Phase 1

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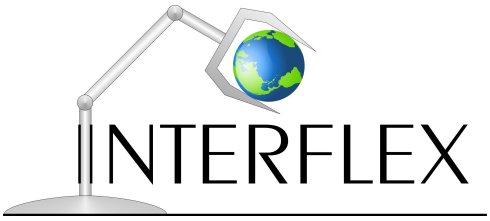

1 Collaboration

1.1 Belbin

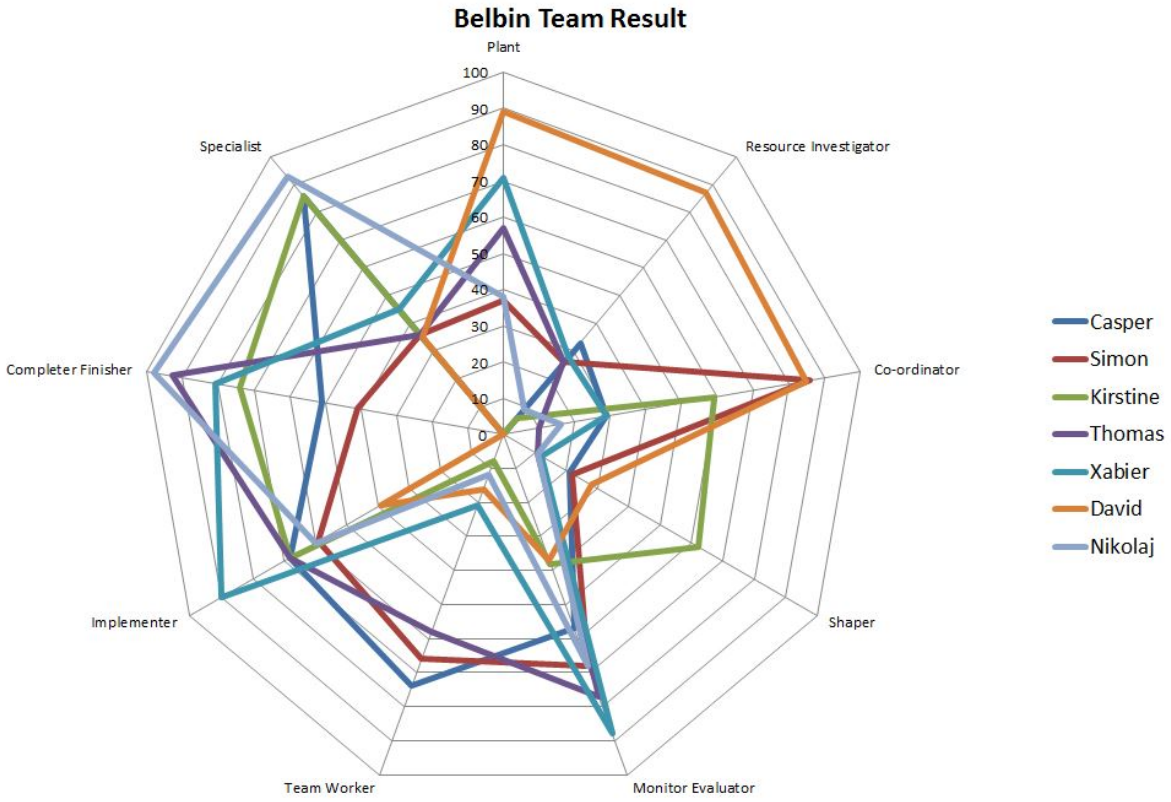

Figure 1.1: Belbin Self-perception "Spiderweb"

Table 1.1 is based on the results of the individual tests, which is also reflected by the spider web chart on figure 1.1. The table shows the strong and weak roles for the team profiles.

It is very clear that the group has a major potential when it comes to developing solutions to perfection, while being able to investigate the different possibilities. This could be explained by the amount of specialists in the group.

It is also very clear that the group lacks drive and a key person to set the pace of the work processes. The group has to be aware that the beginning of project can potentially cause issues. This is due to the lack of Plants and Resource Investigators. The Plants provide creativity and innovation, while the Resource Investigators validates the possibility of and idea.

