s even if customer order would belong under the management of project management. In these cases, internal order is made by the project engineer/manager to the gas analysis department. Otherwise, the internal order is always made by the sales department and order documents are handed over to the corresponding department. FB 7027 Order and technical Requirement MCA 10 is filled by the analysis department director or project engineer/manager. FB 7027 is a form that has detailed information on the wanted qualities of MCA 10. Form also includes schedule and deadline dates. Form FB 7027 follows the whole manufacturing process from start to the end and it is updated on the way.

Figure 13 presents the order processing stage of the MCA 10 product flow. Order processing is dived in to two tasks: creation of the drawings and the documents. Purchasing process is started according to flowchart VA 07 that was described in the previous chapter, if during the creation process is noticed that some parts are not available in storage. From the figure 13 can be seen that purchasing and supplier selection are strongly linked with the whole process and close cooperation is required with all departments.

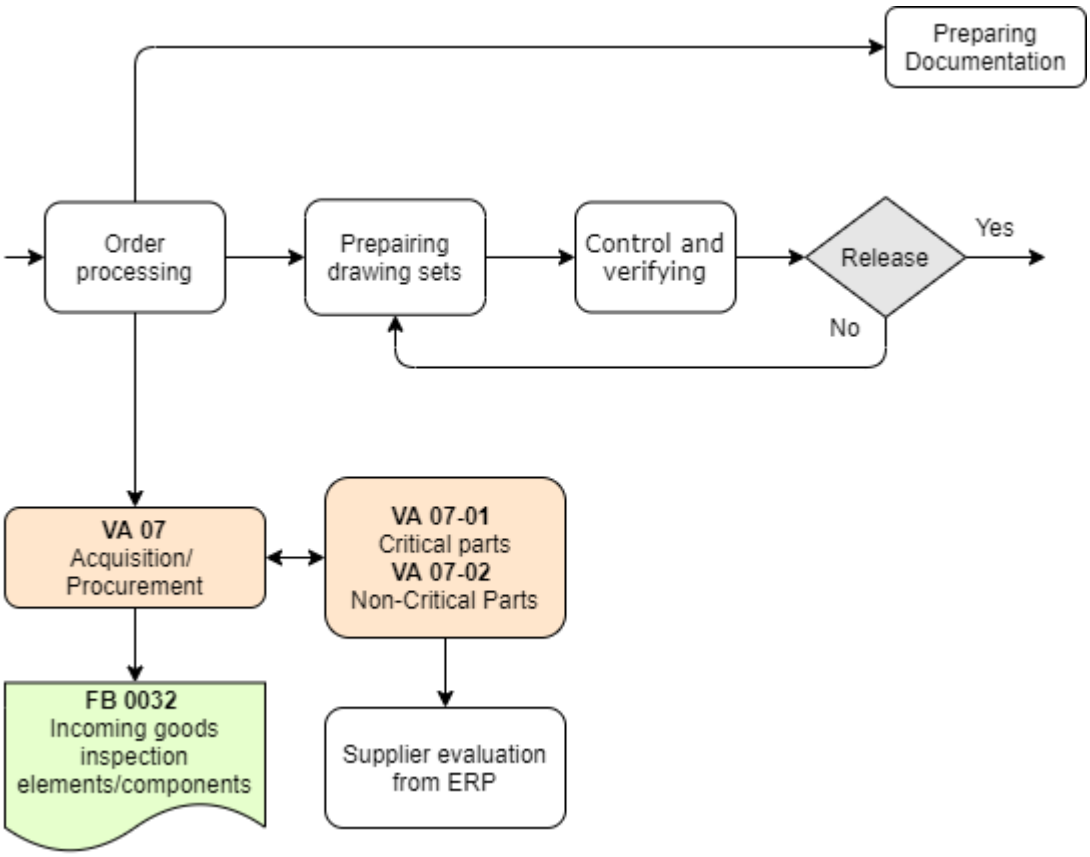


Figure 13: VA 04-02 Single analyzer/system product management: Order Processing

Drawing sets are being made according to customers' requirements, always considering legal and regulatory provisions. Drawings are provided to the customer for inspection before cabinet is being assembled. Person in charge coordinates customer order technically and in content wise.

After customer acceptance begins the assembly of the cabinet. At Dr. Födisch UMT AG there are detailed manufacturing instructions, so called blue maps, on how MCA 10 is to be constructed. Before assembly, all test equipment is checked and approved by using form FB 0034 Test equipment overview. Whole manufacturing process is controlled by production manager who also conducts the schedule control of the process. Referring to worldwide lack of professional handworkers despite constant search, there can occasionally occur manufacturing process problems. Designated specialists are a few and they are the key personnel who knows every detail of the manufacturing process and the product.

Assembled product is subjected to thorough testing and results are recorded on the forms FB 0036 Test data MCA 10 and FB 0047 Outgoing goods quality control. Form FB 0048 Internal and external quality control and corrective actions and supplier evaluation is being used for internal and external quality control. On this stage it is used for finding and reporting failures that can be corrected before product leaves to the customer. Later during the process, the same form is being used when receiving possible failure or error report from the customer referring the assembled product. When defect is detected, process follows company's flow chart VA 14 Improvement process gas analysis. Internal quality control prior to shipping includes both the cabinet and the documentation.

