UNIVERSIDAD DEL ROSARIO

Flottweg SE - Market Research

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Homologación Trabajo de Grado.

Daniel Gil Jiménez

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Homologación: Trabajo de Grado

Daniel Gil Jiménez

Supervisor:Dr. Michael Schmidthaler

Administración de Logística y producción

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Glossary

AGVS: Abbreviation of automatic guided vehicle

Centrifuges special device which separates components of a liquid by the use of centrifugal force

Hurdles: a problem or situations which needs to be overcome

Trade off: analyses of the benefits of decide for an option over other

Trends: Tendency that takes a important position in the market and most of the company try to simulate or being part of

Uncertainty avoidance: “reflects the degree at which a society or members of a society, tolerate, cope with or combats unpredictability otherwise known as the unknown. “(Gordon,2021)

Abstract

The German company Flottweg SE, which is one of the world's leading companies in the mechanical separation industry, decided to further move into the direction of industry 4.0, by putting more effort into the topic of digitalization. We, as students from the University of Applied Sciences Upper Austria, could apply our knowledge by providing Flottweg with a new perspective on the topic of digitalization. Our project was focused on conducting comprehensive research in the fields of megatrends, hurdles and barriers on the pathway of digitalization, and strategies on change management with a focus on implementing new technologies.

As every other corporation, Flottweg is facing certain challenges on its way of implementing new digital technologies. These challenges have to be taken into account when developing the strategy of introducing any new technology. Our project is based on pointing out those challenges from both, the customer's point of view as well as the company's point of view.

Furthermore, in our research, we focused specifically on particular physical trends which are autonomous vehicles, additive manufacturing and advanced robotics. Additionally, we looked on certain digital trends such as Internet of Things, Smart Sensors, Artificial Intelligence or Blockchain technologies. As the crucial new technologies that can be applied in the company environment

Additionally, we particularly looked at technologies that are already used by Flottweg's three main competitors Andritz, Alfa Laval and GEA , to to build up competences

as soon as possible and change the position of being a fast follower to the position of being a first mover. In order to build up these extremely important competences, a very customer-centric approach is required and a good balance between costs and benefits has to be found.

As we worked on this project from an outside perspective, we were not able to conduct a detailed analysis for Flottweg SE about trends that could be beneficial for the company. With concluding comprehensive research, we tried to establish implementation guidelines that could help Flottweg SE to introduce new technologies in a sustainable way.

A strong digital adoption strategy is based on continuous flow of information and getting all stakeholders involved. We ascertained six important steps that should help to achieve a sustainable and long-lasting effect when implementing new solutions within a corporation, particularly Flottweg.

Key words: Digital adoption strategy, Trends, Megatrends, Physical trends , Digital trends, Centrifuges , Internet of the things , Digital implementation, Customer perspective , Company perspective

Resumen

La empresa alemana Flottweg SE, que es una de las principales compañías del mundo en la industria de la separación mecánica, decidió seguir avanzando en dirección de la industria 4.0, poniendo más esfuerzo en el tema de la digitalización. Nosotros, como estudiantes de la Universidad de Ciencias Aplicadas de Alta Austria, pudimos aplicar nuestros conocimientos aportando a Flottweg una nueva perspectiva sobre el tema de la digitalización. Nuestro proyecto se centró en la realización de una investigación exhaustiva en los campos de las megatendencias, los obstáculos y las barreras en el camino de la digitalización, y las estrategias de gestión del cambio con un enfoque en la implementación de las nuevas tecnologías.

Como cualquier otra empresa, Flottweg se enfrenta a ciertos retos en su camino de implementación de las nuevas tecnologías digitales. Estos retos deben ser tenidos en cuenta a la hora de desarrollar la estrategia de introducción de cualquier nueva tecnología. Nuestro proyecto se basa en señalar estos retos tanto desde el punto de vista del cliente como de la empresa.

Por otro lado, en nuestra investigación nos hemos centrado específicamente en determinadas tendencias físicas que son los vehículos autónomos, la fabricación aditiva y la robótica avanzada. Además, nos fijamos en ciertas tendencias digitales como el Internet de las cosas, los sensores inteligentes, la inteligencia artificial o las tecnologías Blockchain. Como las nuevas tecnologías cruciales que pueden aplicarse en el entorno de la empresa.

Además, nos fijamos especialmente en las tecnologías que ya son utilizadas por los tres principales competidores de Flottweg, Andritz, Alfa Laval y GEA, para construir competencias lo antes posible y cambiar la posición de ser un seguidor rápido a la posición de ser un primer motor. Para crear estas dichas habilidades, es necesario adoptar un enfoque muy centrado en el cliente y encontrar un buen equilibrio entre costes y beneficios.

Como trabajamos en este proyecto desde una perspectiva externa, no pudimos realizar un análisis detallado para Flottweg SE sobre las tendencias que podrían ser beneficiosas para la empresa. Al concluir la investigación exhaustiva, intentamos establecer las directrices de implementación que podrían ayudar a Flottweg SE a introducir las nuevas tecnologías de forma sostenible.

Una estrategia de adopción digital sólida se basa en el flujo continuo de información y en la participación de todas las partes interesadas. Hemos determinado seis pasos importantes que deberían ayudar a conseguir un efecto sostenible y duradero a la hora de implantar nuevas soluciones en una empresa, especialmente en Flottweg.

Palabras clave: Estrategia de adopción digital, Tendencias, Mega tendencias, Tendencias físicas, Tendencias digitales, Centrifugadoras, Internet de las cosas, Implementación digital, Perspectiva del cliente, Perspectiva de la empresa

1 Introduction

Flottweg SE is a well - established German company, with a long history of continuous innovation. The company is one of the world's leaders in mechanical separation technology and separation solutions and they continue to strive to provide their customers with the best solutions.

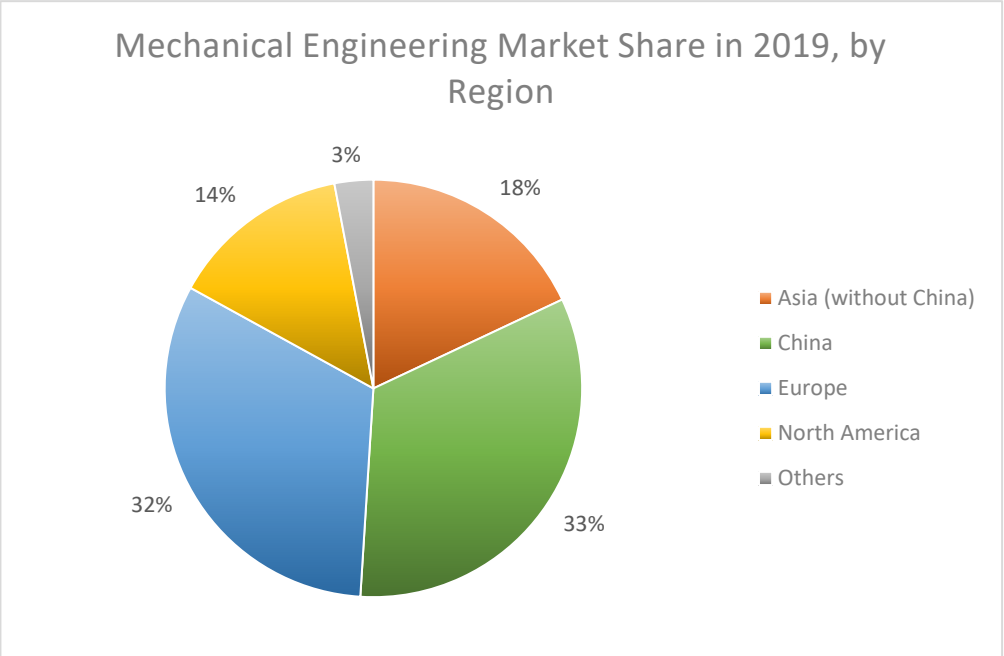
Since more than 60 years the company Flottweg SE has been creating and supplying high-performance decanter centrifuges, belt presses, plants for solid-liquid separation as well as other types of separators like Flottweg Disk Stack Centrifuge. With an export share of more than 80% they are one of the leading companies in the industrial centrifuge market all over the world and one of the big companies in Germany's mechanical engineering market .

The global industrial centrifuge market has shown to have anticipated to have a small percentage of growth as there has been an increased demand for centrifuges in not only process industries, but also in the wastewater management industry. Flottweg SE, as one of the key players in the industrial centrifuge market, could benefit from the mentioned key drivers in the industry. However, Flottweg could also face problems, which could restraint the market growth such as higher costs and trade barriers.

The mechanical engineering market, which Flottweg is connected to, has continued to grow over the years. The mechanical engineering market counts to the largest industrial sectors in the European Union's economy regarding employment, number of enterprises, manufacturing, and the generated added value.

Europe has the second largest market share in the mechanical engineering industry, not far behind the Chinese region, indicating Europe's importance in the industry. Although, when looking at Germany's ranking in the leading countries in the mechanical engineering worldwide, Germany is third, with China and the USA as first and second, respectively. The graph, *Figure 1*, shows that in 2019, China was the region which held 33% and Europe followed on the second place with 32%, meaning China and Europe together already held two thirds of the world market. These figures prove that Europe is an important region for the engineering market.

Figure 1: Mechanical Engineering Market Share in 2019, by region



1.1 The Magnitude of the unfolding Technological Revolution researched and developed with the PESTLE Model

PESTLE analysis is a mean for business insights about the key factors **(Political, Economic, Sociological, Technological, Legal and Environmental)** that influence Flottweg SE from an outside perspective .

Using PESTLE analysis helps organizations such as Flottweg to determine the external factors which could impact decisions made within the company.

1.1.1 Political

Many businesses are influenced by political factors like political stability as well as export restrictions.

Political stability affects almost every company which exports a lot as they are dependent on the stability in the different regions, they are operating in.

The mechanical and plant engineering industry, the industry that Flottweg is a part of, has been experiencing decline in GDP through the years in comparison to other industries. Some political and economic drivers are:

- Russian and EU Sanctions
- Brexit
- Turkey – sovereign debt crisis
- US trade dispute

- China’s unexpected slow growth
- Iran and nuclear agreement

Due to the lower sales and profits in comparison to other industrial companies outside the mechanical engineering world, players in the mechanical and plant engineering sector are having difficulties to finance their transformation or change of business orientation.

However, the political and economic drivers do not have massive impact on the business of Flottweg as there are other factors that could have more direct impact on the organization.

Furthermore, export restrictions or reforms would affect especially Flottweg a lot, as they have an export quota of above 80%. There is an expectation that there would be an increase in the percentage of German machineries exported, up to 90%. Nevertheless, issues such as environmental factors as well as the Corona pandemic have led to more and more countries taking protectionist measures.

1.1.2 Economic

Economic factors such as economic growth, interest rate, and unemployment rate can have either direct or indirect influence on Flottweg SE’s strategic decisions.

"The global pandemic has had a major hit in many economies, including Germany. In 2020, the outbreak of the pandemic, which resulted in a whole country lockdown, led to a decline in GDP (price adjusted) to 5%"(DeStatis, 2021).

As the article published by Flottweg SE on the 22nd of February 2021 states that Covid-19 affected the Revenue of the year 2020 in the way that it declined by around 8%. Nevertheless, the results are still slightly above the figures from the previous year, 2019. Flottweg created two Corona task forces to ensure the safety and health of the workforce (first task force) as well as to keep the economic impact of the pandemic as low as possible (second task force.

When looking at Germany's long-term interest rate for March 2021, the percentage is -0.36%. In comparison to the previous two months, the interest rates were at -0.45% (in February) and -0.54% (in January). The current interest rate is still lower than the long-term average of 2.32% The interest rate has been negative since 2019. Main intention for the low interest rate is to urge lenders to use the money in more useful ways than saving the money. Another reason for the low interest rate is "to help weaken the Euro to provide some assistance to Eurozone exporters" (Hessler, 2019). The negative interest rate can lead Flottweg to invest more.

Germany's current unemployment rate is 6.3% (in February 2021), which is a higher percentage in comparison to the target of 5% (natural unemployment rate). The growth of unemployment in Germany and in the rest of European countries considered to have been moderate as employers are supporting subsidies around short – time work programs. In Flottweg's case, they have been aiming to expand their business and they have started with building the

second plant at the Vilsbiburg site. According to the organization, the workforce was also expanded in the past year, with 1032 employees working in the Flottweg Group (Engelke, 2021).

1.1.3 Sociological

Sociological factors are for example cultural norms, population growth rates and the age distribution of a society.

Technological developments have caused a paradigm change to companies' cultural norms and Flottweg is not different as they have other norms and values concerning the usage of computer technology and AI. Flottweg has a more conventional and traditional company culture than other companies. Companies like Flottweg, will need to follow the current trend in order to remain competitive. The increasing advancement of technology has led to disruptions of the other norms and there is a fear of being too dependent on modern technologies (Burgliarello, 1991).

Population growth does have some impact on Flottweg, whether it may be direct or indirect. Growing population means for a businessman greater demand for products, which leads to greater supply needed, thus resulting in lower supplies. Nevertheless, population growth is important as a growing population mean steady flow of new customers (Ozimek, 2016).

As an example, one can look at Germany's population growth, in comparison to US's rate of population growth. Germany has a growth rate of 0.32% while US 0.59%. There is not a huge difference between the rate of population growth of the two countries, but it can be concluded that Flottweg can gain more new customers in the USA than in Germany.

Age distribution is one demographic figure which is essential for organizations to look at as observing the age demographic can help businesses with targeting and segmenting their customers. Nowadays, the new target demographic is the Millennial and according to Forrester Research's principal channel analyst Jay Bean, "Millennials will comprise 75% of the B2B market by 2024" (Gunn, 2020). The growing increase of millennials in the work-force will cause a change in the cultural norm of an organization as mentioned before.

1.1.4 Technological

Technological factors may have effect on the company's operation. From technological changes, research and development activities to the organization's technological awareness can majorly impact strategic decisions.

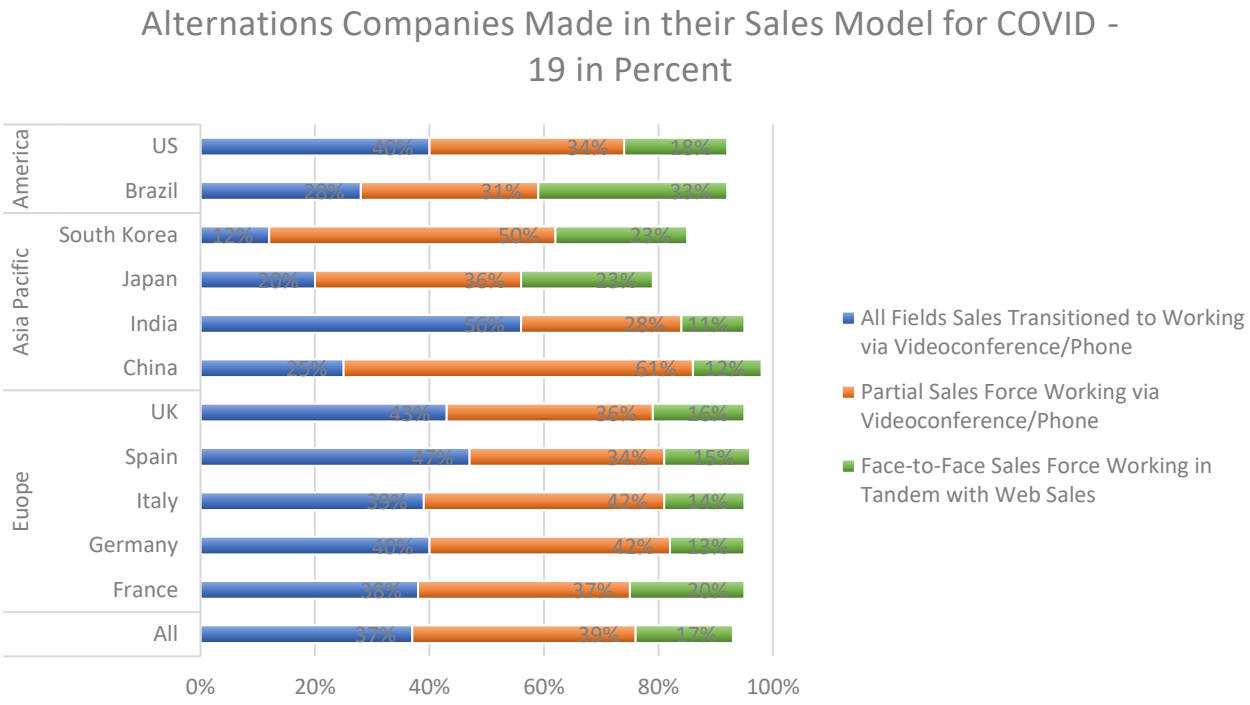
Flottweg SE focuses on developing and producing high – performance machineries and creating customized solutions. In many ways, they are very successful in making technologies and they continue to strive to satisfy their customers. The major technological factor that could immensely influence Flottweg is digitalization.