Contribution:	*Allowable Weaknesses:*
Top 3 roles:	
Monitor Evaluator	
Sober, strategic and discerning. Sees all options and judges accurately.	Lacks drive and ability to inspire others. Can be overly critical to others.
Implementer	
Practical, reliable, efficient. Turns ideas into actions and organizes work that needs to be done.	Somewhat inflexible. Slow to respond to new possibilities.
Completer Finisher	
Painstaking, conscientious, anxious. Searches out errors. Polishes and perfects.	Inclined to worry unduly. Reluctant to delegate.
Bottom 3 Roles:	
Shaper	
Challenging, dynamic, thrives on pressure. Has the drive and courage to overcome obstacles.	Prone to provocation. Offends people's feelings.
Plant	
Creative, imaginative, free-thinking. Generates ideas and solves difficult problems.	Ignores incidentals. Too preoccupied to communicate effectively.
Resource Investigator	
Outgoing, enthusiastic, communicative. Explores opportunities and develops contacts.	Over-optimistic. Loses interest once initial enthusiasm has passed.

Table 1.1: Top/Bottom 3 Belbin Self-perception for the group

1.2 SWOT

Table 1.2 shows the combination of the SWOT-analysis of the individual members. By combining each SWOT-analysis into one, we get a very good overview of the strengths and weaknesses for the group.

By looking at the two boxes with strengths and opportunities we see that there are a lot of words and sentences that indicate that our team can solve and work with problems, as well as being structured. The two boxes that contain weaknesses and threats indicates that the team is marked by stubbornness, non-shapers and non-innovative members. This implies that the team will probably have a hard time generating ideas and to start work on a problem.

It is a kind of a paradox when we take a look at the strengths and weaknesses of the team. We are very good at solving and working with problems, but at the same time we are having difficulties finding and or creating these problems. This means that the team should be aware of difficulties especially in the beginning of the project.

1.3 Competence triangle

In order to learn more about each group member a competence triangle was created (figure 1.2). The competence triangle separates competences that are on a personal, theoretical and experience level. This is done to get a better understanding of how people view themselves and what their education involves. Each member wrote down 2-3 things about themselves and each item and its relation to the project was discussed. The group has a lot of math and programming focused people, but lacks business oriented people.

1.4 Conclusion

The team has had a lot of difficulties finding a problem that we wanted to work with. We have been using innovative tools including brainstorming to come up with ideas particularly around e-waste but we never got anything useful. After a meeting with the supervisors, we decided to work with an idea that was

Strength	Opportunities
Patient(2)	Problem solving(3)
Tolerant	Good presenter
Open minded	Broad contacts
Working with others	Interested in management
Communicative	Solve problems on time
Strong work ethics (2)	Able to structure the report
Adaptable	Can finish a project.
Team player	Can work from somebody's schedule
Open minded	Can work late
Communicating	Not afraid to delegate and face impacts
On time	Mindful of others and open for communication for instance the workload
Social	Can work in different areas
Experience (work)	Idea generation
Effective	Technical skills
Technically skilled	Easily can learn other subjects
Clever	Team worker
Logic thinking	
Able to prioritize	
Well organized	
Decisive(2)	
Ambitious	
Thorough	
Decisive	
Dedicated to solving issues/problem	
Comprehensive	
Discipline on my own	
Creativity and innovation	
Weaknesses	**Threats**
Stubborn(2)	Not a specialist
Impatient	Easily get stressed
Inflexible	Impatient, if others don't understand
Being on time	Might be difficult to understand
Express my ideas	Bad at solving problems myself
Unwilling to recognize the value of my work	Bad at remembering details
Not starter (If goal is unclear)(2)	Might ignore good suggestions when focused on other/own ideas
Loses focus easily(3)	The development phase might be slowed down
Not very innovative/creative (2)	Reduced working time
Overview	I like parties and going out/I prefer fun over work
Working fully on my own	Focus on too many areas
Skeptical within my area	We might never get started
Not a perfectionist	Bad at getting ideas to startup a project
Bad at keeping track of who knows what	Losing focus
Meeting deadlines	Need things planned in good time
Uncomfortable with uncertainty	Get stalled in some point of the project
	Don't finish on time

Table 1.2: SWOT-analysis

mentioned in the introduction of the project.

