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Ride Sharing application for Aviapolis Business region

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This thesis proposes a flexible platform to help improve employees' mobility through ridesharing applications. Since ridesharing is a familiar adopted but complex taxonomy. The topic provides a solution to an existing common requirement: commuting from point A to point B via shared rides. Some areas lack frequent public transportation, which means that the time interval between transport is very high or varies. It results in long waiting hours, long traveling time, and higher cost. Ride-sharing may be one of the most useful solutions when there are no other means of transportation to a specific location but generally, it is not the only option.

This study was carried out using Action research methodology to develop solutions to a problem. The study began by asking the employees to share their viewpoints and envisage suggestions to tackle the problem. The purpose was to hear it from the participants, detect the core factors considered for the service design, and compare it with the public transport during the town hall sessions.

After the brainstorming part, the study turned to the development of the actual ride sharing service and mobile application. As part of PiggyBaggy's transition from crowdsourced delivery to ridesharing, the software team performed a comprehensive code update.

The outcome of the thesis is a tested, sustainable ride-sharing web application with backend servers for users to access the ride-sharing service through their smartphones or computers. Additionally, the application includes some characteristics that are essential to the service. Using Web Development Tools and Libraries and dynamic backend solutions that was developed to make the application simple and easy to use. The solution tested in this Thesis on a trial basis opens up an alley to further elaboration, refining the service design, and a real-life service that will most likely be launched in the near future.

Keywords	Ridesharing, Web application, Sustainable development, Angular1 Native, Google Map API

Contents

1. Introduction

Employees working in late shifts often get left behind when it comes to public transportation. The Aviapolis business region is transforming into one of the central business hubs in Helsinki. There are more than 1,000 companies in the area, employing 37,000 people. The region will grow further as expected in the next few years, and more than 15,000 new jobs will be created, as desired. The rapid growth of the area creates demand for new innovative services and smart city solutions.

The objective of this thesis is to develop a sustainable mobility service concept between the employees of the participating companies as a solution to cater to the needs of employees working late evening and night shifts.

1.1 Business Challenge

Building a new and fast-growing business region also brings challenges to mobility. The Aviapolis area has its challenge to the heavy commuter traffic, which congests parking lots and main roads during the busy hours of the morning and afternoon. The area's challenge is also the lively Helsinki-Vantaa Airport, through which more than 20 million passengers pass each year.

The companies have a high growth projection rate but inadequate public transit service for late evening and night shift workers. Lack of transportation may prevent from applying for opportunities also late arrivals, absentee rates, and fatigue.

The business area has several companies operating 24/7 in shifts. There are always challenges for employees who do not own a car and reside where public transport mobility is not accessible or with multiple connections. Many of the night shift workers' pay makes it difficult to afford a car and likely to be under transportation cost burden, making them rely on public transport. On average traveling, car owners have around 2-3 seats empty, and utilizing them in exchange for money or other incentives is where the ridesharing industry thrives.

The potential advantages of increased ridesharing are substantial and create an impact on a wide range of companies. Also, the web application will impact drivers and

passengers to save travel costs, potential travel time, and share parking costs. It affects congestion reduction and reduces greenhouse gas.

The application must be user-friendly, efficient, and deliver value. The companies operating in the Aviapolis business area will request their employees to participate in the pilot by joining the free service. The higher the number of employees registering for the service, the more routes available to offer rides.

- 1.2 Objective, Scope, and the expected outcome

The “Rideshare Application project” aims to create a scalable rideshare application with a vital infrastructure that opens up growth opportunities for new companies.

The objective of this thesis is to design, develop and test a sustainable ride-sharing web application concept between the employees of the participating companies in a trial as a solution to cater to the needs of employees working late evening and night shifts.
Around rides, additional modules have to be implemented to be able to provide a sustainable and scalable service. Some of the features include chat messaging between users, weekly work schedule update, number of rides available, google map integration, and notifications to make the user aware of his shared-ride status, etc.

The companies operating and participating in the trial will request their employees to participate in the pilot by joining the free service. The greater the number of employees registering the service, the more routes will be available to request for rides.

To promote the application and user acquisition to participate in the trial, the companies will promote its use within their companies. Head of departments and Managers will encourage users to join the service. Car owners will be encouraged to offer rides to their colleagues. Employees using public transport will be motivated to request rides using the web application and share their service experience.

The objective of the test/ trial are as follows:

- Develop a web-application
- To have a maximum number of employees registered in the service
- To have 15% of employees request or offer a ride
- Out of 15%, 10% would continue using the service after the trial ends.

○ 1.3 Key terms and concepts

UI	User interface
JSON	JavaScript Object Notation
SQL	Structured Query Language
OAuth	Open Authorization
SEO	Search Engine optimization
API	Application programming interface
AGM	Angular Google Maps
SDK	Software Development Kit
NoSQL	Non-Relation Structured Query Language

○ 1.4 Case company

The company responsible for initial specifications, client coordination, design, development of the Web-Application is CoReorient. CoReorient specializes in the custom web app, mobile app, and Developing Professional Grade Software and has developed software for Real estate companies, municipalities, and privately-owned organizations. The team consists of a Project Manager, Full-Stack developers, Software Architects, Sr. UI & UX Designers, Jr. Frontend Developer, Interns, and Quality assurance team.

I have worked in CoReorient as a Project Manager since 2017 and leading the PiggyBaggy web application development till the final execution. My task is to sketch out the designs for the project, including setting the scope, designating employees, establishing project end dates, setting out communication policies, test runs, and maintenance, delivering completed software projects to clients, and performing quality checks on the services during the maintenance period.

For Piggybaggy, I have reserved a team of senior-level developers with competencies covering all aspects of the project and dedicated to the project full time during the project

duration and UX/UI designer and the equivalent of 5 mid-level developers covering the selected backend.

- 1.5 Thesis outline

The thesis will develop as follows. The first chapter consists of the objectives, scope, and expected outcome of the application. The initial part explains the business challenge and the reason for the pilot project and introduces the case company.

The following chapter presents and describes the methods of how the thesis is carried. This assists the reader in following the structure of this study more comfortably. First, the study method and research design are explained. After that, data collection and analysis and the efficacy and authenticity of the research are described.

The theoretical background of the application will be explained in the third chapter. The chapter describes the background of the ride-sharing and a brief introduction of the competitors and market leaders.

The fourth chapter explains the current state analysis of the application: the design and the requirement front UI of the application, including clarity, maneuverability, and usability. Moreover, the development challenges that are faced are briefly described.

The implementation and the use of the application features will be explained in the fifth chapter. The Screens are the application's building blocks that present the parts and functionalities separated to their specific task.

The sixth chapter will emphasize the stages of the pilot project and the results. It will also consist of the interim report and the project's impact on employees and their behavior. The second part provides the application's improvement to scale up, and the last part describes the initial objectives versus the results.

Step	Content	Outcome	Data

Research Objective	A need to provide a better transportation option for employees working in the Aviapolis region.	Objective: Create a web-based ride-sharing application	
	Identification of the technical problems.	Overcome Development challenges Application clarity and usability	Software team meetings to modify Crowdsourced delivery platform to RideSharing web application.
Conceptual Framework	Updating Software language Angular1 to the latest version or to continue using Angular 1	Front and backend design	Mind map for understanding the flow of the web application and also receive feedback and improvement from the client
Initial customer Acquisition plan	Plan for customer onboarding test	Testing the registration flow and quality assurance of the service. Feedback from test users	Bugs, improvements, and UI fixes
Validation of the proposal	Launching the application	Onboarding customers test users on production	Evaluation from test users
Rideshare application launch			

Figure 1: Research design model illustrating the thesis process progression

Split into six sections, research objectives, current state analysis, conceptual framework, initial customer acquisition plan, Validation of the proposal, and final launch. The first stage explains the goals, which define the reason and challenges. The second phase consists of current stage analysis and a brief historical data of the existing web application and design challenges. The section contained in the framework highlights the technology selection to update code. The frontend UI and backend technology was carefully examined, and the integration process was analyzed to get a deep understanding of the development time and quality assurance. The next stage is the

Initial acquisition plan containing quality testing with a mock version of the application with the users.

The users provided valuable feedback for UI changes and highlighted minor bugs. The fifth stage consists of launching the application on a limited scale and onboarding the users who showed their interest in joining the service.

The final stage is to launch the application on a wide scale in all the participating companies and request them to start offering rides or requests for rides.

● 2. Methods and Material

The chapter thoroughly discusses the methods and approach and introduces the pilot project idea to the employees of participating companies. Allowing them to share their opinion, propose suggestions to tackle the problem. The aim is to hear it from the participants, detect the core factors considered for the service design, and compare it with public transport.

The data was collected in three steps. An email was shared with the employees with a brief introduction to the project. The second step was to conduct town halls to collect questions, feedback, and improvement ideas on feedback forms. The third and final step was to obtain registered users, ride requested, offered, and completed data using the backend API.

○ 2.1 Data collection and research approach

It is not sure who developed action research. The creation of the method is often associated with Lewin (1946), and while he appears to have been the first to publish his work using the term, he may have earlier found it in Germany from work performed in Vienna in 1913 (Altrichterand Gestettner,1992)

○ 2.2 Research design

Authors mainly consider research design as the choice between qualitative and quantitative research methods. The research design refers to the selection of specific

forms of data accumulation and interpretation. Essential details of research design include research strategies and methods related to data collection and analysis.

Table 1. Data collection process

Action research is conducted to recognize solutions for a problem, or it can be a continuous method of problem-solving with a focus on reflection. Action research is a disciplined method of analysis conducted by and for those taking action. The principal logic for engaging in action research is to assist the "participant" in developing and improving their efforts.

Data Round	Data Type	Data Source	Date	Purpose/Focus
Data 1: Discussion with HR Gather employee details	Email	Email	9.11.2019	Requesting employees to provide feedback about the project details and participate in Town Hall
Data 2	Townhall, feedback survey	Employee feedback	15.11.2019	Feedback on the service design, improvement ideas, and participation in the trial.
Data 3		Backend API		Register users' ride requests and offered numbers.

The research was conducted with a group of employees of companies participating in the trial who showed their interest after Human Resources shared the details of the pilot project proposition to all the employees via email. The interested employees replied with their interest in participating in the survey, attending a town hall, and face-to-face interviews.

2.2.1 Human Resources

The data round one is sharing the web application trial plan with the employees and seeing their interest in attending the Townhall—human resources of trial partner companies introducing the project and its benefits to 400 employees. The email sent briefly explains the long, single commutes experienced by many employees and

emphasizes additional expense along with extended productivity due to fatigue and the most effective means of decreasing smog emissions and enhancing the overall air quality in our neighborhoods. For this reason, they are encouraged to participate in the trial project and confirm their participation in the town hall arranged for 15.11.2019. A total of 62 employees signed up for the town hall as the timings of the town hall were convenient to attend during their shift timings. A group of 20 employees requested to conduct a second town hall during their shift timings. We agreed to conduct another town hall based on small groups matching with their work shift timings.

2.2.2 Town Hall feedback

The data round two is getting feedback and improvement ideas from Townhall. Townhall groups have performed a critical function in the qualitative analysis since its modern resurgence (Morgan, 2004). Because of its significance as a methodology, there have been various patterns for leading focus groups. They range from complete guides (e.g., Bloor, Frankland, Thomas, & Robson, 2002; Litosseliti, 2003; Morgan, 2004) to practical guides (e.g., Krueger & Casey, 2000; Puchta & Potter, 2004), and even advanced principles (e.g., Fern, 2001).

Out of the total 62 employees who agreed to attend, several 45 successfully were present to participate. Our first assignment was to approach the initial circumstances of the group.

This group grouping was quite interesting in the trial; this assisted to perform our town hall gathering extra flexibly. The groups were rearranged to a group of better networking. The seating pattern was shifted from theater-style, with chairs in straight rows to round tables, with employees seating arrangement in a semi-circle.

The presentation started by outlining the concept of ride-sharing with examples of the existing applications in use in different parts of the world. The second part of the presentation was sharing the commute duration during peak, off-peak hours and multiple connections to commute to work and back. Also, the impact and change single-car owners can make by offering rides to fellow employees was also addressed.

The presentation was led by a member of our company, Heikki W.

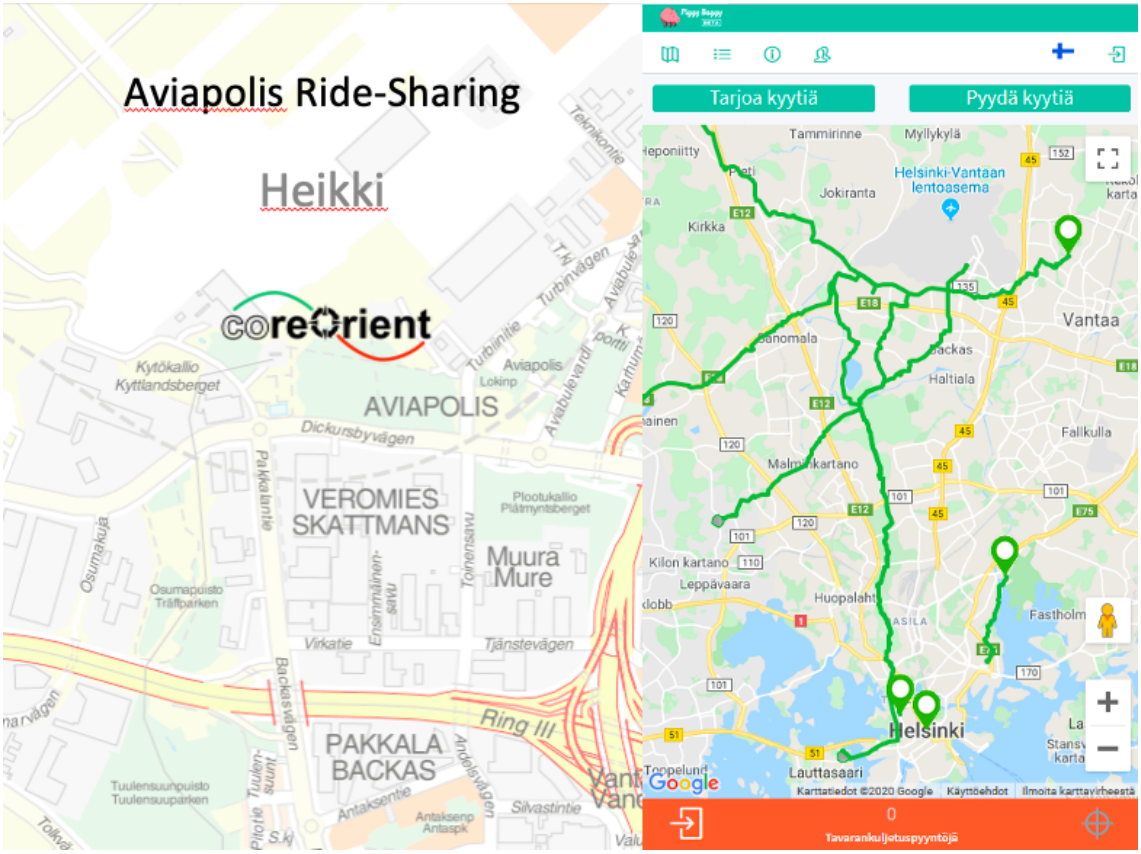


Figure 2: Introduction of the presentation to members of the TownHall

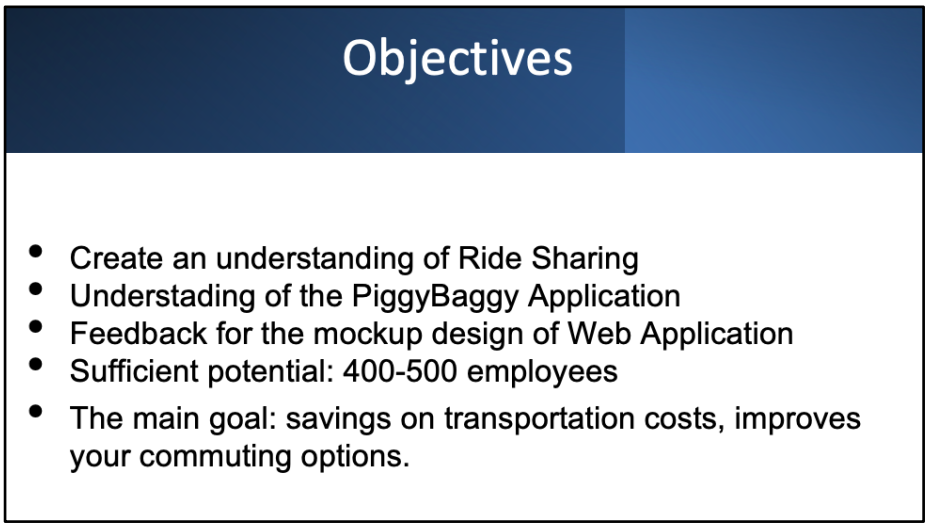


Figure 3: Objectives of the Town Hall

Figure 4: Presenting the benchmark service across the globe

The second round of the presentation was followed by a mock-up design of the application. The visuals of the application assisted in explaining the flow of the application, sharing benefits, clarifying some usability issues, and most importantly, collecting feedback and improvement ideas for each group. Each group presented five improvement ideas by the end of the second round. Some of the questions and improvement ideas were similar, but this showed the interest of the employees.