Digital transformation is incorporation of digital technology in all aspects of a business, by replacing the non-digital or manual processes into digital processes. It could be that one replaces older processing technology to a newer and modern technology.

There are many reasons for businesses to take on digital transformation, but the main reason is because businesses want to survive, meaning that they are pressured to change their processes into digital ones. Another reasons for businesses to go through digital transformation are:

- Expectations and demands of both internal and external customers.
- Businesses are looking for opportunity to improve efficiency for their employees.
- Ensuring the security in the company.
- Being up to date with the latest digital developments gives businesses to be at the top and make themselves more available to future partnerships.
- The use of big data and data analytics helps decision makers make decisions faster and choose the best suitable solutions.

Figure 2: Alternations Companies Made in their Sales Model for COVID - 19 in Percent



Source: McKinsey & Company(2020)

From the graph shown above, many businesses have transitioned, or partly transitioned to having virtual sales model. The leading continent to the transformation is Asia Pacific, with China and India leading the way. In Europe, Spain and the UK businesses have also transformed its selling processes to virtual means.

There are still some resistances from either the customer or the companies, as some view the remote selling to be more effective, while some see remote selling to be less effective in comparison to the conventional sales model.

1.1.4.1 Digitalization in Mechanical / Plant Engineering

The global pandemic has pushed digital transformation in companies worldwide, including the mechanical and plant engineering sector. There are two reasons for the necessary shift to digitalization. One reason is due to the safety regulations that are imposed for the workplace. Another reason is that digital innovations have become more pertinent ().

Digital solutions are becoming a differentiating factor and an instrument for securing customer loyalty for European mechanical and plant engineering companies. Additionally, digital solutions are gaining importance as an additional source of revenue, although, this is only true at a subordinate level. The main challenge that prevents mechanical and plant engineering companies from participating in digital platforms is considered to be the lack of business models. There are also problems with the insufficient strategic relevance and an absence of standards).

When looking at the current stand of mechanical engineering companies in regard to digitalization, these are the other key findings:

- **Fast - follow / follow strategy**

  Mechanical and plant engineering companies tend to follow a fast – follow strategy instead of having first-mover strategy when it comes to participating in digital platforms. In fact, the result of the survey conducted shows that only 15% of the companies pursue a first-mover strategy, which can be seen on Figure 17

(See Apendix) The strategy of being a follower can hinder companies like Flottweg as they could fall behind, hence losing their market position.

- **Collaboration for Successful Digitalization**

  Another aspect that needs to be emphasized is the need for collaboration in order to have a successful digitalization. To be successful in digitalization in the mechanical and plant engineering industry, companies have stated that having collaborations, especially with companies along the value chain or the production process of the end customer, to be more promising. Companies can also collaborate with their competitors if preferred, however, this prospect of success are still viewed with skepticism. Nevertheless, there might be a pressure for companies to open up their digital solutions to competitors if they want to create added value for customers and use their resources wisely. This is because many end customers are not interested in closed, manufacturer-specific solutions for a fear of a potential lock-in.

- **Lack of Relevant Sales Models**

  The business models around digital platforms and applications can be seen in different pieces of the picture. On the one hand, majority of the companies surveyed said that they use digital offerings to stay competitive, but usually not monetizing these products separately. On the other hand, the aspect of selling non-product related digital solutions and offering of business models like pay-per-outcome operator models are not considered a major relevance for the companies and there are no clear plans if these would be adopted in the future. This issue can be seen in Figure 18 (See Appendix).

1.1.5 Legal

Legal regulations especially if they concern exports are a huge risk for Flottweg SE due to their high export rate and also because they have branches and employees all over the world.

Furthermore, if the access to special materials is not possible, this would disturb the production. Tax policies could heavily impact Flottweg. If there would be higher taxes for environmental pollution and it would be expensive if the wastewater would not get treated in the right way, this would definitely increase the sales of centrifuges for this sector.

Another legal factor which could influence Flottweg is intellectual property, as they are a company who is very keen on protecting their technologies and innovations. One aspect that Flottweg must keep in mind is the mechanical engineering's need for "a stable, predictable and coherent regulatory environment" (European Commission, 2016). The European Commission's solution for this challenge is the "New Approach" legislative approach, where legislation establishes important requirements, "with detailed technical solutions laid down in standards" (European Commission, 2016). Furthermore, Flottweg always ensures to issue such IPs like patents to their creations.

Data protection compliance is a relevant issue in the modern world. Each country has its various regulations for protecting data of companies and individuals for example the General Data Protection Regulation (GDPR) in the EU. Flottweg are strongly compliant to the

EU GDPR not only because they are legally obliged to but also to earn the trust of their customers.

Flottweg has always followed through with safety and health management. The company is always awarded by Lloyd's Register on multiple occasions with certifications and awards for their successful occupational health and safety management and safety policy. The pandemic has led to internal changes within Flottweg, since new regulations have been enforced to ensure the safety and health of their employees. Flottweg has handled the new legal changes properly through the creation of the task force.

1.1.6 Environmental

Flottweg SE has to consider the importance of environmental factors as the topic of sustainability and conserving the environment is one of the most talked about issues.

Germany, Flottweg's home base, has established governmental instruments and regulations to ensure the environmental compatibility in companies. Not only Flottweg SE has to follow German environmental regulations, but they also follow the EU's regulations. Flottweg SE is aware of the prevailing environmental issues and has been following the regulations implemented by German's government officials and the EU.

Another environmental issue is the ongoing pandemic. As we can see at the moment also pandemics influence companies like Flottweg as you need to find new ways to stay in

contact with your customers and you need to ensure that your workers are safe as well while working. Flottweg has supported their employees by providing them with FFP2 masks, disinfectants and sets of coronavirus rapid tests.

1.1.7 Conclusion of the PESTLE Model

Through investigating the driving factors that influence Flottweg, one can tell how some factors are more prominent than other factors, particularly political issues, mainly Germany's foreign trade. As export is very crucial for the company, it is important for Flottweg SE to keep an eye out for the current political and economic situation of Germany, the EU, and other countries where their customers are located.

Environmental factors, particularly sustainability is a quite common topic. There is a new trend for companies to work with innovative technologies to be more environmentally conscious and sustainable. Flottweg SE is aware of these issues and has been catering their solutions to be as environmentally friendly as possible. Regarding the global pandemic, Flottweg also handled the global pandemic well and they provided their staff with supplies such as disinfectants and masks.

Another determinant that has a considerable influence on Flottweg SE's further development is digitalization. With Flottweg SE as one of the key players in the industrial centrifuge market, they must learn to understand to not underestimate the rapid advancement of

technologies and digitalization. Nonetheless, there are barriers that Flottweg SE and other companies in the industry face that prevent further digital transformation.

2 Challenges for Implementing New Technologies

2.1 Constraints from the Companies' Perspective

Implementing digital transformation in a company is a huge hurdle for many reasons. In order to stay competitive and keep up with the modern times transformation is a pre-requisite and an ongoing process. Moreover, it effects the whole company in every conceivable way. According to a study conducted by SAP in 2017 with 3000 participants (mostly business leaders and decision-makers) a vast majority of 96% agreed to the statement that digital transformation has the highest priority for them. Deciding to implement modern digital solutions is easy, but to implement them is extremely difficult. Today's businesses must be aware that there are specific steps they must take to achieve true digital transformation and maintain an elevated level of success. To do so here are several barriers that need to be overcome:

2.1.1 Missing ability to experiment quickly

The first primary barrier from a companies' point of view according to a survey conducted by the Harvard Business Review, is the missing ability to experiment in a quick way. More than half of the survey participants agreed that this is a repetitive obstacle and the reason so many projects fail. That makes sense because. This is due technological development advancing at an unprecedented speed. As a result, companies need to react quickly and adapt to these ever-changing processes. Following the strategy of "never change a running system" may sound beneficial but is the wrong setting. To ensure that their digital transformation will be successful, companies must be open for innovative ideas and implement them in the fastest kind of way.

2.1.2 Obsolete systems

The second challenge is the changing process and the necessary willingness to get away from obsolete systems. As a result, for many companies, digital transformation includes a significant change in how they operate. For this reason, it will remain as a blocker for successful projects if the willingness to change obsolete systems is not given.

2.1.3 Necessity to work and communicate – together

In a company, often different teams and departments compete for financial resources and recognition, usually with a lack of communication in between. While this behavior might

have worked out in the last decades, when it comes to a fundamental change of transformations, teamwork is more important than ever. This is the only way how a fundamental change might work out in the end.

This argument is also valid for the interaction between different departments and the IT department. While every business process is supported or driven by technology, the importance of communication in general must not be overseen. Linking their departments together in a correct manner, functions as a fundamental basis for a successful change.

2.1.4 Uncertainty avoidance

According to the survey mentioned above, around 47% of the participants mention that the cultural dimension of "uncertainty avoidance" hinders the process of a correct transformation in particular regions of the world. The company is in charge to ensure that these changes are supported within the organization and that around 70% of the employees foster this transformation.

2.1.5 Necessity of a clear vision

Deciding that a company will take on the challenge of a digital transformation, does not necessarily mean that they know what to do or how to do it. Businesses need to know exactly what their vision is, where they want to go and always follow this main goal. The ones with a clear communicated vision in their mind are always one step ahead.

2.1.6 Financial hurdle

Implementing always the newest technological solutions in order to stay competitive is especially expensive. The willingness to invest must be given, in particular from the senior management. Companies have to make sure that they are able to use their budget for this particular improvement, in the worst case this has the potential to end in insolvency of a company.

2.1.7 Security issues

Technology is always connected to security lacks and risks. Every company must be informed that the more technological improvement a business has, the higher the risks. Cyber-attacks are serious threats to this ongoing process of improvement, that is the reason why a company must be aware of that fact.

2.2 Constraints from the Customer's Perspective

Being part of the digital transformation has a profound impact on the customer behavior, who will have contact with the new capabilities that the company would have in their lines. In this part, we will analyze which are the most relevant ones that can affect the interaction and the purchase process of the users with the main idea of offering anticipated insight rather than responsiveness.

2.2.1 Resistance

The first barrier according to the professionals in the field, is the resistance with over 35 resources which support the idea of the "innovation fatigue" (Vial ,2019), which is the avoidance of some stakeholders to change their mindset about the traditional way to do the processes to an innovation because of a lack of vision about the possible benefits that the new IT can carry out.

In addition, the customer has a strong change resistance where the implementation of a new capability would charge a set of changes which they are not willing to accept, regarding their internal process and the condition with each supplier.

2.2.2 Inertia

The second major factor is called “inertia” which means “when the existing resources and capabilities can act as barriers to disruption” (Vial ,2019). Most of the times, B2B stakeholders have rigid but optimized relations and core processes settled in the continuous development of the traditional patterns, where the introduction of a new technology can delay and affect the main past concerns that both companies have already stated. In other words, the rigidness of core processes hit the rely of the companies to get involved into the transformation afforded by digital innovation.

Passing through the IT necessities of the customers of the engineering sector, according to the 2020 McKinsey survey, they are searching for the company which offers the best solutions based on functionality and benefits of the application.

2.2.3 Functionality

Based on the interviews conducted by Mc Kinsey & Company and VDMA (2019) “the B2B clients of engineering companies consider functionality as the user interaction with the innovative technology, making a priority to them in this point the openness, the performance, and the availability of the IT”. Afterwards, the clients consider the Security standards,

the customer orientation, and the scalability as second factors. Hence, the innovation functionality should be focused on the development of an intuitive technology with high standards of security and performance which secure the adaptation of the customer to it.

2.2.4 Trade off

The customers of engineering companies have a purchasing decision process in terms of cost and benefit therefore any new innovation should provide optimization of resources, processes, or outputs to being accepted as useful. Nevertheless, the clients perceive the flexibility as a benefit below resistance, inertia and functionality.

3 Trend Scouting for Industry 4.0

3.1 Introduction to Megatrends in Process Plant Engineering

Digitalization has become a crucial tool in order to meet existing as well as new customer requirements in an efficient and sustainable way. But digitalization alone does not satisfy customers anymore. Companies have to provide transparency in all business processes as well as in the whole supply chain. Additionally, the EPC market (Engineering-Procurement-Construction market) is changing drastically because market potential is shifting. In fact, a

forecast given by the authors of the study on Digital Business Models in Plant Engineering and Construction, predicts that companies which do not adapt and fail to make a bridge between technology to digital and data-driven services will struggle to position themselves on the market in 2025. Increasing digital and data-driven services require very good cyber security which can be a key competitive advantage in many corporations.

Furthermore, one very important aspect that has to be considered in many companies, in order to successfully implement digitized services and new strategies, is change management. Change management, even though it is tremendously important, is very often completely underestimated in many corporations. This can lead to failure or insufficient results in many transformation processes.

A customer centric approach with the possibility of increased customization and personalization will be required in the near future. Customer requirements in general already shift towards more transparency, a trust-worthy relationship, optimized investment costs, high production flexibility and shorter lead times.

Important areas for Engineering-Procurement-Construction (EPCs) are therefore: cyber security, change management, integration platform, digital sales, agile working environment and innovation governance.

Considering all this, the trend-scouting for megatrends in Process Plant Engineering has to be built upon a very customer centric approach.

3.2 Overview of Technological Megatrends/Industry 4.0

Industry 4.0 can create a significant value by using digital transformation to develop new strategies for operating the business. Industry 4.0 technologies include a variety of capabilities such as:

Table 1: Overview of technological Megatrends

Data, computational power and connectivity	• Sensors • The Internet of Things • Cloud technologies • Block Chain
Analytics and Intelligence	• Big data • Advanced analytics • Artificial intelligence • Knowledge – work automation
Human – machine interaction	• Virtual and Augmented Reality • Robotics and automation • Robotics process automation (RPA) • Chat Bots
Advance production methods	• Additive manufacturing • Usage of renewable energy

Source: (de Boer et al., 2020)

3.2.1 Digital Manufacturing's Scaling Potential

The scaling potential of digital manufacturing is huge and it can bring along many benefits that might be an important competitive advantage in the future. The benefits will have not only significant impact within the company itself but rather along the entire value .Some of the benefits are:

- Reduction of machine downtime
- Improvements in labor productivity
- Increase in throughput
- Decrease in the cost of quality

These benefits have a significant impact along the value chain. Some of the important impacts on the entire value chain are:

- Increased flexibility in order to meet customer demand
- Faster speed to market
- Better integration within the supply chain

3.2.2 Challenges of Using Scaling Potential successfully

According to a McKinsey study, most manufacturers currently transitioning to digital manufacturing stuck in the pilot phase of deploying and implementing these technologies. “The McKinsey research found out that at least 70% of all analyzed manufacturers are deteriorating in the pilot phase” (de Boer et al., 2020).

