## Team

**Alejandro Breukelen Garcia**
Delft University of Technology
Aerospace Engineering

**Alejandro van Breukelen García**
I am an Aerospace Engineering student at TU Delft, with a keen interest in science. I was born and raised in Spain, but I have both Dutch and Spanish nationalities. I joined the Delft honours programme in 2021 and am now working on research in the Space Instrumentation department. I have always been interested in physics and how science can help society; this is the reason why I joined the CERN Summer School. I wish to learn how ideas are developed at CERN and how they can be taken from concept to product.

**Quan Zheng**
Delft University of Technology
Computer Science

**Quan Zheng**
As someone with a motivated and entrepreneurial spirit, I am always looking to take on an extra challenge. My educational background lies in Computer Science and Engineering where I feel in my element, but I am also highly interested in the workings of human nature, which is why I am completing a minor in psychology. Joining the CERN IdeaSquare Summer School has given me great insight into the challenges and opportunities when working in an interdisciplinary team and taught me a lot about how value is created in the industry!

**Samuel Hanssen**
Delft University of Technology
Aerospace Engineering

**Samuel**
I am a Dutch and French Mechanical Engineering student at TU Delft. I have also had an interest in entrepreneurship for a long time. Being an honours student I was able to sign up to participate in the CERN summer program. It was a great opportunity for me as I was able to develop my skills in this field while working with a practical real-life technology. I hope to be able to use the skills I developed in this program someday in my career!

**Tamira Neves Lopes**
University of Amsterdam
Theoretical Physics and Mathematics

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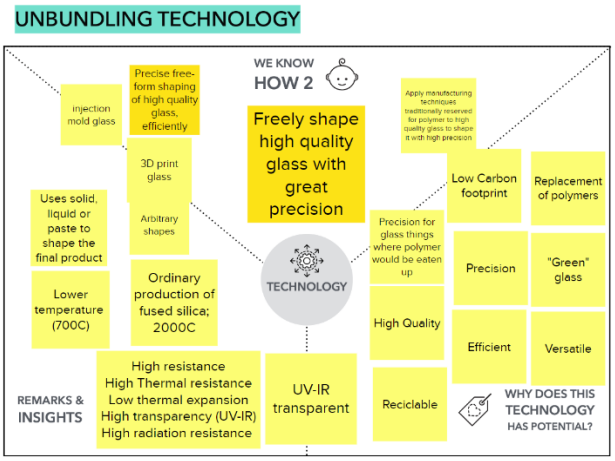
**Tamira Lopes**
I am a master's student in Theoretical Physics and Mathematics. I am a Dutch student of Capeverdian descent. I finished my Double Bachelor degree in applied physics and mathematics at TU Delft. As a physicist/mathematician I have always been intrigued by CERN and it has been my dream to visit it for a very long time. I always have liked seeing how science and business coincide and how they each have different approaches towards new technologies. That is why this project was such a unique opportunity to look at technologies without only taking the technical perspective on things. I also was curious how a team of various educational backgrounds would cooperate and think. This is the environment that we will encounter in the workplace and I was enthusiastic about experiencing it to some extent beforehand

## Innovation process, choices & Milestones

**Preparation**

Following the Kick-off and an afternoon of teambuilding, a first lecture was given on *unbundling technology*. Where it was described what technologies we would be working with, and how we would be working with them. At this point the "*We know how to*" concept was introduced: this is a useful tool to reduce a technology to its essence, to what it can achieve, disregarding the methods or intermediate steps. This is the first step toward understanding the potential of a technology and what the possible applications will look like.
The second lecture was on Design Thinking, and how to come up with ideas as well as how to develop this ideas into working concepts. This was taught as a tool to achieve innovation.
The last lecture introduced the scientific paper we would have to write at the end of the course and described the general layout and themes of papers in the CERN IdeaSquare Journal of Experimental Innovation. The team began discussing possible topics to research: the marketability of climate change, motivating customers against a cheap alternative and the use of prototypes in pitching, among others.