Factory Acceptance Test (FAT FB 0049) is a test conducted to determinate if the requirements of the order specification or the contract are met. FAT is carried out by customer request and it includes testing different areas of analyzer's/systems' functionality in the presence of the customer. Test is non-compulsory and paid by the customer and it is always conducted at the Markanstädt headquarters. After the test customer either approves the product or it is sent back to the manufacturing stage for corrections. During the FAT, customer training is also provided. All the mentioned quality control forms and how they are linked to the whole process are shown in figure 14. Customer is then informed of the completion and the release of the cabinet. Delivery date and the method of transport is agreed together with the customer.

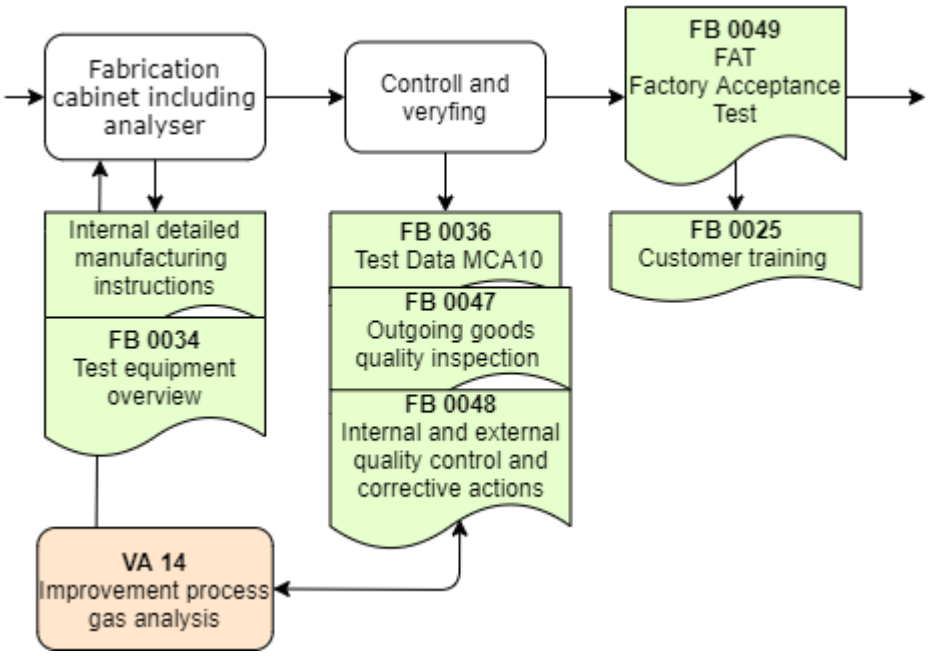


Figure 14: VA 04-02 Single analyzer/system product management: Manufacturing and quality control

4 IMPROVEMENT IDEAS

Dr. Födisch Umweltstechnik AG has a well-functioning supply chain. They have been able to overcome some of the obstacles that are inevitable when manufacturing a heavily regulated product as MCA 10. However, while looking at the company's processes as an outsider with no previous relationship with the company, the author has identified few development targets. Some of them were brought up early in the research process and some were noticed during the data analysis process. Author wishes that these ideas prove to be useful and could be implemented and modified to fit Dr. Födisch UMT AG's processes.

4.1 Supply of the critical parts

One of the biggest threats concerning the product flow of MCA 10 is **securing the availability of the critical parts**. Now critical parts only have one supplier therefore, the supply chain is vulnerable to delays, price fluctuations, and uncertainty with the delivery. Supply process of the critical parts is relying on supplier dominant markets which is not ideal for Dr. Födisch UMT AG. As it was stated on chapter 3, critical part suppliers can be placed at Kraljic's supplier portfolio in the category of bottleneck suppliers. Supplier holds the dominant position over the company due their technological leadership, leaving the company with a few, if any leverages during negotiations. Bottleneck suppliers cannot be easily replaced as it is the case at Dr. Födisch UTM AG and therefore securing the supply of the critical parts is not guaranteed.

In order to have more secure supply for the critical parts, supplier relationship has to be developed into more favourable direction. It would be beneficial for the company if critical part supplier could be moved from being a bottleneck supplier to a strategic supplier. Strategic supplier is seen more as a cooperative partner rather than adversary. These suppliers are market leaders in their field with the specific know-how. Relationship between the buyer and the supplier is more balanced than with the bottleneck supplier. It is driven by a common interest from both parties towards sustainable, profitable, and long-lasting relationship.

Early supplier involvement or ESI is an effective way to engage the supplier's interest towards the common goal. Early supplier involvement can be seen as a means to integrate suppliers' capabilities in the customer's (Dr. Födisch UMT AG's) supply chain and operations, thereby making it possible for the customer to take advantage of the suppliers' technological expertise in design and manufacturing (Meriläinen, 2018). It would increase supplier's involvement and commitment to the overall process, if Dr. Födisch UMT AG were to engage a potential supplier, after severe supplier screening, by allowing them to take part in the designing of the critical part. Furthermore, collaborative efforts reduce costs and create competitive advantages to the company.

4.2 Further development of the flowcharts

During this thesis process company's flowcharts were updated according to their needs and customer requirements. Although new flowcharts have been created there is still a need for more process flowcharts. Couple ideas came up in the discussions with the company representatives.

