Sharing the Ride: A Case Study of E-Scooter Services in Reykjavík, Iceland

Michael Alicea, Jonathan Blecherman, Blake Bruell, Christian Poulin

An Interactive Qualifying Project Report
submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfilment of the requirements for the
degree of Bachelor of Science

Date
13 October 2023

Project Center
Reykjavík, Iceland

Report Submitted To:
Dean Mimi Sheller (Sponsor)
Professor Herman Servatius and Professor Brigitte Servatius (Advisors)
Worcester Polytechnic Institute

Abstract

This paper presents a case study on e-scooter rental services in Reykjavík, Iceland, focusing on usage patterns, urban landscape, and safety concerns. The techniques of surveys, interviews, observation, and archival research were used, and revealed diverse e-scooter usage by residents and tourists, with an overall positive reception. Factors like gender, age, and weather are explored. Safety concerns identified include low helmet use and speeding near pedestrians. The study also discusses government regulations and successful approaches in Reykjavík. An online resource summarizes the findings and provides data visualizations, offering valuable insights for researchers and stakeholders interested in micro-mobility in similar locations.

Executive Summary

Over the past 5 years, the world has seen the emergence and proliferation of e-scooter rental services, which provide a great addition to many cities' mobility options. Reykjavík, Iceland, is no exception, with e-scooters being introduced in 2019 by both Hopp and Zolo, supplementing their public transportation system, and providing an entertaining option for the many tourists who visit every year. The rapid rise in e-scooter use in the past 5 years, though, has led to a lack of understanding of people's actual experiences and usage of e-scooters. Our team's goal was to perform a case study on e-scooter rental services in Reykjavík and produce an online resource that illustrates our findings for researchers studying micro mobility in cities, and groups looking to introduce or improve e-scooters rental services in locations which share characteristics with Reykjavík. To tackle this task, our team broke up this goal into more tractable objectives, which are as follows:

1. Discern the geographical and temporal usage patterns and use cases of e-scooters in Reykjavík.
2. Discover current issues with e-scooter services from the perspective of locals, tourists, the government, and e-scooter companies.
3. Create an informational online resource describing our findings during the case study.

Methods and Deliverables

Our team achieved these three objectives by carefully executing three methods: observations, expert interviews, and surveys. The backbone of our project was four specific zones in the Reykjavík area:

- Tun (Commercial/Business)
- Midborg (Shopping/Restaurants/Cultural)
- Leiti (Residential/Primary and Secondary Education)
- University (Academic Buildings/Housing)

Our first method, observations, allowed our team to build an understanding of the e-scooter usage in our designated zones. The method consisted of highly structured observation in which a specified path was walked in each zone many times, yielding quantitative data on the utilization of e-scooters and comparative bike usage, directly addressing *Objective 1*. Fallen scooters, helmet usage and recklessness were recorded as well, addressing *Objective 2*.

Interviews were used to gather a more professional view from companies discerning their corporate views and any information or data they could provide to our team, providing information pertaining to *Objective 2*. Our team received the opportunity to interview the CEO at Zolo, giving our team a direct account of the corporate perspective and their challenges. The company also provided some usage data, providing context for the data our team gathered ourselves.

Surveys were used to gather opinions surrounding e-scooters and people's individual experiences with e-scooters from tourists and locals using qualitative and quantitative questions. Our team ensured there was diversity across the key demographics of age, gender, residency, and user vs. non-user. The surveys were distributed using QR codes that individuals could scan, as well as delivered in the form of quick in-person interviews. The interviews were recorded using the exact same form as the QR code by one member of our team while the other engaged with the interviewee. These surveys helped address *Objective 1* and *Objective 2* providing data on the demographics of e-scooter users, issues for riders and non-riders, and the reasons people rent e-scooters.

Throughout the process of conducting observations, our team first recorded our data in note form and later distributed it in an excel work sheet. This proved to be inefficient and hard to keep variables controlled, so the ISS Tools application was created. This tool provided our team with a dependable, consistent, easily accessible platform to record and view data.

Our team also developed an application called ISS Tools, which provided functionality for collecting observations, viewing, and analyzing observational data, and marking the locations of QR codes.

Data and Findings

Our team identified three key categories with which to analyze and interpret the data: usage, urban e-scooter landscape, and safety.

1. Usage of e-scooters, including demographics of users, comparisons between travelers and residents, e-scooter services vs other micro-mobility options, reasons for usage, as well as conditions in which e-scooters were used.
2. The urban e-scooter landscape, in which the characteristics of Reykjavík relevant to e-scooters are identified and evaluated on their impact on e-scooter services in the city.
3. Safety, containing data on helmet usage, instances of recklessness, the government's stance on safety, and issues identified by non-riders and riders alike.

Usage

Studying e-scooter usage in Reykjavík, out of 54 survey responses 59% of respondents had said they have ridden e-scooters in the city. Notably, residents accounted for 55% of the responses, and 70% of residents had rented e-scooters before, compared to 46% of travelers. This supports the claim that e-scooters are not just a tourist novelty but a commonly used mobility form of transport for all.

Age was inversely related to e-scooter usage, with older respondents expressing safety concerns, particularly regarding balance. Gender distribution showed 59% male participants, 27% female, and "Not listed," "non-binary," or "prefer not to say" were individually under 5%. The majority of riders, recorded at 53%, had taken 21+ e-scooter rides, emphasizing their frequent use, driven primarily by “being late/in a hurry” at 56% and “for fun” at 44%.

Weather is seen to have little impact on Reykjavikians, with 84% responding that they had ridden in "cold" and "windy" conditions, and seasonal data indicated "rare" usage in winter, "frequent" usage in spring and summer, and "occasional" usage in fall. Overall, e-scooters in Reykjavík seem to cater to a diverse user base, extending beyond tourists, with varying usage patterns influenced by age and little impact from weather conditions.