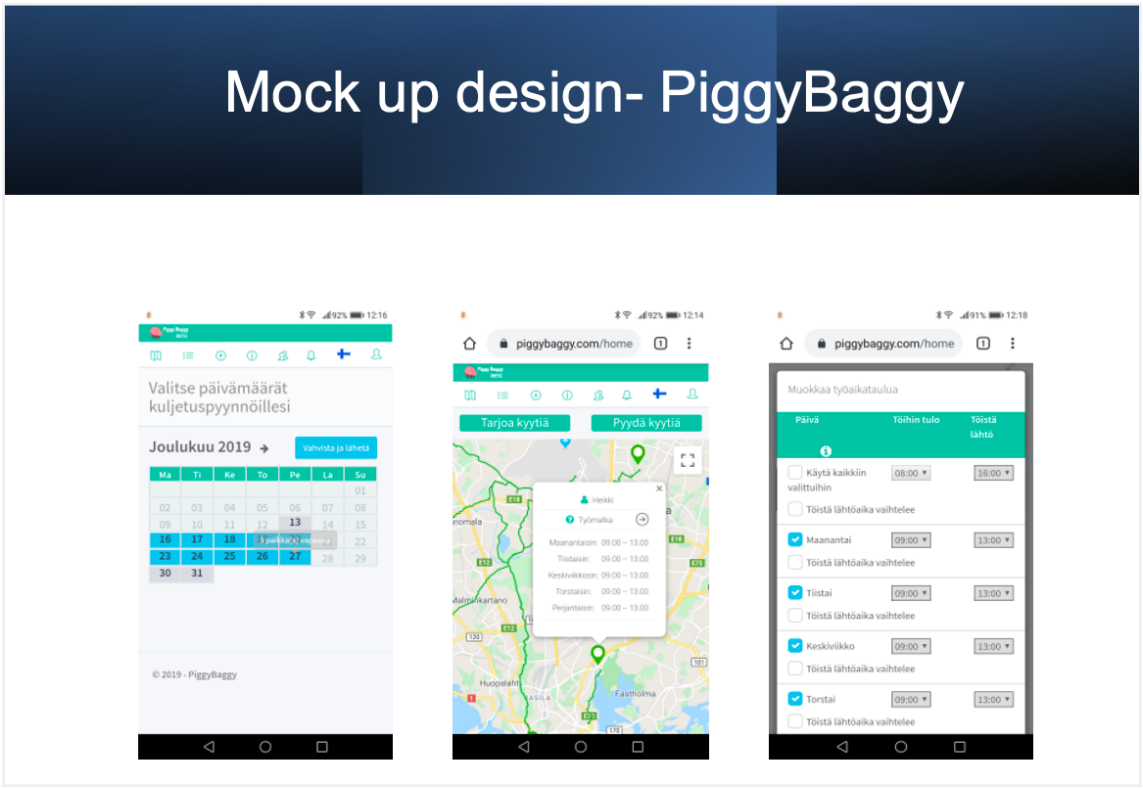


Figure 5: Presenting the benchmark service across the globe

The third and final round of the town hall was to fill a particular feedback form to share the feedback.

1. Select your company (List of companies participating in the trial)
2. What benefit do you think a carpool would be for your employer?
3. What incentives could you provide to employees to achieve these benefits?
4. What should be in the service so that the employer can be sure of the benefits?
5. Under what conditions could an employer pay for a service to a service provider?
6. An open field for users to explain their point of view, share their thoughts, and provide suggestions.

The feedback provided by the participating employees assisted in developing the solution and service designing the application. The feedback back was analyzed with the Software team, and a comparison was conducted between the feedback and objective of the application followed by changes in the mind map.

Most focus groups usually go on for 60 to 90 minutes. In our case, the town hall went on for about two hours. Had we not broken for lunch, it might have gone on longer. We suspect that the fact that people tended to respond at the convenience of their teams made the process less stressful and lowered the participants' strain.

2.2.3 Backend API

Data round three is about getting data using the Backend API. Backend is an additional application for the mobile application app – while the latter typically works in the frontend, the backend section functions very differently. It is a part of the software that works on remote machines called servers. It can be accessed through the internet via API (application public interface). The backend is not meant to be used directly but rather by other applications (frontend apps). Its objective is to perform small tasks which the frontend apps can't achieve.

The developers' back-end API assists in downloading the data of the total registered users and the total number of completed rides. The download option is not available at the moment in the front UI, which makes it challenging. A backend command needs to run to pull the data in CSV format.

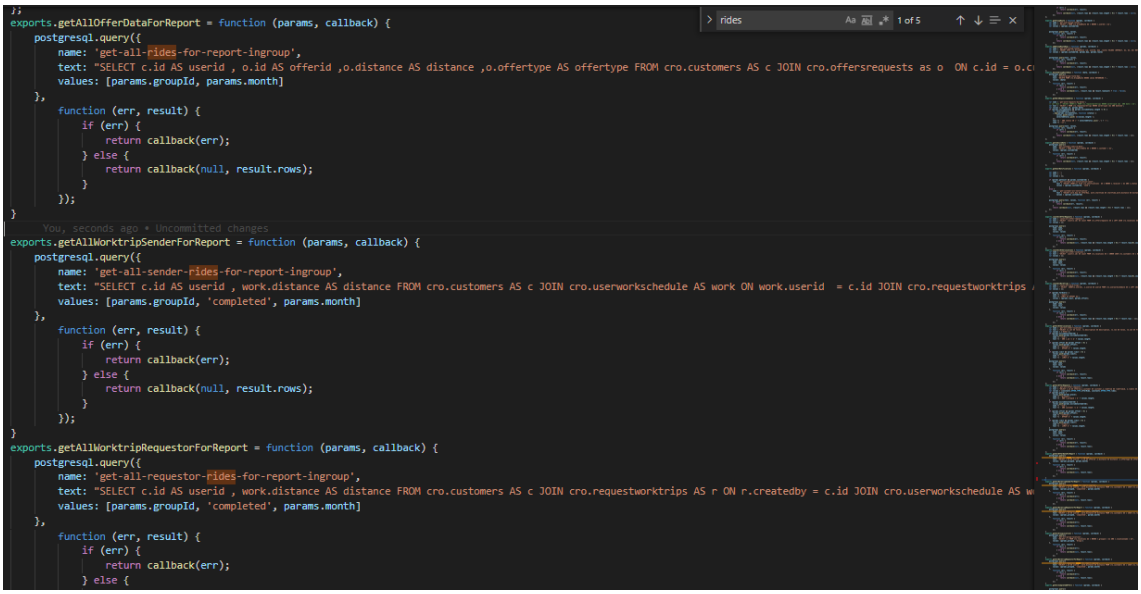


Figure 6: Backend API data download

○ 2.3 Mind map

A mind map was created after receiving the initial project requirements from the client. It helps in a comprehensive understanding of the project flow. I am the Project Lead, UI/UX designer, and developers connected to the plan to place concepts, ideas, and information into perspective and finalize an initial mind-map draft. After the initial draft of the mind map, it was shared with the Client's project coordinator for review, feedback, additional improvements, and some new features suggested by members of the client panel.

The client's confirmation of the mind map leads to finalizing the service feature, developing significant timelines, and developing automated test cases for a faster feedback cycle. Without test automation, feedback for newly developed features can create a huddle.

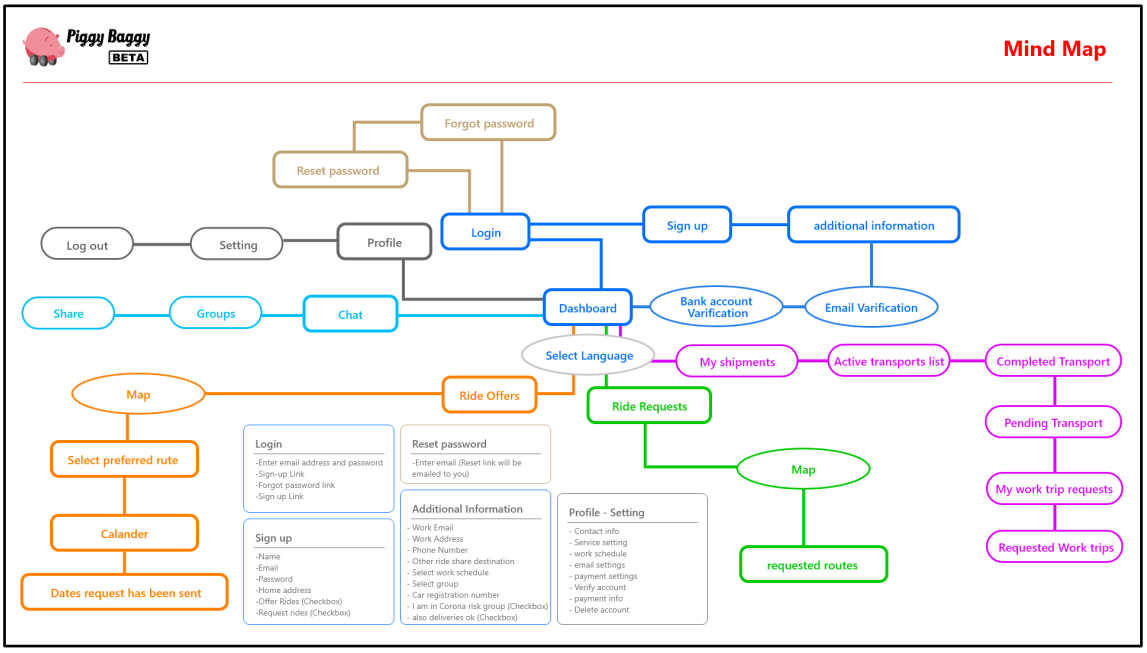


Figure 7: Mind map of the complete web application

The significant findings of the feedback, improvement ideas, request for a change, and the data collected during the town hall will be shared briefly in the sixth chapter. The results of the objective include a list of registered users and the number of rides taken during the trial.

- **3. Theoretical Background**

  - 3.1 Historical background

One of the core strategies for decreasing CO2 increasing from many vehicles on the road is a technical solution. As technology progresses and the availability of more options, the transformation from fossil fuels to different power sources such as electricity, hydrogen, and other fossil fuels is rising. Meyer et al. (2012) claim that technological solutions cannot solve some problems solely; it is essential to disengage private travel and shift the trend towards solutions such as ridesharing.

The aim and objective are to reduce the volume of traffic. The amount of traffic, such as road taxation, showed a sure success in small areas (Eliasson, 2014). Nevertheless, they could not obtain a competent decrease in-car use. A worldwide ranking of congestion level in 2020 still graded Stockholm on number 92 out of 189 with an additional 45% of travel time during the evening peak compared to a free-flow situation (TomTomTraffic Index, 2021).

Strict standards, before-mentioned as a hike in costs, preventing or rationing of car use are not quite in minimizing car-user (Stopher, 2004), “soft” actions, for instance, knowledge sharing and influencing car users to change to sustainable travel methods voluntarily, attract increasing attention (Taylor, 2007; Gärling & Satoshi, 2009; Bamber et al., 2011) and prove efficiency (Brög, 2009; Cairns, 2008).

While “tough” actions, such as increased costs, preventing or rationing of vehicle use are not alone sufficient in decreasing car use (Stopher, 2004), “soft” measures, for instance, data distribution and persuading car users to switch to sustainable travel methods willingly, attract rising attention (Taylor, 2007; Gärling & Satoshi, 2009; Bamber et al., 2011) and prove efficiency (Brög, 2009; Cairns, 2008).

The result of the survey carried out in New York City, around 13000 taxis use about 32 million gallons of gas per year with an average rate of 25 miles per gallon (MPG). The outcome is excessive fuel utilization per annum, and this number grows higher in smaller countries. For Public transportation, the citizens have to wait longer due to rush and

traffic jams. On average, for a bus, the common fare is more than six times a public transport fare in urban cities.

The problems highlighted above have achieved significant momentum in the previous decade, pointing to an interest in finding a solution. Ridesharing is one of the solutions which originated as an answer to the existing problem.

Ridesharing, by definition, is any means of transportation in which commuters use a single vehicle, a person's private or company vehicle, to reach a similar destination or destination that falls on their way. The consent found between 1914 -1918, known as the Jitney craze, allowed individuals to think of an innovative and effective way to use their vehicles.

Ridesharing also indicates the transportation of people in a car when such a transport is incidental to the primary objective of the driver, which is to reach a destination and not to transport a person for profit. (Code of Virginia, 1989, 46.2-1400). A comparable description is stated by Furuhata et al. (2013). Ride-sharing relates to an intelligent means of transportation. Individual travelers share a vehicle with others who have the same destination while splitting journey-related costs such as gas, tolls, or parking fees. A moderately different idea of 'ride-sharing is used by Cohen & Kietzmann (2014, p. 285), who define the financial model of ride-sharing as "Drivers make additional wages while intermediaries earn up to 20% of every transaction.

The earliest reports of ridesharing arise in early 20th century America. With mass-produced cars flooding the market and the early stages of a recession coming into play, enterprising car owners in 1914 began offering rides in their vehicles for a 'jitney' – a five-cent streetcar fare. The idea grew from Los Angeles across America in less than 12 months, with an estimated 1,400 jitneys operating in San Francisco alone.

Jitneys used to operate on famous streetcar lines and lasted on passing commuters. From the passengers' perspective, they offered a greatly improved service over the streetcar. Jitney often operated at speeds 1.5 to 2 times faster than streetcars (Eckert & Hilton, 1972) and could occasionally be convinced to deviate from main routes for drop-offs closer to passenger destinations. For passengers, the ability to decide between two service offerings for the same price was also an attractive service feature. While the

jitney service's reliability was sometimes questionable (many only ran during peak periods, few ran during bad weather), passengers had a second option in the streetcar form. Travel time savings, route flexibility, and transport mode choice were the primary value propositions for passengers. Jitney's use was not without tradeoffs. Jitney drivers were known to drive aggressively, and accidents were frequent. With passengers standing on the back of vehicles and the running boards, serious injuries did occur. Female commuters raised concerns in some social circles (Hodges, 2006). The downfall of the jitneys was nearly as fast as their rise. By early 1915, concerns over safety and responsibility were being reported in the popular press (New York Times, 1915).

In 1973, the oil crisis caused an impact on the market price of gasoline. By the 1990s, Kowshik predicted that ridesharing would exist with a better dynamic system that includes a better matching technique. Ridesharing can include carpooling and even sharing taxis as well. Ridesharing platforms connect drivers and vehicles with consumers who want rides at an agreed price.

Companies such as Lyft and Uber fall under the umbrella of ride-sharing. Lyft cars are adorned with a pink mustache, and drivers are urged to 'fist bump' passengers upon entering the vehicle. Didi Kuaidi principally operates in China, and it states that it facilitates three million trips per day, which it claims is 80 percent of the private car market.

In Uber's case, they offer uberX, UberBLACK, UberSUV, UberLUX, and UberTAXI. Each varies in rate and pattern of delivery, although the basic premise of scheduling a ride through a smartphone application remains the same.

- 3.1.1 The present benchmarks

- 3.1.1.2 Bla Bla Car

At present, Bla Bla car is widely most famous peer-to-peer ride-sharing service described as a “fully operating web service” for travel between cities (Bicocchi and Mamei, 2014; Dillet, 2015, p.85). Travelers can reach out to each other and exchange a time-based charge so that drivers retrieve a small payout while passengers move cheaply. The expansion of BlaBla Car is described as a successive entrance of local markets via acquisitions such as Carpooling.com (Dillet, 2015; Sundararajan, 2016). Gargiulo et al. (2015, p.778) called the growth of BlaBlaCar and Carpooling.com an "increasing success in the last years."

- 3.1.1.3 Flinc Flinc

A university project developed to provide exclusive trips to private customers scaled up to provide ride-sharing for companies (Bicocchi and Mamei, 2014; Brenneisen et al., 2011; Gargiulo et al., 2015). An algorithm was produced that allows the pick up of passengers along the way (Gargiulo et al., 2015). Furthermore, integrations into "navigation platforms" such as NAVIGON facilitated the automated sharing of trips with others, and a social network integration was realized to encourage trust (Bicocchi and Mamei, 2014; Flinc, 2017, p.85). In two years, 30 companies joined the service, and by 2016, the solution serves as a shuttle platform for city centers (Flinc, 2017)

- 3.1.1.3 TwoGo

A German ERP Software company, SAP, designed TwoGo for employees working within a company (Schindler, 2014). The software was released in 2011 for SAP employees, and in 2014, 20 companies are customers of the solution already with 12 000 registered users (Schindler, 2014).

Schindler (2014) further mentions the software to be available to the public so that private individuals can use the software for ride-sharing. Passengers and drivers are matched into a travel group based on their route and time.

- 3.1.1.4 MatchRiderGO

MatchRiderGO is a commuter matching platform that operates on two fixed routes in Stuttgart and Heidelberg city. Drivers work like bus service by having a set course but have calculated stops for the matched commuters (Enge, 2016). This way, the supply for the given routes is tried to be guaranteed (Enge, 2016).

The shared-ride application also has various technical support levels, such as being based simply on a social convention or using a customized and centralized database with pre-registration and pre-booking via the web or mobile app interface. Once the ride is requested, the driver receives the information and heads to the passenger's destination to provide transportation. The drivers are required to carry a commercial license to transport passengers. Some companies only need drivers to take a standard driving license, making them pier to pier or on-demand. Previous researches have illustrated that each brand-new shared car added to existing ridesharing fleets removes 4.6 to 20 private cars from the road. This reduction is because carsharing services are much less likely to purchase their cars and may even sell the cars after joining a carsharing service.

- 3.2 Problems and Risk

The ease of requesting a ride on a telephone, sharing a ride with a colleague has urged ride-sharing to lead the sharing economy. However, ride-sharing isn’t without risk. In various systems, people have limited information about the driver and co-riders. Trust massively influences the usage of ridesharing.

Trust and safety are extremely core of the sharing marketplace, yet several of us do not believe in the service, the technology, or the personalities behind these ride-sharing programs. If building human confidence were easy, consumers would adopt this change more willingly.

