Business report for EIT Tallinn Summer School on "Urban Mobility 2019"

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Executive summary

Cities are quickly evolving and becoming more and more smart. The evidence of the trends is clear, with more than 55% of the global population living in cities, there are more requirements for digital infrastructure and services. Due to such rapid growth cities are experiencing constant challenges, particularly in the mobility area. The investments in the connected city infrastructure are growing year over the years and in 2019 it is estimated to be around $133 billion. Smart mobility is one of the key objectives of the development of urban areas in Tallinn as well. However, smart mobility in Tallinn is performed not in its full capacity. Additionally, the speed of innovation deployment of the city is quite low. This puts Estonia not on the leading positions among the other European countries according to the study of policy department for the European parliament (<7>). This creates a business opportunity.

During the summer school, we were trying to tackle the problem of mobility in urban spaces and particularly solve the low innovation speed issue in Tallinn. Within two weeks we designed SIGO. It is a simple, energy-efficient, easily deployable and maintainable solution for public transportation stops. It aims to improve the experience of public transportation users by providing real-time schedule and traffic info. Nowadays, most public transport stops are not providing real-time data of the buses schedules and on top of that, most times it is not completely accurate due to traffic delays. Therefore, SIGO will offer a turn-key solution by installing a device in public transportation stops to display reliable information to the commuters. Additionally, the SIGO product is easily expandable to other use cases, such as shopping malls or taxis.

On the other hand, the architecture of the SIGO unit can be expanded into IoT hub, which will collect mobility data and data about its surrounding area. Therefore, the network of these SIGO hubs gives a clear real-time picture of the whole city. This network can be used as a platform for innovation tests and correspondingly boost an innovation process in the city. The SIGO design supports its rapid adoption, so the city can start to solve major metropolitan challenges in a shorter period of time.

Problem

Cities are locations with a high level of accumulation and concentration of economic activities and are complex spatial structures supported by transport systems. The larger the city, the greater its complexity and the potential for distribution. Since urban productivity is highly dependent on the efficiency of its public transport to move labour and consumers between multiple origins and destinations, the public transport system has to be managed efficiently. Besides vehicles, one of the fundamental components of a public transport system is

represented by public stops or transit points where the commuters usually seek information about their ways.

The public bus stop is first and foremost about getting somewhere. Anyone who wants to travel (tourist or resident) would like to navigate the transit system in the country easily. Bus stops should be designed by taking into account some design principles and should be able to easily accommodate a variety of users, including people using mobility aids and walking aids, people with a vision impairment, and people travelling with luggage or shopping trolleys. Tallinn is one of the cities where more than 43% of its inhabitants use public transport (<6>). In order to validate whether the current Tallinn's public bus stop system has features like accessibility and provides real-time schedules to commuters, we carried out different data collection techniques.

- 66.67 % of public transport users' check the schedule on the bus stops, these have to be improved as much as possible by adding different features (<2>).
- Currently, only 50 out of 1340 (< 4%) bus stops are equipped with a real-time updated monitor to display bus arrival time. However, according to our observations and from data collected across different bus stops in Tallinn, more than 50% of the buses are late (<5>).
- According to the information received from the Tallinn's public transport department, the municipality spends around 200,000 euros each year to equip up to 12 bus stops with real-time updated monitors. Following this modernization rate, the coverage of all the bus stops in the city will take more than 100 years. A huge part of the cost is given by the lack of power supply and the installation process is slowed down by additional administrative issues.

From our research, it is clear that public bus stops should be equipped with a real-time information system about buses. Around 90% of commuters that have been interviewed consider this feature as extremely valuable. Both tourists and residents would like to navigate easily around the city and providing bus stops with real-time information would likely enhance the mobility experience.