The four main challenges most companies face in scaling are:

- Culture
- Missing strategic direction
- Missing capabilities
- A good data and IT infrastructure

The number of new technologies of the fourth industrial revolution is huge, which is why the focus in this research will be on 2 main categories (physical trends, digital trends) of technological megatrends from “The Fourth Industrial Revolution” from Klaus Schwab (Schwab, 2016).

3.3 Physical Trends

3.3.1 Autonomous Vehicles

Not only self-driving cars but also autonomous vehicles such as trucks, drones, aircrafts or boats are part of this category. Autonomous vehicles benefitted tremendously from new sensor technologies and the use of Artificial Intelligence (AI). As an example, the use of drones, in combination with data analytics can be mentioned. This technology enables human beings to use drones for several tasks e.g., checking electric power lines, delivering supplies etc.

The transportation-and-warehousing industry has the third highest automation potential of all sectors. This implies that in general warehouse optimization and automation in logistic processes is increasingly becoming of real interest for many companies. In fact, there are some technologies as for example autonomous guided vehicles (AGVs) which are extremely useful for a seamless and automated warehouse management.

Technologies of warehouse automation can be grouped into two categories. One category is assisting the movement of goods and the other category is improving the handling of goods.

3.3.1.1 First Category: Movement of goods with AGVs

AGVs are moving pallets and cases in warehouses, fully automated. The new riddle to be solved is how to retrofit existing forklifts to make them autonomous. Another technology is so called swarm robots from which the most famous ones are those of Amazon called Kiva

robots. Swarm robots are moving shelves with goods to the picking stations where advanced conveyors can take on the goods to further move them.

Furthermore, advanced automated storage/retrieval systems can be used to store goods in large racks and robotic shuttle systems are used to move around in three dimensions on the rails which are attached to the structure.

3.3.1.2 Second Category: Handling of goods

Picking of goods can be automated using a robotic arm with sensors determining shape and structure of an object in order to correctly grasp it. There can be fixed devices, which means the goods that have to be handled are brought to them, and there are moving devices which means the device itself travels to the goods and retrieves and moves them in one turn.

3.3.1.3 Challenges of implementing AGVs:

3.3.1.3.1 The Plant Layout

In most manufacturing facilities, materials are widely handled with the use of forklifts or hand carts. Hence, the challenge many manufacturing companies face is the conversion of the previous navigation lanes into pathways that can be used by AGVs. The solution would be a re-organization of the whole shop floor in order to ensure that traditional material handling equipment as well as AGVs can pass seamlessly. Important to consider is that AGV lanes should be able to manage traffic and alarm employees when there is a potential overlap or crisscrossing.

3.3.1.3.2 The Fleet Management

AGVs navigate through a factory floor by having a complete map of the floor. The use of sensors, scanners and mapping features enables AGVs to successfully navigate. Sensors are scanning solid objects like storage racks and they perceive storage racks with legs as a passable passage not as a wall, which can lead to an attempt of the AGV to pass under a rack. The solution for that is to program AGVs to recognize the legs of a rack or low walls have to be added to the rack legs.

3.3.1.3.3 The Speed and Movement Limitations

Manufacturers determine speed, degree of freedom, ability to drive in reverse and the turn radius of AGVs. The decision about which AGVs to buy and which features are essential is of immense importance.

3.3.1.3.4 The Possibility of Collisions

Facility owners have to know and understand that AGVs cannot flee. This means that all AGVs react to head-on collisions with a forklift or a cart by stopping and immediately finding an alternative route in order to avoid the collision and bypass. One way of limiting collisions is that forklifts and AGVs should not have the same or similar navigation layouts or pathways. In manufacturing facilities where more types of material handling equipment must be used, the use of smart cards can help. Smart carts are using optical cameras, motors and microprocessors to navigate.

3.3.1.3.5 The Total Cost of Ownership

The decision to integrate AGVs into a facility can be expensive and owners have to be aware of the true cost of ownership before deciding to purchase the equipment. True cost of ownership is including the power to charge the devices,

the re-orientation of the layout and additional technologies which enable the company to collect data and manage the operations.

3.3.1.4 Advantages of AGVs:

The Advantages of AGVs in a nutshell are reduction of labor costs, elimination of damage to structures and products by human beings, increasing workplace safety, reduction of utility costs and increased inventory efficiency and accuracy.

3.3.1.4.1 Industrial Applications of autonomous guided vehicles:

- **Raw material handling**

  Transportation of raw materials like paper, rubber, metal or plastic is often conducted by AGVs. AGVs are picking up materials and transport it to the warehouse as well as bringing the materials to the production lines.

- **Work-in-progress movement**

  Moving materials throughout the manufacturing process is a very wide use of AGVs.

- **Pallet handling**

  One of the most famous applications for AGVs is the pallet handling in manufacturing or distribution facilities.

- **Finished product handling**

  Moving the finished goods from the manufacturing to the storage can require very gentle handling in order to avoid damages from wrong handling on the finished product.

- **Hazardous material handling**

  Hazardous material handling or working in a dangerous operating environment can be done by AGVs e.g., radioactive materials, chemicals etc.

3.3.2 3D Printing/Additive Manufacturing

Additive manufacturing or 3D printing is the creation of physical objects by adding layer upon layer on the basis of a 3D drawing or model. Until 3D printing was developed, industries widely focused on subtractive manufacturing, meaning layers being removed from the used material.

3.3.2.1 Challenges of implementing 3D printing:

According to a survey of McKinsey & Company, additive manufacturing is facing some technological limitations. These challenges can be categorized into limitations on design, high production costs, limitations of size and product quality and the dependency on a certain number of machine suppliers.

Furthermore, there is still a lack of industry-specific testing procedures, a lack of structural regulations within the supplier network as well as the risk of supply chain disruptions.

3.3.2.2 Advantages of Additive Manufacturing:

Considering all the advantages of additive manufacturing we would conclude that the benefits are predominating. A table from McKinsey & Company presents some of them and the 3 most important once are:

- **Faster time to market** due to very fast prototyping and fast design adjustments.
- **Better customization** due to a more flexible manufacturing process.
- **Product enhancements** because of achieving an improved product performance, new product designs and less weight.

Additional advantages of additive manufacturing are a more flexible manufacturing process, higher material productivity, a simplified supply chain, and a more efficient sales process.

3.3.2.3 Applications of additive manufacturing:

In general, the applications of 3D printing can be grouped into 3 sectors of industries where it is already heavily used. These three sectors are aerospace, industrial applications and the healthcare industry.

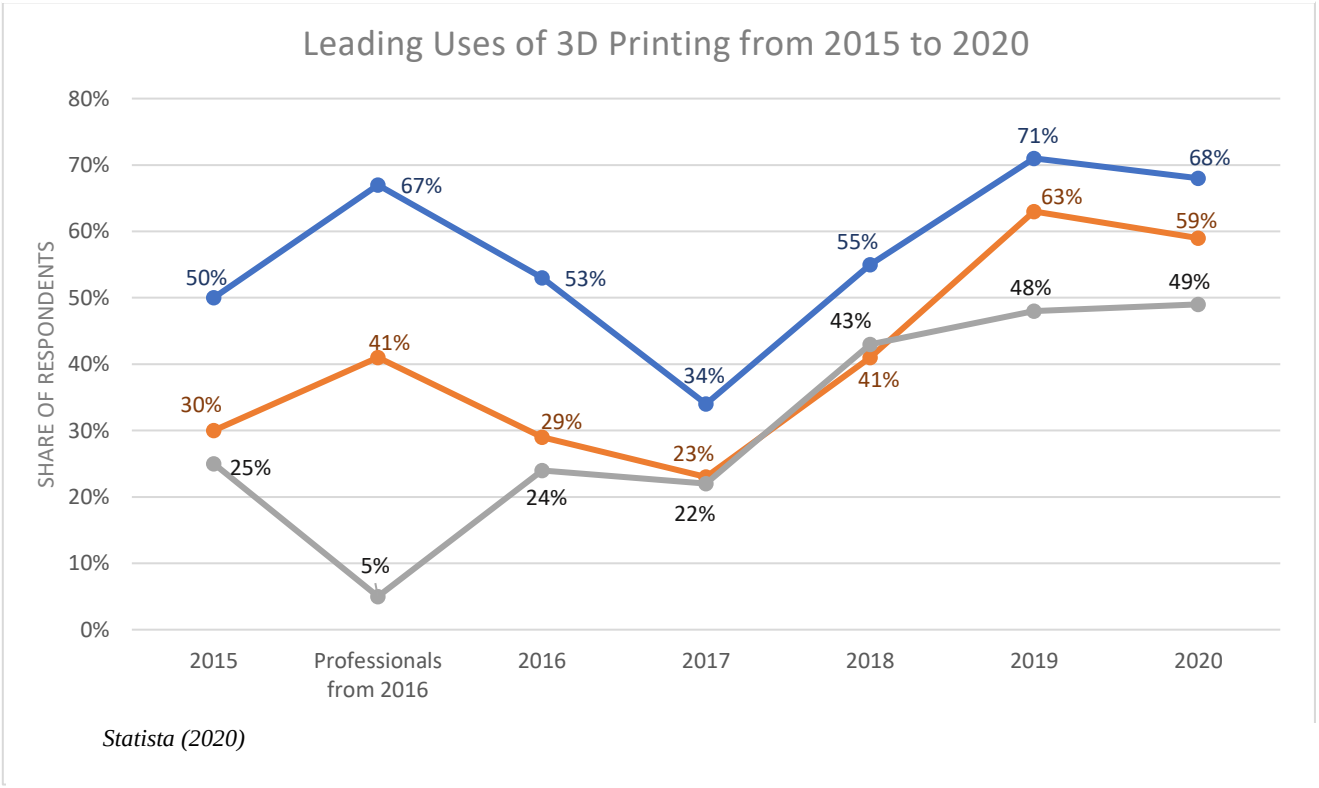
Applications in Aerospace include 3D printing of the fuel nozzle for flight engines, which makes it five times more durable and 25% lighter. Additionally, the thrust chamber for aerospace rocket engines is much more reliable, robust and efficient when produced with additive manufacturing.

The industrial applications are for example repair of burner heads for gas turbines which lead to a reduction of repair time from 44 to 4 weeks according to a McKinsey survey. Moreover, the performance of machine parts increases due to the special design achieved with additive manufacturing.

The Healthcare sector benefits from the use of additive manufacturing as it enables the mass production of highly customized parts such as hearing aids. Furthermore, it is already used for models to aid tumor surgery which reduces the surgery time and complications.

As one of the most disruptive technologies, additive manufacturing is predicted to be at the leading edge of the fourth industrial revolution. The idea of 3D printing turbines or cylinder blocks is no longer an unrealistic scenario. While initially additive manufacturing was only perceived useful for prototyping, in today's world tooling components and patterns for metal castings have gained real potential for the use of 3D printing. According to Statista, the global market for 3D printing and services is expected to grow to almost 50 billion U.S. dollars by the year of 2025.

Figure 3: Leading Uses of 3D Printing from 2015 to 2020



Statista (2020)

The graph above shows the increasing importance of 3D printing. In 2020, 68% of the respondents stated that they use 3D printing for prototyping, which is the most popular use case. Nonetheless, additive manufacturing is not only used for prototyping, an increasing amount (59% of respondents) also uses 3D printing for proof-of-concept purposes and already 49% of the respondents use additive manufacturing for production.

By 2024 the world market for 3D printing products and services is expected to amount more than 40 billion U.S. dollars and the annual growth rate of the industry is expected to be 26.4% between 2020 and 2024 (See Appendix Figure 19) (Statista Research Department 2021). This is applicable when looking at the statistics form Statista, which is only one example of many that shows the increasing importance of 3D printing.

Furthermore, new materials used for 3D printing are continuously developed and will very likely enter many different industries. Metal and metal alloys 3D printing services are increasing. Even though the technology of metal 3D printing is very young, every year we can see new breakthroughs.

3.3.3 Advanced robotics

The technology of advanced robotics provides a faster setup, commissioning, reconfiguration and a much more efficient and stable operation is guaranteed. The costs of advanced robotics technologies are expected to further decline when prices for sensors as well

as computing power are decreasing. Advanced robots can perform tasks in a more economical way than conventional robots and older generations of automated systems.

According to a study of the BCG 52% of participating companies expect that advanced robotics is becoming one of the major drives of productivity enhancements by 2025. Even though, these expectations of companies vary from region to region, the study shows that corporations in Europe and Asia are seeing advanced robotics as a productivity driver even more than companies in the USA.

3.3.3.1 Challenges of implementation process:

Advanced robotics has a major effect on the workforce. On the one hand, jobs involving routine manual activities are very likely to be fully automated and replaced by robotics. On the other hand, jobs involving routine work as well as non-routine work, are expected to have and increase in non-routine work, for example maintenance and shop-floor management.

Employees are forced to gain more sophisticated skills because of this shift from manual work towards non-routine work. Companies will have to adapt to the fact that new job categories are arising due to more technological adoption. Skills such as technical capabilities as well as soft skills including communication skills and being initiative are becoming increasingly important. An example for that would be that technicians very likely would have

to primarily deal with errors made by the system, as the automated system cannot handle them.

Hence, the major challenge for companies to implement advanced robotics will be the increasing demand of white-collar workers instead of blue-collar workers.

3.3.3.2 Advantages of advanced robotics

The advantages of advanced robotics can be divided into four main categories. These categories are the increase in productivity and flexibility, an improvement in quality, improved safety and enhanced agility.

The increase in productivity and flexibility can be explained due to the easy self-adjustment to new process parameters of advanced robots. This will eliminate so called micro-stops in the process, it ensures an easier setup and reconfiguration and it enables companies to react and adapt fast to changing customer needs.

The improvement in quality can be guaranteed because of very high precision of the robots and the increased safety is due to the fact that robotics is used instead of people. Dangerous and physically demanding tasks can for instance be performed by advanced robots instead of people. Moreover, the configuration of new production systems to enable customization or new variations can be done by advanced robotics, which increases the agility of the whole production site.

3.3.3.3 Application fields of advanced robotics

The 3 main application fields of advanced robotics are production, because the technology can create autonomous production processes, quality control as well as maintenance.

3.4 Digital Trends

3.4.1 (Industrial) Internet of Things ((I)IoT)

The difference between IoT and IIoT is that the IoT is focused on consumers and how to connect devices to the internet and making them smarter, while IIoT is concerned with increasing safety and efficiency on manufacturing facilities (Aptean, 2019). We focus more on the Industrial Internet of Things (IIoT) as this term is concerned with the industrial perspective of Internet of Things.

The Covid-19 pandemic once more has pointed out that IoT can be a great advantage for any kind of organization. As an example, we can take digital management tools that helped many companies during the Covid-19 crisis, to immediately react to market changes in an efficient way by making adjustments in the production capacity.

As with all technological trends of Industry 4.0 it can be quite challenging to gain relevant operational or financial benefits by scaling up IoT.

3.4.1.1 Challenges of implementing IoT

Corporations are usually facing two forms of challenges when implementing IoT. On the one hand, there are technical challenges such as heterogeneous systems that need to be overcome and on the other hand, there are certain organizational challenges.