While interviewing company's Sales Manager Mr. Thomas Lambertz, flowchart VA 02 Inquiry/Quotation/Order was examined. For the flowchart to function better for the company's purposes, it should be expanded to cover new customer acquisition and market research processes. Dr. Födisch UMT AG operates in a very niche market and therefore describing their **new customer acquisition and customer market research processes in a flowchart** would provide a clear overview of the two processes. It makes identifying possible flaws and problem points easier and would provide a solid base for process development. More detailed description of the customer acquisition concentrating on the partner companies abroad would help to solve the problem of finding good and reliable partners.

It was said by Mr. Lambertz that if there are no plants to be build, no analyzer can be sold. Identifying every market opportunity is vital and therefore finding the best tools for fine tuning the sales processes will in the long term create significant

competitive advantages. Thereby increasing customer satisfaction with efficient and well targeted market actions.

At the moment, MCA 10's **manufacturing process** does not have a **flowchart** of its own. Process is being described generally in flowcharts VA 04-02 single analyzer/system product management and VA 03 Project management. These flowcharts present the whole process not just the manufacturing part. VA 03 is concentrated on the whole project and its process flow and VA 04-02, even though it applies to MCA 10, as well describes the overall product process flow leaving manufacturing description rather short. An idea of a separate flowchart dedicated solely to manufacturing process of MCA 10 was formed.

Having separate flowchart of manufacturing process clarifies the process and makes it easier to understand for employees and customers whether the process in question is a single analyzer to be manufactured or a whole system cabinet. This would make company's internal communication better and external communication more customer friendly when there is no room for misunderstandings. People are often visual learners and that applies as well in customer-buyer situations.

When transferring process flowcharts as an internal communication tool, it can be an asset in manufacturing. Naturally, all companies have instructions for their products, but a basic flowchart can be a simple starting point in understanding the process. After clear and general understanding of the process, employees are more confident to continue with their work. Company's instruction maps (the blue maps) contain detailed instructions with photographs how to manufacture MCA 10 and other devices and will provide the next steps for the employees.

4.3 Modernizing processes

Firstly, all the company's **data should be transformed into electronic form**. Now Dr. Födisch UMT AG has some practices involving information flow that are carried out manually. For example, the above-mentioned **blue maps** only exist in their physical from. Also, the **goods receipt book** is a physical book that is being

updated manually. Nowadays consistent and quick information flow is vital to any company and manual inputs are being automated whenever possible. Of course, operations should always be monitored by an employee or manager. Optimization of the processes saves time and releases resources for another use.

Dr. Födisch UMT AG is changing their ERP system at the end of 2021 and should integrate all available data into it. When data is accessible by everyone and everywhere, information flow is fluent, and the change of miscommunication is decreased. When data is stored primarily in one location that is used by everyone, all added information or notes are accessible if needed. **At the sales department, automatization can be applied to order follow-up**. Order follow-ups are currently being set manually by the sales engineers from their emails. For example, sales engineer sets the quotation email to come up in their email again after two weeks from submitting the quotation to carry out order follow-up process. Follow-up process is important for obtaining the wanted sale and should therefore be automatized either by integrating it to the new ERP system or automating the email option. This way could be ensured a continuous and smooth customer experience.

As mentioned in the chapter 3.2.2 Dr. Födisch UMT AG does not have **centralized purchasing or warehousing.** At the moment all departments purchase individually what is needed. For example, all departments purchase simple screws by themselves missing volume purchase discounts and engaging more employees into the same operation than would be necessary.

Competitive advantages for centralized purchasing are for example:

- Possibility for volume purchasing, which means greater discounts and better terms and provides known, centralized contact for suppliers, which in return can lead to cost and time savings.
- Allows for more comprehensive control and optimization of inventory.
- Resource reallocation

Warehousing operations are semi centralized since goods are arriving at a warehouse or docking area from where they are distributed to each department separate warehouse. At Dr. Födisch UMT AG processes could be centralized in

to one warehouse from where the goods could be distributed directly to the departments removing the extra docking stage.

Warehousing is expensive and optimizing those processes will reduce company's overall costs and boost other operations. Advantages of centralized warehousing are similar to centralized purchasing and the two operations could be looked as supportive operations for each other's. Handling incoming goods becomes more efficient and unnecessary cost are reduced. Also, inventory control is simplified when purchasing and warehousing operations are managed through single department.

4.4 Competent workforce

One problem that came up during the interview with Mrs. Dietrich and Mr. Siebeneich was that it is difficult to find **new capable employees**. Even after comprehensive training, employees are lacking skills to perform their work tasks. Generation now entering working life is no longer interested in manufacturing jobs and lack interests towards the manufacturing field all together. This shift among younger employees' attitudes can also be seen in Finland. Generation Y (born between 1981-1996) and generation Z (born between 1997-2015 (Kasasa, 2021)) do not look the same aspects in a job as employees 20 or 30 years ago. When looking through their lifestyle and values, manufacturing work is associated with old times and monotonic repetition.

Claire Kapitan says in her blog Why Manufacturing's Not Cool (2021):
"If Generations Y and Z have a chance to learn that manufacturing work is the future, where their ideas and imaginative minds have a place, there will be more of a response and eagerness to fill these jobs."