**Delft Design Sprint**

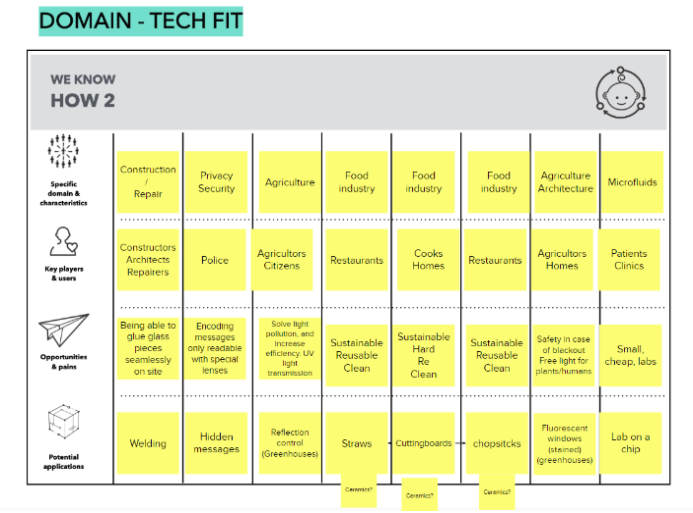



In July, the team worked together for three days in Delft, starting with a dive into their technology. A long list of possible sectors and subsectors for applications was written, to be used as a baseline in the next exercise. 12 domains were selected and arranged on the Mural (as seen in the picture). These were: Lenses for glasses, Scopes, UV cleaning, Glassware, Medical tools, Microfluidics, Windows, Solar panels, Art, Repairing glass, PCBs and Space. Then through different brainstorming phases and for each domain: a set of pictures was added; as many thoughts on each domain and useful characteristics of the technology were written; and lastly from these, applications were thought of, keeping in mind the "We know how to" and disregarding feasibility issues.

Later as part of a technology framing exercise, the question "Where in the value chain does our technology go?" was introduced. This is important for understanding what the value of the technology can be, and what other steps are necessary in order to reach the customer. An important tool of this is the technology tree: an application makes use of different technologies, and that is why a tree is useful to visualize the complementary technologies

used as well as our own. For each technology the maturity was assessed (from embryonic to ageing) as well as the strategic impact (from base to emerging). Later the competitive position of each technology was added (from weak to clear leader) and each technology was plotted on the matrix of strategic impact vs competitive position. For each zone in the matrix, different action needs to be taken, as the benefits to be gained from each will be different.

The second day started off with each team contacting experts in sectors of interest for applications. Followed by a lecture on reframing technology, which leads to a new way of finding inspiration, by changing one's perspective. The use of a technology can, in this way, be broadened. Later, the team discussed what the scientific paper would look like, having filled the paper canvas by the end of the day. After lunch, Marc Tassoul taught us the value of creative thinking and gave us a set of tools to stimulate creativity. We were taught that surprising oneself (like talking to children) and letting go (forgetting about the pre-established) can lead to inspiration; that incubating ideas is important to let them mature in one's head; and how analogies and metaphors (like children's stories) can be used for brainstorming new ideas. Through the story of "Samurai Jack" (the animated show), new sectors of interest were found, such as space and knives.




The last day in Delft began with an exercise on body consciousness and perception, as a way of understanding one's and the team's body positioning, and further team building. Then groups were formed with people from different teams, where one person would expose their technology and the rest would try to find new applications. This was a good exercise to get external input and avoid getting stuck over certain aspects of the technology. In the afternoon, and in Rotterdam's *Kleinhandel* coworking space, another session of brainstorming took place, where we mostly used analogies to get new ideas.

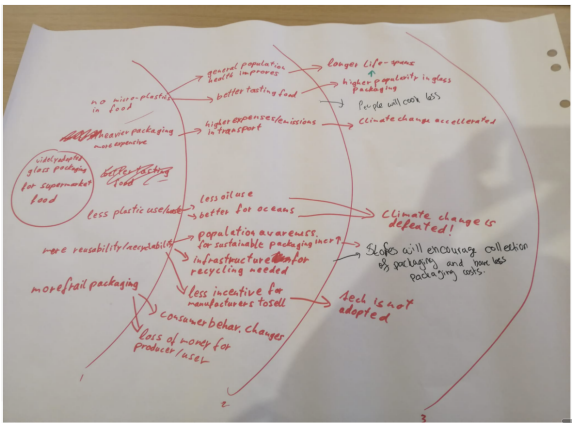
**Geneva Design Sprint**

On the first day of the summer school in Geneva, we focused on limiting the number of sectors for which we wanted to use our technology. We first did this by discussing the pros and cons of each sector and the viability of having a successful application in this field. We were able to limit the 12 sectors we had chosen in Delft to the following eight: agriculture, medicine, construction, art, material science, research and food. Afterwards, we would come up with as many applications for each of the eight sectors we had in mind. We used a rating system to decide how viable and how appropriate for the market each application would be. We had the following criteria in mind for this: feasibility, innovation, social impact and market value.