The table below shows the 3 most crucial technical and organizational challenges that have to be managed when implementing IoT.

Table 2: Challenges of implementing IoT

Technical challenges	Organizational challenges
Heterogeneous systems and application landscapes	Modification of business processes
Determination which functions are supported by which applications/technical systems (supply-chain management, manufacturing operations management, plant maintenance, asset management etc.)	Optimization of IIoT solutions

Governance between IT and OT (operational Technology) as well as between plants and corporate functions	Missing commitment of leadership departments

Source: Own elaboration (2021)

In order to deal with the technical challenges an organization has to first manage the organizational issues successfully. This includes the definition of a clear goal by decision-makers of the company and setting up a team which monitors the progress of implementing IoT. Additionally, it is extremely important to adapt the organizational structure, accordingly, meaning changing types of collaborations, job profiles and roles. A new framework including a common governance model, harmonized processes and a centralized data and security management system has to be established. Training existing employees and hiring new talents might be necessary as well in order to ensure a smooth development, deployment, and operation of the IoT within the company.

3.4.1.2 Advantages of IoT

Once the challenges of implementation are managed, the IoT offers a lot of advantages. The IoT will boost operational performance, it is a key tool for reducing downtimes, implementing new business models, creating a better customer experience and it improves resilience of companies during a crisis. Especially the improvement of resilience during crisis times has become a crucial aspect for many corporations during the Covid-19 pandemic.

3.4.1.3 Applications of IoT in manufacturing

3.4.1.3.1 Digital Twins

A digital twin shows the product to be developed in a digital form. The generation of a digital twin improves effectiveness, efficiency, and accuracy of the system. Potential bottlenecks in the product are easily identified and this can help to develop an improved version of the product.

3.4.1.3.2 Supply Chain Management

Monitoring of the supply chain by IoT devices that track and trace the inventory system on a global scale. Manual documentation can be completely replaced by IoT devices by introducing ERP systems.

3.4.1.3.3 Self-dependent Systems

IoT and machine learning enables machines to recognize problems and to solve the problems on their own. Self-healing automated systems are created in order to take on control in downtimes. Hence, manual interference is reduced, and development processes are improved. Self-dependent systems can help industries to gain a faster time to market.

3.4.1.3.4 Workshop Mirroring

IoT incorporates market-ready solutions and enterprise information management systems, which enables automation of the control of IoT-enabled manufacturing activities.

The commonly known way of working in the industry is completely changed by implementing IoT. Autonomous self-healing machines, inventory systems using machine-learning, supply chain management, economical run of the production cycle and reduced human labor are all benefits gathered through IoT to increase time to market in many industries.

3.4.2 Smart Sensors

Smart sensors are widely perceived as the drivers of Industry 4.0 and IoT in factories. Combining sophisticated sensors with computational power will enable companies to analyze data and make improvements in many different areas of operation.

Smart sensors combine sensors, microprocessors, and communication technology to transform environmental inputs such as humidity, liquid detection etc. into readable data while traditional sensors are relying on the manufacturer to perform the input processing.

Smart sensors are perceived as being smart because they are highly sophisticated. They are using an enhanced detection technology and they have a certain link-ability over wireless network. More and more smart sensors can be linked by 5G networks which can carry much larger volumes of data with a significantly improvement in reliability.

The relationship between an increasing array of measurements produced by sensors and algorithms that easily assess the implications, connects devices to human beings in order to implement tasks, produce products and so on.

3.4.2.1 Challenges of smart sensors

The main challenge for smart sensors, as for many other digital trends, is that new roles for employees emerge. Adaption to new roles, new tasks and new responsibilities is an important challenge that must be managed to successfully use smart sensor technologies.

New training for workers is one very crucial aspect that must be considered before implementing smart sensor technologies. Additionally, the expenditure of existing skills by hiring external and new talented employees will be required. Eventually, new jobs as for example robot coordinators, industrial data scientists, supply chain coordinators or simulation experts are emerging.

3.4.2.2 Advantages of smart sensors

The usage of smart sensors carries along many advantages. The four most relevant once for mechanical engineering are:

3.4.2.2.1 Increasing production flexibility and worker responsiveness

Using smart sensors means adding a valuable contribution to the flexibility of a production by improving the use of Just-in-Time processes.

3.4.2.2.2 Reducing equipment downtime

Integration of smart sensors will improve system reliability and reduce installation as well as configuration and maintenance costs. This is possible because the newest technologies of smart sensors are able to self-monitor and self-calibrate the equipment with the collected data.

3.4.2.2.3 Improving quality control and reducing waste

Sensor technologies improve the ability to reduce waste during production processes, which will be especially useful for industries in which waste is very ubiquitous.

3.4.2.2.4 Improving understanding of cost structures

Increased understanding of the factors affecting unit profit and loss in manufacturing, is one of the most relevant advantages associated with sensors and IoT. Sensor technologies can understand the profit and loss of each unit sold and the collecting of the real-time data can be used to optimize consumptions of energy, material and other supplies.

3.4.2.3 Application of smart sensors

Smart sensors are transforming external environmental inputs into understandable data. The use of smart sensor technologies is an essential part of smart factories because the sensor technology creates the interface between the digital and physical world.

3.4.3 Artificial Intelligence (AI)

The importance of AI in the manufacturing industry is huge. The two most important applications of AI in manufacturing are to improve maintenance and quality. The trend of using AI in manufacturing is very much increasing because of the fact that manufacturing data can be perfectly used for AI/machine learning, because the data includes a lot of analytical data which is easy for a machine to analyze. Machine learning models easily predict the impact each of the variables in very complex situations has, while for human beings analyzing such vast amounts of variables is too difficult. In contrast to machine learning in manufacturing, we have other industries with focus on language or emotions, in which machine-learning models are still behind human capabilities.

According to a study of the BCG, Covid-19 is going to immensely accelerate several major trends that already rose before the pandemic. The BCG predicts that these trends will continue to grow because companies are shifting their focus towards recovery. This already happened several times in the past after severe crisis and is very likely happening after the current Covid-19 crisis as well. Instead of heavily focusing on sourcing and production in some low-cost countries, corporations will put more overabundance into their value chains. Consumers are buying more online and employees more and more work remotely. AI can and will be extremely advantageous for companies who get accustomed to its use.

Using advanced robotics will replace human beings in factories which could lead to the possibility of operating facilities 24/7 in more than one location and with only minor additional costs. On-demand labor forces can be set up as AI-enabled platforms support corporations to simulate live work environments. The use of machine learning models and advanced data analytics can improve the detection of new consumption patterns and the ability to highly personalize products for customers. Nevertheless, a combination of AI with human knowledge and experience will be the optimum solution.

Research of the BCG (2020) showed “that in the four previous economic downturns only 14% of the companies could increase sales growth and profit margins because they invested in these trends”. The challenge for companies is to scale the AI use cases up in order to be able to handle uncertain supply and demand, to quickly adjust to disruptions in operations and supply chains, to reallocate the workforce etc.

3.4.3.1 Advantages of AI:

Artificial intelligence can support companies in many different areas. It can help to handle uncertain supply and demand by providing forecasts in real time and an improvement in decision making processes. Disruptions in operations and supply can be solved by a flexible reallocation of the resources and an improved cost efficiency. Additionally, the problem of the “suboptimal” workforce allocation can be handled with optimization of remote working and the steadily changing consumer priorities can be adjusted by a fast response to the new behavior.

Furthermore, the possibility of 24/7 production in dark factories will lead to an increase in revenues and increasing safety by using robots for high-risk jobs will decrease the number of accidents.

All these possibilities of improvement will significantly reduce costs and increase revenues and safety.

3.4.3.2 Applications of AI in manufacturing

There are a lot of applications for artificial intelligence in manufacturing facilities. We can categorize the many different applications of AI into product and design-based applications, optimization and automatization-based applications and price and quality-based applications.

Table 3: Applications of AI in manufacturing

Product and design-based applications	**Optimization and automatization-based applications**	**Price and quality-based applications**
Product development	Enhancement of shop-floor performance	Price forecasting of raw materials

Customization of designs	Robotics	Quality assurance
Generative design	Optimization of logistics	
	Predictive maintenance	
	Inventory management	
	Process optimization	

Source: Own elaboration (2021)

3.4.3.2.1 Product and design-based applications

Product development can be improved by the use of digital twins. The digital twins enable companies to collect data in order to improve the real product before starting with manufacturing. Moreover, such digital twins can also be used to enable customized designs.

Additionally, machine learning models are used to help engineers in design approaches. The engineers and designers are entering parameters into the generative design software while the model calculates all the design possibilities that can be created based on the entered parameters. This method creates a huge amount of design options in a very fast way.

3.4.3.2.2 Optimization and automatization-based applications

Monitoring and analyzing production processes by using digital twins to identify any quality issues improves the performance of the overall shop floor. Additional optimization of logistics can be achieved as digital twins are helpful for getting an overview of the materials used, and the possibility to automate restocking of materials.

Predictive maintenance allows the identification of potential downtime and accidents by the use of sensors and AI technologies. This enables manufacturers to provide a completely new way of maintenance to their customers. Forecasting of errors or failures in the equipment enables manufacturers to schedule the repair before the failure or accident occurs.

Furthermore, the combination of AI with industrial robots or advanced robotics enables the robot to monitor its accuracy and performance in order to constantly improve. Additionally, demand forecasting and supply planning of machine learning solutions can perfectly support inventory planning and the overall inventory management. Lastly, AI-powered process mining tools are identifying and eliminating bottlenecks in processes of an organization,

for example the timely and accurate delivery to a customer. This leads to an overall process optimization.

3.4.3.2.3 Price and quality-based applications

As the price volatility of raw materials is generally a challenge for manufacturers, the price forecasting by AI powered software is a great benefit. The software is able to predict the prices more accurately than human beings do, plus it learns from the mistakes it makes, and therefore constantly improves.

Moreover, data driven, interconnected and autonomous assembly lines work based on parameters and algorithms in order to produce the best possible final products. AI systems are detecting differences by using machine vision technology.

3.4.4 Blockchain Technology

"The blockchain technology is the technology behind the crypto currency Bitcoin. Blockchain can be defined as a very specific type of database, the difference to a common database is in the way it stores the information. The data is collected and stored in groups, in so called blocks that can then be chained together" (Conway, 2020).

Blockchain technology is all about decentralization and outsourcing of computational power. As an example, we can look at the standard server of a company that might consist of 10,000 computers with one database that holds all the account information of its clients. The computers of this company are all located under one roof and the company itself has full control over all these computers and therefore over all the information. If we look at the way Bitcoin manages its computer network, we see the difference. Bitcoin also has thousands of computers, but the computers are holding the blockchain in many different geographic locations and each of the computers is operated by an individual, which means the blockchain of Bitcoin is decentralized. All those computers that build the entire network of Bitcoin are called nodes.

3.4.4.1 The usage of Blockchain

Originally the blockchain technology was developed for Cryptocurrencies, but nowadays it is already heavily used by many industries such as financial services, real-estate, health care, manufacturing, or aerospace.

The usage of blockchain is appealing because companies can control their supply chains by recording the origin of the materials they purchased. This can help corporations in the verification of the authenticity and quality of the materials or products

Many aerospace companies saw the potential of blockchain and found out that this technology improves their operations and improved the data security. Using blockchain networks also improved aircraft maintenance for many businesses in the aviation sector. This is due to the fact that the usage of blockchain enabled easier record keeping. The way of recording maintenance activities changed due to the usage of blockchain. The databases, spreadsheets, paper logs etc. were simply replaced by blockchain. By doing so, blockchain creates an unchangeable digital record of all maintenance activities on each plane. The operating people immediately know which tasks have been performed on which aircraft, by which technician and at which maintenance interval.

Moreover, the use of blockchain technology built up significantly more trust in the used-parts market. Blockchain enables transparency among the supply chain which also improves the quality of spare-parts. An example would be the online aircraft parts marketplace of the company Honeywell. With blockchain Honeywell ensures that every listed part includes images and the required quality documents. Encrypted data trails are used to build and share a digital register of previous transactions for every single part.

Furthermore, blockchain enables the tracking of every single part in stock. Honeywell's operators therefore know where every component of every airplane is currently located. Regardless of whether the part is installed on an airplane, on storage in the warehouse or not in the house because it is repaired.

In conclusion, we can say that the blockchain technology makes it very easy for companies to keep everything in the inventory tracked for a very cheap price. The example of the company Honeywell, even though it is from a different industry sector, shows exactly how

blockchain networks can improve inventory tracking within a company. We conclude that this can also be of real value for Flottweg SE.

3.4.4.2 Advantages of Blockchain

The first advantage is the enhanced transparency due to the fact that the transaction ledger for public addresses is open to viewing. This engages accountability in all sectors of the business.

Furthermore, blockchain increases efficiency due to the decentralization and no need of any intermediary for fields like for example payment.

Another important aspect is that blockchain is a much more secure system as all new transactions are encrypted and connected or linked to the previous transaction. The blockchain is constructed by a complicated string of mathematical structures and it is impossible to be changed once it is created.

And last but not least, the blockchain technology provides an improved traceability. Which means that every time an exchanging of goods is recorded on a blockchain, the audit trail tracks where the goods are coming from. This enhances the security and prohibits fraud, and it verifies the authenticity of the asset that has been traded. The supply chain in exchange-related businesses can be tracked from manufacturer to distributer until the final location of the product.

3.4.5 Big Data

Big Data is a collection of data in large volume used for analysis to determine patterns, trends, and other advanced analysis. The data can be structured, semi structured or completely unstructured. The main characteristics of big data are high volume, velocity, and variety.

Volume refers to the quantity of data, generated and stored. Depending on the size of the data, the value, and the potential and whether the data can be considered as big data would be determined. Velocity means the speed at which the data is generated and processed when demanded/desired. Variety refers to the type as well as the nature of the data.

There are other characteristics of big data like veracity (referring to the reliability of the data), value (the worth in information), variability (the characteristic of the changing formats, structure, or sources of big data) and many more.

3.4.5.1 Importance of Big Data and Data Analytics

Nowadays, with the ongoing Industry 4.0, Big Data is becoming more used by various companies to compete, become more innovated and create value.

The important aspect of big data is how a business uses the collected data. Using the data companies take from different sources, they could perform analysis and lead to:

3.4.5.1.1 Making Best Decisions

Big Data can help business owners make smart decisions based on the in-depth analysis about the marketplace, industry, their customers and many more. Due to the nature of big data, having a big volume, high velocity and large variety, the analysis made from the big data are accurate and will lead to better decision making, thus leading to cost savings and time reduction.

3.4.5.1.2 Understanding the Market Conditions

Through analyzing big data, one can get a better understanding of the market conditions. The companies can learn about their customer' preferences, which customers suits them the most, reasons for customers choosing which products, etc. By knowing this information, the company can then begin to adapt and optimize their marketing strategies.

3.4.5.1.3 Boosting customer acquisition and retention

There is no doubt that customers are one of the key elements important for any businesses. Knowing the demands of the customers holds significance to any businesses. Using big data can help with figuring out these demands and customer patterns or trends in a and more accurate way, so companies can keep their customer base but also expand it.

Big Data has become vital for data analytics and evaluations based on the big data give more answers to businesses than the traditional methods of evaluation. By using big data, topics such as production process efficiency, productivity and general maintenance can be discussed, and businesses can decide on the best suited solution for the organizations. Moreover, big data evokes new opportunities for innovation and new way of thinking.

3.4.5.1.4 Concerns about Big Data

Regardless of the increasing significance of big data, there are some problems that people have come to know about. Issues such as:

3.4.5.1.5 Security

One of the issues with big data is the lack of security. Although big data provides many businesses with data and information they could not access before, big data is prone to data breach. Many big data platforms do not have encryption, policy enablement and other security features built in their systems.