The following list describes the point of view of the public transportation department of the city of Tallinn:

a. Only 5% of bus stops have electricity connection. Hence, there are extra costs for electricity installation. This costs decreases the speed and make the installation process more complex (get permissions, restrict traffic in order to perform the installation process dig hole to pull electricity wires)
b. One of the main objectives of the city development strategy is to make the city a comfortable urban space: *"Tallinn with a comfortable, inspiring and environmentally sound*

urban space" (<4>). SIGO solution will promote the use of data-driven decisions for public transportation and other urban challenges.

c. "The City of Tallinn is planning to implement various measures in order to improve urban mobility." (<3>). SIGO solution is an IoT hub which can be easily expanded by a variety of sensors.
d. There are a number of players in the IoT market at the moment in Tallinn and Estonia (See competitor chapter). However, there is no coordination between them and it leads to sensor pollution (too many separate installations) and lack of single source of data.
e. Most of the players in the market of solutions for bus stops have a list of limitations and are not cost efficient. Get more details in the competitor section.

Solution

All the aforementioned problems need to be addressed to provide the commuters of public transport the best out of it. To address those issues, SIGO proposes to create a smart bus stop which is easy to use and to install, provide real-time schedules to public transport users, and increases the accessibility of stops. SIGO is powered by a solar panel and it does not require any additional power supply. Thanks to its modular design, a wide variety of sensors can be plugged in to boost the data collection process of the cities. The proposed smart bus stop will have the following features:

- **Real-time schedule**: SIGO will provide real-time schedule using GPS attached to the bus, predicting traffic congestion through the use of the street sensors' data, and performing time-series data analytics from historical data collected so far by the Tallinn Public Transport Department.

- **Zero-energy**: thanks to the solar panel and the long-lasting battery integrated into each SIGO unit, there is no need to provide additional electricity to power the bus stop monitor.

- **Simple**: SIGO can be easily integrated into the existing bus stop and it does not require any additional power supply.

- **Scalable**: the simple installation and maintenance of SIGO can speed up the expansion process. Being low cost, SIGO can be deployed in remote regions providing additional services for public transportation users and data collection capabilities for municipalities.

- **Modular:** the modularity of our solution allows the integration of new features and sensors if required by the customers. Additionally, SIGO can be configured with different types of displays, batteries, and solar panels to meet customer's needs.
- **Cost-effective**: the proposed solution is provided for free to the public transportation department so there are no upfront costs.
- **Data collection:** through the sensors that can be plugged in, SIGO can collect a wide variety of data such as bus' arrival times, delays, vehicle capacity and accessibility, air pollution, number of passengers at stops, etc.
- **Sustainable:** being powered by a solar panel, SIGO units are much more sustainable than normal electrical-powered displays. Furthermore, the digital schedule will reduce the need to print and paper schedules.
- **Expandable** to other use cases, such as shopping malls or taxis.

We strongly believe that our proposed solution will help the Tallinn city administration to achieve their strategy of creating *"comfortable, inspiring and environmentally sound urban space" (<4>).* Since the City of Tallinn is planning to implement various measures in order to improve urban mobility, they will be our potential partners in acquiring and using our proposed solution.

Vision

The vision of SIGO is to create a network of interconnected smart bus stops. Each unit will be converted into an IoT hub powered by a solar panel. Hubs will communicate with each other data of various types, such as air pollution, traffic congestion, delays, updated time tables, transportation news, etc. The network of IoT units will allow SIGO to collect the aforementioned data and become a data analytics provider. Thanks to the development of prediction models, SIGO will be able to provide data-driven insights to public administration regarding urban mobility. Additionally, this network is a good base for innovation tests of the city.

Business modelling

This section will be divided into explaining the business model of SIGO's product and the business development process that was followed to arrive at the proposed solution.

Business model

SIGO offers a B2B solution for the public transportation department. The deployment and installation of SIGO units into existing bus stop will be done for free. SIGO provides a Product as a Service (PaaS) solution asking for a monthly subscription of 80€ for each unit, including maintenance and update service. After three years from the installation, the monthly fee will be reduced to 15€ for each unit (See Figure 1).