Urban E-Scooter Landscape

Comments from Zolo’s CEO, Adam Helgason, highlighted the idea of designated parking areas called “drop-off zones” and their pros/cons. Further data from the interview revealed that e-scooters cover an average trip length of 4.9 kilometers and see 2.1 daily trips per e-scooter, with hotspots mainly in downtown Reykjavík. Seasonal trends showed lower usage in winter, mitigated by more adapted e-scooter models for Icelandic winters, winds, and roads.

Safety concerns regarding the landscape emerged as some e-scooters were knocked over in different districts, as poor road conditions being reported, affecting user experiences. Obstructed pathways were a significant percentage of respondent's reports, either from bad parking or wind blowing them over. The Government provides clear directions as to park in a manner that does not impede the movement of other road users (S&U). Some areas of concern include parking in the middle of pavements, footpaths, ramps, houses, or pedestrian crossings (S&U).

Provided by the Icelandic Government, the *Service Agreement Contract* summarizes at section *4.2.3* that an average of 2 rides per e-scooter per day for 3 months, as well as an average of 0.5 rides per day for any 1 month period is minimum for all companies. Furthermore, there are specific "drop off zones" for e-scooters which less clutter in areas but not required for that takes utilization away. The city of Reykjavík has also implemented the Green Deal which is an agenda focused towards improving the city's environment, economy, and society. One of their stances is to put more pedestrians on the road in eco-driven ways like bikes, e-scooters, and public transportation (GD). Pertaining to the environment, both e-scooter companies here make maximum efforts to retrieve lost e-scooters, even from unusual places. They do this through using user-provided pictures when users take pictures at the end of their ride, hooks and ropes when in water, and sound signals to locate if not seen nearby.

Safety

Regarding safety, observations revealed a startlingly low use of helmet use among e-scooter riders, with just 10 of 467 riders from our data seen wearing helmets on a Hopp or Zolo e-scooter. Reckless behaviors were also noted during observations, particularly the very common occurrence of two and even three riders on a single e-scooter, which violates the rule of no passengers (S&U).

To address parking concerns, both Zolo and Hopp implemented a feature in their apps that requires users to take a picture of their parked e-scooter after their ride. As stated by the Icelandic government, a rider needs to keep in mind pedestrians do not expect a fast scooter flying from behind them. A bell must be used in advance and to slow down when passing (S&U) as well as the use of turn signals on e-scooters for better communication. Another solution to road user safety is in the Governments Traffic Act, Article 46 stating that if a bike lane is parallel to a footpath, you may only drive on that bike path (TA).

When analyzing issues faced while riding e-scooters in Reykjavík, our data highlighted significant concerns. With the highest issues both being “battery depletion without warning” and encountered issues related to “poor or dangerous road conditions” being at 38%, other issues included e-scooter breakdowns or sudden stops, accidents, and various "other" scenarios.

Additionally, issues while users were not riding an e-scooter were recorded. The main issue, affecting 41% of respondents was “e-scooters left on walkways”. “Reckless behavior near pedestrians” 33% and “not following traffic laws” 22% were also prevalent issues, with 15% of respondents elaborating on these concerns.

Deliverable

To address *Objective 3* our team created a portable document containing the key themes and findings of our report in a website format. This online resource discusses the common e-scooter issues seen in general and then how Reykjavík successfully approaches most of them. Data illustrations are provided within this section as well to give additional information and support our findings. For the issues Reykjavík could not solve, or have yet to solve, are in the following section, explaining what they are in some reasoning behind them.

Acknowledgements

Our team would like to extend our sincere thanks to those who made this project possible:

Dean Mimi Sheller for sponsoring our project and providing invaluable guidance throughout.

Worcester Polytechnic Institute for providing our team the opportunity to work on this project.

Dr. Sarah Strauss for providing feedback, advice, and assistance during the early stages of the project.

Dr. Herman Servatius and **Dr. Brigitte Servatius** for providing guidance throughout the duration of our project.

Table of Contents

List of Tables

List of Figures

1 Background

Electric scooters have become an increasingly popular mode of transportation in many urban areas around the world, and Reykjavík, the capital of Iceland, is no exception. Electric scooters provide a cheap, convenient, and eco-friendly way to navigate a city's busy streets, especially for tourists who may not be familiar with the local public transportation system. However, as with any new technology, electric scooters have also raised concerns among citizens and policymakers regarding safety, clutter, and the use of public space.

Reykjavík has some unique features which make it a very interesting case study for e-scooter services. The use of electric scooters in Reykjavík began in 2019 (Andie, 2019) and was quickly embraced by tourists and locals alike. Unlike mopeds, which require operators to have a driver's license and adhere to traffic laws, electric scooters are not subject to the same rules and regulations. In Reykjavík e-scooters are legally considered bikes (*Umferðarlög*, 2019), and therefore follow the same traffic laws as bikes, allowing for easy adoption and use by the general public.

1.1 E-Scooters: Where Did They Come From?

The history of e-scooters begins much longer ago than one might expect, with Autopeds. Autopeds are the foundation of the electric scooters seen and used today, designed and built in 1915 in New York (*The Scooter*, 2023). The scooters were intended for use in short distance travel, among professions such as postmen, police, and as entrainment for the wealthy. Interestingly, independent women were also one of the main demographics targeted by these new inventions, acting as a symbol for women's newfound increased mobility and freedom (TAUR, 2020).