Another issue is that the spending for security is still low. Not many businesses consider IT security as an important section to spend on. According to experts, around 10 percent of the company's IT budget should be spent on security, yet most companies would spend under 9 percent of the budget on security. Like the quote "data is the new oil of the 21st century", large amounts of data are valuable and are seen as gold in the eyes of cyber criminals and other companies.

3.4.5.1.6 Anonymity

There are a number of customers who may feel discomfort with sharing their information to businesses. There are some companies who respond to this issue with data masking policies, which are not always the most effective solutions. Furthermore, it is a challenge to completely remove the ability to identify an individual due to the large amount of data as well as advance analytics.

3.4.5.1.7 Complexity

One of the characteristics of big data is the high variety of data. While having vast variety of data can be beneficial for businesses, this could be a problem. Big Data also comes in several forms, from structured to unstructured data. The more diverse the data is, the more difficult it is to protect.

3.4.5.1.8 Data Discrimination

Big data analytics is not always truly objective. With the amount of data shared and the different algorithm can lead to discrimination.

3.4.5.2 Companies' Willingness to Share Data

The term data sharing gains an increasing attention for many reasons, but perhaps the main reason is: To optimize the overall workflow and all the processes.

In the ever-changing complex business world, smooth connectivity between companies is an absolute necessity in order to facilitate cooperation and make it more effective.

The advantages are overwhelming, but some companies raise their concerns about the free sharing of internal and sensitive data. This skepticism leads to a low willingness to share.

The major concerns are summarized below and are based on a survey conducted by PwC.

3.4.5.2.1 Security concerns

When it comes to data sharing, data are collected in a big pool where all the participating companies have access and provide data to. These pools are managed and provided by external firms, which then have access as well. As a matter of fact, companies' hand over the security of their most important data to such firms. According to the PwC study, 57% of the companies are afraid that their valuable data may fall in the wrong hands, because the rapidly growth of the information systems do not match with the lack of cybersecurity systems present in the actuality. Indeed "Gartner predicted that 60% of digital businesses would suffer major service failures by 2020 due to the inability of security teams to manage digital risk" (Collett ,2020), whereby its notorious the necessity of the B2B consumers to secure their value data of possible violations.

In a 2019 survey by data aggregator Acxiom (now LiveRamp Holdings), more than 80% of respondents said they were concerned about the collection and use of personal data, but 58% were willing to make tradeoffs on a case-by-case basis as to whether the service or enhancement of service offered is worth the information requested .What means that the willingness to use the data is directly proportional to the uses that the company can give to them and the relative benefits for the data provider, in terms of performance or features to the acquired product. To figure out which of the providing firms fits best and delivers the best solution, all stakeholders must agree on one provider.

3.4.5.2.2 Traceability concerns

Another reason for concerns is that it is almost impossible to overlook who will work with the data and how it will be further processed. 59% of the participating companies agreed on that.

3.4.5.2.3 Responsibility concerns

In 99% of the cases the data will be handled properly and just those who are entitled have access. But what happens if this is not the case? Due to the lack

of traceability, no one can be held to account. The affected company has to deal with the consequences in the end, because it is literally not possible to find the guilty person. More than the half of the participating companies in the PwC study mentioned that this is a huge disadvantage.

Also, it makes possible that the sophistication in cyberattacks is becoming asymmetric and less predictable. Therefore, it is necessary to create a secure environment where the data sharing by both sides is supported by the idea of common analysis of the product and possible updates according to the particular necessities of each client.

3.4.5.2.4 Concerns about data slipping away

If a company shares its data in a pool with others, a company is likely to lose the overview. It must be clearly stated which internal information can be shared and which not.

3.4.5.2.5 Technical defect concerns

One of the worst-case scenarios of every foundation is a complete break-down of the production line and all combined departments. Such a standstill results always in a financial loss and less produced quantities. In such an emergency situation, every minute counts and to solve the problem quickly everything must be undertaken. Pretty bad if this plight is depending on an external data pool and the affected company cannot do anything to fix it.

3.4.5.2.6 International cyber regulations

The continuous development of new systems is creating complex cyber regulations to ensure the data protection and avoid possible misunderstandings in terms of distribution and analysis.

3.4.5.2.7 External dependency concerns

The biggest downside of such data sharing solutions is the dependency of a foundation to an external provider. A lot of trust must prevail between the companies. In terms of security, responsibility, and economic stability.

All the mentioned concerns above are huge hurdles to overcome. For a modern and successful company, it is necessary to implement the technological advantages and not to oversee them. By using a decentralized data pool, a company can ensure that just the necessary data will be transferred and only to the responsible person. The market in this sector provides a variety of companies who offer such digital solutions.

However, the best way to provide security in terms of digital transformation is using it for security purposes. For instance, the use of automation as artificial intelligence, which is under constant learning, would be in the capacity to analyze and determine security violations giving the best course of action to overcome the situation. It also provides trends of which kind of attacks they are suffering to continuously improve the security strategy.

Another way to offer better security is with decentralization and cloud computing. That means the avoidance of having all the servers in one physical place, making it vulnerable to attacks and try to use the block chain technologies to divide the big data into packages all over servers around the world converting it, hardly findable to possible hackers. Nevertheless, the best possible recommendation is not spare in the budget for security, it is necessary to see it as a service and an added value for the customer that is completely crucial for the performance of the company in a globalized world, which is ruled by information and trends.

3.5 Conclusion Trend Scouting

After analyzing all the physical as well as digital trends that were selected out of a variety of technologies of industry 4.0, we can definitely see a connection between all the mentioned trends. For instance, smart sensors which are part of the digital trends are used to improve advanced robotics or AGVs which are in the category of physical trends. Moreover, the implementation of AI based machine learning models in production processes will have an impact on already existing technologies in the manufacturing facility such as 3D printing.

The strong interconnection between the trends of industry 4.0 is why we decided to mention “Big Data” as one of the digital trends. Big Data itself is not really a trend it is more an important topic that has to be considered and implemented when doing trend scouting.

The number of new disruptive technologies seems to be limitless. Every year new developments are made, and existing technologies are improved. Therefore, it is extremely important that companies regardless of the industry they are operating in, adapt to these changes and implement new technologies.

Flottweg SE as one of the leading companies in the mechanical engineering industry, has to build up competences in the field of digitalization as every other company. To successfully build up competences in the field of digitalization a very customer centric approach is required and a balance between costs and necessity has to be found. As we work on this project from an outside perspective, we cannot conduct a detailed analysis about which trends would be of interest for Flottweg SE and which are not relevant for the company in terms of technologies.

The mentioned trends are therefore to be seen as examples of what digitalization brings along and based on what we assume to be relevant for Flottweg SE. However, we believe that it is tremendously important that also Flottweg SE builds up certain competences in the digital world in order to stay competitive in a fast-changing world. Hence, it is all about getting all stakeholders on board and developing a good strategy and concept on how to build up the essential competences in the digital world.

4 How successful are the solutions already in use?

4.1 Physical Trends:

4.1.1 Autonomous Guided Vehicles

While autonomous vehicles are at the moment not classified as regular consumer goods, currently around 10% of US manufacturing companies already adopted this technology. The main driver for district transformation in a digital way is cost saving while acquisition costs are the number one barrier. This discrepancy leads to the conclusion that the same cost saving technology is necessarily combined with high financial investment upfront. So firstly, some investment needs to be done to gain those ground-breaking benefits. But there are much more advantages of AGVs to underline their successfulness.

- **Safety benefits**

Safety is improved by the quite simple and essential aspect that human activities are replaced by machines.

- **Material traceability benefits**

With ERP systems, content traceability is automatically synchronized and monitored electronically. In this way, each component can be immediately located and processes.

- **Labor & production benefits**

AGVs have the feature to deliver the needed material on the exact spot, to the time when they are needed without any delay. That safes time and money, and therefore increases the productivity and reduces production time. While the vehicles do the simple get and bring work, the employees have more time to solve those tasks which require more skills.

- **Work-in-process time benefits**

By using AGVs in a company, work-in-process time will be lowered. This increases manufacturing throughput and contributes to better delivery performance, increasing profitability and customer satisfaction.

Briefly, the increased use of autonomous vehicles is unstoppable and without a doubt a major future trend. Even though, there is still a lot of room for improvement, the solutions currently offered are excellent and constantly being optimized. The company gains value from this technology and so do the customers. Not only production and labor costs decrease, but also production time. These advantages lead to the conclusion that this has far-reaching advantages, for example, when it comes to the rapid dispatch of urgently needed spare parts for the company and the customer.

4.1.2 Additive Manufacturing

In the last years, additive manufacturing technologies (AMT) have become increasingly important in the industrial world. The main aim for businesses using modern production technologies is to provide additional value to customers while still increasing process productivity in the value generating system. Besides that, such printers were extremely expensive 10 years ago, today every private person can afford them. For a good reason, they provide the foundation and the customer with enormous benefits and effective solutions.

- **Decreasing cost benefits**

The first barrier is the acquisition of such a manufacturing machine - as already mentioned above - this kind of technology is affordable for everyone. Due to the tremendous potential of additive manufacturing to reduce the financial resources which are needed to increase and fasten the productivity, manufactures are able to increase their productivity.

- **Easy to change and creativity benefits**

The creative freedom, which is connected to this process, is one of the major advantages. Changes can be executed easily and quickly before the implementation of this technology that was much more complicated. The customers advantages are also connected to these facts. For example, a spare part can be fast and simple re-produced, just by sending the lattice model all over the globe in a few seconds.

- **Waste reduction benefits**

Additive manufacturing allows a producer to save raw material, because material will be added and not removed. In former times by using production processes such as drilling and milling, material was removed and created a bunch of waste. By just adding the material, which is needed, the required amount of material can be reduced to a minimum.

- **Energy reduction benefits**

Compared to traditional production processes, the needed energy can be significantly reduced by a huge amount. Every stationary drilling, milling and turning machine needs high voltage current, while every common 3D-printer works with regular 220 Volt. As a matter of fact, only 2 to 25 % of the energy is needed with this technology.

In short, the importance of additive manufacturing machines is increasing more and more. Improvements are made constantly and provide benefits to producers and end-customers at the same time. The possibilities are almost limitless.

4.1.3 Advanced Robotics

In the industrial sector, robotics plays a significant role. Automated production systems are a critical component of any operation aiming for the best performance, safety, and a competitive advantage. It is not surprising that this technology is on the way, such as the term “dark factories”, which means factories without lighting. These buildings are equipped with fully automatic processes that do not need the intervention of any human being. Furthermore, it is important to distinguish between “robots” and “cobots”. The simplest way to understand how cobots and industrial robots differ is that cobots are designed to work alongside human employees, while industrial robots work in places separated from human beings. To generalize, in this part of this research paper only robots are mentioned, but both are meant. Because both provide ground-breaking results in terms of productivity and effectiveness.

Some of the major advantages of advanced robotics are:

- **Safety benefits**

  Safety combined with efficiency is the major benefit of advanced robotics. Heavy machinery together with very hot and sharp material has the potential to harm employees. By passing on dangerous tasks to a robot, these risks decrease enormously.

- **Speed benefits**

Robots do not need a rest, vacation or sick leave. They are 24/7 just there to produce in the most efficient and possible way. Robots can work all the time, and this speed up production enormously.

- **Quality benefits**

Robots will always deliver the highest quality on demand. They are less likely to make errors when they are designed for accurate, constant motion. So somehow, they serve as a quality assurance as well because natural human failure can be completely excluded.

- **Productivity benefits**

Although robots are so good, they can never replace humans. Any activities require the help of a person to accomplish. If people are not held up with simple tasks that robots can take over, they can take care of the important and complex things. The efficiency increases enormously, and the advantages are overwhelming.

In a nutshell, robots are being used more than ever before, and manufacturers are constantly relying on technology to remain competitive. Nobody can predict which tasks they are able to accomplish in the next few years, but it can be assured that the results will be breath-

taking. In a highly innovative foundation modern technical innovations such as AGVs, additive manufacturing and advanced robotics are simply indispensable.

4.2 Digital Trends

The digital trends are the principal trends that the sector is focusing on, knowing the advantages in terms of cost benefits, where it is easier to adapt the general processes and products to the modern technologies under the idea of traceability and analysis.

However, the most important trend in this category for the sector is the development of IIoT (Industrial internet of the things). It can be referred as the network of devices connected to the internet that can collect and exchange data with the goal of achieving a better product experience.

The reason this is considered as the most important trend in the sector is because of the dependence of the other trends to the Internet of Things. For instance, sensors are the hardware component of the Internet of Things which gather data like pressure, temperature, vibrations, rotations, location, torque or force, voltage, light, etc. Limiting the capacity to the recollection of the data.

Likewise, artificial intelligence uses machine learning as the main way to develop the trend. However, that continuous learning supposes the use of IoT to connect the software and

hardware in a useful machine with the industrial environment that can provide information, learn about the data given and use it to acquire knowledge.

The internet of things provides the complete system to secure the gathering, analysis, connection, and exchange of the useful data for the company under the concept of "asset tracking" (Arumugam, 2019).

4.2.1 Benefits in Facility Management:

The IIoT provides an environment where the continuous flow of data enables the use of sensors to monitor the conditions of the machines, providing alerts and signals when it deviates the measure from the parameters stated. Giving a faster service avoiding long constraint in the operations of the clients, also using that data the company can close the loop and offers future solutions regarding the performance of the actual machines.

4.2.1.1 Inventory management

The development of inventory management systems with the use of AI in software, allows the company to optimize materials and search for opportunities to standardize pieces among products, reducing the waste and the operational cost of the clients.

4.2.1.2 Increase of the output

The digital trends as data analytics provide useful tools to the solution of the concerns in the production lines of the client, traduced in the reduction of cost and increased the operational effectiveness. Therefore, the decision process supported with that data can increase the general productivity of the business and offering a major amount of throughput for the supply chain.

4.2.1.3 Plant safety and security

The connection between all the machines using cloud computing, offers tracking of the key performance indicators, proving a real-time overview of the operation, interpreting, and avoiding the possible course of action that can be human mistakes. These benefits can compromise the health and security of the users, “such communication helps in predicting mishaps and responding to emergencies in time” (Arumugam 2019).

4.2.1.4 Reduced downtime

The interconnection of the machines and the analysis of real time data enables to supervise the performance and efficiency of every part of the system creating a flow of process which overcomes the bottlenecks increasing the productivity and ultimately reducing the downtime.

4.2.1.5 Integration user-provider

The share of information in IoT enables to create close relation of engagement between the B2B stakeholders, through the flow of information. The creation of a particular system that provides the best practical solutions to the necessities of the customer, with response rates and customer satisfaction.

4.2.1.6 Benefits in the facility of application

The derivate cost of appliance and the adaptation into the present processes of the company makes an optimal option the digital trends. Nevertheless, its necessary search for the correct innovation which fits with the current necessities of the process into it would be introduced.

4.2.1.7 Field testing

For the field testing of some products, the IoT sensors can help the understanding of the performance before going live, improving the features and solving further problems.

4.2.1.8 Increased customer value

For a client, a product which can offer them valuable information is more functional for the operation, increasing the user experience and adding engagement with the flexibility and convenience that the IoT can offer.

The tradeoff between the decision of using digital trends in an industrial engineering company would be in terms of cost and benefits. The tendencies in the globalized world are forcing to reshape the strategic and operational business lines towards a new kind of B2B consumer line, based on data insights. Businesses must maintain their position in the game, so the suppliers must be in the capacity to offer them products that fulfill their necessities. Therefore, the cost of lost market share is higher than the cost of introducing new digital trends.