Manufacturing (regardless of the product that is being manufactured) is seen as not environmentally friendly work. Dr. Födisch UMT AG should sell themselves to specifically younger potential employees as an "manufacturing company on a mission to save the planet, one analyzer or system at the time". Younger people could also be interested in a training program that is tailored to their interest. By

emphasizing the green values of the company and all the environmental action it is currently doing, interest towards manufacturing and Dr. Födisch UMT AG could be raised. Using the latest technology (not the blue maps) to train new employees gives a fresh and modern feel of the company. Engaging Generation Y and Z by interactive learning allows them to utilize their full potential. Younger generations want to have the feeling of making a difference and by offering the opportunity to be involved with the process, employees are more committed to the work they are performing and will not lose their interest to learn.

5 CONCLUSION

Supply chain management is considered an integrating function with a primary responsibility for linking major business functions and business processes within and across companies into a cohesive and high-performing business model (Grant, Trautrims, & Wong, 2017). An effective supply chain ensures for a manufacturing company their success and customer satisfaction. Dr. Födisch UMT AG's supply chain has challenges due their product range and their manufacturing regulations, however those have been efficiently overcome.

The two research questions of the research paper are answered in the data analysis and in the process descriptions. Process descriptions were made according to interviews and were based on the updated and newly created flowcharts. Purpose of the flowcharts is to offer better understanding of the company's processes and can be used in both internal and external communication as was requested by the company. Supply chains are changing rapidly more complex and managing them efficiently requires full knowledge of the processes and how they link with other company operations. According to (Hugos, 2018) for a supply chain to support a product, it has to be moulded by the product design. Purpose of the process descriptions is to present the adjustable supply chain of Dr. Födisch UMT AG and act as a base for the possibility of creating even more detailed flowcharts of individual processes. Descriptions revealed some issues that still needed further development and the improvement ideas aim to offer solutions for them.

Improvement targets are as follows:

- Securing the availability of the critical parts
- Further development of the flowcharts (manufacturing and sales)
- Transforming manual data into electronic form
- Automatization of order follow-up process
- Centralize purchasing and warehousing processes
- Present company more appealing to new competence workforce

Every supply chain is different and requires its own approach towards its threats and problems. It is good to remember that no theory is perfect and that they

should always be adapted to fit company's own vision, values, and operating methods. Future vision of the Dr. Födisch UMT AG is to always be flexible and to offer exactly what the customer wants by supplying every kind of devices, analyzers and systems. Fulfilling that vision requires close cooperation between departments and understanding of the whole process that takes place when offering customer excellent customer service and a product they need. Supply chain must be viewed as a system, not as a group of individual entities doing its own thing (Morga, 2020).

REFERENCES

Çağlıaltuncu, M. (2020). *Evaluation of sales process and development needs.* Tampere University. Tampere: Trepo. Retrieved April 12, 2021, from https://trepo.tuni.fi/bitstream/handle/10024/124228/CaglialtuncuMert.pdf?sequence=2&isAllowed=y

Chase, R. B., Aquilano, N. J., & Jacobs, F. R. (1998). *Production and Operations Management: Manufacturing and Services* (8th ed.). Jeffrey J. Shelstad. Retrieved March 23, 2021

Chen, Y.-J. (2010, August 3). Structured methodology for supplier selection and evaluationin a supply chain. *Information Sciences 181*, 1651- 1670. Elsevier Inc. Retrieved March 22, 2021

Cips.org. (2021). *Category Management*. (C. I. Supply, Producer) Retrieved April 16, 2021, from https://www.cips.org/knowledge/procurement-topics-and-skills/strategy-policy/category-management/

DeFranzo, S. E. (2020). *What's the difference between qualitative and quantitative research?* Retrieved March 15, 2021, from Snapsurveys.com: https://www.snapsurveys.com/blog/qualitative-vs-quantitative-research/

Dr. Födisch Umweltmesstechnik AG. (2020). Company and MCA 10 system presentation. Markranstädt, Germany. Retrieved May 8, 2021

Dr. Födisch Umweltmesstechnik AG. (2020). *Dr. Födisch Umweltmesstechnik AG*. Retrieved 2021, from https://www.foedisch.org/company/

Eeherald.com. (2017, February 16). *Electronic Component Sourcing: Supplier and Component Selection guide (part-4)*. Retrieved April 2, 2021, from http://www.eeherald.com/section/sourcing-database/component_sourcing_guide4.html

GEP.com. (2021). *What is meant by competitive bidding?* Retrieved April 15, 2021, from https://www.gep.com/knowledge-bank/glossary/competitive-bidding

Grant, D. B., Trautrims, A., & Wong, C. Y. (2017). *Sustainable Logistics and Supply Chain Management: Principles and practices for sustainable operations and management* (2nd ed.). Koganpage. Retrieved April 16, 2021, from https://web-b-ebscohost-com.libproxy.tuni.fi/ehost/ebookviewer/ebook/ZTAwMHh3d19fMTQ5NDU

0NF9fQU41?sid=0f6e4b38-875b-4af3-a71b-1555cb7a0994@sessionmgr101&vid=0&format=EB&lpid=lp_155&rid=0

Hugos, M. H. (2018). *Essentials of Supply Chain Managment.* John Wiley & Sons Incorporated. Retrieved Marc 29, 2021, from http://ebookcentral.proquest.com/lib/tampere/detail.action?docID=5313438

IfM, I. f. (2016). *JIT Just-in-Time manufacturing*. (U. o. Cambrige, Editor) Retrieved May 10, 2021, from https://www.ifm.eng.cam.ac.uk/research/dstools/jit-just-in-time-manufacturing/