> "Just like the bicycle before it, the advent of the motorized scooter promoted a level of freedom and mobility for women that gave the messaging 'Look out for the Autoped girl,' more heft. […] Amelia Earhart, the famous aviatrix, appeared in multiple photographs with the Autoped around California, even after it stopped being manufactured around 1921" (Mansky, 2023)

In the 1930s they saw an increase in use around military bases, airports, urban areas, and movie sets (*The Scooter, 2023)*. Uses also included shopping, physicians answering calls, traveling to school, salesmen selling trade, merchandise delivery and many more (Mansky, 2023). Throughout all this time, though, Autopeds remained a fairly obscure invention, never seeing widespread adoption.

While scooters were beginning to gain popularity in the early 1900s, the lawmakers were also beginning to react to the quickly changing landscape of roads. In 1901, Connecticut became the first state to create traffic laws for motor vehicles, and New York followed up with drunk driving laws a decade later (Mansky, 2023). These laws set the precedent for public safety in transportation which has been carried over to scooters. As the Great Depression came and went, so did popularity for scooters, as the laws kept getting stricter and tighter, and it was harder to keep the scooters up and running (TAUR, 2020; Mansky, 2023). It was not until 1974 that motorized scooters began to be sold again, when the Go-Ped, a low-cost, fast, low-profile gas-powered scooter was patented and produced (*The Scooter, 2023)*. The early 1990's saw a large increase in the popularity of scooters when the infamous "Razor" scooters were released, bringing scooters back into the public mind with their easy-to-use lightweight kick-scooters. Lithium-ion batteries, also invented in the early 1990s, were a key discovery which alongside Razor gave rise to the eco-friendly e-scooters everyone is familiar with today (TAUR, 2020). The final innovation was e-scooter sharing services, which were piloted in 2017 by the companies Bird and Lime. These dockless, rentable e-scooters transformed electric scooters from a niche transportation option into something present on a large scale in many cities nowadays.

1.2 Dockless E-Scooters: Catching Up to the Boom

Nowadays, scooters have become an integral part of many cities' transportation options. For example, people can book trips where their navigation path will connect bus routes with electric scooter options to get to a specific location (Zubenko, 2022). Studies conducted in Paris and New Zealand revealed the main motivations for e-scooter use include time savings, leisure activities or fun, and saving money (Christoforou, 2021; Fitt & Curl, 2019). In Reykjavík, Iceland, Hopp is the most prevalent electric scooter company. The main cause of Hopp's popularity was that e-scooters allowed people to skip traffic. As popularity and use rose, minor laws/restrictions were put in place, such as fines for scootering under the influence. Restrictions and bans have become much stricter to ensure safety, creating tension between companies, regulators, and the public (Fontaine, 2019).

With the increased use of electric scooters, cities are seeing the need to look at their infrastructure to see if it is adequate. According to David Carrignon, "surface cracks, potholes or any type of irregularity are an issue when it deflects the front wheel sideways, usually leading to the rider falling. For example, some block pavement patterns tend to steer the front wheel" (Carrignon, 2021, p166). Cities want to avoid accidents for obvious reasons, but e-scooter accidents also greatly affect the perception of electric scooters and the safety of a city, creating a secondary consideration for legislators and city planners. Fortunately, most municipalities have integrated electric scooters into their mobility infrastructure. In Reykjavík, electric scooters are treated with similar rules to bikes, and companies work directly with the government to ensure that the e-scooters are best serving the city.

An example of infrastructure which e-scooters work well with is public transportation systems, such as buses and trains, where electric scooters make a great solution for getting to and from stops. Matteo Ignaccolo et al., found that in Palermo, Italy, "electric scooters are generally used to perform short-distance trips in a brief time. For this reason, they are a good candidate to become an alternative to private car, especially for the first/last mile connection" (Ignaccolo et al., 2022, p. 449). Last-leg connections are a defining feature of public transportation, and electric scooters fit that role quite well. Despite this, Ignaccolo pointed out a handful of reasons why there was not a large adoption of e-scooter services in Palermo. Limited coverage made it hard for people to use e-scooters for a last-leg journey to use. Many of the public transportation spots do not have easy access to rental scooters, again making it harder for e-scooters to be used for last mile transportation. Finally, only one of the five companies had dedicated parking for their scooters, which Ignaccolo argued is necessary for e-scooters in a city.

It is clear then, that when introducing an e-scooter service to a city, it is important to consider how to best integrate and merge the new capabilities they offer with other services. A study by Li et al. (2022) presents many ways to increase use while supporting both the city and the companies, such as the need for dedicated parking spaces. Li et al notes that it is important to design "appropriate parking areas for e-scooters to avoid the circumstances that users park e-scooters in remote and sparsely populated places" (Li et al, 2022, p. 16). In this circumstance, the study mentions that parking spaces would be useful for the users because they won't have to search long for a scooter, and useful for business because the scooter will therefore see more use. The study also mentions the importance of considering the number of e-scooters, as although it may seem as simple as more scooters being better, there are many factors that determine the number what number works best for a city (Li et al, 2022, p. 16). If there are too many scooters in one area, it will lead to wasted resources. If there are too few scooters, then individuals looking for scooters are likely to have to walk further, and search longer, decreasing usage.

Understanding *why* e-scooters are used and adapting them for those uses is also important for increasing their use. In a 2019 study conducted in New Zealand, the top uses for electric scooters were for fun, at around 58%, going to work, at around 55% and going to a downtown area at around 60% (Fitt & Curl, 2019). Scooters encourage more people to take more trips as well. 52% of participants reported they would have walked without access to a scooter, 6% would have used a human powered vehicle such as a bike, but 11% would have not gone on the trip at all. Rental scooters have shown great potential to be a replacement for walking, and a great choice for trips that are just for fun, and even encourages people to travel more, but e-scooters also carry significant risks, which must be addressed as to not negatively influence their perception and therefore use.