While making all these considerations we also had classes to help us in our design thinking and selecting ideas. On this day it was more focused on the work we did as a team, but also

the time limit made it very stressful to have the idea in time. We each had to take the sectors and come up with applications for our technology individually.

On the following Monday, we had a lot of lectures that would help us in our process. We had experts come in and talk about their experience in the business world and as scientists themselves. This really helped to clarify what kind of mindset is required when a technology student enters the business world after they have graduated. We were taught the concept of value propositions. As practice, we all had to use this way of assessing ideas on three of our technologies.




In addition to this, we also were made to look at the ripple effect of our application. This way of thinking was also proposed during a second lecture. This time we chose to use the idea of glass instead of plastic containers for microwavable foods. This technique encourages you to think deeper about the consequences a product can have on society and what problems can arise from it. Also, this helps to put into perspective the indirect advantages your product can have. We have been encouraged to look beyond the business and the sector our application has and think about what this can solve for society, what other sectors are affected by introducing our product to the world and what it does for the environment and the society.

One of our supervisors gave a presentation on deep diving into opportunity fields. The takeaway from this lecture was that when we dissect our technology and learn about its qualities on multiple levels. This also requires feedback from the ones who will buy it and the ones who work in the intended field for the product. By consulting with specialists and having a team with diverse backgrounds various hidden advantages can be brought to light.

On Tuesday we had a full day of tours at experiments at CERN, namely the antimatter factory and the CMS experiment at the large hadron collider. These visits were not directly correlated to the process of a design sprint, however, we got a lot of inspiration and it has spiked a lot of curiosity in each of us.

In the afternoon we had to pick two applications to get an illustration. Also at this point a new application idea had been adopted. Namely one in the form of making glass chips for quantum computers.

After thoroughly researching the application of replacing the harmful plastics in medical instruments and after speaking with someone whose job primarily revolves around the organisation and sanitation of medical instruments, we established that it was very hard to convince medical professionals to replace plastic with glass. This had been a disappointment, but as there were numerous articles about how using plastic instruments revolutionised the way hospitals go about using instruments now and how these are the cheapest, safest and cleanest options we could not find any arguments as to why they should adopt the glass ones. They have already been used in the past and the use of glass for containers or syringes has been connected with the spread of Hepatitis A and other illnesses.

For this reason we went with the other two applications: the newly suggested

quantum computer chip and the glass welding application. To briefly illustrate, the idea for quantum computer chips made of glass involved nanolithography imprints on glass chips. This lithography could be used to put very small inscriptions on glass to be used to enclose ions as used by quantum computers. The advantage of using glass is that glass has minimal (material-related) noise signals. Our other application was the principle of glass welding. The idea was to use glass to connect two separate pieces of glass. Therefore we could make an entire building from glass without having to use metal or concrete dispensers between the plates of glass. This would make architecture, construction and fixing anything made from glass easier and also more aesthetically pleasing.

However, due to the fact that either application lacked any real word business examples or any pre-existing markets, they would prove to be hard to realise. Hence they did not feel fully realised yet, but the consensus to use these had already been made.

We had to propose them for the supervisors and the illustrator. The feedback did not feel too positive but this was the best thing we could come up with.

On Wednesday we received the visualisation of our two applications. They had been beautifully drawn and they gave some insight as to what was possible in the fields of those applications. It was now time to explain our two applications to other teams and have them ask questions and judge our ideas. This was one of the most crucial parts of the whole design print. In retrospect, our ideas had not been that fully fledged out yet and were based on concepts that were still too vague and too niche to be very useful in today's business world. Seeing other groups having these very well-versed and concrete ideas was a little humbling. We realised that too much of our application was still a question mark and not yet an established fact. This is because our ideas had no clear competitor or predecessor. The hardest thing about our technology is that anything that has been made from glass, has already been made and already is being produced at a cheaper rate than the current prices of our application. Either the competition was too fierce or the other and current solutions to the problems we were trying to solve made more sense.This was reflected by the amount of our peers that we could not answer in order to justify using glass chips, to use the nano lithography on the chips for storage and the fact that the market was so far into the future, made me have reconsiderations about our ideas. This affected the team's atmosphere because of the realisation that neither of the two big ideas for applications would work and, that the little research up until that point had been in a way pointless was a hard blow.