The acknowledgment from customers on ride-sharing programs ought mainly stayed concrete, being explained with their tremendous global increase. People acknowledge the convenience, diversity, and cost-effectiveness of sharing. There has been unusual pushback on critical issues like security and protection for both riders and drivers. At one

conclusion of the spectrum, there have been cases of security, Legality, and money. In contrast, the opposite end of the spectrum has shown that consumers are unsatisfied with the driver or the other passenger(s) in the car.

3.2.1 Security

Comparable to the problem of picking up hitchhikers, in ride-sharing, people go with a stranger. This remains the common significant matter to be discussed because there are many risks from the typical psychopathic to an inexperienced driver. One possible and yet inefficient solution suggested by Murphy (2007) is introducing Auto Event Recorders on cars, something as easy as real-time feed cameras to implement security. Further reasonable solutions for open association ridesharing safety include using RFID, face identification, voice identification, live location tracking on maps; however, these are all costly and technically challenging solutions. (Gruebele, 2008).

3.2.2 Trust

This problem is similar to security in various styles due to the undeniable fact that there is a complete outsider involved in the act. The most recommended and most logical solution to avoid this problem is integrating a rating method to rate each other on different subjects varying from regularity to friendliness.

3.2.3 Money

This is a complex problem, as some users might find it awkward and unreliable to transfer money by hand. If money is transferred by hand, the ride-sharing system does not have any check over it and has to take precautions to limit liability issues that might appear between people. The sensible move would be to have an online payment system connected to the carpooling system. However, that solution is imperfect as well due to the insecurity people feel against online payment systems.

3.2.4 Legality

Legal matters are different obstacles that must be overwhelmed. For example, PickupPal ridesharing has gotten into a problem by engaging customers to pay operators for rides, which bus transportation services thought was taking their business, and profaned the Public Vehicles Act in the USA. They had to set in place a set of courses to sustain the lawsuit.

3.3 PiggyBaggy history

Online sales are growing, consumers are offered free and instant delivery UX, but conventional home delivery costs do not scale well. Retailers cannot provide home delivery service outside densely populated areas without subsidizing them from the product sales margins. Consumers, especially in the rural areas, get poor or no affordable delivery service, and most of them have to use cars for their shopping. Instead of intelligent crowdsourcing, large-scale positive social impacts investments flow into courier clone services and the exploitative Uber model.

Another benefit of crowdsourced delivery is that it is technically sound and asset-light. The ride-sharing drivers utilize their vehicles to support the delivery industry. It's an easy way to ramp the delivery operations up and down as needed. This option reduces many efforts involving hiring delivery staff, salaries, vehicle purchase capital, and companies' maintenance.
However, as there are cons, the platform has uncertainties. The reliability is a question when compared with the traditional courier companies.

Additional insurance can be opted for, but it increases the cost of the delivery. Companies have to consider the uncertainty and the sustainability of the large pool of part-time labor force. Last but not least, managing the geographically dispersed labor force may also be a challenge.

The platform developed in 2015 as a crowdsourced logistics service allowing users to safely and efficiently deliver groceries to their neighbors and get paid for it. It was an efficient, sustainable, and affordable transport alternative for home deliveries from retail stores and parcel pick-up points. Compared to the crowdsourced service transport services. Peer consumers transported parcels instead of semi-professional drivers.

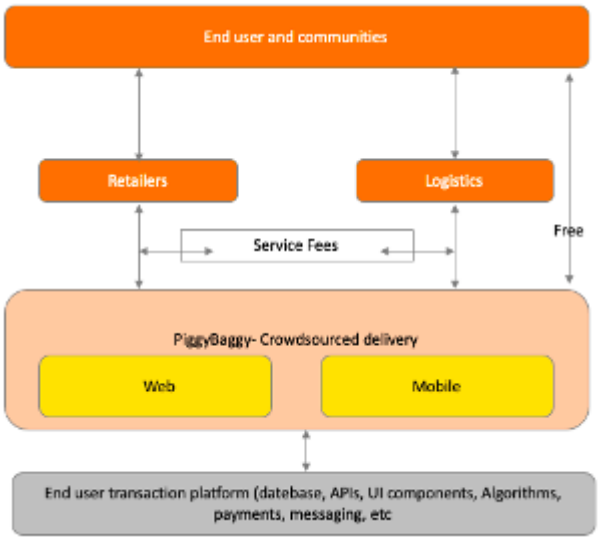


Figure 8: PiggyBaggy platform flow diagram

- **4. Current state analysis of the existing application**

This chapter reflects on the historical development of the platform along with the aim and objectives set for modifying the Web App from crowdsourced delivery to the ride-shared platform. In addition, the challenges analyzed during the development and the solution proposed will also be explained

- 4.1 Current state analysis and specification

The platform offered to the group of companies is PiggyBaggy which is part of ShareEconomicy and has been featured on various platforms as a signature crowdsourced delivery service that improves logistics efficiency. To accelerate the pilot project, it was decided to use the existing software code and the domain name to transform the crowdsourced delivery into a ridesharing application.

In-depth analysis was done of different ridesharing applications to understand the service flow and service design complication. However, developing a platform that suits the employees' shift timings of multiple companies was a challenge. Besides, the flow of the application needed a complete overhaul.

The following interface qualities or characteristics shall be aimed at while developing the web application platform.

- Company selection during the registration.
- Authentication for roles
- Accepting rides
- Declining rides
- Switch role between driver and passenger.
- MapView for available passengers requesting rides.
- MapView for drivers offering rides.
- Profile view.
- Chat integration

4.2 Development challenges

The core challenge is to transform the application with a new interface design and avoid any complicated functionality. As the technology and design advance, the users have set high expectations on how good and easy the experience should feel. Interaction design is essential to tackle the graphical interface for the efficient and easy use (Preece, et al., 2015).

The PiggyBaggy application UI design was created in 2015, which supported a crowdsourced delivery model. One of the difficulties was updating outdated code and technology, replacing it with the new version, and following UX law, which delves deeper into the relationship between visual appeal and user experience.

4.3 Application requirement & design

UI defines how we communicate with a website or any mobile app, so designing a sharp user interface holds several advantages and can eventually produce a significant impression on customer comfort. If a design has a neat design and is simple to communicate with, then the experience will be positive, and users get the job done with less stress and time.

By having a natural, easy layout experience on the Web app, you give customers the comfort they're looking for, along with a positive relationship with your label and customer service. Stable navigation and a minimalist layout are your essence northern lights to creating this fact.

- 4.3.1 Clarity

  A clear interface is a better interface. It is the most crucial factor while brainstorming the application's idea as it makes the user bond with the easy interface and improves the experience. The interaction design, the prototyping, and overall design interface play a pivotal role in the development.

- 4.3.2 Concision

  The core challenge in developing the application is to keep it clear and concise. Adding labels and text in the service can make it overcrowded and clarifying making it difficult for the user to navigate.

- 4.3.3 Interaction design

  An interactive design plays an important part and significantly connects the user with the application. The UI has to be designed keeping the most amateur user navigation skills in mind. The user of all age groups should perform all the desired actions with minimum hassle. The consistent UI design, furthermore, provides discoverability and understanding for users. (Norman, 2013). As the UI is an essential part of the application that users see to form an opinion in the first place, and it is visible in terms of the software. The lousy user interface creates misunderstanding and leads to transmitting information to users (Mayhew, 1992).

- 4.3.4 Usability

  Usability is always seen as a term of central concentration of the UI interface. It allows users to measure the ease of navigation and hassle-free experience. The benefits for easy user experience go in all directions, along with using the stakeholder and the development team to prioritizing usability.

  Usability includes five attributes below (Molich & Nielsen, 1990):

- Learnability: The navigation through the application should be easy to learn.
- Efficiency: System efficiency and responsiveness should be efficient all the time
- Memorability: The application features should be easy to remember
- Errors: The errors and unresponsiveness should be minimum
- Satisfaction: The application should provide a satisfying experience to all age groups.

Several studies have been conducted in the past and proved that there are several benefits from good usability. Few out of many benefits are: minimizing the development cost and time, limiting the training, enhancing the standards to meet delivery deadlines, bringing more traffic, and increasing returning investment. (Bloomer & Croft, 1997). The web application has limited usability when used with a mobile phone due to its little screenplay. The UI design is needed to concentrate more on how to maximize usability without any user frustration.

4.3.5 Responsiveness

The application is designed to be used with Web browsers. But the dimensions of the mobile is the first fact of consideration as users prefer to use smartphones for ride-sharing apps, and as per the feedback by the Human resources of the participating companies, it is expected that mobile usage will be higher compared to web usage of the application. Some web applications are static and frequent updates are not needed, while others are designed to be responsive due to higher interactivity. Piggybaggy will be accessed via the internet browser and adapt to the user's device. It will not be native to a particular system and doesn't need to be downloaded or installed. Overall it is challenging to create a UI with responsiveness for all the dimensions of screens. (Gilthorpe, 2016) (McCartney, 2017).

4.3.6 Proposed Solutions

Designers and developers must pre-determine appropriate server requirements, bandwidth limits, programming languages, graphical elements, and applets according to their targeted user group and site content to improve responsiveness effectively.

There are some commonly suggested solutions and suggestions that would help improve the responsiveness of a website. - Avoid inline stylesheets and javascript. It is further relevant to make the outside as most of the utmost pages will get used to the same stylesheets and javascript. This will make the HTML document shorter in lines of code, but more importantly, stylesheets and javascript will become cache-able by browser, thus decreasing response times. - Be careful not to use the same script twice.

After finishing coding, try reducing HTML or minifying stylesheets and javascript. Minifying is a method that can be performed through applications that can be found openly on the Internet. Minifying eliminates unnecessary spaces, line-breaks and decreases the code into a few lines. Code becomes harder to understand but also significantly smaller, correlated to its former size. On the other hand, HTTP compression is claimed to reduce large textual data by around 70%.

Over-using graphical elements and installing too many articles into the web page are the principal causes of poor response rates. "The number of embedded objects was 2.6 times extra expensive than complete page measurement for response time. Caching was found to enhance response times by over 19%.

The number of lines of code and the size of cookies found to affect reply times the least." (Chiew, 2009) However, it should not be overlooked that web page response time will be dependent on the characteristics of a website and its design. Producing and defending a decent balance among visuality and responsiveness will provide the site/application the best usability.

-

- 4.3.7 Simplicity

Simplicity leads to easy maneuverability and a better user experience. Enhancing easy navigation in UI design may contain clear visibility of the rides offers and requests, minimizing mandatory fields in the form, allowing the save password option, and avoiding scrolling unbearable scrolling. Google maps locator should be responsive and very clear and concise to understand the details of the ride. Various features to prevent could be over-complex graphics, tiny buttons difficult to tap, and rollover pictures. In this way,

users can achieve their actions as few steps as possible and keep their attention on the application longer. (Gilthorpe, 2016) (McCartney, 2017).

- 4.3.8 Finger-Friendly design

As technology advances, the mobile phone interface is becoming more complicated. The users are interacting with the touch of the finger with the screen to maneuver through the application. Smaller buttons are difficult for users to tap compared to controls with larger dimensions. Small buttons can lead to touch errors; when small buttons are grouped near each other, users can accidentally click the button in its neighborhood and initiate a completely different operation, resulting in an awful user experience. Smaller buttons also slow down the navigation as the user pays extra
attention to tap the right button. The users should be able to figure these gestures without any difficulty in a mobile application. (McCartney, 2017).

● 5. The Web Application

Software development is a human action. It requires a clear and concise knowledge of the field of application, such as the library and learning science; an understanding of the technology such as the computer operation, including understanding the programming languages; expertise to communicate and recognize; and a talent for discovery ' integration.

Application software is the standard classification of computer programs for executing jobs. The application software may be general-purpose (word processing, web browsers.) or have a specific purpose (accounting, project management, designing, or controlling a particular task.) Application software contrasts with system software.

While application software is intended for consumers, and system software is meant for computers or mobiles, programming software is for computer developers composing a code. These are applications that are applied to address, generate, examine, and debug different software applications. It’s helpful to think of these programs as a translator of sorts: they take programming languages like PHP, Visual Basic, Laravel, Python, C++, and more and translate them into something a computer or phone will understand.

- 5.1 Applications Type

There are mainly three classifications of applications- Web-based, Hybrid, and Native. The PiggyBaggy ride-share application is designed as a Web application.

Each category works as follows:

- 5.1.1 Native Application

All Applications targeted towards distinct mobile platforms are known as Native applications. Therefore, an Application meant for Apple devices will never open on Android devices. This is why leading enterprises produce applications for various platforms. While developing native applications, experts include best-in-class user interface modules.

These values for more reliable production, flexibility, and good user involvement. Users also profit from broader access to Applications Program Interfaces (APIs) and unlimited use of all Applications from the particular device. Further, they also switch over from one application to different effortlessly.

- 5.1.2 Hybrid Application

The concept of Hybrid Applications is a mix of native and web-based applications. Applications generated using Flutter, Xamarin, React Native, Sencha Touch, and other similar technologies fall within this classification. These were created to assist web and native technologies beyond various stages, hence the name hybrid. Furthermore, these applications are more straightforward and quicker to develop. It includes the use of single code which runs in various mobile operating systems. Notwithstanding such benefits, hybrid applications are slower in agility and performance. Often, applications fail to bear the same look n feel in diverse mobile operating systems.

- 5.1.3 Web Application

Web Applications are coded in HTML5, CSS or JavaScript. A powerful internet connection is needed for the proper functioning and user experience of these

applications. By default, these Applications capture the least memory area in the user devices compared to Native and Hybrid Applications. The only con is that application developers don't get enough passage to mobile operating method API

Phase -1 is initiated with a service where the Web Application PiggyBaggy service is customized to lower the threshold for providing and requesting coworker rides as much as possible. The organization of an individual ride is allowed to take place manually at this stage, as there may be more important factors for users than the user interface of the service can use, keeping the user experience still straightforward and easy enough.

5.2 Authentication

■ 5.2.1 Registration

The user must register to the service by using the name, email, password, home address. The registration email is sent to the user's email address to confirm the registration process. The option to select the "Offer rides" or "Request rides" option is available in the registration. The user can choose either one or both the options. The choice of the option can be changed from the profile after the registration is completed.

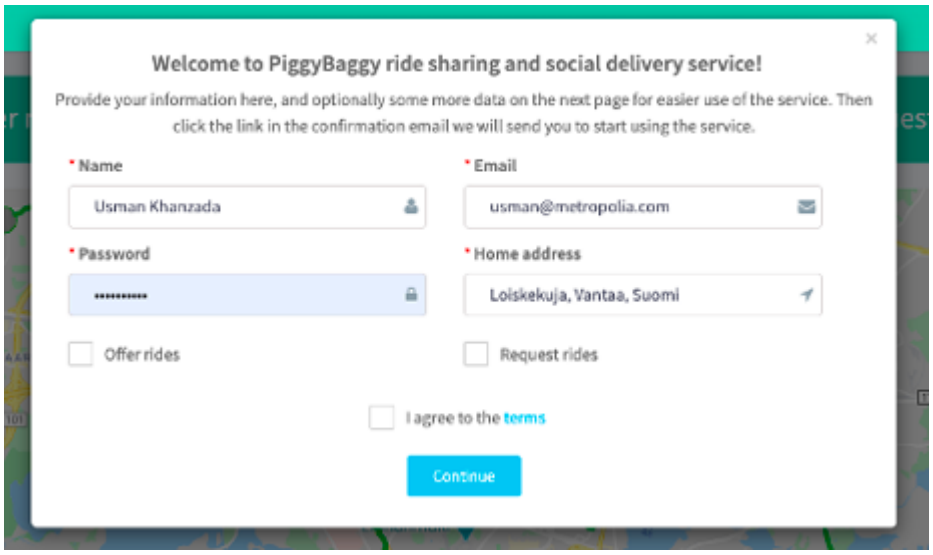


Figure 9: The registration option is available on the right corner of the application. The user clicks the registration button to get to the registration page on the figure. It consists of name, email,

address, password, and option to be a driver, passenger, or both. The SignUp screen submits button will successfully create a user account and redirect users to the Home screen.

The users are required to provide the additional information, including phone number, work email address, Introduction, work address, select group (The groups include the companies that have joined hands to conduct the trial. The user will be notified when there is an Offer ride or Request rides notification from his group or the other groups depending upon the options selected by the user), select work schedule, and additional route for the ride. A User can also hide their location and pick up a different location for pick and drop.