5 Competitor Analysis

5.1 Andritz

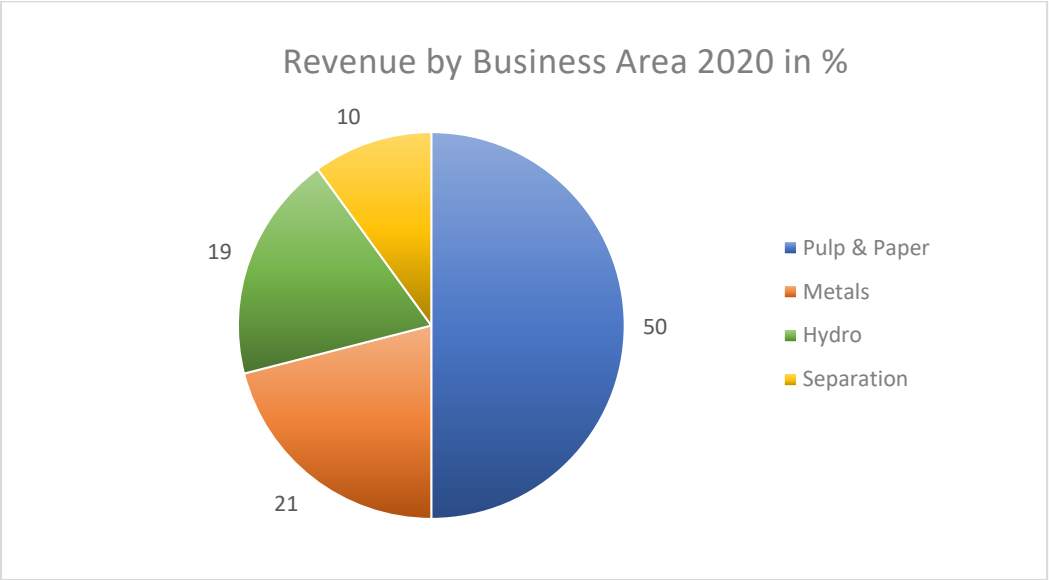
5.1.1 General Information

The company was founded in 1852 by Josef Körösi in Andritz, a suburb of the city of Graz, Austria. Today, the company has developed into an international technology group, employing approximately 27,200 people in more than 280 locations in over 40 countries worldwide. Andritz is one of the global market leaders in the hydropower business, the pulp and paper industry, the metal working and steel industries, and in solid/liquid separation in the municipal and industrial segments.

The Andritz group earned a total revenue of 1,493.2 million Euros in the first quarter of 2021. The Andritz group managed to earn a total revenue of 6,699.6 million Euros in the financial year 2020. Furthermore, the financial statements of the year 2020 show that the revenue of the Business Unit Separation was 644.1 million Euros. The report mentions that the global markets for solid/liquid separation equipment had developed overall rather satisfactory during the year 2020. Especially the environmental and food sectors experienced good project activity, while the feed and biofuels sector reports only satisfactory project activity.

The graph shown in the Andritz financial report 2020, clearly shows that the Business Unit Separation (D) with a revenue-share of 10% of the total revenue in 2020 amounts for the smallest share of revenue for the entire group.

Figure 4: Revenue by Business Area 2020



Andritz (2020)

5.1.2 Digitalization Strategy

Andritz has declared digitalization in its annual company presentation from March 2021 as a strategic long-term goal. The group has developed an all-in-one internet-based, human-machine interface. The company has a portfolio with numerous digital service products, all of them united under the umbrella of the technology brand name Metris.

5.1.3 Digital Services Metris UX Platform

Metris offers digital state of the art products aimed at digitalizing and networking machines or even entire plants. The Metris brand covers individually adapted products within the IoT/Industry 4.0 sector and can be fully tailored to fit the individual needs of Andritz's customers. Metris exploits the advantages of Smart Sensors, Big Data and Augmented Reality.

5.1.3.1 Platform Functionalities

5.1.3.1.1 Metris X – Distributed Control System (DCS)

Metrix X is a hardware independent control system, allowing the customer to choose their preferred industrial components. The application is open to integrate different Data Scientist tools and allows automation engineers to create, build and train AI-based models in one environment.

5.1.3.1.2 Condition Monitoring

Metris Vibe is a wireless vibration sensor for monitoring mechanical equipment, regardless of the manufacturer. Metris Vibe App is available for Google Play store and Apple App store and offers basic analysis graphs for acceleration, velocity, and temperature.

5.1.3.2 Process Optimization

With Metris Optimization of Process Performance (OPP), Andritz offers a service contract to improve the performance of a variety of production systems. OPP is a part of Metris – Andritz Digital Solutions. The system identifies opportunities for savings and efficiency is based on continuous developments in the main technologies:

- Smart Sensors
- Big Data
- Augmented Reality

5.1.3.3 Cybersecurity

In cooperation with OTORIO, a leader in industrial cybersecurity, Andritz has developed an extensive cybersecurity program ranging from advanced assessment and consulting services to implementing cybersecurity and risk management technologies.

5.1.3.4 Metris Smart service

Simplifies and optimizes business processes along the value chain. The focus lays on the optimization and digitalization of internal and external business processes.

Table 4: Metris Spare Parts Catalog

Customers' own plant and equipment	User-friendly interface
2D drawings and 3D models	Spare part kits and maintenance packages
Transparent part information	Quotation and order status incl. history
Approval workflow	Key contact with call-back function
Machine manuals and as-built documentation	Customer material number

Andritz (2021)

5.1.3.5 Metris Secure Remote

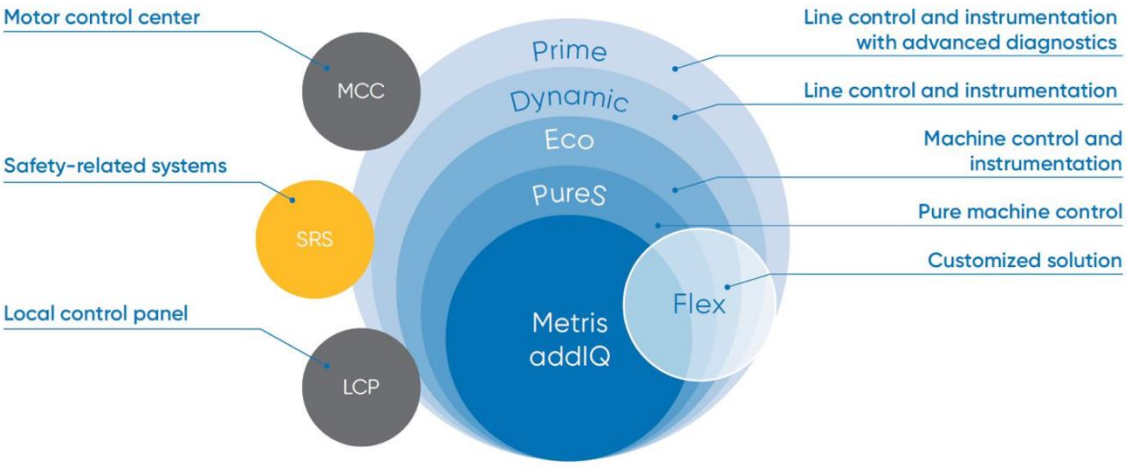
Through remote assistance, Andritz connects their process/equipment experts to provide real-time assistance through audio, video, and AR-guided support.

5.1.3.6 Metris Risk-Based Management

Metris Risk-Based Management (RBM) is an application within the Metris software package and its purpose is to allow the prioritization of maintenance tasks according to risks applied on assets in the production floor.

5.1.4 Metris addIQ Control System for Decanter Centrifuges

Figure 5: Metris addIQ packages



Andritz (2021)

The addIQ control system is, a modular, PLC-based system designed to optimize the efficiency of a decanter centrifuge. Metris addIQ is available for new and existing decanter machines form Andritz, or any competitor decanter. The control system is available in different packages and can be purchased as Metris addIQ Dynamic, Metris addIQ Prime, and Metris addIQ Flex. What is included in which package, can be seen is the figure below.

5.1.4.1 Benefits of Metris addIQ

AddIQ can be easily integrated into new or existing dewatering lines/plants, hence ensuring a short start-up time. The system claims to have a high availability and reliable performance in operation for all decanter-related functionalities. AddIQ uses an intuitive machine

interface and avoids downtime through visualizing preventive maintenance alarms and offers process improvements where applicable. Furthermore, Andritz says that Metris addIQ control systems would open the door for all future IIoT solutions. Additional features and options are shown in the table below.

Table 5: Metris addIQ additional options and features

Additional Options	Additional Features
Metris addIQ Connect: • Displays most important process parameters.	**Polymer Saving Function:** • Operation of highest efficiency • Reduced operating cost.
Metris addIQ Monitoring: • Health status accessible from anywhere in the world.	**CIP Cleaning-in-place:** • Allows intermediate cleaning during production without disassembling.
Metris addIQ Optimizing: • Analysis tool for process optimization.	**Thickening Function:** • High stability of dry solids content at machine outlet

Andritz (2021)

5.2 Alfa Laval

5.2.1 General Information

Alfa Laval is headquartered in Lund, Sweden and was founded in 1883 by Gustav de Laval. The company has over 17,000 employees, 42 large production units worldwide and is selling its products in 100 countries. Alfa Laval is divided into three core business divisions covering Energy, Food & Water and Marine. Their main customers are found in industries such as chemical, oil & gas as well as pulp and paper.

Alfa Laval's latest financial statement shows for the full year 2020, that net sales decreased by 8% to SEK 41,468 million. The Energy division of the Alfa Laval group, managed to gain a net sale of 12,187 million SEK, the Food & Water division earned a total net sale of 13,414 million SEK and the third division, the Marine division reported a total net sale of 15,867 million SEK. Which means in terms of revenue figures the Marine division is the most profitable one of the Alfa Laval group.

5.2.2 Digitalization Strategy

In December 2020, Alfa Laval has taken a 20 percent stake in AMI Global, a specialist in end-to-end Industrial Internet of Things solutions. The investment was made as part of Alfa Laval's digital transformation, and to further strengthen their competences in IoT technologies.

5.2.3 Digital Services for Decanters

Alfa Laval offers its “Connected Services” as part of a service agreement. On the base of a fixed annual fee, customers can purchase tailored service packages for an ideal fit.

Services are comprised of Remote Support and Monitoring, Cost Calculator, ConditionAlert™ and Constants Solids Loads and Adaptive Polymer Control.

5.2.3.1 Remote Support and Monitoring (IFS Remote)

Alfa Laval is using IFS Remote Assistance, a collaborative merged reality software, to enable real-time interaction between two video streams within an interactive environment. While the service has helped to provide assistance in areas where travel was banned due to the corona crisis. Alfa Laval is planning to continue the use of IFS Remote Assistance, thus improving efficiency while reducing unnecessary travel and to provide a better work/life balance for their field service engineers.

5.2.3.2 ConditionAlertTM

Alfa Laval's ConditionAlert™, is a condition monitoring system designed for decanter centrifuges, to predict machine failures before they occur and therefore allows optimized service intervals with the intent to increase equipment reliability and reduced service costs. To detect the condition of a decanter's critical components, a dedicated set of sensors is used to evaluate anomalies. The data is sent to a central server where Alfa Laval's service engineers can assess the problem and to coordinate further steps together with the customer.

5.2.3.3 Constants Solids Load and Adaptive Polymer Control

Wastewater plants can use this process optimization tool to decrease the operation costs of Alfa Laval's decanter centrifuges through optimizing the dosage of flocculants. Alfa Laval offers two ways to set up the system, either in Constant Load mode or in Adaptive Polymer Control mode.

- **Constant Load** □ In this mode, the system is trying to keep the number of solids passing through the decanter. This is achieved by measuring the concentration of solids in the feed, while constantly adjusting the flow rate, so the solid load can be kept constant.
- **Adaptive Polymer** □ In the second mode, process optimization is achieved by ensuring a constant feed flow while adjusting the number of flocculants being added. To cut operation cost and to optimize the consumption of flocculants, the solid concentration in the feed is measured and allows to add flocculants accordingly.

5.2.3.4 Cost Calculator

Offered as an add on to Remote Support & Monitoring, Cost Calculator algorithms execute a real-time calculation of operating costs based on live data, costs of raw materials and power consumption. The Cost Calculator gives immediate feedback on how a certain setting affects the overall operation cost of the decanter. Furthermore, the system identifies and shares best practices between different machines and facilitates the forecasting of polymer consumption.

5.3 GEA

5.3.1 General Information

GEA, former Metallgesellschaft AG was founded in 1881 in Germany. The group has over 18,000 employees, 2000 operating subsidiaries and is composed of five individual divisions: separation and flow, liquid and powder, food and health care, farm, and refrigeration technologies, each with up to six business units.

In 2020, GEA achieved a total revenue of 4,635 million Euro, which is a reduction of 5% when compared to the previous year. The division Separation & Flow Technologies alone earned a revenue of 1,192 million Euro.

5.3.2 Digitalization Strategy

In 2019, GEA announced a cloud-based open service portal, and named digitalization as a core innovation driver for the company. In cooperation with MachIQ, GEA developed the supplier independent customer platform which can be integrated with most ERP systems and enables a seamless digitization between customer and supplier. Furthermore, the platform includes e-commerce for purchasing spare parts and GEA also wants to add additional services such as Condition Monitoring, video support and remote support.

"With the strategic partnership between GEA and SAP in May 2020, the company takes another step towards digitalization by implementing a global ERP system" (SAP, 2020). Noteworthy is also GEA's utilization of the Automated Machine Learning software from Weidmüller.

5.3.2.1 GEA Centrifuge Simulation Tool (Digital Twin)

During the development phase GEA uses the simulation tool to conduct software tests.

The software is also used for the Factory Acceptance test and virtual commissioning. By creating a digital twin, GEA can detect and solve software failures early in the project-phase, resulting in a more efficient execution of installation and start-up. Unforeseen operating conditions can be made visible, independently of the physical availability of the centrifuge.

6 Digital Adoption Strategy

The best way to overcome the barriers stated before (in chapter 2), is with a strong digital adoption strategy. Based on the continuous flow of information - with the stakeholders involved - in the implementation process. Below six crucial steps are described, which will support a company during this endeavor.

6.1 Step 1 - Eliminate resistance to change

Usually, projects are set up to produce some kind of change in the organizations, but organizational change is often accompanied by resistance. A company needs to understand why people resist change, what forms this resistance can take, and the effects of resistance on the organization. Change can mean disruption and uncertainty; and most people naturally seek stability and order in their lives.

6.2 Step 2 - Educate and communicate before kick-off

To have any chance of a smooth transition it is necessary to have a common education and a proper communication. This creates a culture of acceptance which will lead to an atmosphere of excitement instead of fear. At least 70% of all included persons must be convinced about the upcoming transformation, otherwise the endeavor is very likely to fail.

6.3 Step 3 - Proper training and support

The development of a new technology has to be accompanied by the development of a robust training, depending on the particular usages and relevant information for each of the groups of interest. While the people involved are trying to use the training provided, they develop the necessary skills and increase their self-confidence.

6.4 Step 4 - Maximize the engagement

Pointing out the new benefits and stating the advantages that the new solution will provide to them, is extremely important. Especially comparisons with other/older existing solutions are helpful.

6.5 Step 5 - Keep them up to date

Keep all stakeholders interested in the new innovation with continuous functionalities, training and on-going proper communication.

6.6 Step 6 - Track the users

Use analytics to track the effectiveness of the new technology on the different users and boost the engagement. As every technological transformation is a temporary endeavor, optimizing your processes should always be in the interest of the company.