It was hard to convince the team members to completely abandon the applications we already had. We had already used our opportunity on visualisations, market research and making a scrappy prototype on them. These prototypes were very useful in helping to learn in the process of learning how to visualise very abstract and technologically very advanced ideas. The lecture from the employee at idea square on prototyping was very helpful in deciding what part of the application was important to represent because our applications were pretty hard to realise with the limited resources we already had. At this point, there was a very clear divide in which application each member of the team preferred. Goofing around with clay and seeing how the other party solved the hard problem of how to make a prototype created a sense of respect and bonding that was needed again. The idea to show the principle of nanolithography in a glass chip by using play-doh and a structure made from sticks and a piece of carton was very insightful on how our technology would actually make the chip. Also, the prototype for glass welding by mimicking a glue gun with a red laser

shooting heat source showed how glass welding could be used. We mimicked glass by plastic and we even had cling film in a foam box which could be wheeled.

Even though no one was on the same page as to which application we had to pick as a team, the creativity and ingenuity behind each of the prototypes reawakened appreciation for each idea and sparked the inspiration to do more research on what way they could actually be used to still be a viable application.

Unfortunately, neither of them seemed to be proper applications and their feasibility was too questionable to proceed with them as our main application. We wanted to impress the supervisors and we just did not want to present something that we were not fully behind as a solution to any problem. The dismissal of experts of the idea in the field of quantum computing was the last straw. We did not know enough about the structural integrity of the welded glass and we were too uncertain about the fact that when broken and fixed, it would still look presentable.

This was a source of frustration and this day was the biggest challenge for our cooperation skills. No one shared the same opinion and the possibility of reaching a consensus felt impossible. Now we had to retrace our steps to figure out what we wanted to choose instead. This was very risky to do as we were already nearing the end of your stay in Geneva and the pitch was only a day away. However, this was the moment to shift our entire idea to something that would be applicable and suitable and actually solve an existing problem.

We have come across the problem of making curved glass in our research for glass welding. In a conversation with a lecturer, we looked into the apple building. She pointed out how hard that building was to make and that making it in one go with glass welding would be something that would make a difference in architecture. Now we were speaking with our supervisors about the curved windows of a museum in Antwerpen. He pointed out that the process was very expensive and hence we decided we could offer the application of freely shaping windows and disregard the glass welding in the process. This way we did not have to question the structural integrity as we had to with glass welding itself. This sparked a new idea and one the team could finally agree on. Even though we had an idea that we were confident would be very attractive to architecture and would be one that is actually solving a very real problem, we had a very big gap to catch up to.

Thursday was the day of making a prototype for the pitch. Because we had just switched on our idea, it was very hard to do market research. We had to divide tasks; two of us were prototyping and two of us were calling professionals. Here the challenge was in finding an architect the same day to review our prototype. Our prototype itself consisted of 3d printed plates with a three-dimensional lion and Eiffel tower attached to it. This was to show the possibility of putting three-dimensional structures on a window or a side of a building. Then we represented the curved glass on the two other sides of the structure. These were made from heating polycarbonate sheets to have curves in them. In order to appeal to our target audience, we made a little building from these four plates. We even attached a self-made foundation to it and because we also have the possibility to use our 3D printed glass structures in interior design we made a very rough representation of glass stairs using plastic.

On the market research side, the day was a lot less rewarding. With one French speaker on our team and also a Dutch student, we were busy contacting both Genevan and Dutch architecture firms. We used every method from mailing them, calling them and we approached them in a total of three languages. Even with all this effort we were quite aware that the chances of succeeding were very low. At this time all architects were either too busy, on vacation or not responding. We only could get a hold of three professionals. Two of them we just interviewed online about the idea of our applications and they gave enthusiastic responses. They also gave some new insights on what to take into account for our presentation and research. We were reminded to look into how to isolate the windows, the etching patterns of the 3D printers on the windows and how they would still be stable. Thanks to a connection through one of the supervisors, we still could get a professional to judge our prototype via video call. This was less than ideal, but we were able to show him the possibilities of our idea by using our prototype as an example. He was positive about it and raised the aforementioned concerns.

On the last day of the Geneva summer school, we just had to put up some finishing touches. Due to the limited market research, we could do we were trying to get some ideas from any present person who would be appropriate to ask for feedback. We had a discussion with the in-house artist of CERN, and an engineer who is also an artist. But neither would give a lot of insight since their area of expertise was not in this field. We had to take the positive attitudes of the architects to heart and make sure we were knowledgeable enough to present this at CERN for the pitch. From this point, we had a quite smooth process of making the pitch and the poster. We were becoming more and more convinced we made the right decision by switching. We knew we had a different idea from the others. We could not show any cool tech stuff, but we had to focus on the aesthetic and artistry for our application. We could not really name numbers because neither of these concepts can be quantified and since our technology is not yet capable of producing windows of any scale large enough, the cost effectiveness could also not really be accurately reflected in any figures.