By looking at the results from the Belbin and SWOT-analysis it is not surprising that the team ended in the situation that we did. It is very clear that the team has a weakness when it comes to idea generation and as well a strength in problem solving. Prospectively it would be a good idea to look at the results

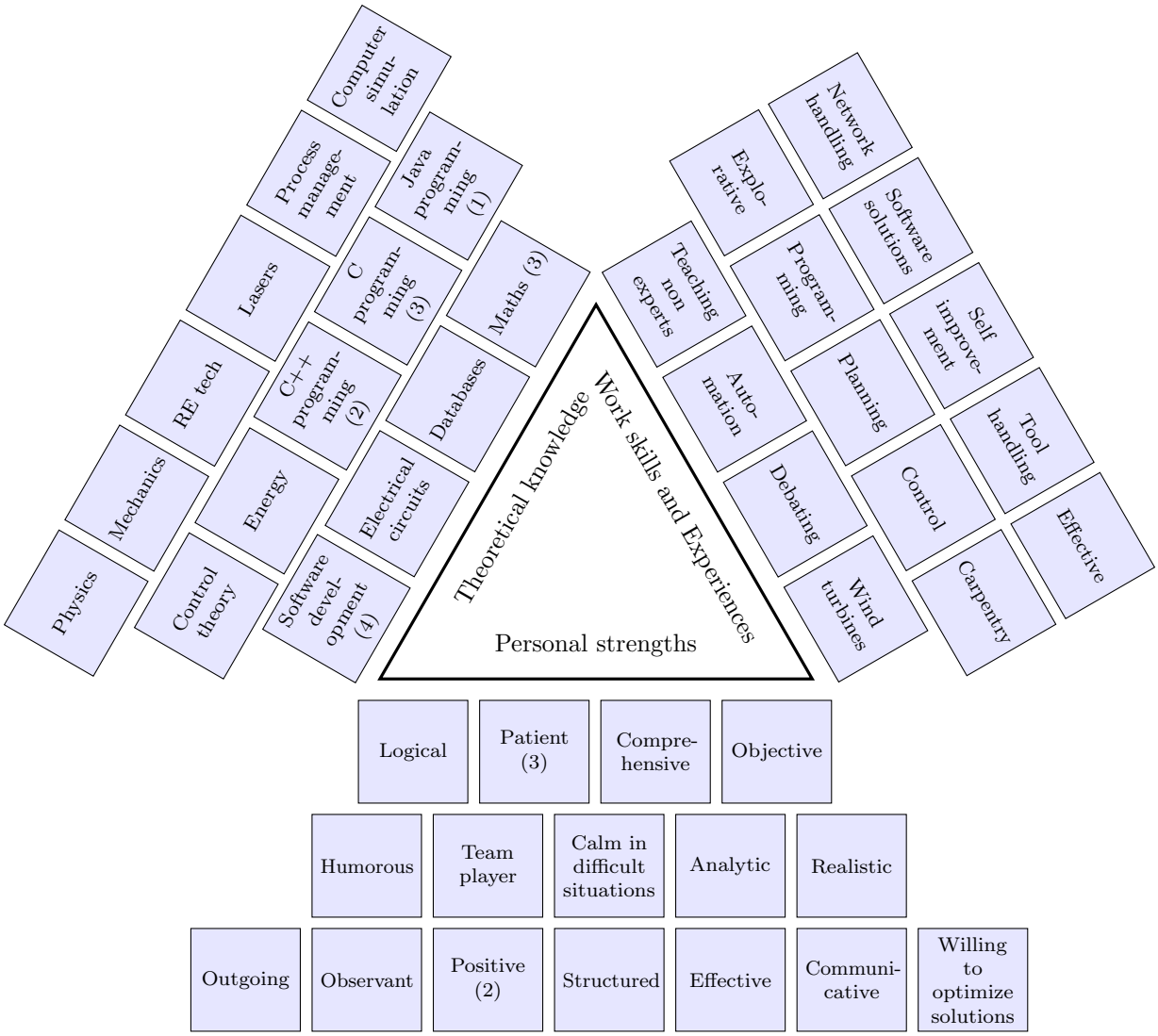

Figure 1.2: Competence triangle

from the team tests so we don't end up in the same situation as we already have.