Investopedia.com. (2020, July 28). Retrieved April 14, 2021, from Total Cost of Ownership – TCO: https://www.investopedia.com/terms/t/totalcostofownership.asp

Investopedia.com. (2021, April 28). *Just in Time (JIT)*. Retrieved May 10, 2021, from https://www.investopedia.com/terms/j/jit.asp

Jawalkar, C. S. (2016). *Introduction to Basic Manufacturing.* Aplha Science International. Retrieved March 29, 2021

Jobber, D., & Lancaster, G. (2015). *Selling and Sales Management* (10th ed.). Edinburgh: Pearson Education Limited. Retrieved April 12, 2021, from https://web-a-ebscohost-com.libproxy.tuni.fi/ehost/ebookviewer/ebook/bmxlYmtfXzE0MTkzNTFfX0FO0?sid=a0065a3f-7673-42d7-ba25-37f3b5ec3315@sdc-v-sessmgr02&vid=0&format=EB&lpid=lp_vii&rid=0

Kalliokoski, S. (2020). *Tampere University of Applied Sciences.* Retrieved April 14, 2021, from Intro to purchasing operations: https://moodle.tuni.fi/course/view.php?id=14455#section-0

Kapitan, C. (2019, February 28). *Why Manufacturing's Not Cool*. Retrieved May 10, 2021, from IndustryWeek: https://www.industryweek.com/leadership/article/22027236/why-manufacturings-not-cool

Kasasa. (2021, January 13). *Boomers, Gen X, Gen Y, and Gen Z Explained*. Retrieved May 11, 2021, from https://www.kasasa.com/articles/generations/gen-x-gen-y-gen-z

Kotler, P., & Gary, A. (2006). *Principles of Marketing* (11th ed.). Pearson Prentise Hall. Retrieved April 12, 2021

Lucidchart.com. (2021). Retrieved March 3, 2021, from What is Process mapping: https://www.lucidchart.com/pages/process-mapping

McNeill, P. (1985). *Research Methods.* London: Tavistock Publications. Retrieved March 3, 2021

Meriläinen, S. (2018). *Development of Early Supplier Involvement (ESI) Process -Study for a Case Company.* Oulu University of Applied Sciences. Oulu: Theseus. Retrieved April 23, 2021, from https://www.theseus.fi/bitstream/handle/10024/140624/Merilainen_Sami.pdf?sequence=1&isAllowed=y

Morga, S. (2020, February). Warehouse Management. Tampere, Finland: Tampere University of Applied Sciences. Retrieved May 11, 2021

Rebecca, M.-P., & Welch, C. (2004). *Handbook of Qualitative Research Methods for International Business.* Cheltenham: Edvard Edgar Publishing Limited. Retrieved March 3, 2021

Schmitz, A. (2012). *Powerful Selling.* Creative Commons. Retrieved April 12, 2021, from https://2012books.lardbucket.org/books/powerful-selling/index.html

Soren, M. (2020, March 18). *Reduce your warehouse costs with capazity optimization*. Retrieved May 10, 2021, from mixmove.io: https://www.mixmove.io/blog/how-to-reduce-warehouse-costs?gclid=Cj0KCQjws-OEBhCkARIsAPhOkIbk480v2LZ6YsJIf7UvoqVjQNzrh-mFHF4NpW9qnhBa5UVDiyJgbRoaAt_eEALw_wcB

Technopedia.com. (2021). *Flowchart*. Retrieved March 23, 2021, from https://www.techopedia.com/definition/5512/flowchart

TÜV Rheinland. (2021). *Product certification: Product testing and test mark as proof of quality*. Retrieved March 10, 2021, from https://www.tuv.com/world/en/product-certification.html

van Weele, A. J. (2018). *Purchasing and supply chain management* (7th ed.). Andover: Cenage Learning. Retrieved March 3, 2021