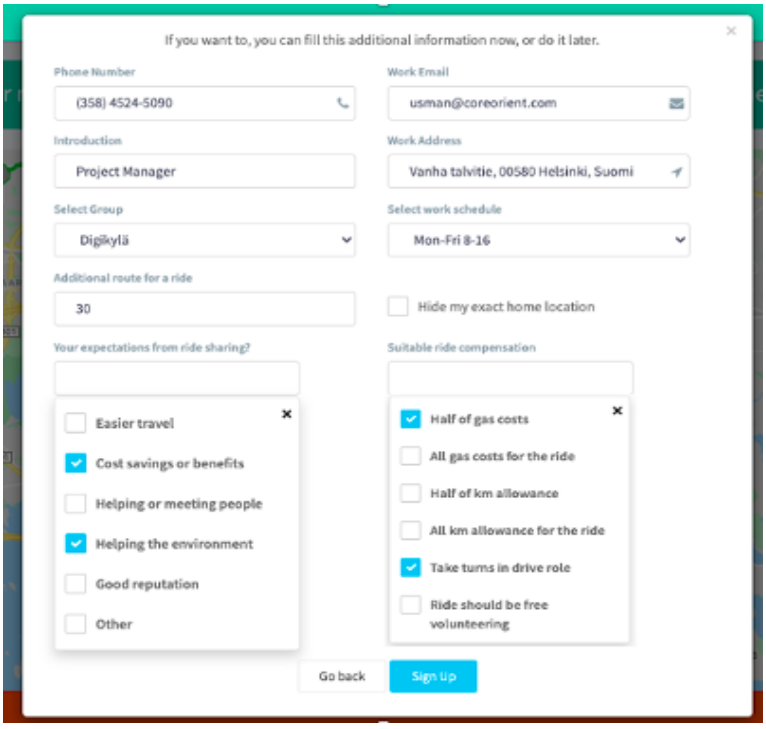
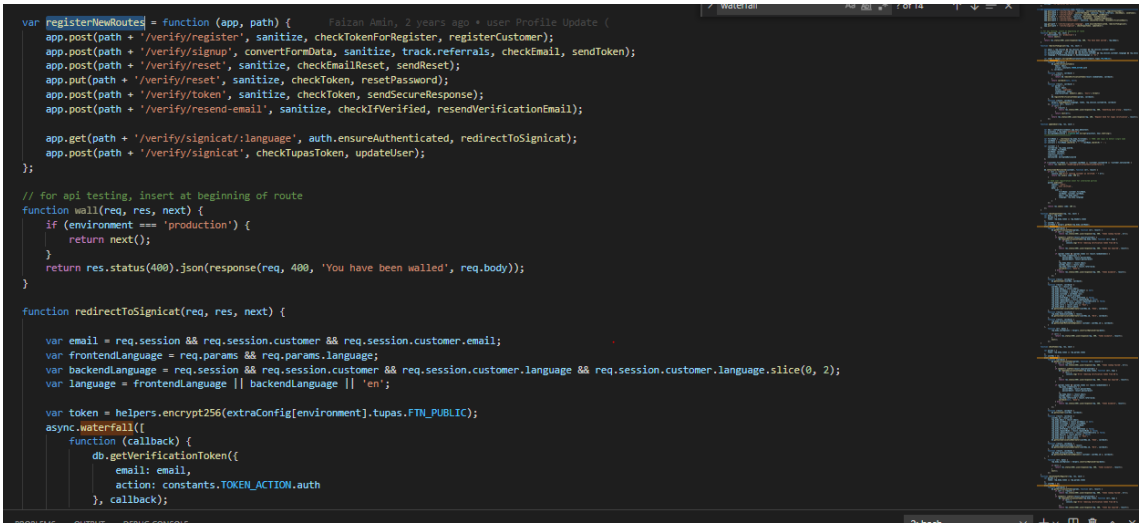


Figure 10: Page- 2 Sign up page view

The data will be saved in the backend application name “Truevault” when the sign-up is submitted.



```
var registerNewRoutes = function (app, path) {
    app.post(path + '/verify/register', sanitize, checkTokenForRegister, registerCustomer);
    app.post(path + '/verify/signup', convertFormData, sanitize, track.referrals, checkEmail, sendToken);
    app.post(path + '/verify/reset', sanitize, checkEmailReset, sendReset);
    app.put(path + '/verify/reset', sanitize, checkToken, resetPassword);
    app.post(path + '/verify/token', sanitize, checkToken, sendSecureResponse);
    app.post(path + '/verify/resend-email', sanitize, checkIfVerified, resendVerificationEmail);

    app.get(path + '/verify/signicat/:language', auth.ensureAuthenticated, redirectToSignicat);
    app.post(path + '/verify/signicat', checkTupasToken, updateUser);
};

// for api testing, insert at beginning of route
function wall(req, res, next) {
    if (environment === 'production') {
        return next();
    }
    return res.status(400).json(response(req, 400, 'You have been walled', req.body));
}

function redirectToSignicat(req, res, next) {

    var email = req.session && req.session.customer && req.session.customer.email;
    var frontendLanguage = req.params && req.params.language;
    var backendLanguage = req.session && req.session.customer && req.session.customer.language && req.session.customer.language.slice(0, 2);
    var language = frontendLanguage || backendLanguage || 'en';

    var token = helpers.encrypt256(extraConfig[environment].tupas.FTN_PUBLIC);
    async.waterfall([
        function (callback) {
            db.getVerificationToken({
                email: email,
                action: constants.TOKEN_ACTION.auth
            }, callback);
```

Figure 11: Registration, the front will hit a specific route request in line number 35 /verify/signup. All the defined validations rules will be checked (means required fields). The email will be confirmed if it already exists or not, and then a new user will be created.

■ 5.2.2 Bank Authentication

Bank verification is a powerful digital verification method that is linked to an individual's bank account. The security protocol allows users to verify their identity to gain a route to their accounts on a website.

The critical two factors in the service are website authentication (the customer's UX experience) and security. The users must be able to verify and complete the process without any hassle. Otherwise, the risk of users becoming frustrated or even dropping out of the service is high. That's an unsatisfied consumer including an end of possible revenue.

On the other hand, an optimized verification process would allow the user to verify the identity and complete the process within seconds and hassle-free- thus removing the barrier and ensuring higher conversion rates.

The user can request or offer a ride after the bank authentication is completed in the service. The mandatory option is created to keep the security protocol of the service intact.

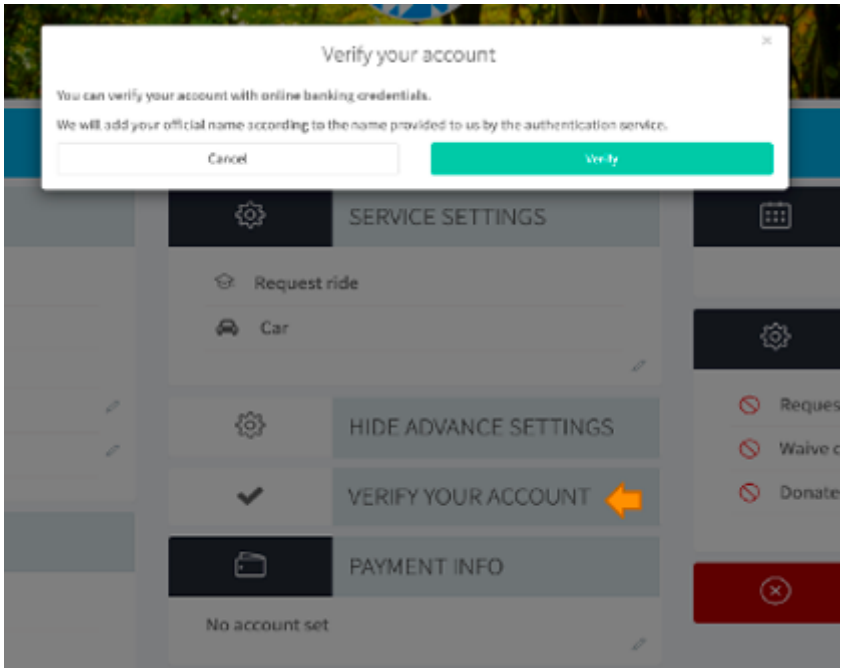


Figure 12: Bank account verification notification

The link to verification leads to a bank authentication page where all the banks are listed to the users. The user can verify their identity using personal banking credentials. This is completed using personal banking credentials provided by the bank. You only need to verify your identity once. You will see Signicat mentioned as the service provider when making the Finnish bank identification. Signicat is our trusted partner for verification services. You can also do this using your Mobile-ID.

```
function redirectToSignicat(req, res, next) {

    var email = req.session && req.session.customer && req.session.customer.email;
    var frontendLanguage = req.params && req.params.language;
    var backendLanguage = req.session && req.session.customer && req.session.customer.language && req.session.customer.langua
    var language = frontendLanguage || backendLanguage || 'en';

    var token = helpers.encrypt256(extraConfig[environment].tupas.FTN_PUBLIC);
    async.waterfall([
        function (callback) {
            db.getVerificationToken({
        },
        function (result, callback) {
            if (result) {
            }
            return callback(null, null);
        },
        function (result, callback) {
            var params = {
            };
            db.registerVerificationToken(params, callback);
        },
        function (result, callback) {
            helpers.tupasRequest(language, token, req.session.customerId, callback)
        }], function (err, result) {
        });
}
```

Figure 13: Bank authentication sent to Signicat for verification. After authentication, a call-back URL is shared with Signicat to redirect the user back to the platform.

List of banks

The Finnish Bank ID consists of a set of Finnish banks.

- Osuuspankki
- Nordea
- Danske Bank
- Handelsbanken
- Ålandsbanken
- S-Pankki
- Aktia
- POP Pankki
- Säästöpankki
- Oma Säästöpankki

The verification is completed, the user receives an acknowledgment email from the service.

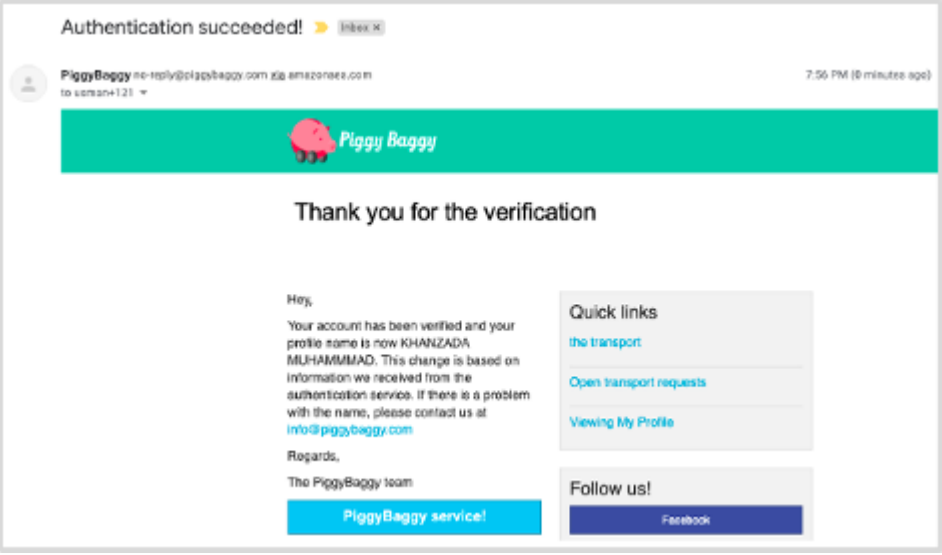


Figure 14: Successful verification confirmation email

```
function updateUser(req, res, next) {


    var key = config[environment].app.keys.dbContent;
    var plaintext = req.body['nationalId'];
    var encryptedNationalId = CryptoJS.AES.encrypt(plaintext, key).toString();
    //**************************

    var firstName = _.startCase(req.body.firstname); // TODO: add logic to detect single name
    var lastName = _.startCase(req.body.lastname);
    var initials = firstName.charAt(0) + '.' + lastName.charAt(0) + '.';

    var customer = {···
    };

    if (!customer.firstName || !customer.lastName || !customer.customerId || !customer.nationalId) {···
    }

    db.setCustomerNationalId(customer, function (err, result) {
        if (err || !result) {
            console.log("Error setting customer as verified: " + err);
            return res.send({ code: 400 });
        }

        // Send user registration event for interested parties
        postal.publish({
            channel: 'users',
            topic: 'user.verified',
            data: {···
            }
        });

        return res.send({ code: 200 });
    });
```

Figure 15: A confirmation of verification is received

- 5.2.3 Login

To log in to the platform, the user must use the email address and the password into the web application displayed on the Sign-In screen. At the login, the user authenticates as a member of the service and before the server. The backend API handles the user's login credentials by verifying the email and the password. To understand the login protocols, we need to understand the communication that travels between segments.

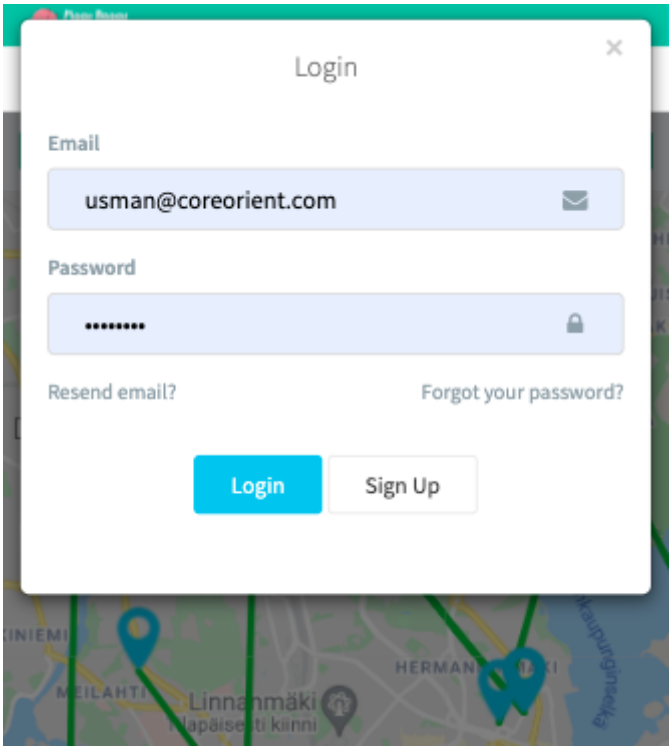


Figure 16: The SignIn screen consists of two input fields. The user enters a registered email address and password and clicks the sign-in button to access the application. The user is redirected to the Home Screen.

Authentication server- The server facilitates the authentication of the member that has registered to the service and now attempts to the web application, the server which is responsible for validating the credentials and issue tokens to the application server

Application Server- Responsible for hosting the application and giving access to users to the user.

Resources Server- It is integrated into the service to handle the authenticated request and handle issued token and run the application

Application- The interface developed which accesses all the resources and responds to the user request.

```
34
35    var registerLoginRoutes = function (app, path) {
36        app.post(path + '/users/login', auth.ensureUnauthenticated, sanitize, passportLocalLogin);
37        app.post(path + '/users/login/facebook/token', sanitize, passportFacebookTokenLogin);
38        app.post(path + '/users/logout', passportLogout);
39    };
```

Figure 17: The API confirms the login successfully and returns the data object

If an incorrect email address or a password, the API will generate a validation error that prompts an error command. For example, an incorrect email address or a password for a valid email is stored in the Authentication table. The API rejects the credentials and prompts a validation error. The front UI shows a pop-up message to inform the user to recheck the credentials or contact support if the problem persists.

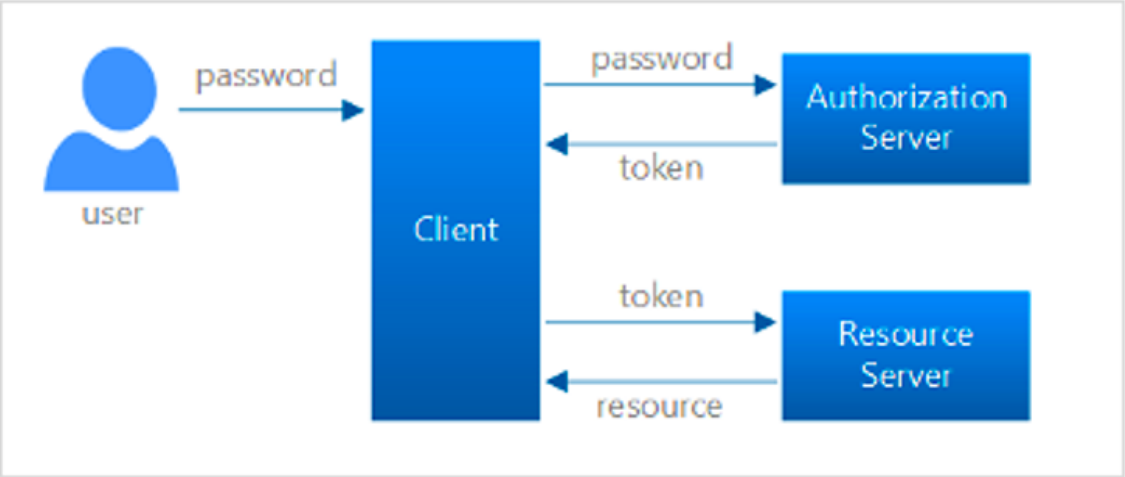


Figure 18: Password integration to server.

- 5.2.4 Password Reset

Passwords are critical sections in network protection. They give authorization and support to users to enter a web service and private information. It is essential to save passwords in a high network defended application and have a robust protocol. A significant problem that results is how to maintain and have strong reset password tools. Some methods will ask users questions such as personal preferences, matters, or data that other people might not simply acquire when users need to reset their passwords. Still, it is not simple for some customers to remember all of their personal information to keep using identical data across applications. The process becomes not comfortable or prevents Front-end- based validation from being performed by the browser, enabling users to insert details such as login username and password in a textbox. Hypertext Markup Language (HTML) is the conventional style for building web pages and applications. The HTML label is usually practiced to permit application users to insert data. The quality required will force the field not to be empty when users click on the submit button. If the front-end browser can receive the capacity to deliver

essential checking before the data is sent to a back-end server, it will guard the web server against being damaged and loaded. All data figures series should be interpreted, such as examining blank areas, correct information strength, range of authorized input.

Changing a user's password has two different situations:

Example 1: Renewing the state when the prevailing state is identified. For instance, if the password is terminated. The user will need to enter the old value and the new values. Once the distinct different password is verified, a simple SQL UPDATE query can reinstate the password.

Example 2: Asking a distinct password because the existing one is forgotten. For instance, a customer fails their password, and the user can't insert the past value. Hence, the site will want extra data and steps to verify if the user is the actual owner of the Login ID and provide a reliable way to support users to replace their password. Some people might not want to share personal favorites, and the answers to users' inquiries might switch and often cause the user to be confused.