Figure 1: SIGO cost structure

Thanks to the modularity of each unit and the sensors that can be integrated into it on demand, SIGO will be able to collect a wide variety of data that can be used to improve the public transportation experience. SIGO is also planning to sell data to external companies as a secondary revenue stream. Below is the detailed description of the SIGO business model (See Figure 2).

<table>
<tr>
<td rowspan="2">Problem
• Only 4% of stops equipped with realtime schedule monitor
• Only 5% of stops have access to electricity
• Slow and expensive growth of innovation</td>
<td rowspan="2">Solution
• SIGO solution is a real-time schedule and data monitors
• Turn-key service (installation + maintenance + support)
• Zero-energy and cost-efficient solution, portable

VISION: Network of smart stops and public transport, which accumulate mobility data in platform, Network of IOT HUBS</td>
<td rowspan="2">Unique Value Propositions
CUSTOMERS:
• Cost-efficient solution
• Fast and easy deployment
•Easily integrated with existing systems

VISION:
Platform for smart city innovations
USERS:
• Improvement of expirience of communters
• Bus stop accessibility</td>
<td>Unfair Advantage
• SIGO deployment speed
• Cost-efficient solution
• Inhouse expertise and network of the team</td>
<td rowspan="2">Customer Segments
• Tallinn Department of Transportation
• Data Companies

END-USERS:
Users of public transport
46% of Tallinners

EARLY ADOPTERS:
Tallinn, remote stops</td>
</tr>
<tr>
<td>Channels
• Face-to-face
• Web page/phone
• Personal connections (Pirko)</td>
</tr>
<tr>
<td>Key Partners
• Tallinn Transportation Department
• IOT Companies</td>
<td colspan="3"></td>
</tr>
<tr>
<td colspan="2">Cost Structure
• SIGO unit production cost
• Development of SIGO system
• Installation/Maintenance</td>
<td colspan="2">Revenue Streams
• SIGO subscription fee
• 80 euro/month (15 euro/month after 3 years)
• Data set</td>
<td>Key Metrics
• Number of SIGO units installaitions a year
• Amount of data recollected</td>
</tr>
</table>

Figure 2: The Business model canvas of SIGO

- **Problem:** SIGO considered as key problems the lack of power supply in existing public transport stops, the small number of equipped stops that provide reliable information to commuters, and the expensive and slow modernization rate. For a wider description of the problem refer to the dedicated section.
- **Solution:** SIGO is a zero-energy smart bus stop that provides real-time information to public transportation users. In particular, the proposed solution is a Product as a Service (PaaS) that includes the deployment of SIGO units, their maintenance, and their updates. Dedicated section.
- **Unique Value Proposition:** from the customer point of view, SIGO is a cost-efficient solution that can be easily and quickly integrated with existing systems. Instead, from a user point of view, SIGO improves the commuters experience thanks to the provision of reliable and real-time information.
- **Unfair Advantage:** a key advantage of SIGO is the deployment speed that combined with the cost-effectiveness of each unit allows us to spread much faster compared to existing solutions. Another advantage is represented by the expertise of the team that holds all the required skills and knowledge to develop and deploy the solution.
- **Customer Segment:** the customer is represented by the public transportation department that is in charge of maintaining and updating the existing bus stops. Thanks to future expansions, the customer segment may include companies that collect and analyse data.
- **Key partners:** SIGO has two key partners thanks to which the development of the solution becomes faster and easier. The partnership with Tallinn's public transportation department is key to provide SIGO with a fast and efficient go-to-market strategy, whereas the partnership with IoT companies is crucial for the cost-effective development of the solution.
- **Channels:** the three main communication channels used by SIGO are face-to-face communication, website and phone communication for remote interaction, and personal connections.
- **Cost Structure:** the cost structure of SIGO is composed of the production costs of SIGO units, the development of the IoT system, and the cost of deployment, maintenance, and update.
- **Revenue Stream:** SIGO revenues are structured as a monthly subscription that the customer will pay for each installed unit. This fee includes maintenance and update costs and will be higher in the first three years to cover the production costs. Thanks to

future expansions, the use of collected data might become a source of income for the company.