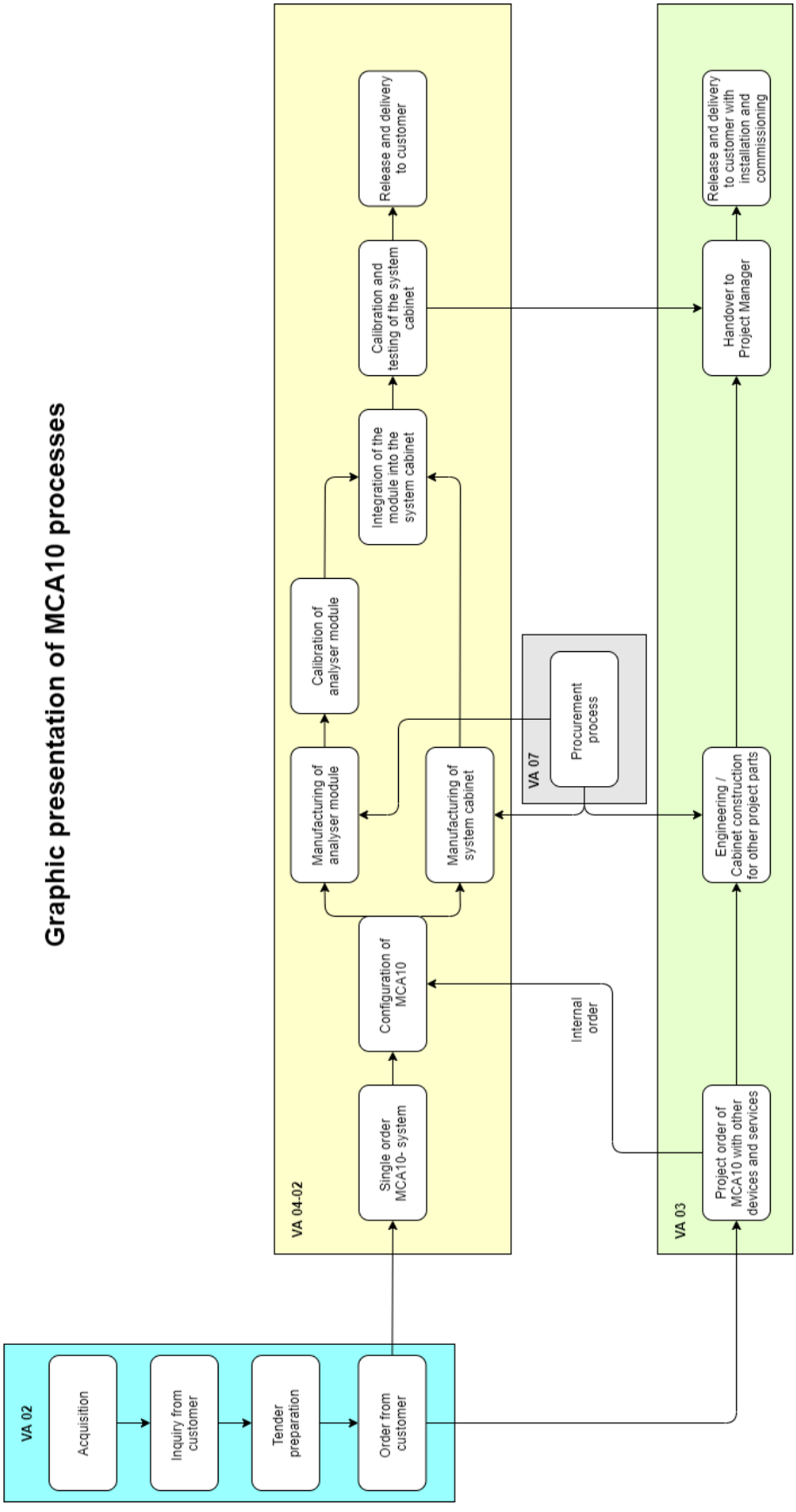
Wikipedia. (2021, May 2021). *Cross-docking*. Retrieved May 10, 2021, from https://en.wikipedia.org/wiki/Cross-docking

Wikipedia.com. (2021). *Engineering, procurement, and construction*. Retrieved May 8, 2021, from

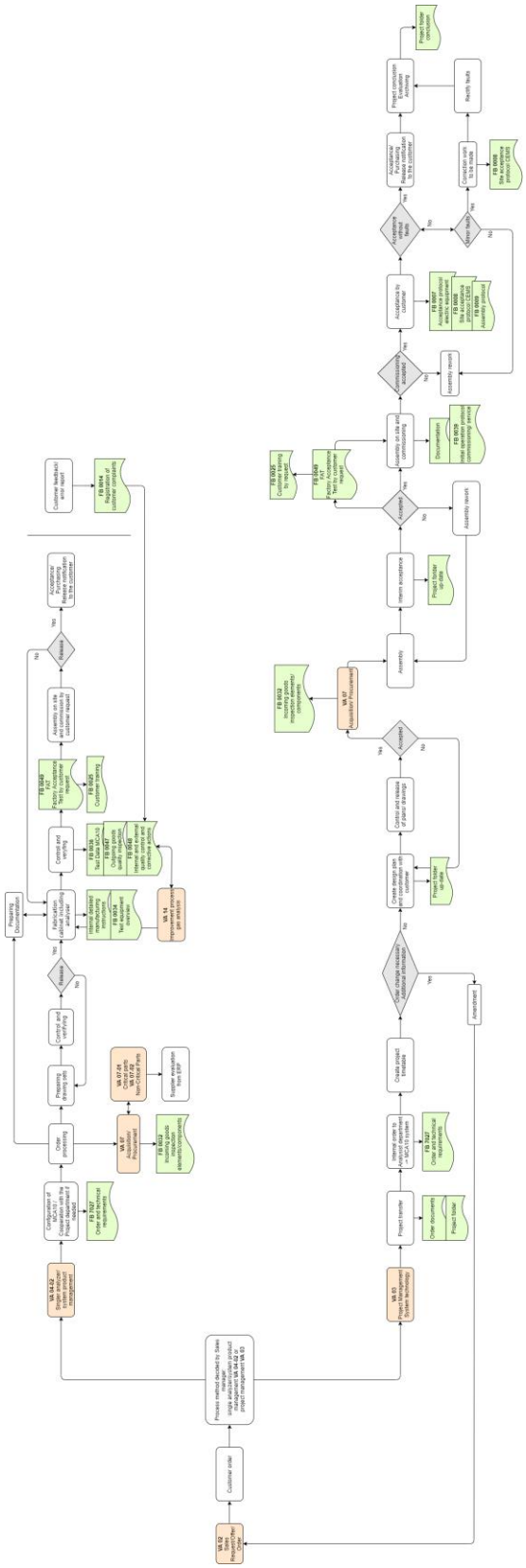
https://en.wikipedia.org/wiki/Engineering,_procurement,_and_construction