1.3 Safety: Not All Sunshine and Roses

There are some obvious safety concerns of e-scooters, chiefly their high speed and maneuverability. A review by Kim & Campbell (2021) of traumatic injury patterns due to e-scooters in the U.S. revealed that because crashes on e-scooters are a “high-energy mechanism” the resulting injuries resulting from crashes can be quite severe. These injuries range from head and neck injuries (58% of patients), fractures in the extremities (over half of patients), severe head trauma (10%), and even spinal injuries (rare). It is important to note that the high rates of head injuries are in large part due to low helmet use by users of shared e-scooters, around 61%, which is significantly below the average for common micro-mobility options, which is around 90% (Harworth et al., 2021). It is also interesting to note that the average helmet use in private owners of micro-mobility devices was around 97%, and for shared micro-mobility users was around 70%. This massive discrepancy reflects on systematic issues surrounding people's understanding of scooter laws and regulations, as well as the higher risk that rental services carry in comparison to personal ownership.

In terms of accident patterns and statistics, the demographic involved in e-scooter accidents follow some trends, with all reviewed studies finding a higher rate of injuries with male riders, people in the ages of 18-30, and people who are intoxicated (Tian et al., 2022; Pétursdóttir et al., 2021; Blomberg et al., 2019). Blomberg et al. (2019) found that 86.6% of injuries on electric scooters were simply due to falling off, reflecting the fact that e-scooters carry much of their risk in their very nature as fast and maneuverable micro-mobility devices.

Infrastructure is also an important consideration. An analysis of the riding habits of e-scooter users revealed that 66% of riders perceived protected bike lanes to be the most preferred (safest) surface, sidewalks coming in second with around 17% of people saying they preferred them (Tian et al., 2022). Interestingly people who more often used sidewalks were over 30% less likely to have accidents, but this is not the only consideration. Injuries are not isolated to just the users of the e-scooters, though, as many injuries were also a result of pedestrians being struck by scooters.

Looking into the regulations of e-scooters regarding safety reveals that many places do not have clear rules. For example, Harworth et al. (2021) noted that in Australia 40 percent of e-scooters ride within 1 meter of at least one pedestrian, posing a potential safety risk to both e-scooter riders and pedestrians. In general, e-scooters are allowed operate in whatever traffic regime they desire (sidewalk, road, bike-lane), which becomes especially problematic with e-scooter services as individuals renting are likely to be less experienced, and less likely to be wearing safety equipment. The authors noted that dockless-systems also pose a risk to road users in general with the random and unpredictable distribution of scooters that results from such systems. Possible regulatory solutions include requiring e-scooter users to use specified road infrastructure, mandate helmet use, and the requirement of a driver license with punishments for intoxicated operation.

1.4 Iceland: How Do E-Scooters Fit In?

Iceland is a top choice for tourists with its unique landscapes and natural wonders. Iceland's economy is heavily reliant on tourism, which makes up nearly 40% of their total economy (Iceland's Economy & Society, 2021). The tourism industry therefor plays a significant role in the country's regulations and economic growth and is an important consideration for our project and e-scooters in Iceland.

With the rise of e-scooters as a mode of transportation gaining attention in recent years, their impact on urban environments and public perception is still a topic of discussion. A study conducted by James (2019) explored the issue of blocked sidewalks due to improperly parked dockless e-scooters, finding that more than half of the respondents (55%) reported encountering sidewalks blocked by dockless e-scooters "always" or "often," compared to only (18%) for dockless e-bikes. This suggests that e-scooters may pose challenges in terms of proper parking and obstructing pedestrian pathways.

Perception of e-scooters vary depending on familiarity with the mode of transportation. James' Sustainability study showed that non-users of e-scooters had significantly more negative perceptions about their impact compared to users who have ridden e-scooters. This could be attributed to the familiarity of e-scooters in certain areas, such as downtown areas, city centers, and university areas, where ridership is concentrated, as reported in a study published by Kimpton (2022). Weather also plays a role in e-scooter usage patterns. Kimpton (2022) found that e-scooter ridership tends to peak in the afternoon and dip at night. Additionally, rain is negatively associated with choosing e-scooters, with (31.8%) of trips taking place in rainy conditions compared to (68.2%) in dry conditions. This suggests that weather conditions, such as temperature and rain, could have an impact on e-scooter usage patterns.

Iceland has its own share of issues with e-scooter safety. Pétursdóttir et al. (2021) found that emergency room patients reporting with injuries from electric scooter use in Reykjavík, Iceland matched the demographics of electric scooter accidents found more generally. This includes issues with lack of helmet use and reports that high speed and loss of control were the primary causes of injury. It is our team's responsibility to understand how injuries on electric scooters can be mitigated and codify how they impact people's perception and opinions on them. If e-scooter safety were taken more into consideration, their perception as reckless devices operating at high speed and used with low care could very well be impacted for the better.

2 Methodology

2.1 Project Goal and Objectives: What, Why, and How

Our team's goal was to perform a case study on e-scooter rental services in Reykjavík and produce an online resource that illustrates our findings for researchers studying micro mobility in cities, and groups looking to introduce or improve e-scooters rental services in locations which share characteristics with Reykjavík. To tackle this task, our team broke up this goal into more tractable objectives, which are as follows:

1. Discern the geographical and temporal usage patterns and use cases of e-scooters in Reykjavík.
2. Discover current issues with e-scooter services from the perspective of locals, tourists, the government, and e-scooter companies.
3. Create an informational online resource describing our findings during the case study.