- **Key Metrics:** SIGO will use as key metrics the number of units installed in each year and the amount of data that can be collected by the entire network.

Business development process

The team is composed of six professionals with different educational level and background which we consider being an advantage in the business development process. Before we come up with the proposed solution, we did a number of tasks.

Initially, our focus was on the accessibility and mobility issues of public transport and stop of Tallinn. We made a list of hypotheses that had to be validated by doing market, customer, and user research.

- Most of the local daily commuters know their way
- Most people use their smartphones to check their way
- Most of the stops are not accessible
- Most buses are not accessible
- Tourists are lost when arriving in Tallinn
- Local people prefer using public transportation
- “Poor” stigma for using the bus
- There is free public transport for Tallinn residents
- Local commuters plan their routes from home (app), tourists plan their routes on their way
- There is no enough visibility and transparency for people with special needs
- Tourists do not have enough information on bus stops
- Locals want to be fast and efficient in time
- Most of the bus stops display a screen with the line and time
- Government benefits from people using public transportation (sustainability, less traffic in the city)
- Government benefits from having and smart and modern city that gives prestige, and also from having an accessible city

We made research and validated the numerous of them, by providing a number regarding their importance for the city and accuracy from 1-3, being 1 the lowest and 3 the highest hypothesis validity. This voting system was used during two times: first by Chief of Strategy of Tallinn Transport Department. Then, by our team that after doing the market and user research gave votes to the hypothesis, based on the results of the survey and observations (<5>, <2>, <6>).

- Accessibility of public transportation
- Lack of information in time, traffic, map and visibility of real-time schedules
- Buses not on time

Additionally, we made field research: participant observation, conducted interviews at several bus stops and locations in Tallinn. The outcomes from these observations were that realtime data is very valuable for the user, 50% of buses were not on the time scheduled, and that around 30% of the users check the static timetable when arriving at the bus stop. Moreover, our research showed that the majority of people are satisfied with public transport. However, they found that most of the stops and vehicles are not accessible to people with special needs.

These observations were very relevant for the team to create identify our target. To do so, we used the technique of creating empathy maps to identify the different profiles of users of public transportation.

1. **The tourist and the non-daily commuters.** This empathy map is used for people new in the city or that they are not regular users of public transportation, so they have a feeling of being lost and unsure of the routes they are taking.

2. **People with special needs.** This empathy map is used for people with some kind of disability or dependency on other people: reduced mobility, blind, cognitive problems… These users have a pain regarding uncertainty and also not having control of the situation, whereas the gain would be independence and control.

3. **Daily commuters.** This empathy map is used for people that are used to take the bus every day/week and are considered experts. These users want to be efficient with their time and having an accurate timetable to avoid arriving late.

Based on that, the focus of the project shifted towards the new tram lines and enhancing the stops experience by supporting not frequent commuters in their mobility tasks. Therefore, at this point, we focused on having an interactive screen able to provide real-time information to the user. Our real target were tourists and not daily commuters and our goal was to provide them with the information they need and to avoid the feeling of being lost and confused. Also, this solution was focusing on having some accessible buttons for disabled people to allow them to speak with an operator in case they needed any type of help.

We created for this solution a low-fidelity prototype (See Figure 3) to be able to identify the different parts of the screen and how to distribute them, and then we passed it to a high-fidelity prototype to show to the investors how this screen would be looking. Still, we needed some research and testing to improve this solution.