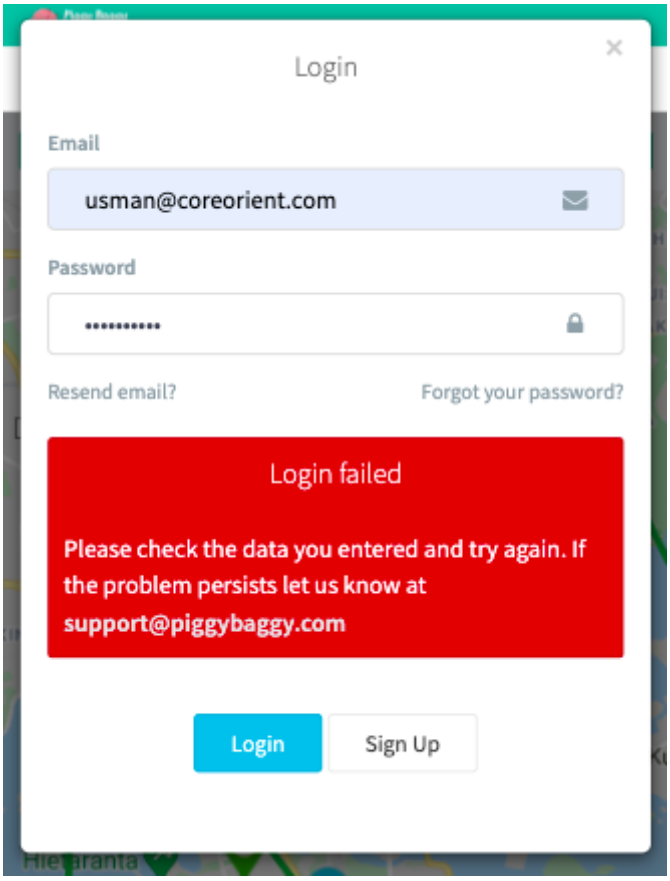


Figure 19: Login failed error due to incorrect password or email ID

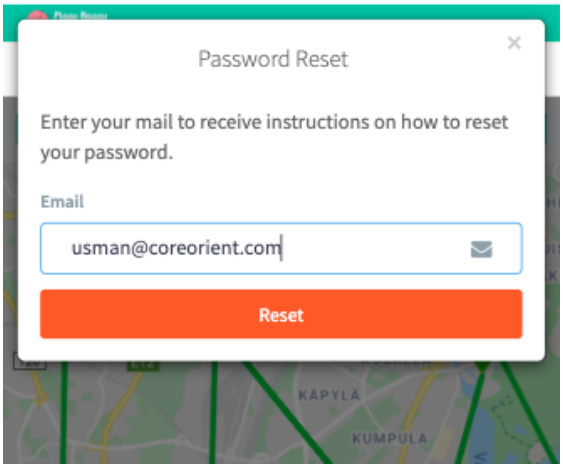


Figure 20: Email address required to get a reset link.

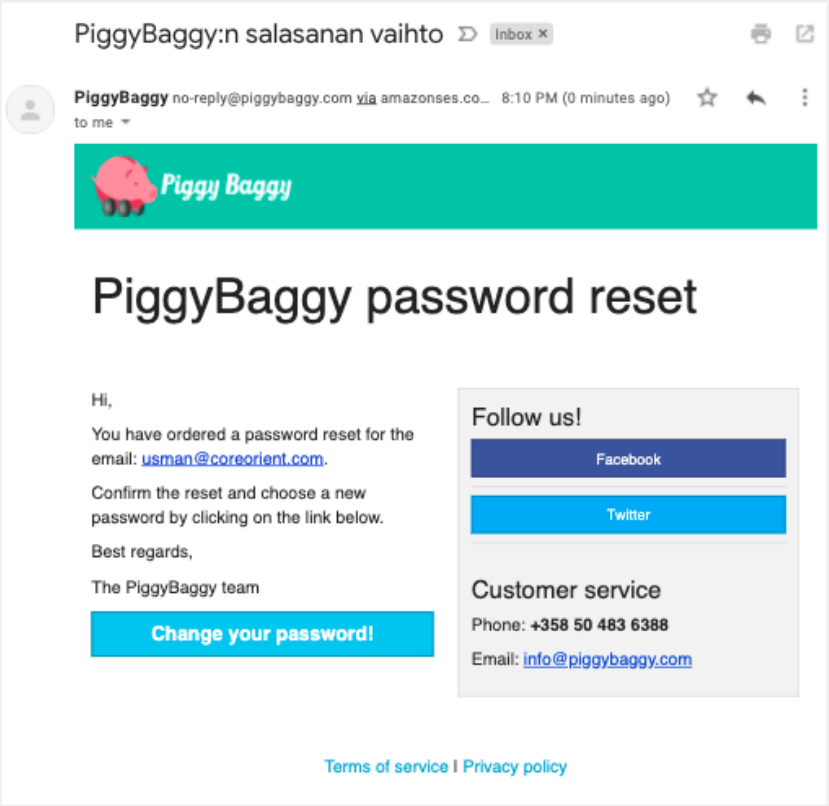


Figure 21: Password reset email with a link to change password

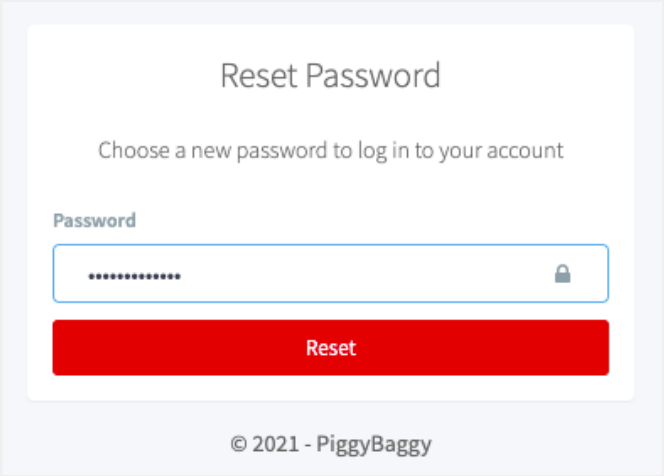


Figure 22: Option to enter a new password

- 5.3 Logout

Logout option acts as termination from an authenticated session and disassociates the Authenticated user role. A successful logout is achieved by provisioning a logout option available in the profile user interface.

Logout is an essential part of the session lifecycle. Reduce the session token limits the likelihood of a successful session hijacking crime. This can be seen as a check versus limiting other crimes like Cross-Site Scripting and Cross-Site Request Forgery. Such charges have relied on a user having an authenticated session present. Not holding a strong session finish only increases the attack cover for any of these attacks.

A safe session ending requires at least the following components:

- Availability of user interface controllers that permit the user to log out manually.
- Session ends after a given amount of time duration without activity (session timeout).
- Proper invalidation of server-side session state.

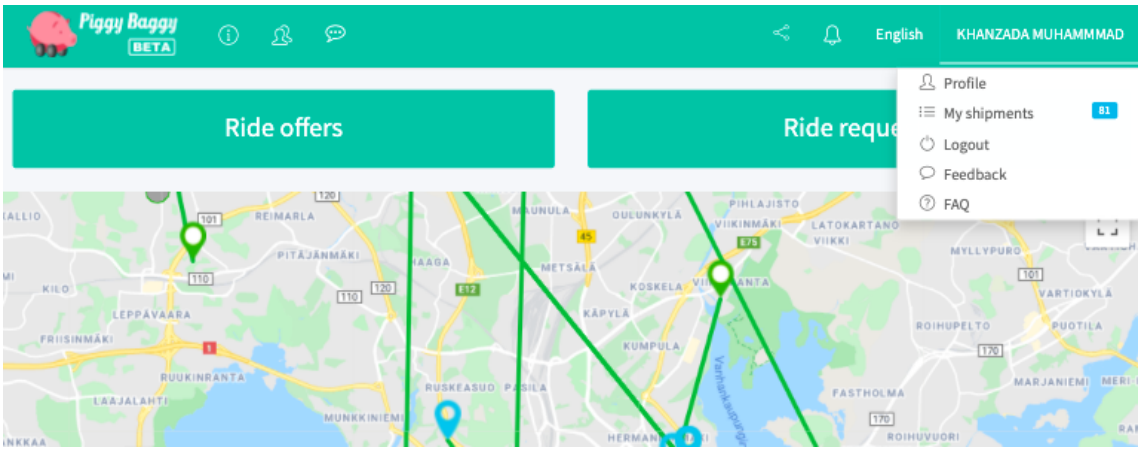


Figure 23: Logout option in the profile dropdown

The logout functionality is a customarily three-session layer.

1. Application layer: The primary and first session is integrated inside the application. The application uses Auth0 to authenticate users; the backend server still needs to track if the users have successfully established themselves into the application. In a regular web application like PiggyBaggy, we will achieve a similar process by storing information inside a cookie.

2. Auth0 Session Layer: Auth0 also holds a user's session, authenticates, and stores the data inside a cookie. When the user is rechanneled to the Auth0, users' credentials will be remembered. To log the user out of Auth0, the Single Sign-on, which sends the command and link validating the user's credentials, the cookie id should be cleared.

3. Third-party integration: This is the last provided login layer (for example, Google or Facebook). The users can opt for this option to directly sign in to the service to bypass the email verification process. The users may be requested to share their credentials information with Auth0. The user can log out from the live session by using the force logout option.

```
var passportLogout = function (req, res, next) {
    req.logout();
    req.session.customer = {};
    req.session.customerId = null;
    return res.status(200).json({
        success: true,
        message: 'Logout successful',
        redirect: '/'
    });
};
```

Figure 24: The logout ends the session and redirects the user to log in

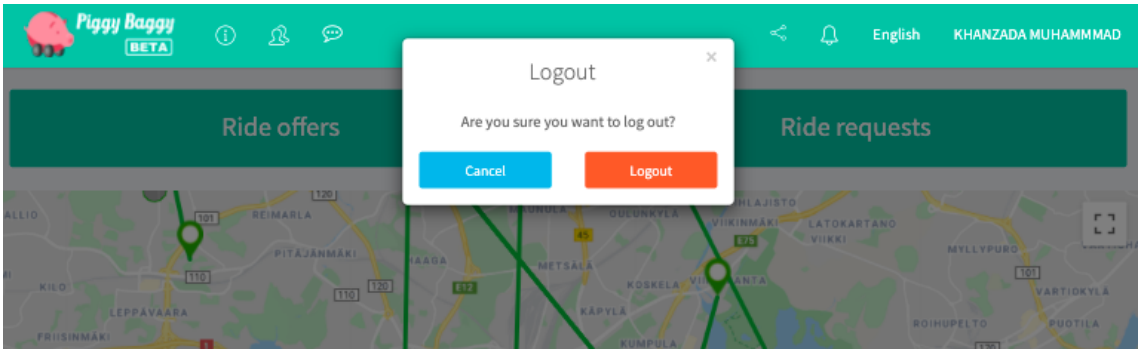


Figure 25: The logout ends the session and redirects the user to log in.

○ 5.4 Map integration

The application stands integrated with Angular Google Maps (AGM), which is easy to use and has many rich functionalities to offer a seamless ride experience. The Google Maps were incorporated into the service using NPM. npm is a package manager for the JavaScript programming language. Google Maps supports ride-sharing, shipping firms, including industries that handle transportation lines to advance driver navigation including performance. Developers can integrate a Google Maps-powered turn-by-turn navigation activity into their platform and recover data about a driver's trip. Operators don't have to shift within applications to take directions or data regarding their following task. Also by programmatic check and insight into drivers' performance, companies can thoroughly designate drivers, lower drivers' idle time, and expect times for customers. Initial users from the ridesharing solution have found it offers notable benefits, including a 4% reduction in drive times and up to a 48% increase in accuracy of ETAs (estimated time of arrival).

We also used google markers which represent different user locations such as home or work. For integrating routes from one point to endpoint, we have used google direction service to fetch the user's location shown in the map. Google Distance Matrix API was also deployed to calculate the distance between two points.

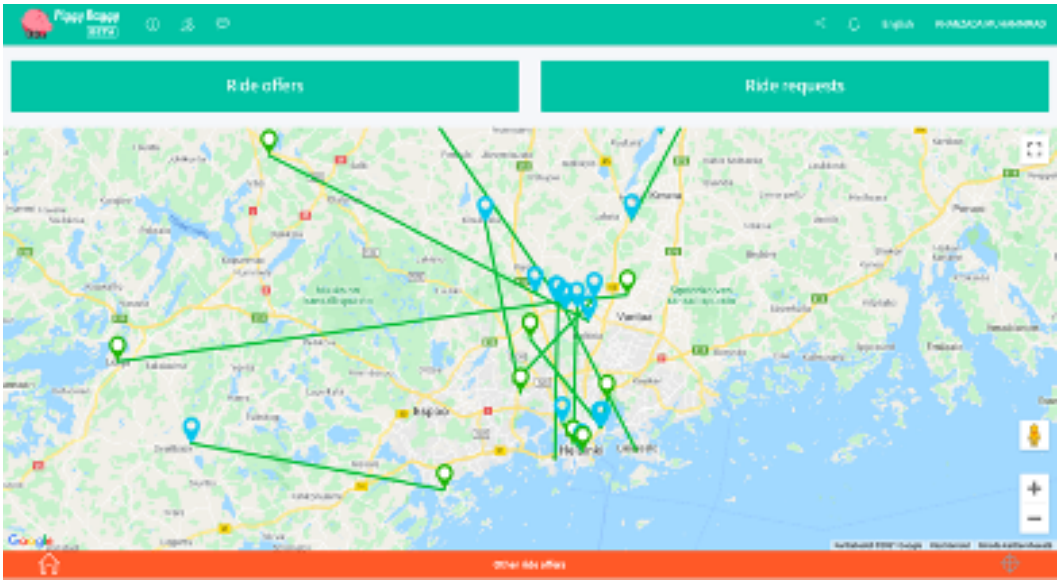


Figure 26: Google Markers shows the location. The blue indicates the start point, and green highlights the endpoint.

○ 5.5 Passenger

The app allows passengers and drivers to switch the role anytime without any restriction.

5.5.1 Ride Request

A Ride request specifies the desired ride of a possible passenger. We need three values to handle a new proposal: The beginning of the request, the address of the request, and the shift time matching with the traveler offering the ride.

Users interested in providing and receiving rides (the same user may be both) shall update the mandatory requirements, including use of work address, weekly work schedule (day, arriving at work, leaving work, and flexibility). For work trips, it would probably be best if the user could request rides for the whole week at one time (the offer already covers the entire workweek). The ride must be requested no later than the night before. The rider will be notified of the new request by notification or e-mail (if the notification cannot be sent) and may accept or reject it. The requester of the ride receives a corresponding acknowledgment. This will allow both parties to prepare for the day's trips well in advance.

There are three defined levels of the ride request process.

1. Map search
2. Address Search
3. Directly contacting a colleague via app

User updates the address. The location is obtained from the Google API using the autocomplete feature. The component library is react-native- google- place autocomplete. This feature is integrated into the service to avoid incorrect addresses filled by the user. The autocomplete service can match the address, which includes place names, addresses, and postal codes. Selecting a pre-listed complete address reduces human error chances.

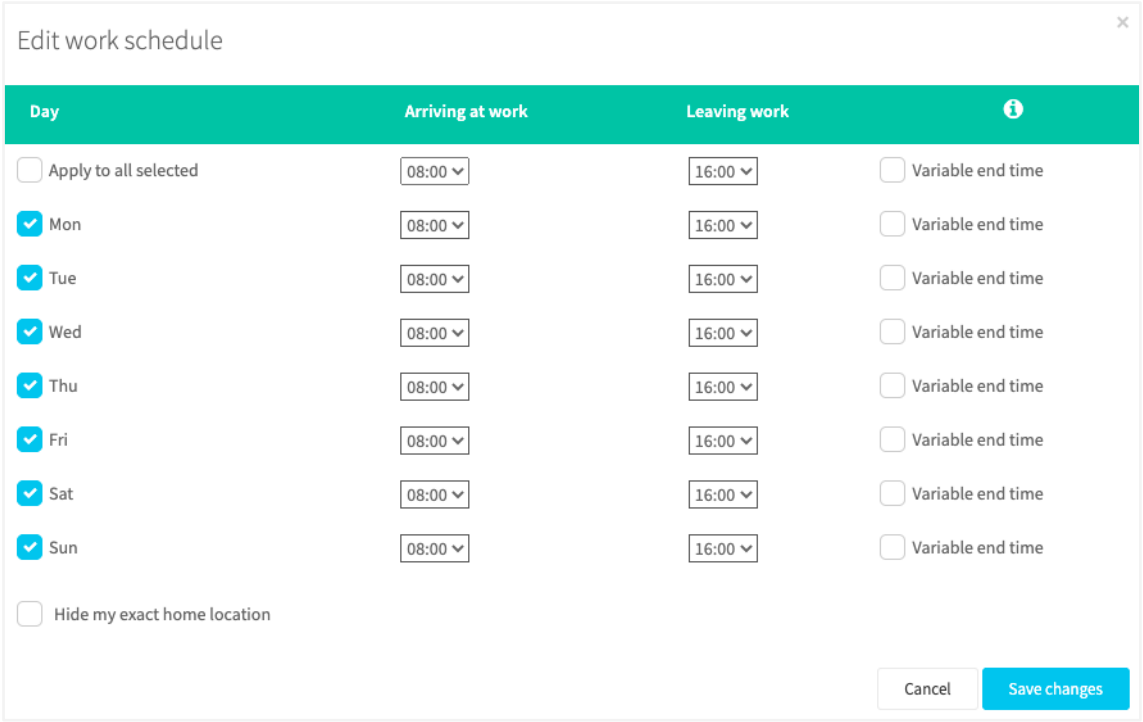


Figure 27: Option to edit work schedule

We simplified the “calendar” with a top row Mon-Sun trip from home to work and the bottom row Mon-Sun trip from work to home in UI. Only those can be selected that the ride offering user has indicated in the settings (e.g. only Mon-Fri) and that match the ride requesting user’s schedule (e.g. only trips to work shown from user A, therefore requesting user must look at the ride offers of user B to get trips back from work to home).