APPENDICES

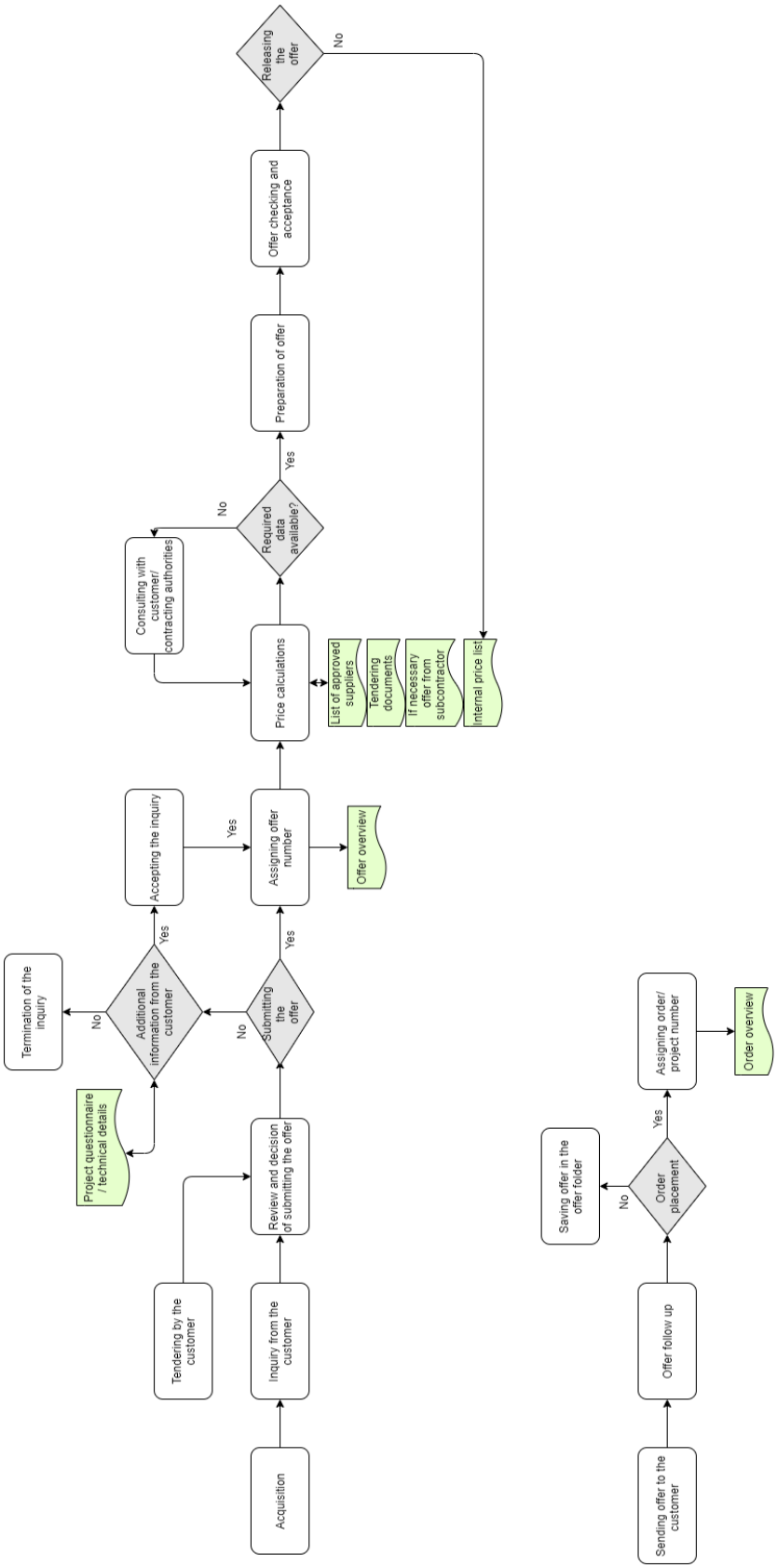
Appendix 1. Graphic description of MCA 10 process



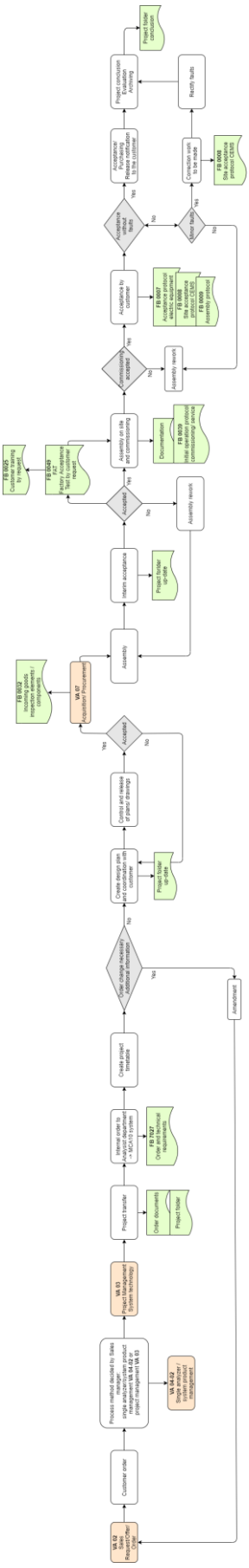
Appendix 2. VA 01 Main flowchart of MCA 10 product flow