Furthermore, the development of such technologies should be focused on the client and on the user experience. Offering a strategy that supervises the collective understanding step by step of the new solution, and pointing out all the new benefits for the customer, only leads to successfulness.

Figure 6: Individual steps of digital adoption strategy

Source: Own elaboration (2021)

7 Analyses of the "Implementation Guidelines" of Digitalization in different Industries

7.1 Introduction of the Importance of Digitalization in the Industry

Many studies have conducted that digitals gain more and more importance not only in the B2C but also in the B2B environment. Studies like the one of McKinsey a few years ago measured the impact and potential that digital solution can have for companies in the B2B field. Another part of this study focused on the readiness of the companies to implement such digital tools and to transform to a developed environment. Digitalization in B2B is more complex than in B2C, that is why the implementation lasts much longer than in B2C.

Digitalization is widely used for high-quality customer interaction, yet most of the deals are closed offline. Reaching the whole buying center using one tool is very complex. A lot of B2B sales teams lack the real-time analytics or tools that they would need to close the deal online.

Still, leading B2B companies adopt an "all in" digital strategy, as they know that it is inevitable for the future. Those leading companies are not only focusing on customer interaction but also on harnessing digital assets in the firm to empower a better performance of their teams. The terminology "Industry 4.0" is the expression for a full-on review of solutions and digital tools that can reveal substantial performance gains across automation, real-time connectivity, data, predictive maintenance, and the supply chain as a whole.

PWC found that the leading companies in the industrial sector are planning to highly invest on digital technologies like sensors, connectivity devices, software, and execution systems. The area where digitalization is used most is in the Supply Chain as finding data and data analytics can be used for customization and further innovation.

Findings show that establishing an effective eco-system with customers, partners and with suppliers offers the possibility of an end-to-end view of the whole supply chain and with this to a just-in-time solution. This just-in-time solution is a win-solution for all the parties mentioned before. This solution offers them the possibility to participate and integrate from signing-up until the end.

The key parts, when it comes to identifying opportunities, are data and data analytics, as those will ramp up innovation chances and ideas and will set a new bar.

7.1.1 Automobile Industry on the example of Ford

The company Ford has used a plant for industry 4.0 innovation and change as well, as a key hub for eco-system. The products produced in the already mentioned plant vary a lot,and involve many different parts from multiple suppliers located in different places around the world. This was reason for an environment where frequent delays and non-availability of parts was normal until they introduced the “Material Flows Wireless Parts”-system.

The “Material Flows Wireless Parts” is a wireless messaging infrastructure, which enables to locate the needed part and to keep track of the inventory. As for now they have a button that you click if a part is needed, but Ford is working on AI techniques that should replace this button and automate and predict the replenishing time. The installation of the up to now available infrastructure caused a productivity increase of around 20 %. Moreover, the system reduced on-hand inventory to 24 hours, and it decreased the downtime to almost zero hours. It also offered the possibility to forge more effective partnerships with suppliers who are enabled to take initiative in the whole process.

7.1.2 Networking solution Industry on the example of Cisco

The multinational technology conglomerate Cisco did not only look on the production process but focused more on the customer engagement and how to ensure a growing demand. Cisco is one of the leading companies that adopt B2C advantages to the B2B world. They pushed Cisco into multi-channel selling and got a remarkable reputation in terms of sales and buyer friendliness on the web. You get every information that you need directly on their web page regardless of if you search for the distribution centers or the supplier list. Furthermore, the company offers an application which makes the search even simpler.

7.1.3 Logistic Industry on the example of TGW

For the company TGW in their customer segment, digital transformation means for example, a warehouse management system “WMS”, which is a software solution that provides visibility to a company's entire inventory and manages order fulfillment processes along the supply chain - from the distribution center to the store shelf. This process has usually already taken place before the investment in an automated intralogistics system. Regularly, these are individual solutions that have grown over the years and here one avoids an adjustment. This "sitting out" does not solve the problem but only postpones it and worsens the situation if, for example, the old warehouse management system no longer has sufficient capacity or support. This transformation phase usually takes years and should not take place in parallel with the investment in intralogistics technology.

For SMEs (small and middle enterprises), however, this transformation is often a stumbling block because the resources in the form of personnel, time and money are lacking or difficult to provide. However, companies do not only demand short-term solutions for digitalization but also want to understand which topics of digitalization a company like TGW can offer apart from the respective task.

This includes e.g.

- A digital twin to make the behavior of physical plants visible, traceable and predictable.
- Monitoring products to monitor processes and conditions in order to detect and eliminate wear and tear at an early stage.
- Workshops to evaluate and identify digital pain points.

In order to convince a potential customer, a regular blanket statement is not possible here. Essentially, it is necessary to understand the customer's requirements and motivation and to develop the best possible solution.

7.1.4 Change Management on the example of Jungheinrich

As a leading system supplier for smart intralogistics solution, Jungheinrich believes that connecting and conducting processes perfectly can be beneficial for each and every company. These process changes ensure the profitability and efficiency for the future.

The company Jungheinrich offers a WMS for future digitalized and connected warehouses. Reliability and industry agnostic are keywords when thinking about the software which manages, controls, and optimizes warehouses. This system gets constantly updated and grows along with the company. “The modular arrangement offers to perfectly customize the whole experience" (Jungheinrich, 2021).

7.1.4.1 How to get the perfect orchestrated warehouse with 4 principles:

Table 6: Factors to executing a perfect orchestrated warehouse

Simplicity	The company offers services where they try to simplify the challenge of the change because of Industry 4.0 for their customers as a change in the network system might be complex but should not be complicated. The first question to ask as a company is, how is it possible to implement smart connectivity, to conduct these processes perfectly, and to ensure to stay profitable and future-proof at once.
Customization	The usage of machine platforms and components which have been proved in practice and customized to companies` requirements should help to find the right solution as there is no single right solution, but only one right for each company. It is crucial to find a fitting solution for the companies` processes as this is a corner stone for the right implementation of digitalization in any company.
Automation	For Optimization in terms of process time and also safety, part or full automation systems offer potential. Moreover, automation offers a certain flexibility to the company itself and reduces faults. Again, these automation systems need to perfectly fit to the company. However, before starting to implement an automation strategy the company needs to set its requirements so that working manually, partly and fully automated goes hand in hand. Furthermore, the adjustment flexibility makes it difficult in the beginning to find the right degree of automation, but if it is perfectly implemented it offers the possibility to react on peaks and future growth.

	Jungheinrich offers with its Warehouse Management System or short WMS as they say the -metronome- that sets the beat.
One source	When implementing a WMS it is important to stick to one source as they know your initial situation and know which targets you want to reach. A mixture of different services leads to more workload and could end up in chaos.

Jungheinrich (2021)

7.1.5 Logistic Industry on the example of Linde Material Handling

The global acting “Linde Material Handling (MH)” foundation has many sectors in which they operate. One of those and the most interesting in this case is the logistic sector. Linde provides companies with highest technological and automated intralogistics solutions. Implementing such process changing solutions is a challenging and complex undertaking.

For the sake of a better insight in how this company operates, an experienced sales-person of Linde’s Material handling division provided us with valuable information. In order to get an idea of how Linde MH handles such changes with customers in their company.

7.1.5.1 How Linde handles "change management"

They work out the new processes very detailed with the customer and are still able to react very quickly during the engineering phase. At the end of the contract, a so-called "change request" is issued, in which they evaluate in the team whether the customer's change requirement is possible or not, or with what effort the adjustments can be made.

As a result, a supplementary offer is made again and, after completion of the installations, an appendix to the specifications is created or the specifications are adapted.

7.1.5.2 Guidelines how this process is handled at Linde

From the first appointment with the customer, they evaluate whether the investment in new processes makes sense in technical and economic terms or not, or to what extent this is relevant for the customer. They work very closely with the customer and carry this out individually. In a nutshell, there is no one solution fits all guideline.

7.1.5.3 The willingness of companies to undergo a digital transformation

After many years and discussions with customers, they have figured out that most customers want a single change without affecting other processes. Unfortunately, all processes are less or more interrelated and must also be reconsidered and adjusted when changes are made. Without any adjustments to the "upstream" and "downstream" processes, the new

process usually cannot be implemented. For example, when automating individual processes, the automation system must be told where to pick up the goods and where to take them.

7.1.5.4 Resistance to change

Due to the fact, that many people / positions are often involved in this issue and the resistance side changes. Unlike in Germany, they don't really have problems with the works councils in Austria. In Germany, the Union is very strong and tries to argue with resistance especially in the topic of automation.

7.1.5.5 Convincing the customer

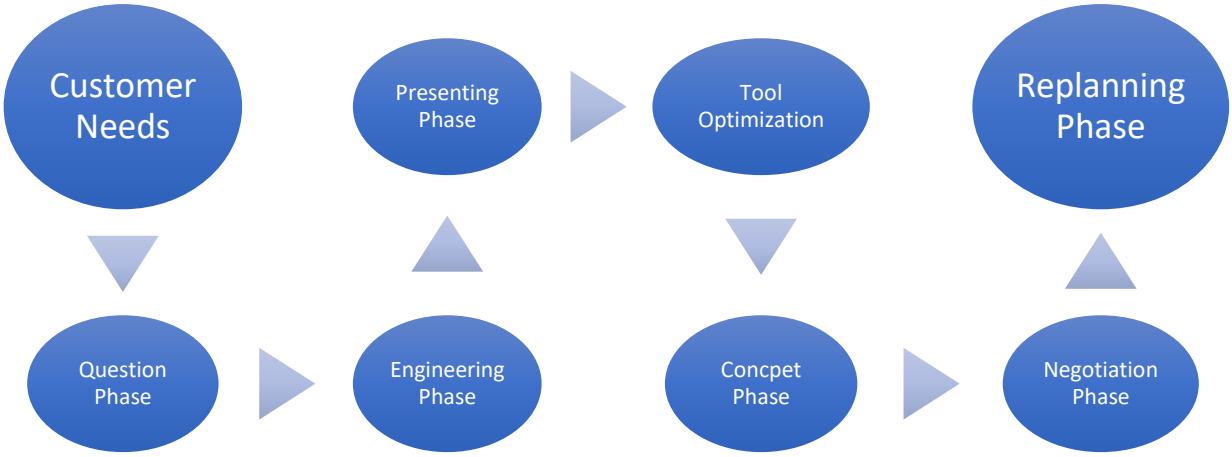
The biggest argument is without a doubt the economic aspect. How many FTEs (full time equivalent) will the company save by introducing the new processes. This often involves the controlling department, which calculates the ROI (return on investment).

Sometimes Linde also had requests from customers who want to support their employees in the best possible way and therefore do not perform a cost/benefit calculation. Or they want to keep up with the times and present their company as modern.

7.1.5.6 Rough automation procedure at Linde Material Handling in Austria

1. Seller receives need from the customer.
2. Seller has several tools and asks predefined questions.
3. Engineering team is contacted.
4. Team member visits customer and presents Linde's capabilities.
5. Expert analyzes customer's readiness with several tools.
6. Several concepts are created together with the customer until an offer ready for order is created (All departments control the contracts).
7. After various rounds of negotiations, a contract is set up and the expert hands over the project to the project manager, who is responsible for further procedures.
8. If there are any changes to the contracted scope, the PM analyzes this with the team and creates a new offer.

Figure 7: Rough Automation Procedure at Linde Material Handling in Austria



Dort and Haidlinger (2021)

8 Digital Adoption Strategy – with the Example of a Data Collection System

One of the main advantages of Flottweg over their competitors is without a doubt that they provide the highest qualitative products. In fact, it makes perfect sense to constantly improve their creations overall to extend their lead in this direction.

A digital adoption strategy is described by Krishnan Kaushik as

"The process of creating a plan to adopt any application seamlessly."

To achieve this goal, companies need to constantly optimize the processes, overcome barriers, and create a framework that supports the organization's aim in every possible way. According to Forbes Magazine around 70% of such change programs unfortunately fail because of the resistance of the employees. Consequently, most companies know about the importance of such a fundamental change, but to implement it successfully is the major challenge.

Therefore, the next example provides a compressed insight of how such a complex process could look like. Of course, there is no one-size fits all solution but all the tasks can be broken down into smaller pieces and hurdles can be cleared aside before they even occur. Collecting data has enormous potential to improve a company's position in every thinkable direction. In fact, this example is based on the gathering and analysis of big data, under the support of a big data analytics company.

8.1 Step 1 - Eliminate Resistance to Change

A major challenge for businesses is to assist employees in overcoming their resistance to change which is a necessity for innovative solutions. One could say that the majority of employees resist due to a lack of awareness, understanding, knowledge, and training. Accompanied with the different stakeholders involved in the adoption of the big data technology, employees must be aware of the importance of it for the processes. In short, a sense-making perspective to all stakeholders will provide valuable insights why this process is necessary.

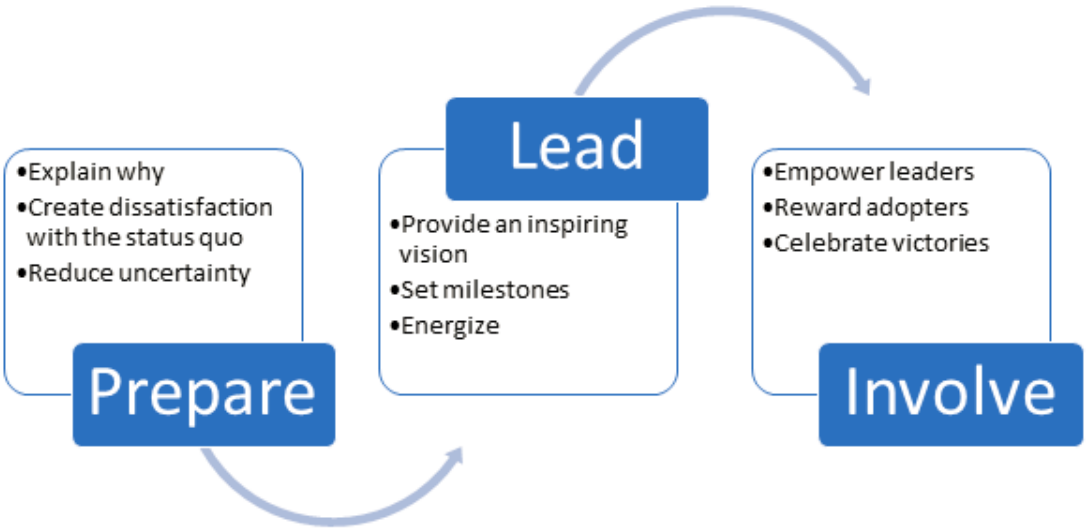
Consequently, people must be included in sense-making processes. One approach is to manage this task based on three levels:

- fostering an inclusive and equal workplace environment
- inspiring leaders who motivate the employees to be agile and function as a role model
- helpful and emphatic teammates who have the emotional support and inspiration to be innovative

From the Flottweg side, they could apply the sense-making perspective focusing on the idea of state and understand the potential benefits for each department and the company as an overall. Targeted communication of future benefits must be made within each division, to increase the commitment for the implementation of the upcoming data analytics methods. For instance, the possible new pricing strategy in the financial department or the post service advantages that the innovation would provide and save the company an enormous amount of money.

Flottweg and the big data analytics company could destroy the client hurdles as well with the proper information about which possible advantages they would receive acquiring and adopting the innovation. Stating that it would not be a threat or barrier for their current processes and the main point is the continuous tracking of the machine to avoid any future concern and provide solutions on time for them and possible future users.