The user can then see on the map or the list of available offer rides by clicking the “Request ride.” The map view assists the user in visualizing the location and redirects the user to the detailed picture, which consists of the ride work schedule.

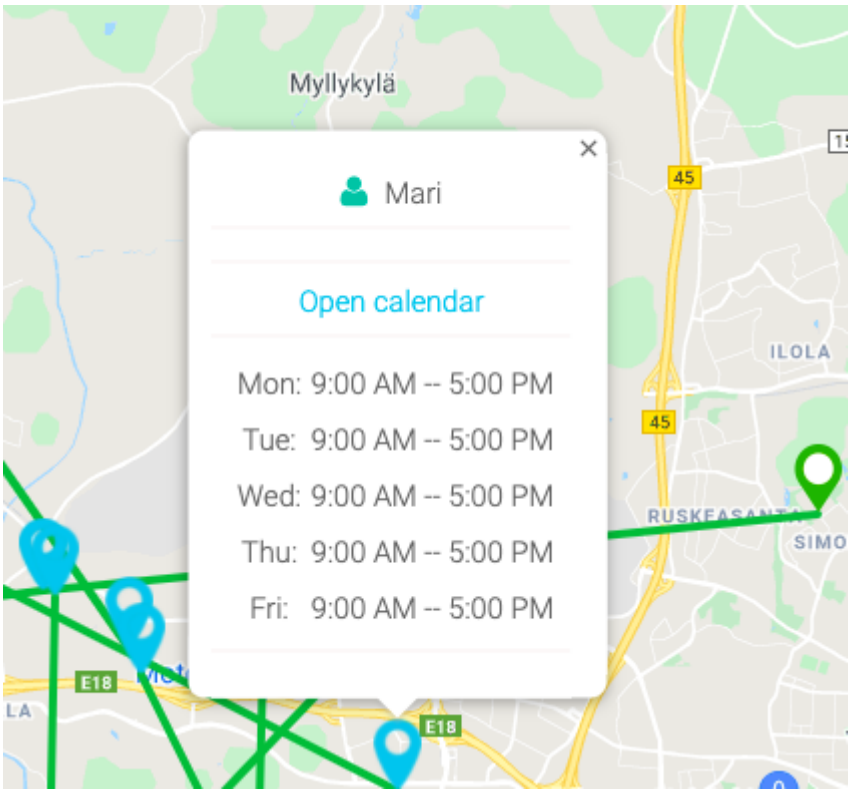


Figure 28: Shows the schedule of the user offering rides

Request ride option redirects the user to the list of available offers generated by Offer ride users. Who is participating in the trial and willing to boost the community and the platform. The details of the route include the pickup address, pick-up time, and the drop-off location. Users can also view a list of all the offers on the details page.

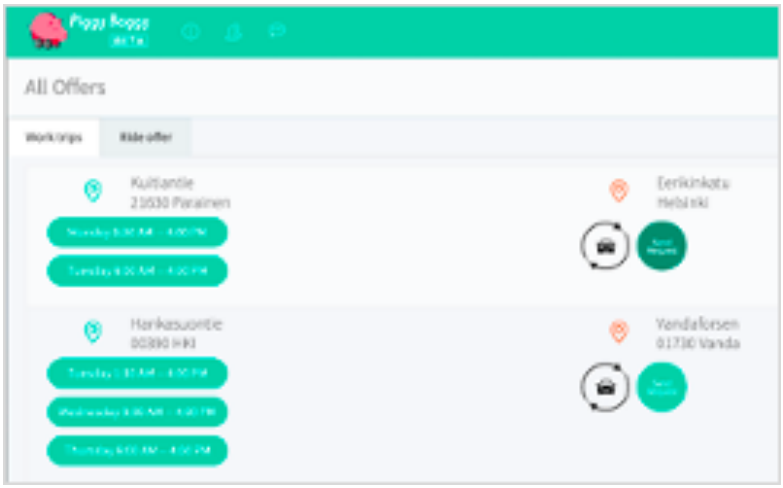


Figure 29: Complete list of Ride offers.

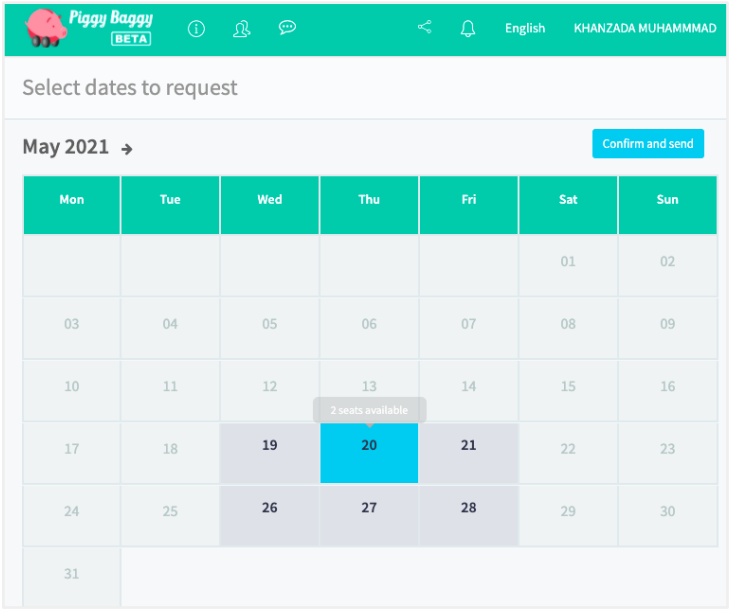


Figure 30: Calendar view to request rides and check availability of seats

Multiple dates selection view.

The ride request confirmation occurs with a pop-up that the request has been sent, and the user redirects to their dashboard, which shows the status of unconfirmed rides along with the ride offer user and the address.

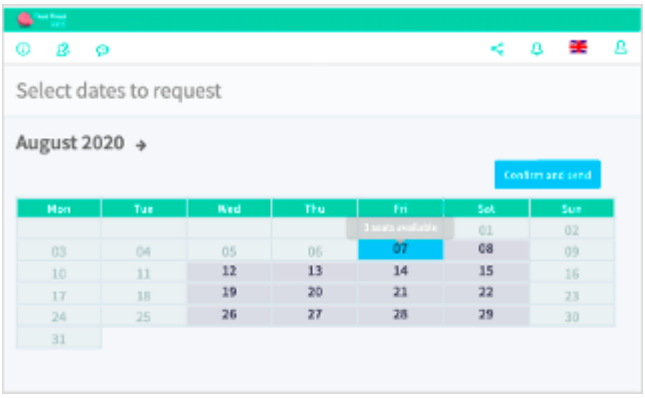


Figure 31: Multiple dates selection in a single request

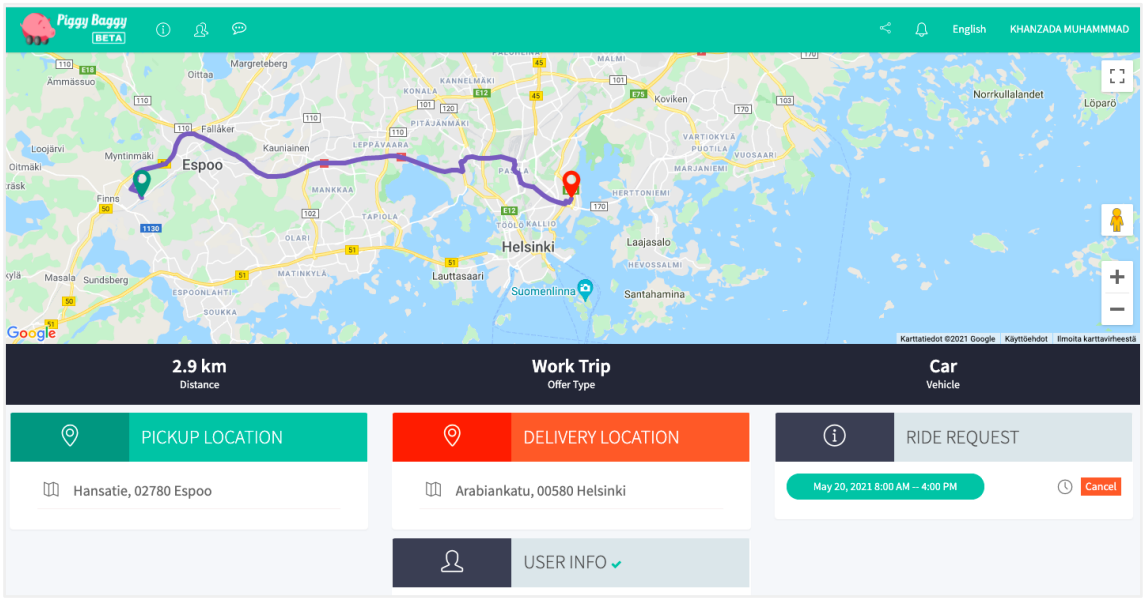


Figure 32: User's dashboard

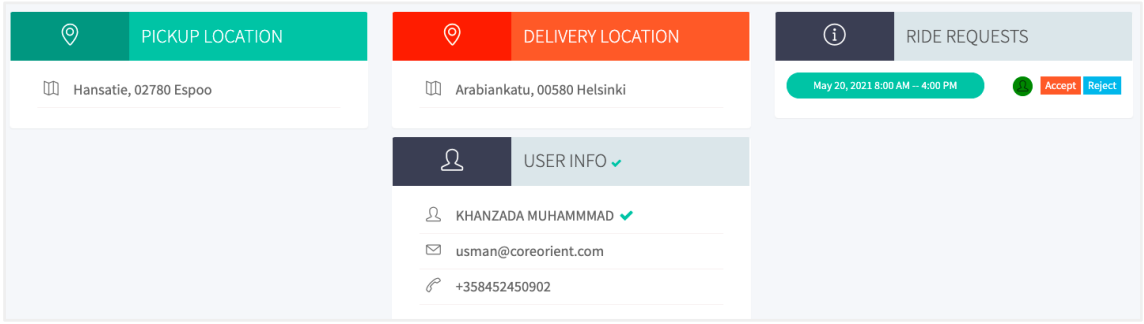


Figure 33: Driver's notification alert message

■ 5.5.2 Offer Ride

The user can opt to offer rides to the members of his group by updating the option from the service settings and updating the work schedule. The edit work schedule allows users to update working days and shift timings. For user convenience, we offered the option “hide my exact home location” option. This option will hide the user’s location and show the endpoint as a 5km radius.

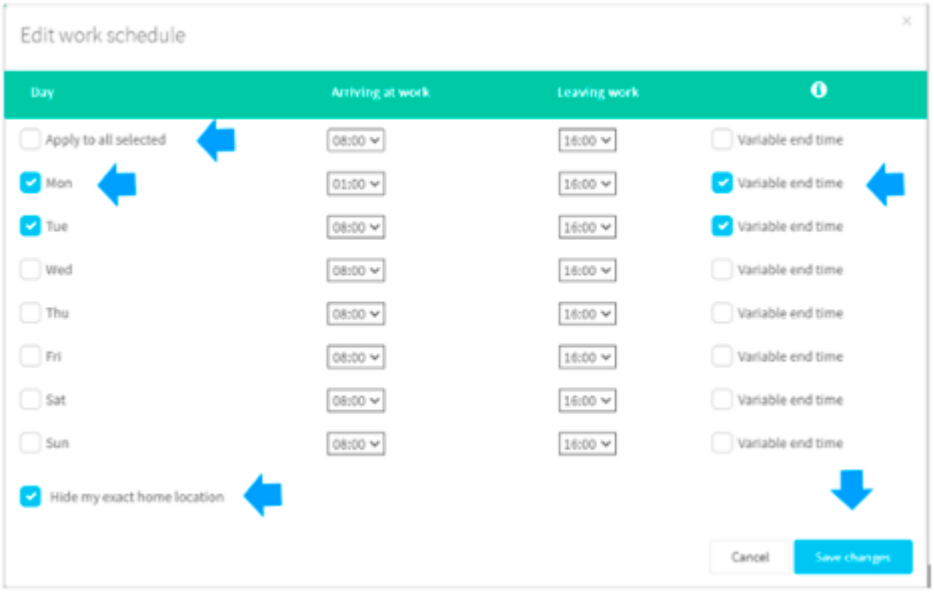


Figure 34: Work schedule along with hiding my location option.

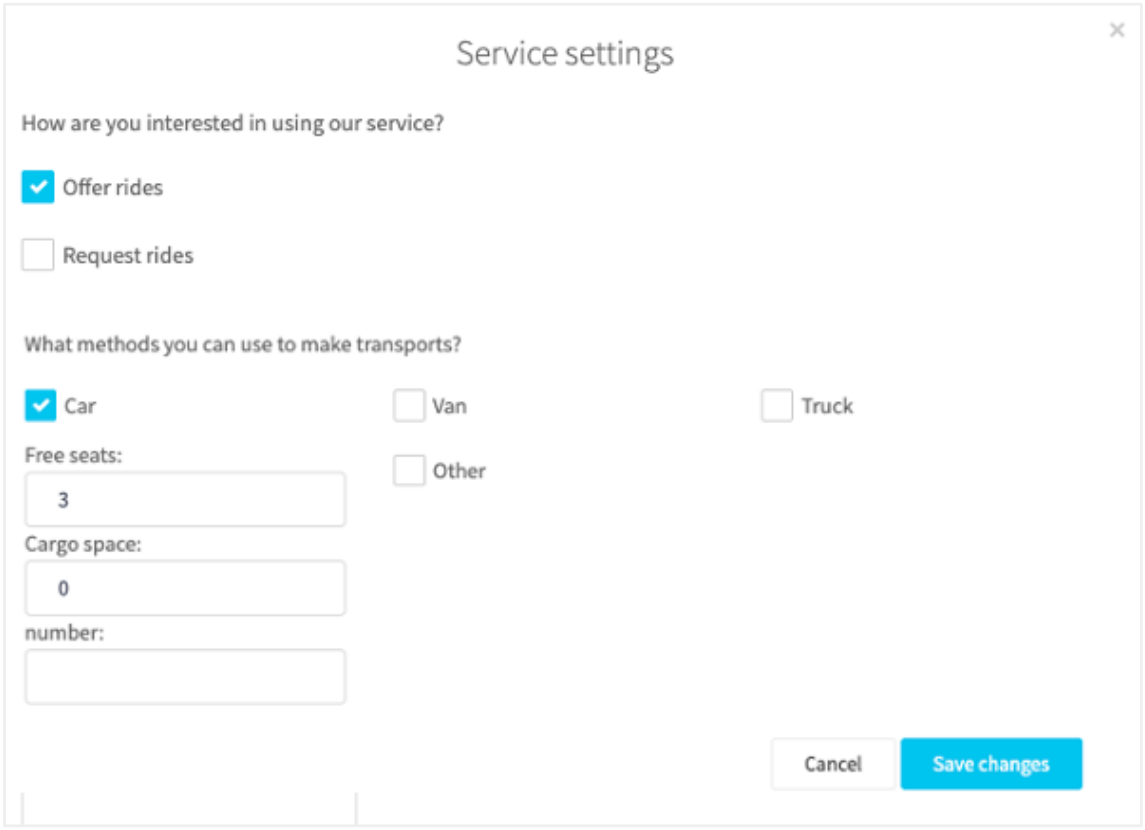


Figure 35: Work schedule along with hiding my location option

5.5.3 User Dashboard.

User dashboard is beneficial in applications for two principal causes. One involves information management, the other knowledge administration.

Users will expect to see information about their current status and any urgent information, warnings, or alerts for most application dashboards.

The dashboard can be viewed by clicking the user's name on the right top followed by "Profile." The Profile redirects the user to a page where the following information is available.

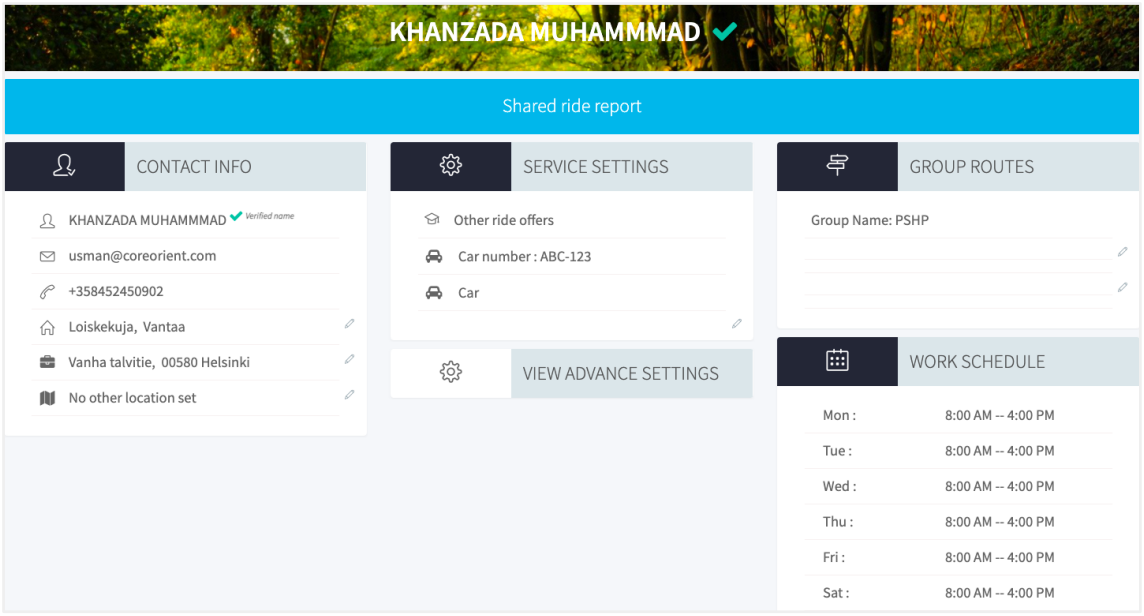


Figure 36: Overview of the dashboard

- 5.5.3.1 Contact Information

A user can edit their name before the bank authentication from this view. Confirmation of the bank authentication enables the user to edit the name any further due to security reasons. Users can change the home address, work address, and secondary address, which is optional.