2 Innovation and business

2.1 Pictures

For an idea generation process we all sat around the same table and passed around pictures. We started with the pictures face down so we would pick them at random. When passing the pictures around, each of us said what came to mind when looking at the pictures, always keeping in mind that we were to make a creative functional robot. We made sure not to comment on each others thoughts so all thoughts were allowed.

It was very interesting to see how different pictures generated different thoughts. There was a picture of an opera singer, and the thoughts there were: "Loud", "Hard work", "Love for your work", "Human interaction", "Service provider", "Sound recognition" and "Training algorithms". Another picture was of a cellphone and the thoughts there were: "Interface", "Monitoring", "Portability", "Connectivity", "Extension/Multi-functional", "Compact", "User experience", "New experience", and "Awareness/focus".

(a) Picture of opera singer used in the idea generating process.

(b) Picture of cellphone used in the idea generating process.

Figure 2.1: Pictures used in the idea generating process

In the beginning of this process several of us found it to be somewhat a waste of time. It was difficult to see how a picture of an opera singer should help us design a robot. After the process, however, we all agreed that we had come up with some really good words, and a lot of them were words that we would like to describe our product, e.g.: "Mobility", "Safety", "Combined knowledge", "Service provider" and "Precision". Other words we would have to make sure would not end up describing our product, e.g.: "Loud", "Danger", and "Legal issues".

2.2 Business Model Creator (IDEA - BMC)

After defining the business idea we wanted to specify problems that our idea could solve. To get the maximum from our idea, we decided to make a business plan. The question was how to generate cash flow and to create value for the customers and this helped us answer it. It helped us to better define the situation in which we found ourselves and the direction we should take.

We started with "Value Proposition", which should help us define the services we would like to provide and the products we will develop the business model for. We saw this step as very important and that it will define the course of our business plan, so we decided to spend some time thinking about how we could define what we are going to do and the value we want to create for potential customers.

In the end, we defined our customers as the companies in the welding industry. Companies working on improving the welding technology and companies with non-mass production. We expect the first to be interested in acquiring the technology to implement it to their own system to gain a competitive advantage and the latter one can use it to improve their production and facilitate flexibility of the production, making it possible for further customization of their products and reduction of costs and time.

In the next step, we began to define ideas related to the product. We saw an opportunity in creating value from our product as an innovation in areas, where the competitors failed to achieve it. We decided that the best option in terms of price of the final product would be to suit the current market price, as it would be almost impossible to sell it under the price and selling it with a high price would not be profitable for our customers as the value it creates for them is not crucial for their production.

Will have to make the following comments in reference to the product configuration:

- We are trusted partner in a highly integrated value chain. We focus on adding value in a very specific chain.
- As we focus on developing the technology necessary for the development of sensing system lines for automation of welding, a strong relation with our partners will be necessary, as we need the rest of the technology and components, in order to create the full product.
- Our processes will be quite the same as the industrial production in general:
  - Inbound logistics
  - Production
  - Outgoing logistics
  - Sales and marketing

There is also the financial part. Our prices depend on the product features. The more or the better the features, the higher the price, so it will be more expensive if we had to develop a new type of product with different specifications than if they buy the standard product. We will try to make a price list suitable to all kinds of potential customer's production.

Finally, we have the customer configuration table 2.1. We have an extremely narrow area of focus, but we can develop the product in response to the customer needs, which we know. As this is not a cheap product and the market is not that big, we will try to keep our customers through loyalty programs, where customers are rewarded for remaining loyal to our product. This is also a good way to acquire new customers, because if they are happy with the service/product we provide them, it is very likely that they will provide positive references and recommendations and spread the message about our product.

Customer Configuration Channel				
Channel	Awareness	Evaluation	Purchase	After Sales
Internet	✓	✓	✓	✓
Product brochures		✓		
Journals	✓			

Table 2.1: Customer configuration

2.3 Brainstorm

One of the main techniques applied in the ideation process was brainstorming. In order to get the best outcome from this technique it is important that any idea, no matter the absurdity, is allowed on the drawing. Others may benefit from these seemingly absurd ideas. Early on in the ideation process there

was a strong consensus in the group that we find our project in the waste recycling domain. Figure 2.5 shows the first brainstorm the group made.