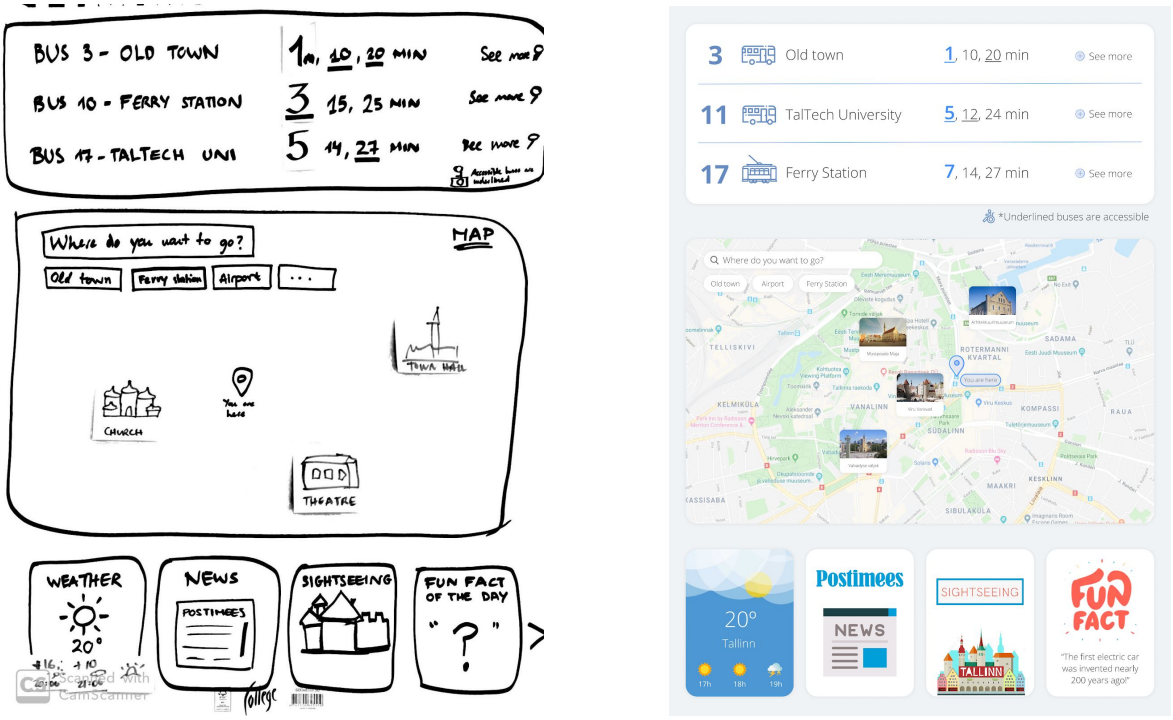

Figure 3: SIGO early prototypes: low-fidelity (left) and digital interpretation (right)

After a while, we decided that this solution was not innovative enough and that was not solving any real problem for the users. Therefore, we started looking for new approaches. We had an interview with Liivar Luts, the Project Manager of the Tallinn public transportation department (<3>) and we learned that stop modernisation process currently is very expensive and slow. As a result of this conversation, we have pivoted our initial idea towards improving the process of deploying real-time monitors all over the city with a more cost-efficiency, sustainable and rapid solution. We developed a web-based prototype (see Figure 4).

Figure 4: SIGO unit prototype

Then we performed a product and hardware research to calculate the production cost of the device and establish a marketing and pricing plan for the customers. Additionally, we designed different architectures of units for a variety of use-cases.

Market Analysis

Market Size

SIGO market size has been derived through a bottom-up estimation of the number of public transport stops in Baltics, Scandinavia, and Europe.

The bottom-up estimation worked first taking into consideration the capitals of the region of the Baltics, as an initial market. Then, the expansion is taking over a bigger market, Nordics, and finally going to Europe. The first step was to find approximately the number of bus stops in the biggest cities in each country. Then, to do an estimation, we tried to find the whole country's total stop number based on the population of the country. For example, in the case of Estonia, Tallinn was around 1'340 stops with a population of 400K people, whereas Tartu has around 300 stops and a population of 100K. Therefore, it is estimated that if Estonia has 1.3M population, the number of bus stops will be around 4'200.

The described process resulted in the following estimations:

- **Estonia:** the estimated number of bus stops in Estonia is more than 4'000 and results in market size of approximately 1.3 million euros.