This meant we needed a different approach to present our idea. We made use of pretty pictures and called up on people’s imagination to get them excited about our application

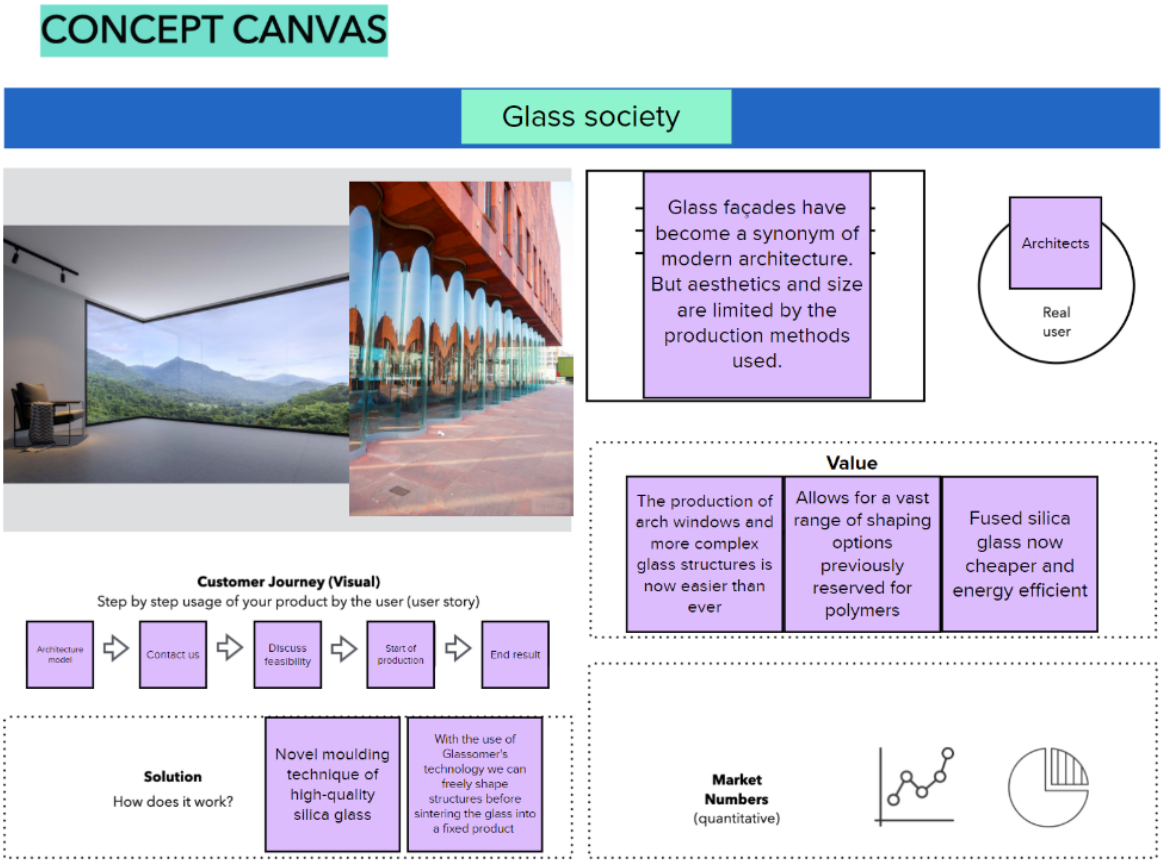
Even though we did not end up winning, we were able to make a lot of people curious enough to come and talk to us about it after. We had a very hard task. To make up an innovative idea about glass products one of the oldest materials humanity has ever used. In spite of the limited time and the less conventional process, we went through by switching last minute to another application. We did the best we could with what we had been given and we can truly be proud of what we have delivered. Each member has put their passion into it and it has definitely paid off.

## Problem

Making curved windows is a very time and money consuming process. This leads to only very expensive buildings and exclusive buildings having the possibility to have them. With the approaching popularity of organic architecture, straight windows are interrupting the fluidity and continuity of more freely shaped and curved buildings. A lot of time architects resort to putting flat windows into curved walls, which is less appealing than the windows curving along with the outline of the building. Flat windows are also restricting the design and creative freedom of the architects themselves. With current techniques, windows can only be made in the cylindrical shapes or curves, making any other shapes in almost impossibly expensive or not conceivable.