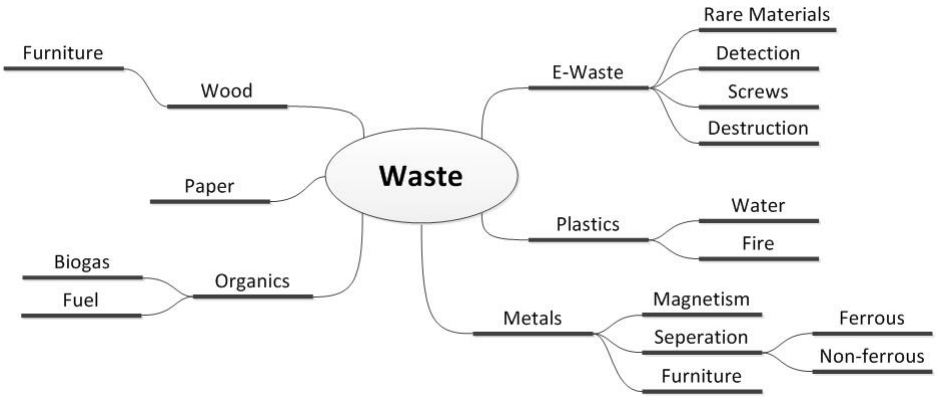

Figure 2.2: Brainstorm on different areas of waste recycling and possible ways of sorting

As can be seen, the two fields of metals and E-waste received the most interest. A vote was held to decide which of the two fields we were going to continue our research on. E-waste was chosen. To further specify the problem of our project another brainstorm was started, this time on different problems within the field of E-waste. The result can be seen in figure 2.6.

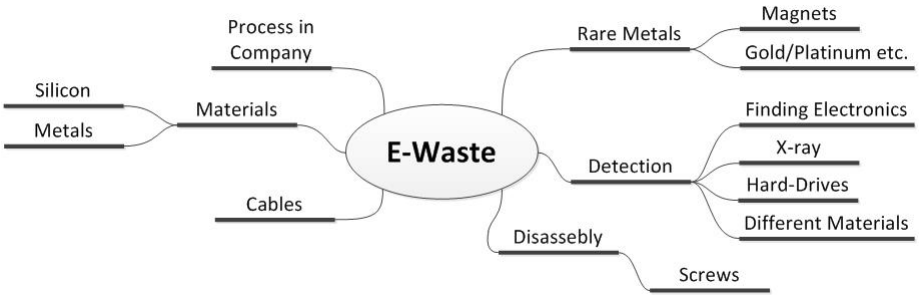

Figure 2.3: Brainstorm on problems within the field of E-Waste

No real result came from the brainstorm on E-Waste, and we came to the realisation that more research was needed for us to finalize our project idea. A list of questions was devised and each member assigned to do research on some of these questions.

At this point we were advised by the supervisors to either make a choice based on the research we had already done, or to go in another direction entirely. It was decided to do a brainstorm entirely focused on concepts, this can be seen in figure 2.7.

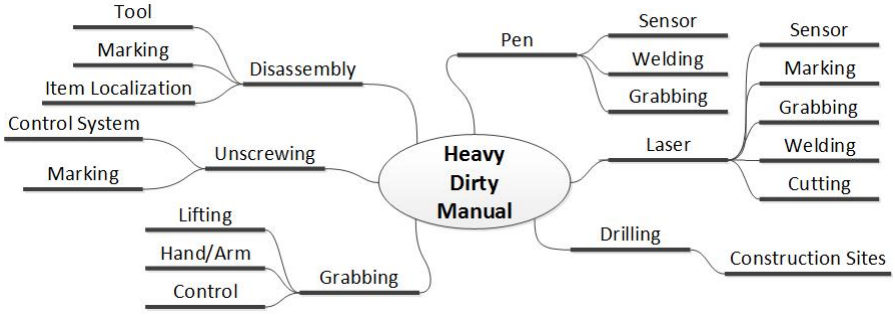

Figure 2.4: Brainstorm on possible concepts

Upon finishing the brainstorm the team split into two groups, each group discussing applications for each concept. Ultimately, we decided to focus our project on the development of a flexible welding robot, using a derivation of the pen principle.