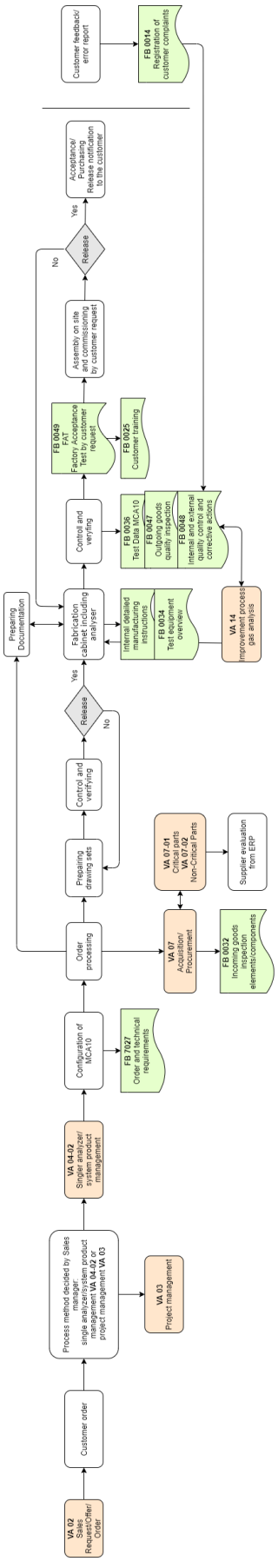
Appendix 3. Flowchart VA 02 Inquiry/Quotation/Order



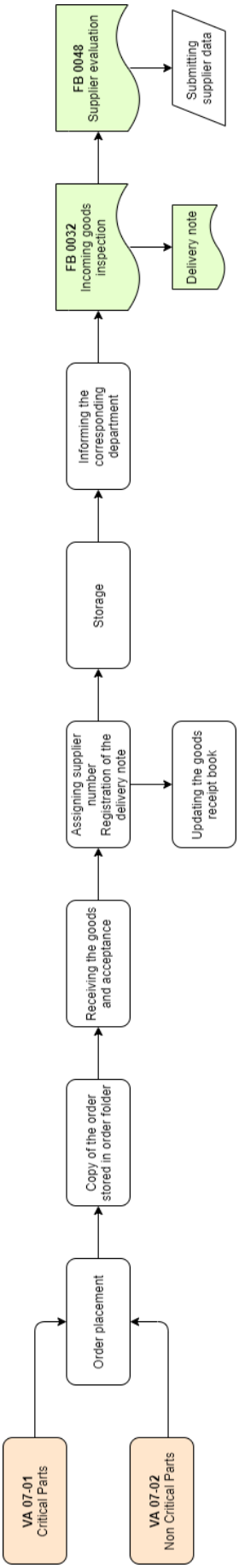
Appendix 4. Flowchart VA 03 Project Management



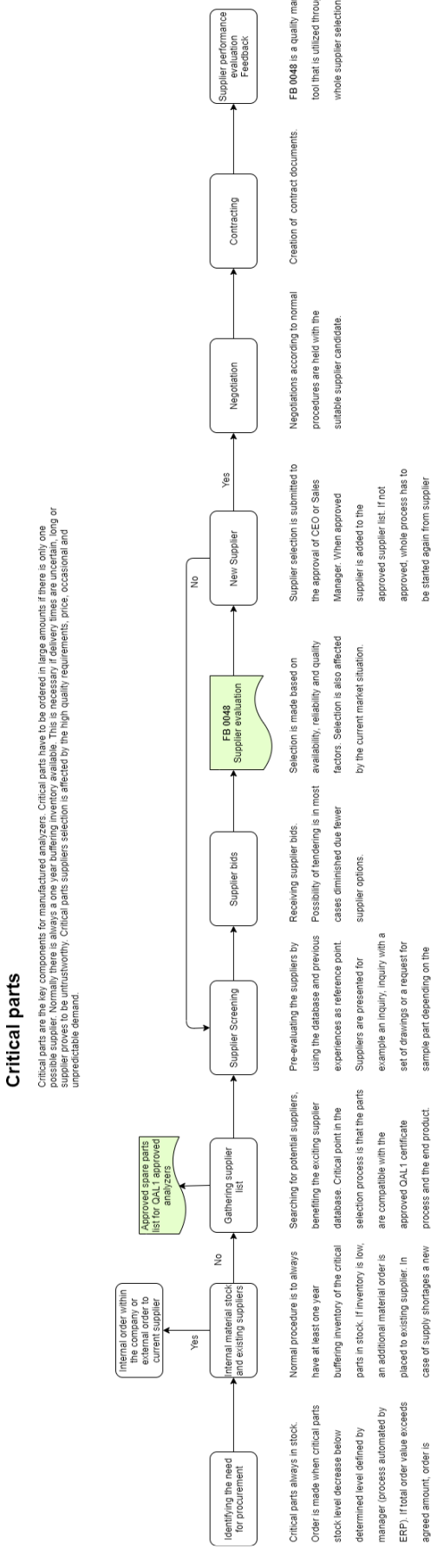
Appendix 5. Flowchart VA 04-02 Singler analyzer/system product flow



Appendix 6. Flowchart VA 07 Material Purchasing



Appendix 7. Flowchart VA 07-01 Critical parts Supplier Selection



Appendix 8. Flowchart VA 07-02 Non-critical parts Supplier Selection