Figure 8 :Three steps for eliminating resistance to change



Source: Own elaboration (2021)

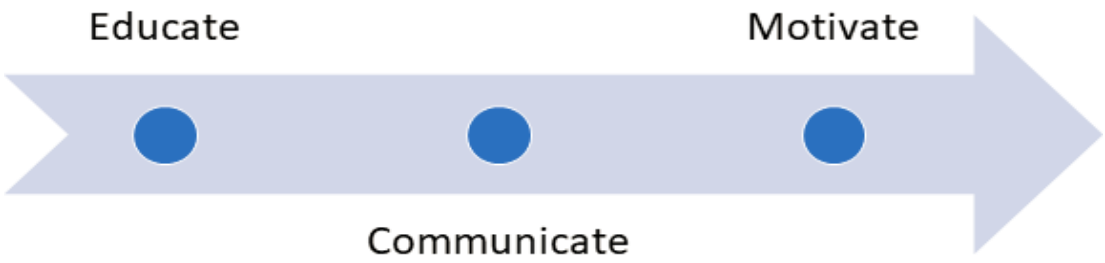
8.2 Step 2 - Educate and Communicate before Kick-Off

Under the gaze of the Big Data analytics company, Flottweg should create theoretical and practical training to convince the employees about the solution that they will have soon and the benefits of the big data in their particular areas. Therefore, it is necessary to implement a personal training which aims for each employee under the personal perspective to create a level of compromise in them, increasing the engagement and the rate of early adopters in the company. The focus should lie on those early adopters. Working closely together with them, many teething problems can be eliminated right at the start of the changeover phase.

For the clients, Flottweg should give the power to the Big Data analytics company, to create a particular training for the customer's interests. This training must be focused on the tradeoff

analysis between cost and benefits of using big data. Another aspect that the training should focus on are higher advantages, increased engagement and an improved use rate in the client's company.

Figure 9: Educate and communicate before kickoff



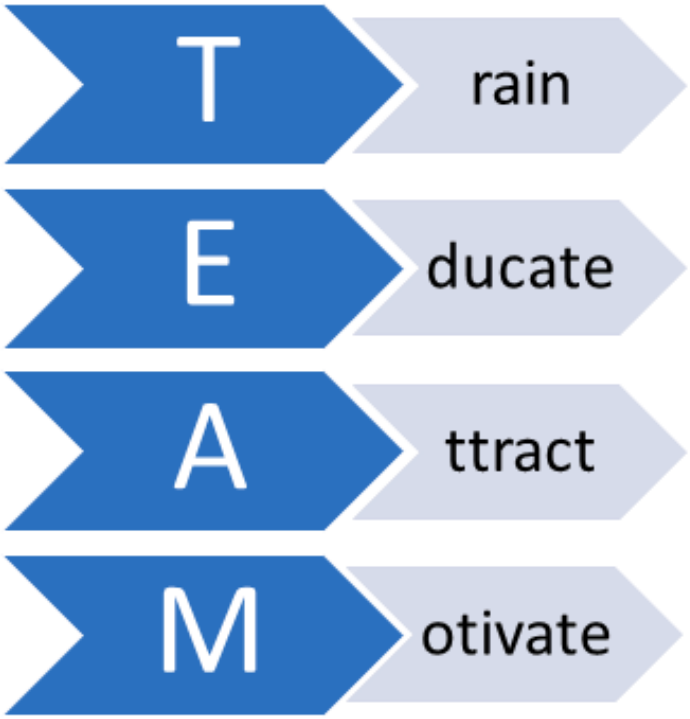
Source: Own elaboration (2021)

8.3 Step 3 - Proper Training and Support

The development of a training program based on the different uses of the big data by stakeholder is crucial for the smooth adaptation to the innovation. Therefore, Flottweg with the help of the experts in the area, must select the correct strategy for training their employees of the different areas with contact with big data and the level of uncertainty that they could have about information systems and the contemporary trends in the scope. However, the practical training is crucial, whereby its necessary to measure the performance of the users on live using analytics to recognize the possible advantages of it in their areas and all the seen weaknesses to secure the overcoming of them as soon as possible.

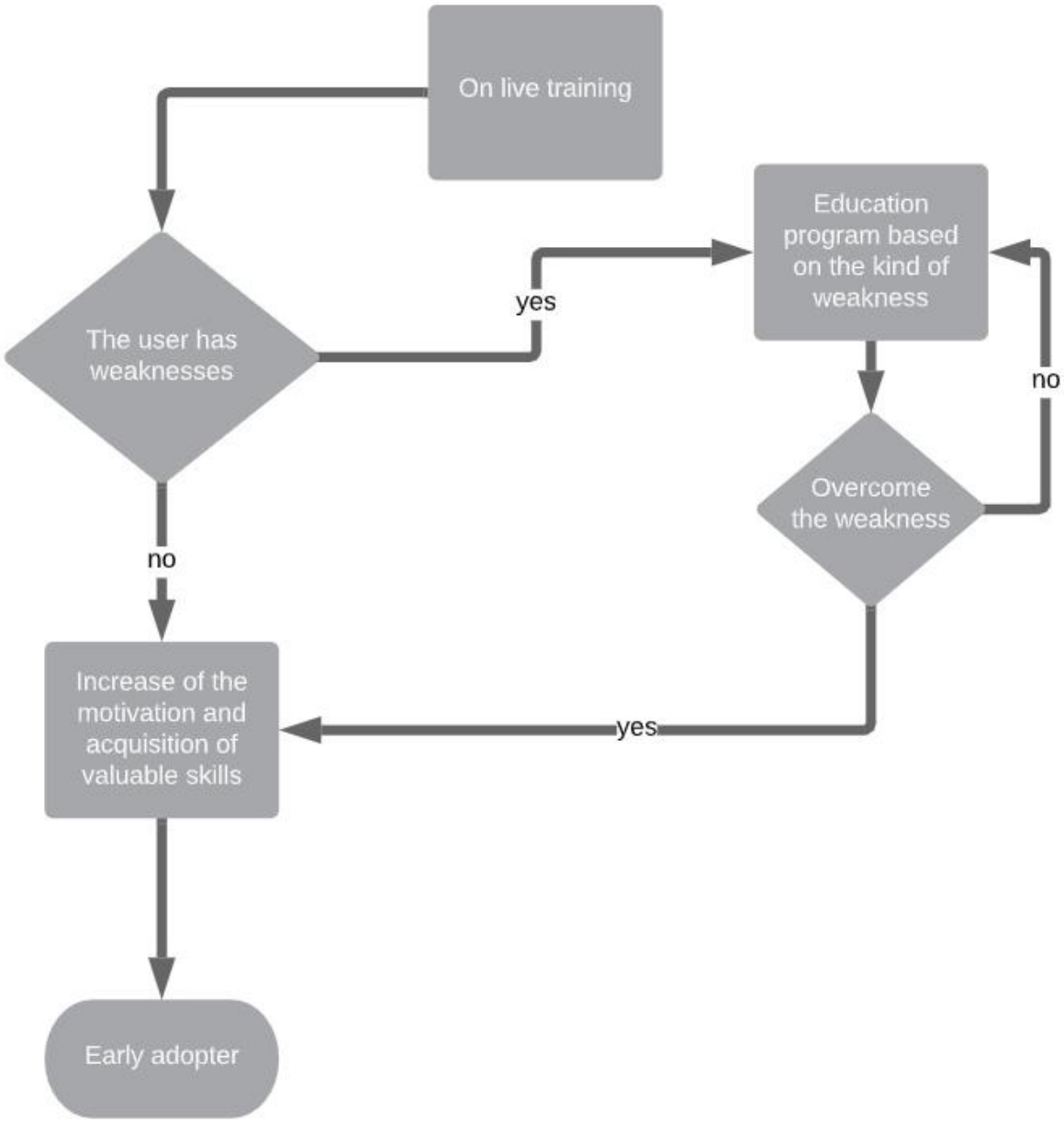
It is important to regard that the training program should be based on the users and the acquisition of the necessary skills for the implementation of the big data in the current organizational processes. Nevertheless, it is a long-term process with phases that ensure the complete motivation of the stakeholders, passing through the first training under real conditions helps to identify weaknesses. Educating to overcome the problems identified, ensuring their attraction for acquiring new skills for their professional development and giving them the feeling of being relevant is vital.

Figure 10: Proper training and support for the team



Source: Own elaboration (2021)

Figure 11: Process of supporting employee



Source: Own elaboration (2021)

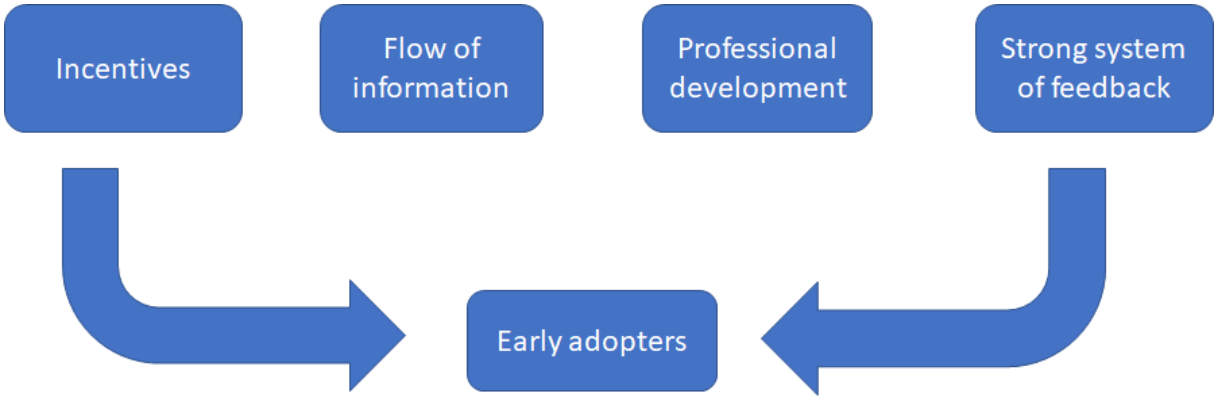
8.4 Step 4 - Maximize the Engagement-

To keep the stakeholders interested in the digital transformation that would be taking part in the moment, Flottweg can create a system of incentives for the early adopters and the users which use the big data analytics in their processes, as current examples of the success of the innovation. Indeed, Managers should work out both financial and non-financial benefits for employees who show more engagement in their jobs. Several management theories have indicated that when employees get more pay, recognition and praise, they tend to exert more effort into their job. There should be a clear link between performance and incentives given to the employees.

In addition, the creation of opportunities to professional development in big data and a correct flow of information are strategies that should be considered with the incentives to ensure the reliability of the workforce in the digital transformation process.

Nonetheless, for the client, the benefits pointed out before, should be motivation enough to fully involve them in the development of big data analytics. However, a strong system of feedback and continuous learning of the innovation, with the implementation of the other strategies, can increase the engagement with the users and their interest in understanding how it really works.

Figure 12: Promoting early adopters



Source: Own elaboration (2021)

8.5 Step 5 - Keep them up to date

It is a necessity to keep all stakeholders interested and motivated in the ongoing progress of the transformation. In order to do so, implementing the right "change communication strategy" is equally difficult and important.

Change communication, is essential to accompany people from where they are at the moment to where you want them to be, without putting too much stress on them.

To be effective and successful there are four steps that must be undertaken in every changing process.

8.5.1.1 Awareness

Create awareness for the need for change. Make people aware of the problems with the status quo and the implications of not making a change. By focusing on talented early adopters this can be communicated even faster and more effective, especially among the workforce.

8.5.1.2 Understanding

Involve people as much as possible in determining what the changes should be. Creating task forces to research results of the present course of events and to analyze and promote future options is a good way to begin. There are times, of course, when this step is not feasible for example, when you are told what the changes will be without being given any chance for input. In a nutshell, it is always about proper internal communication.

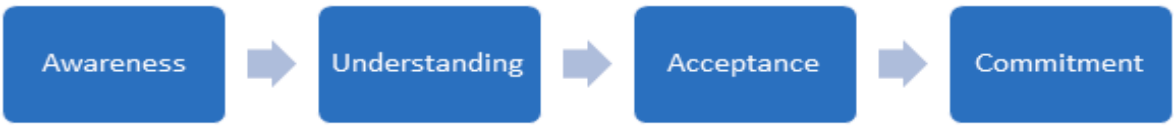
8.5.1.3 Acceptance

Communicate the changes honestly and explain the reasons for them - appeal to rationality. Even people who do not accept the changes may find it easier to live with them, if they have an understanding of the purpose behind. Deal forthrightly with people's concerns. Provide a platform for people to raise their concerns and questions about the changes. Address the most critical question for those affected, and sometimes even inconsistencies must be discussed one-to-one to avoid misunderstandings.

8.5.1.4 Commitment

People feel much more comfortable with fundamental changes if they have a clearly defined role. This is especially important if they have not participated in the design-phase and were not able to take part in the decision-making and structuration. The more people can contribute to the design of systems that affects them, the readier they will be to accept change. Often, questions of implementation, timing, and strategy are best addressed on a personal level by those most affected. Other ways to involve people include monitoring and providing feedback on the implementation of change.

Figure 13: Regular updates



Source: Own elaboration (2021)

8.6 Step 6 - Track the Users

Use analytics to track the effectiveness of the new technology on the different users and boost the engagement. As every technological transformation is a temporary endeavor, optimizing your processes should always be in the interest of the company.

The most proper way to understand user progress is to constantly track them. On the market exists a variety of digital tools which provide clear insight of which features and progresses work out well and those which still need some improvement. If this information will be forwarded and analyzed by a supporting team, this valuable data can be used to spot issues, maximize training efficiency, and increase customer and user experience.

Accordingly, to overcome the customer barriers the development of those steps might be focused on the client and in his/her user experience. Offering a strategy which supervises the common understanding of the new solution step by step and pointing out all the new benefits for the client.

9 Conclusion

The key goal of this particular project is to tackle the topic of digitalization by looking at the various trends available as well as the major hurdles companies like Flottweg SE face when executing such digital technologies. Initially, the project team investigated Flottweg's current situation in regard to the global market to help us get an insight of the major influences that may have an impact on the company like the political, environmental and technological factors.

From exploring the outside factors affecting Flottweg using the PESTLE model, the project team followed the report with a detailed analysis of challenges companies like Flottweg face when transitioning into digitalization. By examining both the companies' as well as the customers' perspectives, these emphasizes the difficulty of transforming a company into digital one and such problems are needed to be known to help ease digital transition.

One of the major parts of the report is the megatrends in the current Industry 4.0, ranging from physical machineries to digital systems. As there are tons of popular trends, the project team selected some trends, which could be beneficial for Flottweg SE like advanced robotics, smart sensors and big data to name a few. Moreover, the project team underlined how such trends are applied and their advantages when choosing to implement the trends.

It is always a good thing to get some knowledge about one's competitors' status. In the report, the project team investigated the three major competitors of Flottweg SE, Andritz, Alfa Laval and GEA, and dives specifically into the digitalization strategies these companies

currently acquire. The digitalization strategies of the mentioned companies differ from one another and Flottweg SE could get some inspiration from these strategies.

Another important aspect of the report is the implementation guideline, analyzing the digital implementation strategies of various industries (automobile, network solution as well as logistics industry) with some examples of specific companies, namely TGW, Jungheinrich and Linde in the logistics industry. By studying the implementation strategy of other companies, Flottweg could get some understanding and vision of how to introduce digital change into their company.

Ultimately, the project team created an implementation guideline for Flottweg SE about a digital adoption strategy they could introduce into their internal system. This digital adoption strategy should give Flottweg some ideas of how to establish digital transformation to their company in order to stay on top of their game and continue to provide high quality technological solutions as well as customer satisfaction for many more years to come.

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