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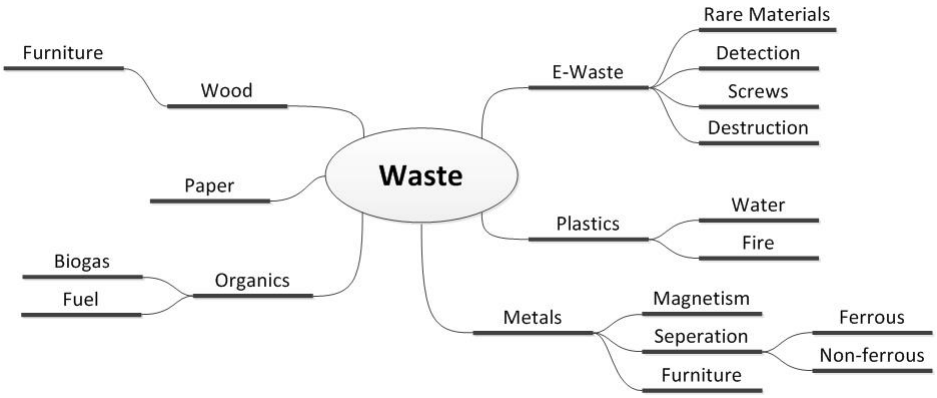

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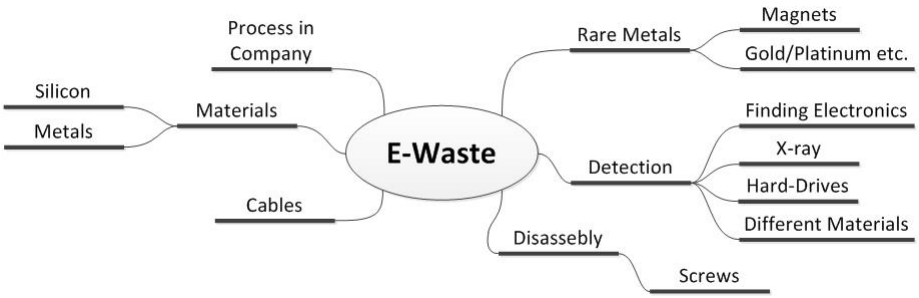

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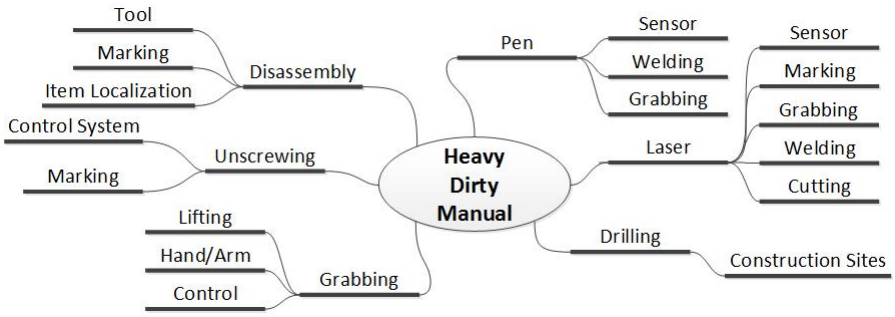

Figure 2.7: Brainstorm on possible concepts

3 Expert skills

3.1 Technology description

The idea consists of a welding robot, which is able to recognize a line prepared for welding. To be able to do this, we have to use different technology, as it is a complex case that requires a variety of components to carry out this project.

It is necessary to have a welding robot with a lot of sensors to allow the robot to be more independent. Standard welding robot, which can support up to 6kg with a range of 810mm (to 5 axis) would be used. These robots are perfect for arc welding, assembly, cleaning etc. so it is ideal to use this type of robot.

We also have to take into account all types of protection needed for the implementation of these robots, in this case the following would be used:

- Foundry Plus
- Wash
- Clean Room ISO Class 6

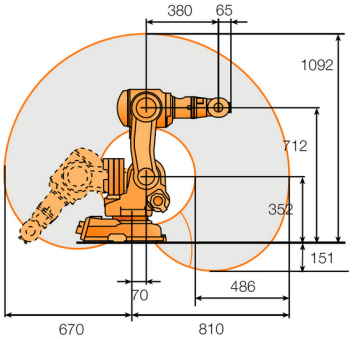

Figure 3.1: Possible type of robotic arm used

We would like the robot to be able to precisely weld holes, which can be as small as 0,1 mm. Precision of the robot is a key component for this task so we have to use a measuring tool.