## Solution

Glass2mass is a revolutionary technology making a range of processes and techniques traditionally reserved for polymers, available for high-quality fused silica glass. This glass will now be able to be freely, cheaply and efficiently shaped in the field of architecture. This will lead the way for many of the craziest ideas that were simply not possible beforehand with traditional shaping techniques.




Our technology allows for efficient making of complex geometrical shapes out of glass. Ways of bringing innovation to otherwise austere environments.

## Impact

Using Barbaglassa, Architects will be able to bring their true architectural visions to reality. Our technology breaks the shackles that glass has traditionally placed on architecture, using a manufacturing process that allows us to freely shape glass into any form.

In addition, our unique glass sintering process requires a temperature of only 600°C as opposed to the 2000°C in traditional glass manufacturing, making it much more energy efficient.

Now with Barbaglassa, the only limitation is the architect's creativity. We can't wait to see what masterpieces the greatest minds in architecture will be able to create using our technology!

## Individual Reflection

**Alejandro van Breukelen García**

I thoroughly enjoyed this summer course and certainly learned a lot from it.

The main take for me would be the design thinking process. The lecture by Marc on the use of analogies and metaphors for sparking creativity, as well as the exercise on the 100 sectors were incredibly useful and were used throughout the project.

The team was enthusiastic to find new fields for the technology and managed to find useful applications. However, due to a lack of communication within the group (and conflicting personal preferences), none of the ideas were properly researched, and in the end, were disregarded in favour of a new idea. This helped keep the team on track even if it was thought off on the last day.

On another note, some tasks seemed to be a bit rushed and some exercises were left uncompleted for some time. Moreover, the scientific paper was unclear on how it should be connected to the project even though it seemed to be quite important, meaning it was completely left out during the work at Geneva.

Finally, I am very glad to have had the chance to talk to scientists and engineers at CERN about their experience working there. And the enthusiasm and experience of everyone working at the Summer School have certainly inspired me to develop my own ideas.

**Quan Zheng**

The CERN IdeaSquare Summer School was a great learning experience for me. It was a unique opportunity to work with an interdisciplinary team in a fresh and inspiring environment that pulled everyone out of their usual rut.

Though there were challenges in working together, we combined our forces to come up with a wide array of applications for our technology, which we then gradually cut down to find a final application. At times it took long discussions for everyone to get to a common viewpoint, but in the end we made the project work and delivered something that I believe we are all happy with.

The numerous talks we got to hear were a real treat and a great way to bring new inspiration into the innovation process. I particularly enjoyed the ones from Tulin on the ripple effect and Han on finding a strong value proposition for your product.

Last but not least, the opportunity to interact and connect with great students in other disciplines is simply invaluable. In talking with business students, I have gained a whole new perspective and respect for the field. It made me realize that what I had thought of as the discipline was only a distorted caricature of it and made me curious for what other fields this might be the case.

**Tamira Lopes**

I enjoyed the change of environment from the academic setting to a more business oriented one. The main take away from this experience is that selecting an idea is a lot more harder than it looks.

**Samuel Hanssen**

I have always had an interest in innovation and entrepreneurship and they are areas which I hope will be a part of my future. This CERN summer program has not only amplified my interest in these fields but also taught me a range of valuable knowledge and skills.

The program started with a range of lectures where I learnt team building, design thinking and the skill of paper writing. Further on in the program, I learnt a lot about other topics including patents and creative writing. When on the site, our tazk  was to find a promising application to a given technology. It initially felt like good ideas would be abundant. However, the task proved to be a challenge.

By critically thinking, we would realise that each idea did not have as much potential as initially thought. This was due to, for example, feasibility or lack of a market for the product. We would occasionally also run into communication issues with the group due to a difference in opinion which were sometimes challenging times. These times, however, were great points of evaluation which helped me develop my practical team working skills.

Throughout the program there were numerous experts from various fields who we could approach for advice or help. The talks we had with these experts were a source of inspiration in our journey to find an application for the technology.

This summer course also gave us the opportunity to meet and present our ideas to engineers and scientists in the CERN canteen. Talking with these people was very interesting as we also learnt about their work life on the site.

Overall, the opportunity to participate in this program was enriching on both a career and personal level.