In the current literature, there is a range of information regarding the sustainability, utility, and safety considerations of e-scooters services, including some data from Reykjavík. Despite this, it is hard to find sources exploring the issues and successes of e-scooter services in particular cities in a comprehensive manner. This was our team’s motivation for performing a case study on e-scooters in Reykjavík.

Our team achieved the objectives using four research techniques. Observational research provided insights into where and when e-scooters are used, addressing *Objective 1*, as well as information about helmet use and recklessness, addressing *Objective 2*. Surveys gave an understanding of the perspectives of both residents and tourists, and yielded demographic data, statistics regarding why and in what conditions scooters were used, and statistics regarding the most prevalent e-scooter issues, addressing *Objective 1 and 2*. Expert interviews provided our team with a direct understanding of the perspectives and challenges of e-scooter companies, addressing *Objectives 2 and 3*. Archival research into public opinion, such as from newspapers, magazines, and government websites, augmented our primary sources of data, and provided historical context, addressing *Objective 2 and 3*. An online resource was developed to directly fulfill *Objective 3*, containing the insights and findings gathered during the project.

2.2 Observations

In observational research, a researcher(s) systematically observes participants in their natural setting, noting characteristics of events, occurrences, and persons (Jibril, 2018, p. 232). Our team performed uncontrolled, structured, complete observation. This entails observation which was carried out in a natural environment and as per a predefined set of rules, and in which each team member's status as a researcher remained unknown (Jibril, 2018, p. 236-38). Unlike in some cases of ethnographic research, there was little risk posed to participants as our team only conducted observations in public areas where informed consent was not required. Our team observed and recorded events organized by time and "zone," including the number of e-scooters parked, being driven, users wearing helmets, as well as geotagged comments about notable events (Appendix C). As the observation was highly structured, bias was not a large issue. This method produced quantitative data addressing *Objective 1*, and qualitative data, in the form of comments, addressing *Objective* 2. After our team gathered data, statistics were extracted, and potential issues were discerned. Observation was a helpful method of data collection as there were no heavy resources or planning involved, the data was low in subjectivity, and it provided our team with usage data addressing *Objective 1* not otherwise accessible via interviews and surveys.

2.2.1 Zones: Distinct Urban Settings

Our team was not able to observe all of Reykjavík in a structured and repeatable manner, and so our team decided to create a set of "zones" within the city. This reduced the potential diversity and range of our dataset but increased statistical significance of the data, as averaging of multiple samples could be performed, and allowed for valuable comparisons between zones. E-scooter hotspots were identified by downloading the Zolo and Hopp apps (the two e-scooter companies in Reykjavík) and analyzing the publicly available data about the live location of all parked scooters to find areas of high e-scooter density. Five zones of interest were identified and then mapped using Google Earth, and preliminary scouting was done in each region. One zone was particularly difficult for our team to

Figure 1: Four observations zones, with the walked path shown in yellow.

conduct observation in, and was removed, leaving four zones. The scouting revealed that each zone had distinct characteristics, and four urban zones were identified:

- Tun (Commercial/Business)
- Midborg (Shopping/Restaurants/Cultural)
- Leiti (Residential/Primary and Secondary Education)
- University (Academic Buildings/Housing)

The use of zones allowed the geographical aspect of *Objective 1* to be directly addressed using the observation data.

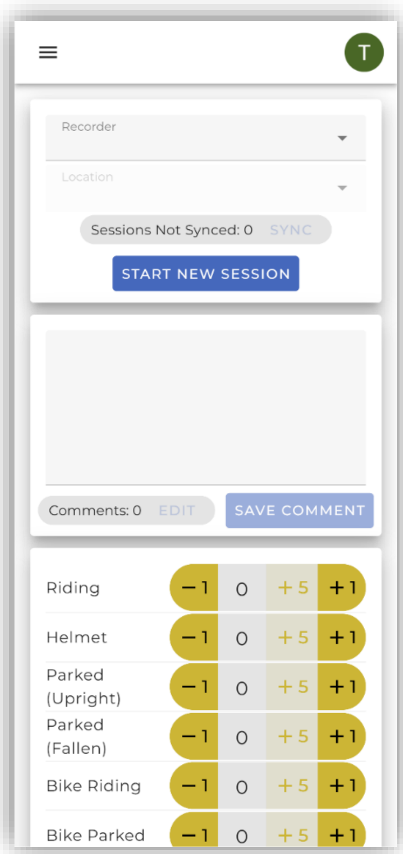


Figure 2: ISS Tools Observation Page

2.2.2 ISS Tools: Observation Tool

Initially when collecting observational data our team used a note taking tool on a smartphone and transferred the data to a spreadsheet manually. This proved to be inefficient, difficult, and hard to manage with multiple members and as the number of observations scaled. To address these difficulties our team developed an observational tool (Appendix E). This collection tool streamlined the process of data collection allowing our team to collect a more robust set of data. The application recorded counts for each numeric data point, start time and duration, geographical zone, name of our team member who performed data entry, and a list of comments for each session. Each comment was recorded with a timestamp and geotag.

2.3 Expert Interviews

The interview methodology consists of interviewers posing an interviewee a series of questions meant to elicit responses regarding a particular subject matter. There is an emphasis placed on gaining insight into the interviewee's thought process regarding the subject matter over direct answers to the original questions ("Interviews", 2022). Our interviews were concerned with the use, perceptions, attitudes, regulations, business, and technologies surrounding e-scooters, and included questions which dug into individual perspectives on e-scooters as well as company views (Appendix A). The interviews were obtained by contacting experts, either via email or in person. Data was captured in the form of a recorded transcript or handwritten notes. Expert interviews gave valuable insight into *Objectives 1 and 2* and provided information and quotes for *Objective 3*.