The decision fell on a laser sensor capable of measuring the distance between the laser and the item prepared for welding, so knowing the position of the laser, we are able to calculate the position of the tool tip, in this case a welding pen. This will serve to correct deviations and obtain a uniform weld, because welding is performed at the same distance.

4 Business plan

5 Product and Concept

5.1 Customer Value

A welding robot will, on average, replace 4-5 human welders, significantly decreasing the cost of wages. Additionally, robots can alleviate workers of potentially dangerous tasks. The quality of the welding done by robots is not only more consistent than that done by humans, who might tire or loose focus, it is also of a higher quality. The tool that we wish to add to the robot will further decrease the labour needed to operate a manufacturing line by removing the need for a programmer. The workers will be able to quickly and easily instruct the robot in the job at hand. This will significantly increase flexibility and potentially allow for smaller businesses to make an otherwise impossible investment.

5.2 Core Product

We propose a tool which can be attached to and interface with an existing welding robot. A worker will, using a special marker, mark the area on a product that requires welding. By combining computer vision and sensors the tool will enable the robot to automatically locate and weld a seam. This scheme will completely eliminate the need for the expensive and time consuming programming processes.

5.3 Pricing

A modern welding robot system will cost around one mio. DKK, the cost of our tool will be added to this price. In order to stay competitive with the programming solutions currently on the market, it is important that the added cost is kept low while still maintaining the quality of the work that the robot can do. Keeping both competition and quality in mind, material and manufacturing costs are close to 30.000 DKK[1] The final sales price is therefore set to 50.000 DKK.

5.4 Development Potential

The initial iteration of the product is designed for producing new products. It is limited only by the size of the welding robot that it is attached to. We envision a future for our product in repair and maintenance of existing products. This is a field where models and standardized methods are rarely in place, and the strengths of our programmer-less approach will truly show its usefulness.

5.5 Production

An important aspect of this product is that we want to keep costs low. One way of doing this has been the use of existing technologies to achieve something new. Production is as advanced as ordering parts and assembling them. The only custom part needed in the product is the housing, which will be ordered from a machinist. Initially assembly will be done nationally, and shipped internationally. Shipping is easy due to the limited size of the product. Once profit allows it, it will be considered whether production should be moved to countries with lower production costs.

5.6 Industry structure and environment

A meeting with Valk Welding in Nr. Åby gave us some insight in the robotic welding industry. Valk Welding sell total robotic welding solutions from Panasonic but with their own modified software. The

[1] A breakdown of the price can be seen in appendix [Price of tool]

market had a total sale of 22 units across the industry in 2013 in Denmark and with a few competitors[2] the market seems pretty tough. Valk Welding said that they did not do canvassing, the production companies came by themselves. Valk Welding offer two kind of programming solutions an online an a offline. The online solution means that the robot is programmed with the controller that is connected to the robot, so you can see how the robot is moving while programmed. This means that the robot can't work while being programmed and this can take up to several weeks. The offline solution takes place in a software program where a 3D-drawing of the object is uploaded. Here the programmer can program the robot while it is working. It takes 5-10 times as less time to program offline compared to online. The demand on the market is offline programming solutions because it gives a lot of flexibility.

A at robot exhibition in Copenhagen the 17th of November 2014 Valk Welding announced their "pistol[3]" for robotic welding. Within a 3D camera zone you take the pistol and place it where and how you want to weld, click it and then place it where the welding should end and click it[4]. Then the robot welds the marked area. This is though a slower process than the offline programming if a lot of welds is needed.

5.7 Entry barriers

There are several entry barriers on the market. A big one is to compete with companies already in the industry which has lot of years of experience and insight in customer demand and behavior. These companies are already working on flexible solutions, which is the marked demand.

5.8 Competitors

All manufactures of robotic welders is more or less a competitor or a potential partner/buyer. This is because they are all working on more flexible solutions for the customer. The easier it is to program your robot, the more flexible it is. The main competitors is listed in table**??**. The resellers Migatronic and Valk Welding buy or cooperate with the robot manufactures ABB and Panasonic, respectively. All the listed competitors are on the same level of competition.