- **Nordics:** the estimated number of bus stops in Scandinavia is 95'600 and results in market size of approximately 40 million euros. The region of Scandinavia includes the number of bus stops of the countries of Denmark, Norway, Sweden, Iceland and Finland.
- **Europe:** the estimated number of bus stops in Europe is 2.2 million and results in market size of approximately 400 million euros.

Go-to-market strategy

SIGO go-to-market strategy is planned over a period of 4 years:

- **2019**: in the next two months, SIGO will develop the first prototype. After a testing period and validation period, the results of the test will be used to improve the prototype with the goal of creating the first commercial unit. During this initial period, SIGO will focus on the creation of a strategic partnership with the Department of Public Transports of the city of Tallinn and with other relevant stakeholders. With this partnership, SIGO will pilot 100 units in the city of Tallinn by the end of 2019.
- **2020**: at the beginning of 2020 SIGO will complete the coverage of the whole city of Tallinn thanks to the installation of other 1200 units. The newly deployed units will be upgraded based on the feedback of first pilots. After the coverage of Tallinn, SIGO will work on the design of new use cases to drive the development of additional units.
- **2021**: thanks to its scalability, in 2021 SIGO will open itself to the Estonian market with the goal of covering all the bus stops in Estonia by the end of 2021. In the same year, SIGO will create new partnerships with the goal of expanding its market into Baltics and Nordics. In 2021, SIGO will also reach its break-even point thanks to the units that will have been installed already.
- **2022**: SIGO will focus on the installation of units around the biggest cities of Baltics and Nordics thanks to the partnerships signed the year before.

Competitor Analysis

We identified three main competitors that are already in the market and we decided to base our analysis on four key characteristics, namely the presence of a digital monitor to display information, the presence of real-time updated schedules on those monitors, the cost-effectiveness of the solution, and its simplicity regarding its deployment, maintenance, and integration with existing systems.

- The first competitor is represented by the paper-based schedules that are currently used around the city and in a lot of other cities around Europe. These are of course not

updated in real-time. Even though the simplicity is high, the cost-effectiveness is not as high as expected. Changes in the schedule require a manual update of each stop, which can be a very long process in a big city, resulting in high maintenance and update costs.

- The second competitor is represented by a smart bus stop built by Innospark, a laboratory of ST Engineering. Their product (called Airbitat Oasis) is composed of a cooling system to address urban heat and an air purification device to remove harmful particles. It comes with a system able to detect suspicious activities and with a digital monitor used to display bus schedules. However, as far as described in the documentation, the schedules are not updated in real-time. Moreover, the deployment of this solution requires to rebuild the entire bus stop increasing the costs and reducing the simplicity of deployment. The need for electricity slows down the installation and increases the costs.
- The third competitor is represented by a smart bus stop developed by Acquisis Innovo, a Hungarian company specialized in smart infrastructures. Their proposed solution combines the digital and real-time updated monitor with additional features such as public telephones, traffic monitors, and pollution sensors. Again, the easy integration with existing bus stops is not possible and the costs are increased by the need for electricity.

A summary of the analysis can be found in the following two figures.