The interviews also provided our team with in-depth perspectives and provided a chance for the discovery of new information and ideas which had not previously been considered. There is no “right” answer in an interview (Evans and Jones, 2011). Instead, interviewees are free to take the line of questioning in any direction they like, which informed our team about what aspects of e-scooters people consider the most important. The results of the interviews informed the content of our surveys and the focus of our observations, allowing our team to adapt them to better reflect the aspects of e-scooters most relevant to Reykjavíkians.

Our team secured one expert interview with the CEO of Zolo, and one employee from each e-scooter company. The interview gave our team insight into the corporate perspective on e-scooters, and yielded data about e-scooter use directly from the company.

2.4 Surveys

According to Ponto (2015), survey research can be defined as the collection of information from a sample of individuals through their responses to a series of questions. The surveys allowed our team to reach a large sample of the population quickly and gave qualitative and quantitative data on individuals’ perspectives on e-scooter services in Reykjavík. The surveys were accessed

Figure 4: QR Code on parking station downtown.

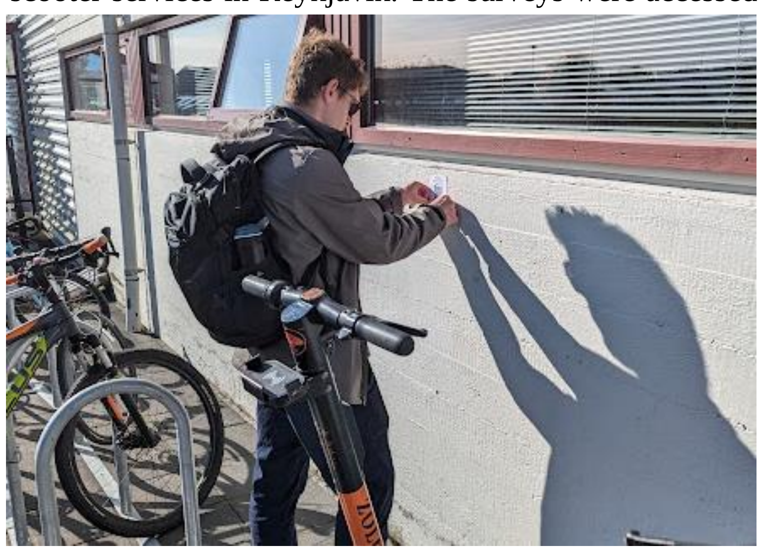


Figure 3: Group member placing QR code in university e-scooter drop off zone.

by QR codes (Figure 15) that individuals could scan, or as later described, delivered in a quick, in-person conversation with one or two team members. The surveys addressed *Objective 1* by revealing overall trends in the demographics and uses of e-scooter services (Appendix B) They also directly provided statics relating to *Objective 2*, chiefly regarding the most common issues that residents and travelers have with riding e-scooters, and with e-scooters more generally. our team taped the QR codes up throughout the observational path in each of the four zones in locations our team believed would attract the most attention as seen in Figure 3 and Figure 4. Figure 16 shows a map of the all the locations in which QR codes were placed.

Our surveys were a voluntary process and thus produced data that only pertained to those willing to participate, leading to a potentially biased data set towards those with strong opinions. Our team also came across two issues which prevented the survey's effectiveness. The first issue was that some QR codes were taken down or had fallen off, and our team had to replace them throughout the project. Finally issue three was that the surveys only gave an average of one to two responses a day. Noticing these difficulties, our team was inspired by another IQP group from one of the advisor meetings to perform survey interviews.

2.4.1 Survey Interviews

During an interview survey one team member carried out a conversation with the same abstract goals as discussed in the expert interview section (2.3), in addition ensuring at some point that each survey question was asked word for word. Another team member recorded the answers directly into the form and wrote down anything that didn't fit into the predefined questions into the comment box on the survey. A note was included in the form which indicated that the survey was conducted as an interview. This method allowed for more surveys to be conducted and provided many unique and individual perspectives. The survey interviews were conducted throughout the city, and were given to people casually standing around, sitting, or not in a hurry. When logistically possible, our team implemented a walking-style interview, which has been shown to lead to responses deeply impacted by the environment in which the interview was conducted (Evans and Jones, 2011).

Survey interviews provided many survey responses efficiently and effectively. People riding e-scooters turned out to be a hard demographic to target, as our team could not simply stop someone who was renting a scooter, as individuals riding e-scooter are most likely in a hurry or late, and they would continue to be charged by the minute while being stopped. To avoid being turned away, our team introduced ourselves as “University students doing a case on e-scooters here in Reykjavík,” which also helped avoid confusion and break the ice with the interviewee(s).

2.4.2 ISS Tools: QR Code Mapping

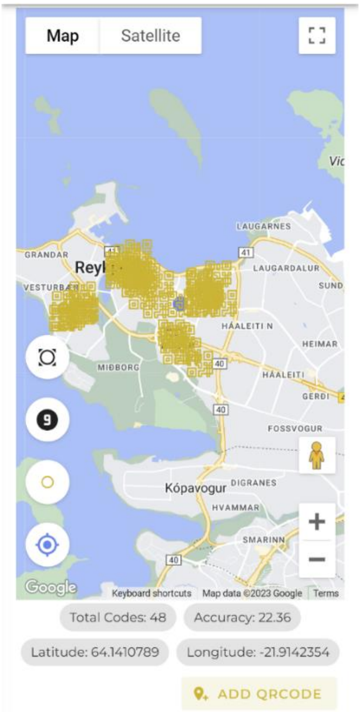


Figure 5: ISS Tools QR code map

During the process of putting up the QR codes, it became apparent that keeping track of where each QR code was placed would be helpful for multiple reasons: first to ensure our team could remove them come the end of the project, second to ensure our team knew how many QR Codes were up, and which fell down or were removed, and finally to allow our team to get an idea of the overall distribution of the codes throughout the project. To address this issue, a new feature was added the ISS Tools app, which allowed a team member to place a pin on a map when putting up a QR code. This QR code feature also allowed for visualization of our QR codes in each of the four zones and allowed our team to keep track of the codes easily and accurately.