	Welding robot resellers	Welding robot manufactures
Valk Welding	X	
Panasonic		X
Migatronic	X	
Kuka		X
Fanuc		X
ABB		X
Yaskawa		X

Table 5.1: List of most known resellers and producers of welding robots

5.9 Competitive advantage and strategy

The flexibility of our product is taken to the next level, the operators programming time is minimized to the minimum. The user friendliness seen in our product is our strongest strategy and this should make all the competitors buy our product.

6 Management and organization

The concept is an equally owned idea between the group members. It has been declared since the beginning of the project in the group contract. Since the group consist of students, the project will require funding

[2] See 5.8
[3] Looks like the last joint of a welding robot
[4] Only works in a straight line though

to become a reality. No one is interested in being personally liable for the debt if the company should go bankrupt. That is why creating an ApS would be a good option. This requires at least 50.000 kr. of value (can be values of objects too) to settle. The risk of doing it this way is that the investors will probably force the group members to sign for a personal liable agreement. When investors act, the ownership will probably change also as they will be a part of it.

6.1 Legal structure and ownership

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6.2 Management

A conclusion has been drawn from the Belbin group result. It is based on the requirements of the different titles within the company. For instance, we felt that the CEO would require a strong represent who has a great overview (Acts as a coordinator), a talent for communication (Resource Investigator) and the drive of a shaper. Within these three fields, a score was created based on the individual Belbin results, which lead to choosing David as the CEO. The same procedure was followed when assigning candidates for the other posts:

- CEO, David
- CTO, Xabier
- CFO, Casper

MISSING HIERARCHY STRUCTURE OF THE COMPANY

6.3 Board and advisors

As usual, the leaders of a company will be sitting within the board, but here by different partners would also play a big role within. If KJV decides to sell our product, they could have an interest in driving our company in certain directions to increase the sale. This would benefit both of us. It could be interesting to have other partners within the board, especially some within the technological field, robot- and software wise. One of the most valuable advisors to have would be a person with experience within innovation and technology, who also has experience with a start up company.

6.4 Partnerships

The strategy of the company relies on having different distributors within Europe, therefore it is essential to have partnerships with these companies. They are not the final customer of our company, but a link to them. This is where the main revenue streams is going to be created. For instance, KJV would be an optimal partner within the Danish market, since they are able to reach the final customers within Denmark. Distributors like KJV is our goal to reach within the market of Europe. Another sort of interesting partners is one of the majors of the market. This could be Migatronic, Valk Welding, Universal Robots or any other sort of major company within the field of technology, who already exist on the market. The reason for this is that they could be interested in the technology our product offers and that they would like to integrate it within their range of products. This situation would usually lead to them investing in our company and putting a limit to which companies we are allowed to collaborate with.

6.5 Key activities

For the project to become a reality it would require financing, unless the group members settles for working on the project through a period of their masters. This would result in a different direction of development, than with a basis capital. Because software is doable without the need of an investment, but when it comes to combining the hardware and software for testing purposes, it is going to require an injection of funds. In this case, the obvious choice would be the group trying to find investors.

Therefore the development of concept is crucial for the company while pitching the idea for potential investors. Other key activities will include the process of combining software and hardware and further testing to improve the product.

6.6 Key resources

The key resources are the assets to the company that are necessary to create value for the customer. These shall support the company and make it sustainable. To summarize the primary key resources to the company:

- Injection of funds
- Accommodations for office and development usage
- Consultancy in form of business innovators who can advice and share experiences

7 Appendix: Pricing of Tool

7.1 Introduction [better name needed]

For the success of this product it is crucial that the price stays competitive. Offline programming methods currently in use today[5] costs 100.000DKK, software and training included. Our product should stay within this budget or offer significant advantages over competition.

7.2 Bill of Materials

Below is a rough estimate of the budget for each component needed to produce the robot:

Product		Budget (DKK)
Camera	:	2.000
Laser scanner	:	5.000
Custom Housing	:	5.000
Embedded Hardware	:	2.000
Software	:	5.000
UV flash	:	2.000
Interface	:	3.000
Marker	:	500
Total	:	25.500

[5] Information courtesy of Valk Welding