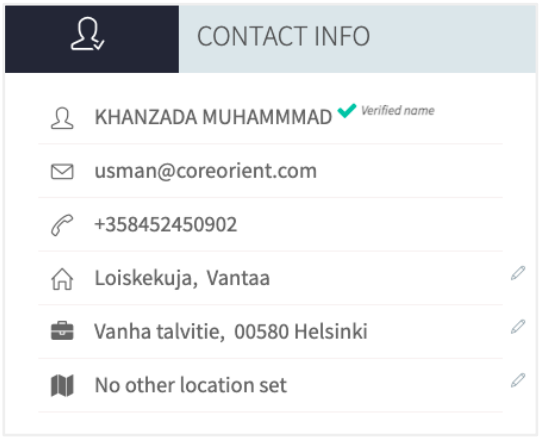


Figure 37: Contact info details in Dashboard

5.5.3.2 Service Settings

The service settings are equipped with the essential options of the web application. The user can modify the request or offer a ride option from this view. In addition, the means of transportation can be changed without any restriction. An optional field of the car registration number is available, shared while offering rides to peers. Moreover, the free seat option can also be modified in the same section.

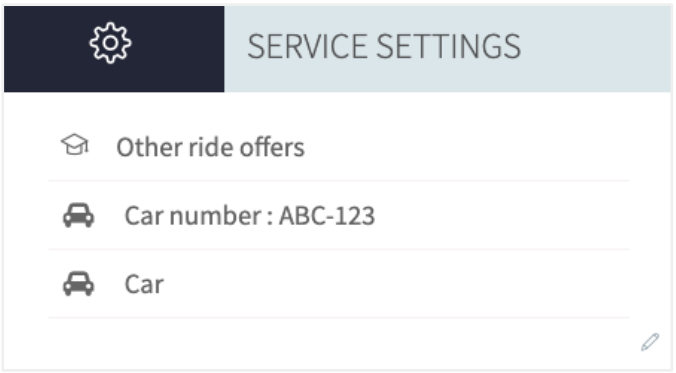


Figure 38: Contact info details in Dashboard

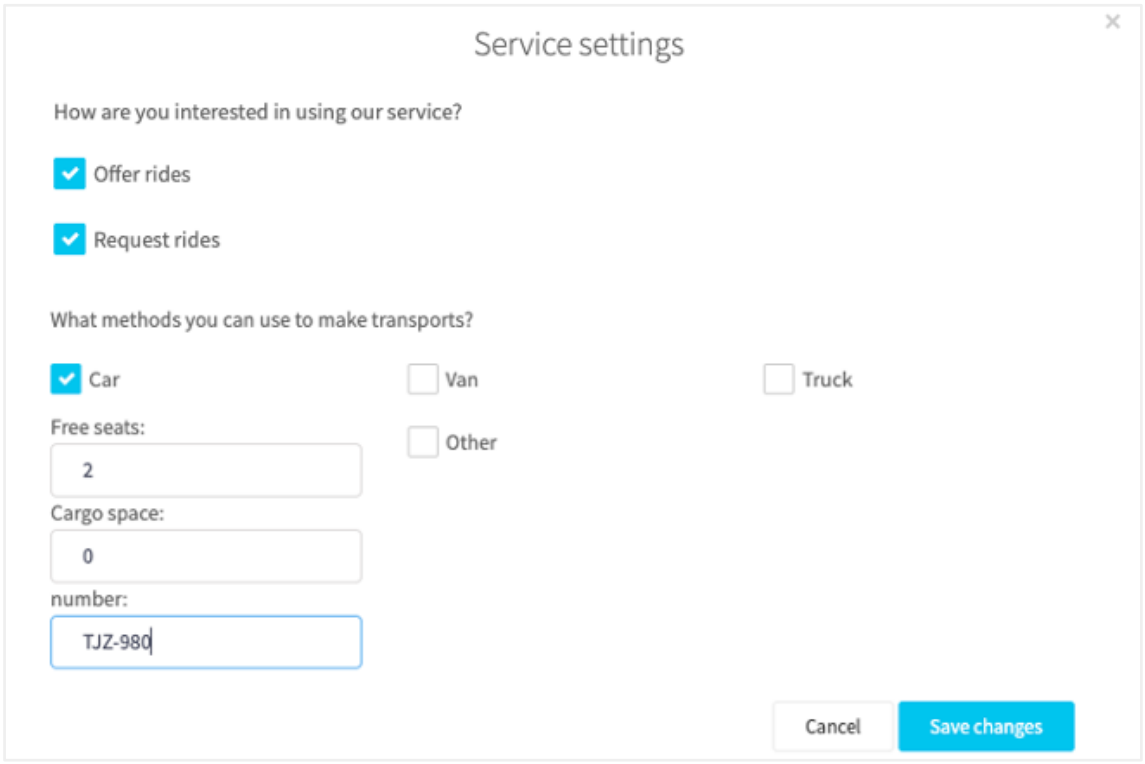


Figure 39: Contact info details in Dashboard

5.5.3.3 Advance settings

Advanced settings include bank authentication. A user must complete the bank authentication process before requesting or offering rides—this feature helps to provide electronic identification for all Finnish customers with one agreement and integration. Also, make binding agreements with, receive applications from or offer access to protected services to customers who have authenticated themselves.

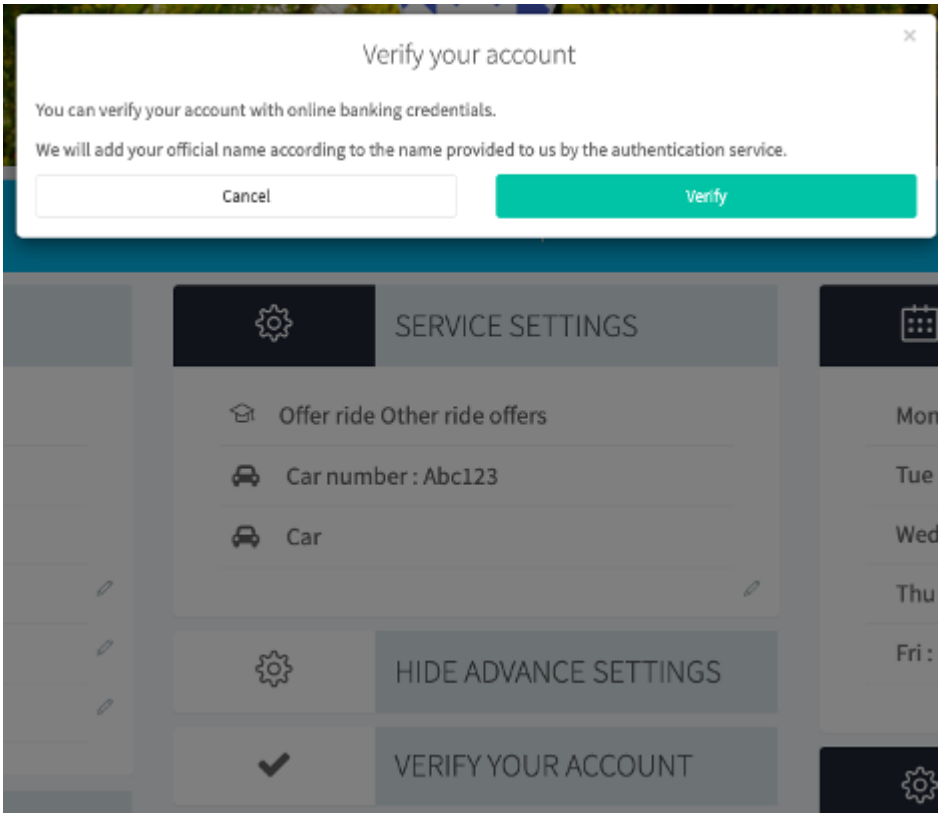


Figure 40: View Advanced settings to complete Bank Authentication

-
-
-
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- 5.5.3.5 Groups

Joined group details are available in this tab. Users can leave the group and join another one from the same field.

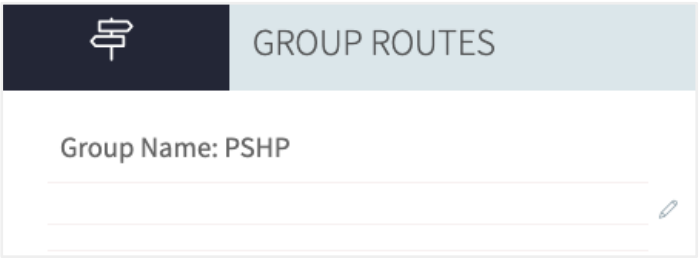


Figure 41: Group routes option

Figure 42: Group user has joined. The leave option will allow the user to opt-out of the group.

5.5.3.6 Work Schedule

The user's work schedule is available in the dashboard to update the work timings based on the user's shift timings. Once the timings are updated, the user's ride offer details are adjusted accordingly.

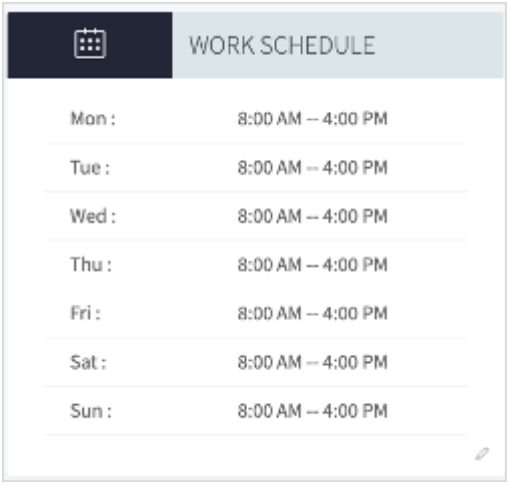


Figure 43: Work schedule details in the dashboard are adjustable as per the user's shift timings

5.5.4 Map Integration

To search for the rides, the Google map platform was integrated on the web application's home page to instantly view the availability of users available to offer or request for a ride. The map displays the transit details of the users along with the ride starting and the ending point. The latitude and longitude coordinates are stored for each address at the time of sign-up. The home and the work address can be changed without any obligation from the profile section.

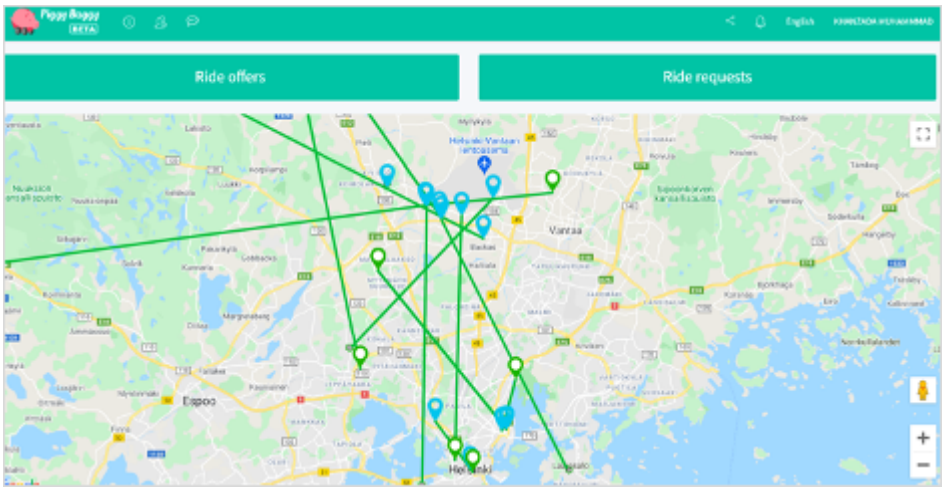


Figure 44: Ride request and offers visible on the map

The Google marker indicates the start and the endpoint of the journey. The green icon symbolizes the ride start point, which is also marked as the user's home address, and the red indicates the destination.

The user can slide through maps to check the details of the route by clicking any part of the route. The selected course changes the color to red, and a pop appears, which shows the details of the ride, the name of the user along the work schedule is visible.

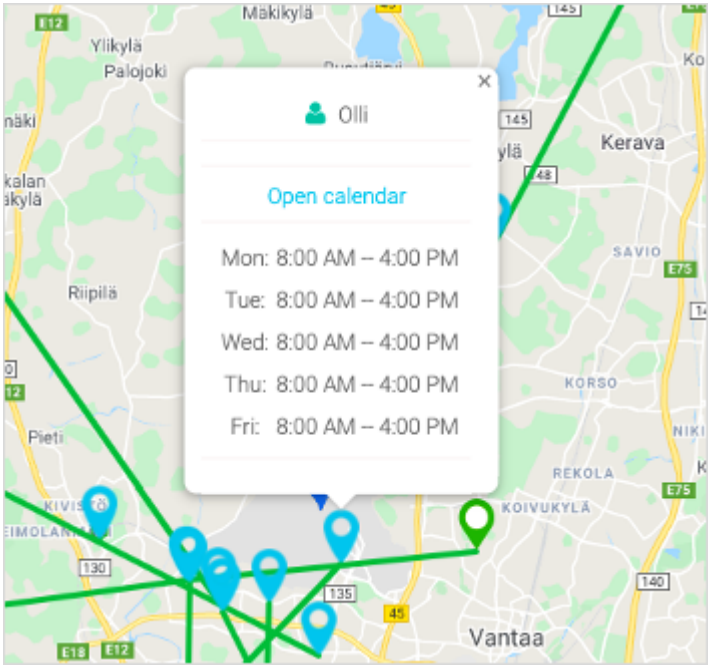


Figure 45: Map view allows users to view the offered or requested trips from Google Map.

5.5.5 Chat Integration

The platform is integrated with the In-app chat feature between the driver and the passenger to smooth the edges. The quality is introduced to preclude the exchange of phone numbers, remove the dependency on SMS, create a new layer of quick and efficient communication, and a better user experience. Also, it is much easier for both parties to connect beforehand and get to know each other, and increase the trust factor.

The chat feature is active when the driver or the offered ride accepts the passenger accepts the ride request. The icon to access the chat is available in the header of the web application and from the received or scheduled rides dashboard. Users select “contact” of the dashboard, click the name of notification to access the chat.

Users connect if needed to inquire about the pickup location, delay in pick up, change the pickup time, request assistance, and discuss road closures, bad weather conditions, etc. The green light indicated that the user is active and available for the chat.

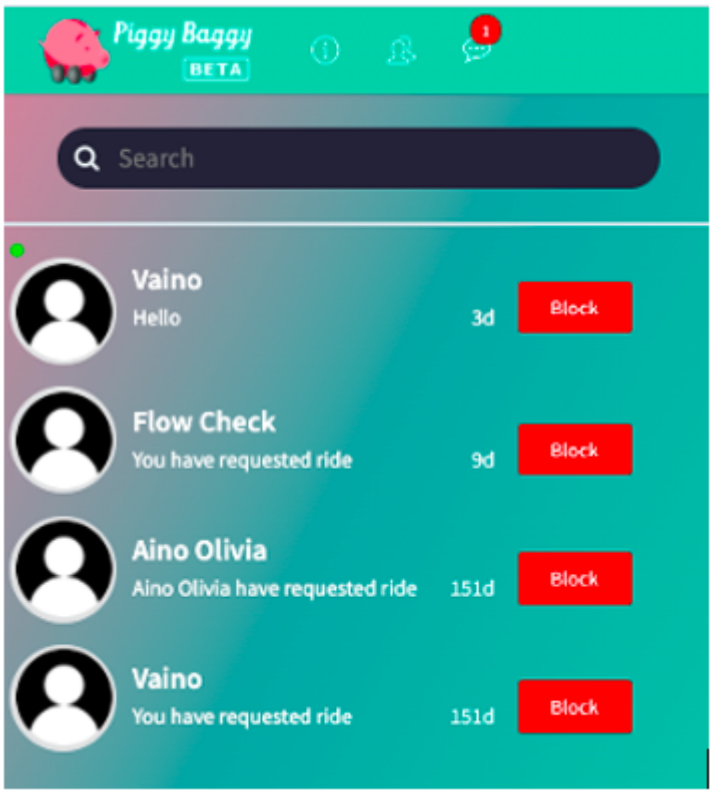


Figure 46: List of a user in chat view

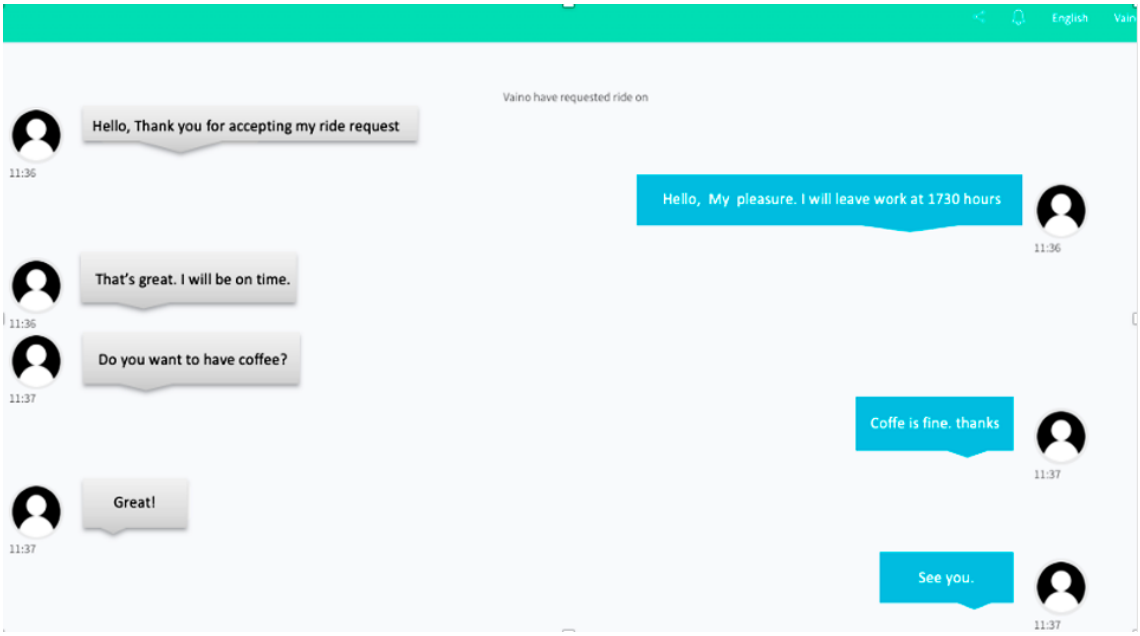


Figure 47: Active chat window

During the trial, the platform is available for the employees of participating companies. However, to keep the application safe, private, and a secure place for users to rideshare. For safety, we have integrated the block feature in the service to stay in control fast and to block anyone who tries to share harmful content, rude behavior, spamming, harassment, or impersonation.