2.5 Archival Research

Our team conducted archival research to gather information from the public scope relating to e-scooters, by looking at current and past information from government sites, blogs, newspapers, and magazines. These sources provided our team with an extra source of information to augment the limited time our team had to enact the previously discussed methods, as well as provided context for the results of our other methods. The research also allowed our team to compare our findings in Reykjavík with the historical trends, which was crucial to contextualizing our research. Finally, archival research provided an auxiliary understanding of how people in Iceland think about e-scooters originating from the population itself, uninfluenced by our teams' methods or position as foreigners.

Our team directly queried the government for documents pertaining to e-scooters, and received four documents pertaining to regulations, rules, contracts, and motivations for using e-scooters. Some resources were in English, but others had to be translated, and Google translate was used for websites as well as for PDFs in Icelandic. For some resources, such as Gallup.is, a surveying company in Iceland, translation was not an option as the documents themselves were not searchable or discoverable in English, but some statistics were indirectly gathered from articles in English which cited Gallup.is.

2.6 ISS Tools: Implementation Details

ISS Tools was developed and deployed by our team during the third week of the project as a response to the issues in our methodologies. The application was developed using Vite build tools, Vue.js web framework, and the Vuetify component framework, all free and open-source tools under the permissive MIT license. The code is publicly hosted on GitHub (link) under an MIT license and was deployed using Continuous Deployment to Firebase, a web hosting service. The licensing allows any users to copy, modify, or otherwise use the code for commercial or non-commercial purposes, as is with no warranty. The Firebase Blaze (pay as you go) tier was used, which incurred a total of cost $0.00, as none of the usage limits made it even to 1%. Firebase provided hosting and automatic builds for the web interface, authentication using secure third-party login via OAuth, and a real-time synchronized database solution with daily backups.

2.7 Deliverable: Online Resource

A rough framework of our team's deliverable was developed during the third week of the project using Wix, an online website creation tool, as it was easy to build a skeleton of the first iterations and ideas. Wix, however, did not allow the online resource to portable or hosted externally, and a new set of technologies was adopted, specifically HTML5 with Tailwind CSS, a utility-first CSS framework. These tools were used to further develop the online resource to address *Objective 3*. Eventually the Svelte framework was adopted on top of html and Tailwind CSS, which allowed code de-duplication and a more robust development environment, eventually leading to the current deliverable (Appendix F).

2.8 Ethical and Research Considerations

One crucial consideration for this project was the cultural separation between our team and the location being studied. The findings of our methods could have been influenced by our bias or perceptions as outsiders. Murphy pointed out that for outsiders conducting research, “the stories they heard were most likely different from the stories those communities told among themselves. Meaningful, useful, illuminating, but different” (Murphy, 2020, p. 43).

The main ethical issues of concern for this project are privacy, interference, and voluntary participation. For our surveys and interviews the solution to those concerns were confidentiality and informed consent. Our team will store and use data in a way that ensures confidentiality and anonymity whenever possible. Informed consent ensures that the interviewee is a willing participant in the interview. Informed consent was important for our expert interviews, but not during the surveys, as surveys have a do not have a significant possible impact on participants and were often conducted in a setting in which there was no secondary party. For expert interviews a consent script was read to the participant (Appendix A). Observations were exclusively conducted in non-private places and did not involve any disruption of the participants' normal activities, and thus informed consent was not needed (Jibril, 2018, p. 233). This project will go through the WPI IRB process, which entails a review process ensuring that this project adheres to standard ethical guidelines for social science research projects.

3 Data and Findings: Reykjavík's Success

Throughout the length of the project one point rang clear: e-scooters services are a valuable asset to Reykjavík. Overall people enjoy their presence and utilize them consistently for a variety of purposes, and importantly Reykjavík has done well to address many common e-scooter issues. That does not mean that potential issues were not identified, and those issues will be discussed in this section. The findings are split into three sections:

1. Usage of e-scooters, including demographics of users, comparisons between travelers and residents, e-scooter services vs other micro-mobility options, reasons for usage, as well as conditions in which e-scooters were used.
2. The urban e-scooter landscape, in which the characteristics of Reykjavík relevant to e-scooters are identified and evaluated for their impact on e-scooter services in the city.
3. Safety, containing data on helmet usage, instances of recklessness, the government's stance on safety, and issues identified by non-riders and riders alike.

3.1 Usage

3.1.1 Demographics

Our survey received 54 responses, and of those responses 59% had ridden an e-scooter in Reykjavík. There was a near even split between respondents who were travelers and residents, with residents making up 56% of the responses. Residents were more likely to have ridden an e-scooter, with 70% stating that they have used an e-scooter before, versus just 46% of travelers.

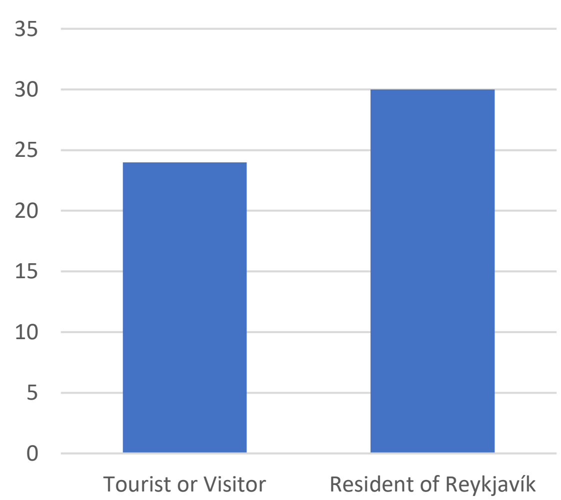


Figure 7: Respondents broken down by traveler vs resident demographic.