Figure 5: SIGO competitor analysis cost-effective vs real-time scheduling

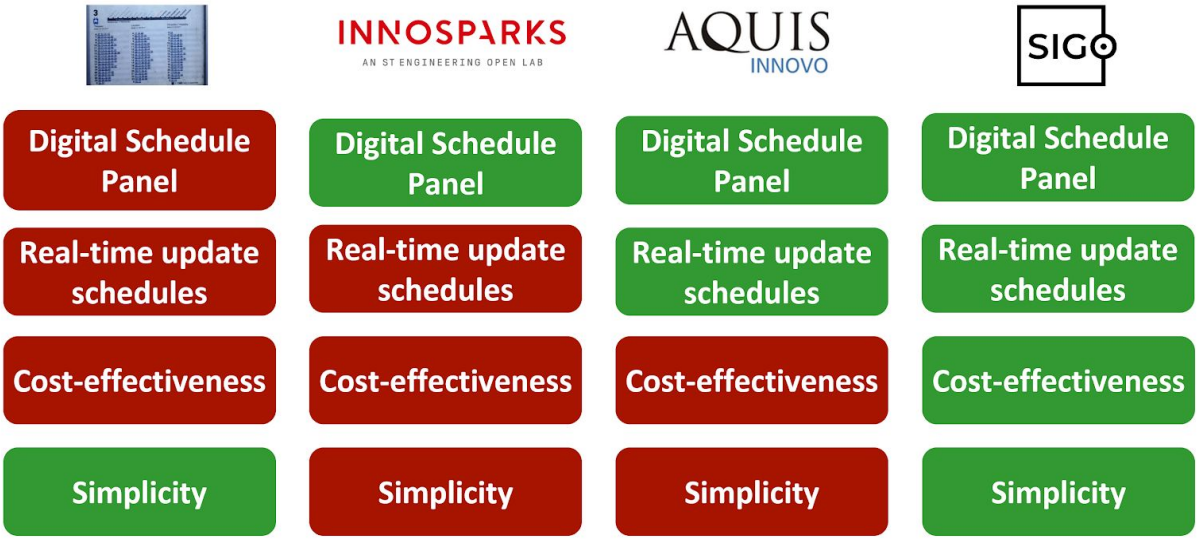

Figure 6: SIGO competitor analysis matrix

SWOT Analysis

This analysis was used to determine the competitive position of SIGO with respect to other competitors and the actual market.

STRENGTHS	WEAKNESSES
Sustainable Easily scalable Cost-efficient Real-time	Sun dependent
OPPORTUNITIES	**THREATS**
More than 1000 stops in Tallinn without real-time equipment Smart-cities trend Recollect data on public transport	Public market (state contracts, slow) Remain with the current solution

Team

SIGO counts with a multidisciplinary team who holds the required expertise to develop SIGO solution. There is one Hardware Engineer (Baaska Erdenebat), which will be in charge of

choosing the appropriate hardware components, sensors and developing the solution. Then, the Software Engineer (Damiano Sartori) and the UI & UX Designer (Leire Litwin) will work together to develop the product and provide a smooth experience for the user. To be able to reach the market, our Marketing expert (Olga Kornilova) has developed the go-to-market and positioning strategy.

Once the product is installed and running, the Cloud Engineer of the team (Charles Ferrari) will work to get the data being captured by our sensors and store it in the cloud to make it available for the clients. This data will be analysed by our Data Scientist (Tsegaye Misikir) to provide valuable insights and be able to sell public transportation data to other companies.

Self-evaluation

SIGO's team has learned mostly regarding the process-wise to keep pushing and never settle down on one idea. The idea started being an accessible bus stop for users, then it changed to an interactive screen to display information about the buses, but also about the city itself and finally, it turned into SIGO's solution. Our team discovered the importance of doing user research and seeing that the product we were trying to make had no value for the users of public transportation. Thus, one of the fundamental learnings is to recover from mistakes and keep looking to improve the idea.

Therefore, the last idea of SIGO's solution focuses more on having an innovative business plan to provide a turn-key solution by offering the Product as a Service instead of selling an innovative product itself. This has a positive aspect in terms of rapidly scaling up into other cities and countries. However, the product was not attractive for the city economically-wise and not impressive enough from the innovation point of view for investors.

Regarding our own competence, we took advantage of the expertise in different fields we had in the team. We fully utilize the knowledge and background of each and every member. It was good to have a UX/UI person to make some user research in the bus stops and also to have three PhD members to be able to make further market research. Nevertheless, our team missed some business skills since the participants had no previous real experience in the market.

References and Links

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<2> Questionnaire

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<3> Interview with Liivar Luts, Project Manager of Tallinn Transport Department

<4> Presentation of Toomas Haidak Chief of Strategy of Tallinn Transport Department

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