The block option is available In-app to prevent users from contacting you for a ride. However, if the ride is accepted, the users will not block each other until the ride cancels. The block user will not be able to request or offer a ride to the same person.

- **6. Results**

Implementing a notion to a practical application was notably challenging though it was beneficial and comprehensive of experience; the final application turned out to be professional and organized. It included all the essential characteristics to make both the Driver and the Passenger comfortable. After many test runs and bug fixes, the application finally reached a final state with no known bugs.

- 6.1 Application launch

We have achieved and launched a complete functional. Non-functional needs and some additional features were added to make the application more usable. Still, the core idea stayed identical because it offers all the mentioned features and requirements in the project brief. It also respects the optimization demands such as good code and design.

The registration process was simplified, and new features were added to the service: a separate piggybaggy.com/aviapolis URL to register and access the service; Aviapolis user group with logos and descriptions; work address and work schedules for user information; hiding the user's exact home address, and taking into account varying shift hours in the service. The reported commuting routes were displayed on the map so that users could see the contact information of the user corresponding to the route and send him an email to arrange carpools. As a result of this phase, the first version of the ridesharing service was ready.

- 6.2 Registration results

A total of 62 users registered in the service during the two-month trial. Out of which, 15 employees registered to offer rides. The remaining 47 users registered to request rides from their colleagues. Most of the users did not complete their profile by not filling in their complete work schedule, Car registration number, and even the number of seats available.
To overcome this challenge, the project coordinator from each company was given a list of users to contact and request the users to complete the profile details.

- 6.3 Total ride

The total shared rides did not complete the expected results. A total of 15 users registered to offer rides; five did not complete their profile; due to this, their routes and work timings were not available to users interested in requesting a ride. The final count of the total number of completed rides was 18. There were 18 rides taken out of which the two colleagues from the same department and the same shift took 7.

- 6.4 Survey results

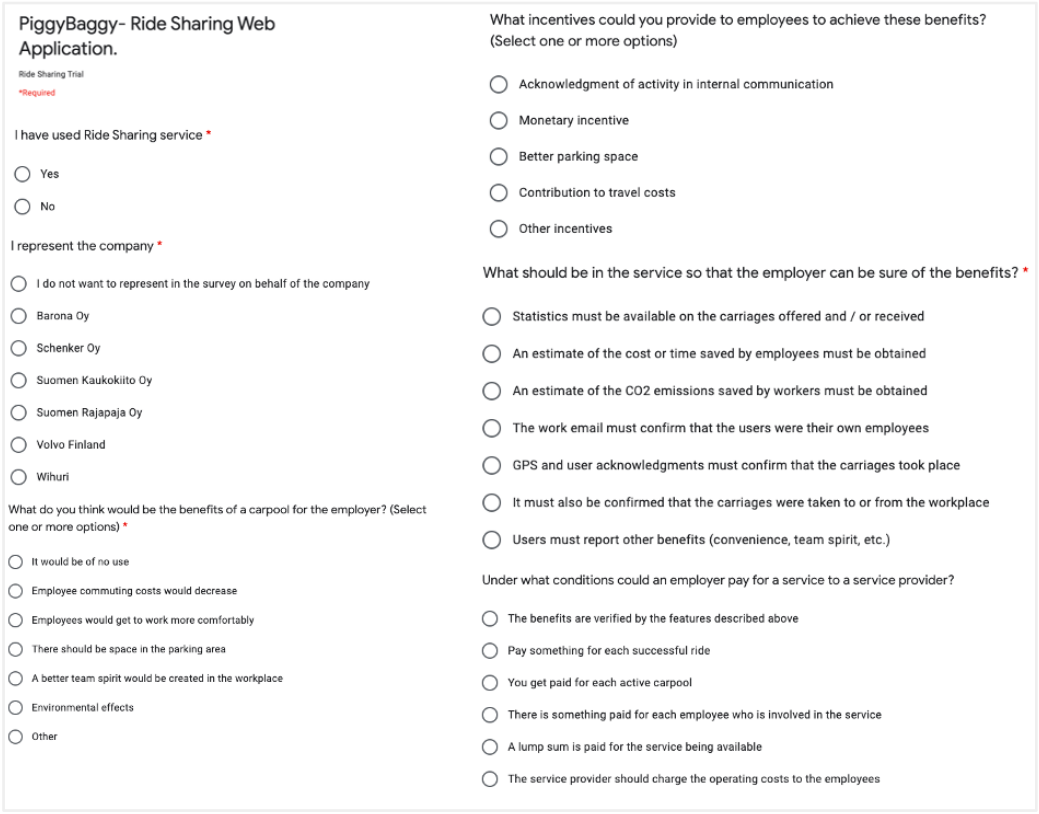
A town hall meeting was held on 15.11.2019 where representatives from six companies were in attendance. The outcomes are based on interviews and an interactive session.

During the town hall, 45 participants filled the survey form.

- Forty-three percent of respondents said they have sometimes used carpools. The exact number of respondents said they have never used carpools.
- The main reason respondents felt that a carpool would make their commute easier was to save on commuting costs.
- Based on the responses to the survey, most shared rides would be used for commuting to work for night shifts. The second most responses from ridesharing should be used to drop employees to the nearest train or metro station for employees who commute to home and have multiple travel connections.
- The majority of respondents thought that the service should be able to reach everyone on the same routes and agree on cost-sharing without significant negotiations. That should be able to easily see if someone else is following the same route if their standard ride fails one day.
- More than half of the respondents wanted to see another user's payment terms for the service quickly (e.g., how much a ride costs per kilometer).
- Half of the respondents wanted the rides to be agreed upon at any time. On the other hand, almost half of the respondents thought that the rides should be decided upon by last night.
- More than half of the respondents thought that the acknowledgment of the ride should be carried out immediately after the end of the ride.
- 45% think that the ridesharing service should be with fees and not free.
- More than half of the respondents believe that offering a carpool to employees would improve the employer's image.

6.4.1 Number of employees/company responding to the survey

The survey questionnaire was given to employees to gauge their views on ride-sharing.



PiggyBaggy- Ride Sharing Web Application.

Ride Sharing Trial

*Required

I have used Ride Sharing service *

- Yes
- No

I represent the company *

- I do not want to represent in the survey on behalf of the company
- Barona Oy
- Schenker Oy
- Suomen Kaukokiito Oy
- Suomen Rajapaja Oy
- Volvo Finland
- Wihuri

What do you think would be the benefits of a carpool for the employer? (Select one or more options) *

- It would be of no use
- Employee commuting costs would decrease
- Employees would get to work more comfortably
- There should be space in the parking area
- A better team spirit would be created in the workplace
- Environmental effects
- Other

What incentives could you provide to employees to achieve these benefits? (Select one or more options)

- Acknowledgment of activity in internal communication
- Monetary incentive
- Better parking space
- Contribution to travel costs
- Other incentives

What should be in the service so that the employer can be sure of the benefits? *

- Statistics must be available on the carriages offered and / or received
- An estimate of the cost or time saved by employees must be obtained
- An estimate of the CO2 emissions saved by workers must be obtained
- The work email must confirm that the users were their own employees
- GPS and user acknowledgments must confirm that the carriages took place
- It must also be confirmed that the carriages were taken to or from the workplace
- Users must report other benefits (convenience, team spirit, etc.)

Under what conditions could an employer pay for a service to a service provider?

- The benefits are verified by the features described above
- Pay something for each successful ride
- You get paid for each active carpool
- There is something paid for each employee who is involved in the service
- A lump sum is paid for the service being available
- The service provider should charge the operating costs to the employees

Figure 48: List of the questionnaire required in the survey

Schenker, Suomen Rajapaja, and Suomen Kaukokki employees were among the top three employers who participated in the survey.

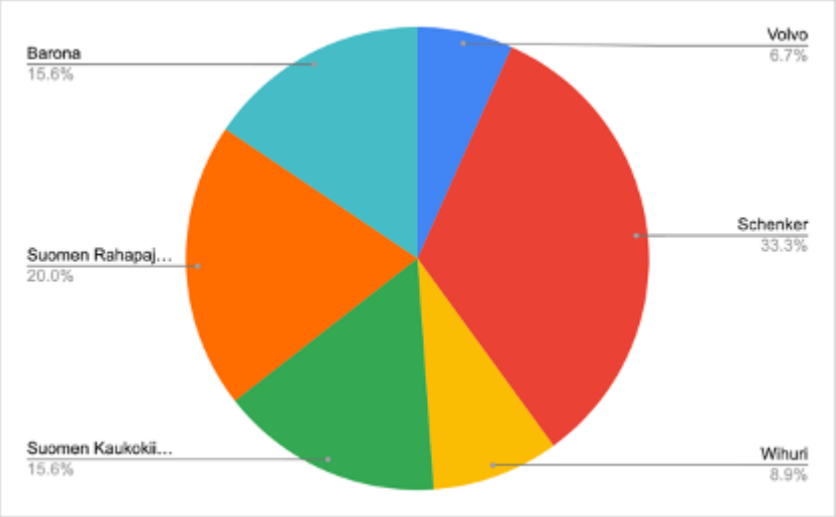


Figure 49: % of participants responded to survey

6.4.2 How could ride-sharing make your commute easier?

- The main reason how carpooling would make commuting easier was to save costs.
- Second, most employees chose the items “Could help others on the commute,” “I would get to work and home faster,” and “a carpool would not make my commutes easier.” Almost the same number of each was selected.
- 38% of Volvo employees think that a ride-sharing would not make commuting more accessible, while only 16% of Schenker's employees next to Volvo do not think that a carriage would make commuting easier.

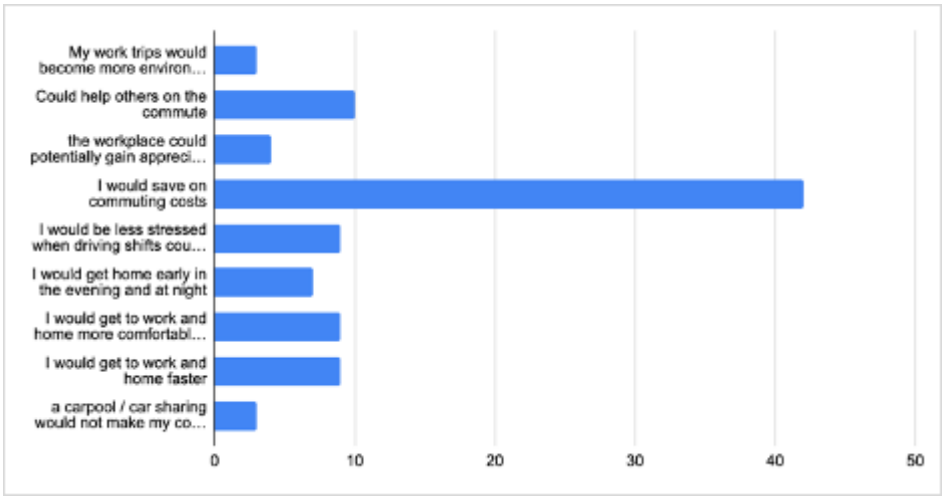


Figure 50: Results to the answer “How could a carpool ride make your commute easier?”

○ 6.5 Conclusions

The purpose of this project was to create a Ride-Sharing web application. The development and the launch of the project were successful, and the stakeholders were able to test the application and use its features without any hassle. However, several elements should have been done creatively in terms of implementation and layout concept, so many different characteristics that an application like this have to have to be helpful and competitive.

The companies involved in the trial requested their employees to use the service over an email, resulting in below expectations and only 62 employees registered. The participating companies must have implemented a thorough marketing and a long-term communication plan to convince employees to register for the service.

The target of 15% of the rides out of registered users was achieved. Out of 62 registered users, 18 rides were completed by the employees. Due to shortcomings and challenges to complete the registration process and application flow, user registration was not achieved.

The application was initially supposed to address so many concerns, but when it actually ran through all the tests and the integration was completed, not all of them were taken into account. We have understood that we learned so many things in terms of concept

design and code integration. Because of that, we modified so many features since we started working on the implementation to make the application more dynamic and user-friendly.

It was also learned that regardless of the many different features of the service, the employees were significantly interested in financial benefits and incentives. The service should have a minimum km cost for all the rides. In addition, incentives may include preferred parking, reduced parking cost, free electric charging stations, employee ridesharing award program, On-site amenities (e.g., convenience mart, dry cleaning, etc.), and Concierge services.

The Final decision was to continue improving the quality of the code and application flow after the trial. The companies participating in the trial will continue to motivate their employees to use the service, but no meetings or town halls will be allowed.

○ 6.6 Reflection and afterword

The thesis topic was selected during the Aviapolis trial as I saw potential and growth opportunities in this platform. However, permission to use the results and project development details in the thesis was granted in the fall of 2020.

We suggested creating Piggybaggy on a Mobile platform due to limited budget, but we had to refactor an outdated code and develop a Web Application. Since I have long experience designing web stores, websites, and applications, my software development team and I decided to challenge. However, it was not late to realize that customer onboarding and communication must be equally vital to have employees participate in the trial. And due to the limitation, we were not able to reach the employees without the company's concern. To compensate, I added additional features and improvements to make the user flow and use of the application comparably easier, which refined the UI.

If the trial had been more extended with a higher budget, I would have launched a mobile application and increased the participation of employees. Even though we did not meet the numbers as mentioned in the objective, I still believe that we rooted the seed of Ride-Sharing and its benefits amount to a large number of employees, which I think will grow timely.

The project was rewarding as I met many intellectual people with a comprehensive vision to boost the Ride-Sharing industry in Finland. I believe the learning curve was enormous, and doing my thesis helped me develop new ideas to enhance the platform with a much better strategy. As I conclude my thesis, I would thank my thesis supervisor, Pia Hellman. She has supported me critically, and without her support and continuous motivation, it would not have been possible.

I have been privileged to experience first-hand how important and inspiring teachers can make a difference. I am grateful to Zinaida Grabovskaia, Head of Master's Programme in Business Informatics, for her confidence and trust during my academic studies.

Finally, I want to express my deepest gratitude to my dear family, who has been patient and extremely flexible in giving me time to complete my thesis.

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Townhall questionnaire

1. I have used Ride Sharing service *

- Yes
- No

2. I represent the company

- I do not want to represent in the survey on behalf of the company
- Barona Oy
- Schenker Oy
- Suomen Kaukokiito Oy
- Suomen Rajapaja Oy
- Volvo Finland
- Wihuri

3. What do you think would be the benefits of a carpool for the employer? (Select one or more options)

- It would be of no use
- Employee commuting costs would decrease
- Employees would get to work more comfortably
- There should be space in the parking area
- A better team spirit would be created in the workplace
- Environmental effects
- Other

4. What incentives could you provide to employees to achieve these benefits? (Select one or more options)

- Acknowledgment of activity in internal communication
- Monetary incentive
- Better parking space
- Contribution to travel costs
- Other incentives

5. What should be in the service so that the employer can be sure of the benefits?

- Statistics must be available on the carriages offered and/or received
- An estimate of the cost or time saved by employees must be obtained
- An estimate of the CO2 emissions saved by workers must be obtained
- The work email must confirm that the users were their own employees
- GPS and user acknowledgments must confirm that the carriages took place
- It must also be confirmed that the carriages were taken to or from the workplace
- Users must report other benefits (convenience, team spirit, etc.)

6. Under what conditions could an employer pay for a service to a service provider?

- The benefits are verified by the features described above
- Pay something for each successful ride
- You get paid for each active carpool
- There is something paid for each employee who is involved in the service
- A lump sum is paid for the service is available
- The service provider should charge the operating costs to the employees

7. I can offer rides

- To home
- Nearest Train station
- Nearest Bus station
- Nearest Metro Station

8. When the ride should be agreed

- One week before
- The night before the ride
- Immediately as per the request

9. The ride should be free

- Yes
- Small fixed cost
- Cost as per Km/h