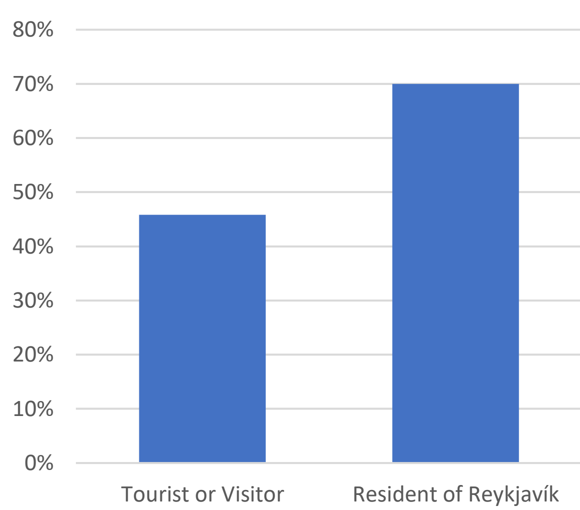


Figure 6: Percentage of people who rented and e-scooter broken down by residency.

This aligns with the information given by the CEO of Zolo, who stated that most of their riders were residents and not tourists. This demonstrates that e-scooters in Reykjavík are more than just a novelty appealing to tourists, but rather a real mobility solution with widespread adoption and use. This point is further reinforced by the fact that 53% of all respondents had used scooters more than 20 times, indicating that their utility was enough to motivate riders to rent again.

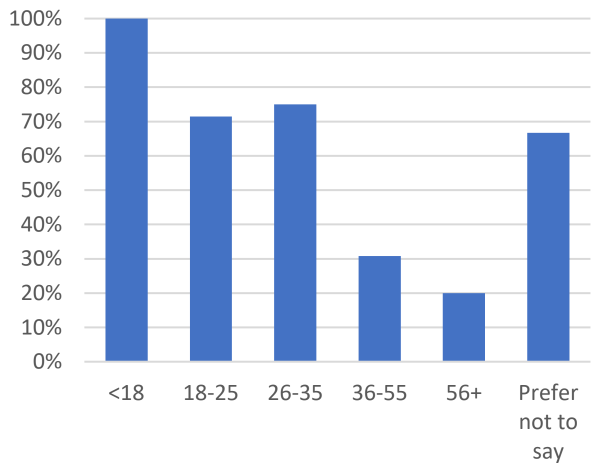


Figure 8: Percentage of each age group who had rented an e-scooter.

The primary age group was 18-25 at 39% followed by 36-55 at 24%. There was a clear negative correlation between age and likelihood of riding scooters, as seen below. This matches with sentiments expressed during the survey interviews, with many people in the 36-55 and 56+ brackets claiming *safety* as a main concern for choosing not to ride, often specifically mentioning worries about *balance*.

3.1.2 Reasons for Usage

Our total survey results showed that out of the 32 respondents who have ridden e-scooters, being late/in a hurry (56%) and for fun (44%) were the most common reasons for choosing to ride e-scooters. Some responses in the “other” category included being drunk or taking an e-scooter home when the buses stop running. These use-cases align with literature, and reflect that even though e-scooters are used often by residents, their reasons for the usage are still often situational, and not habitual.

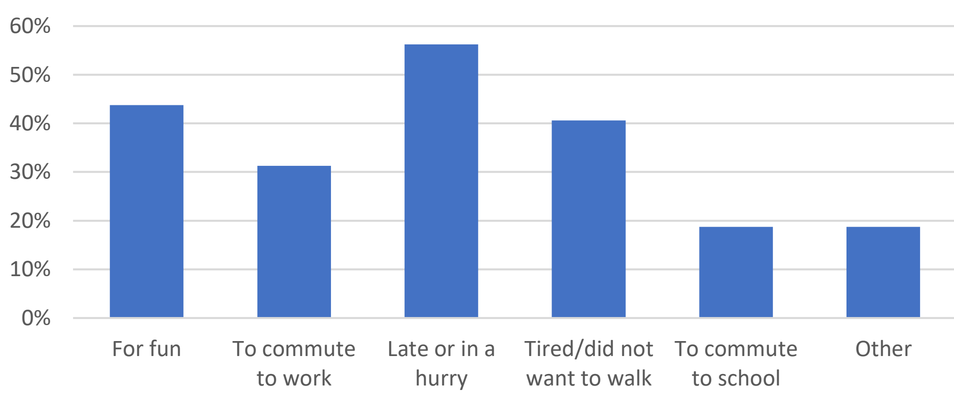


Figure 9: Most common uses of e-scooters

3.1.3 Scooters Versus Bikes

In general, bikes were a more common form of micro-mobility, with 24% more people being observed riding bikes than rented e-scooters in the observation zones. So, while e-scooters are quite popular, bikes are still a preferred mode of transportation to rented e-scooters, but the similarity between the two figures overall indicates a very high adoption of e-scooters. The exception to this is Midborg, which has more e-scooters than bikes and the highest e-scooter riding rate overall. Midborg was our group's Cultural/Shopping urban area, and thus contained many rousts, pedestrians, and narrow streets with shops and restaurants. This environment suits e-scooters very well and shows how the urban layout can have a large impact on the usability and appeal of e-scooters.

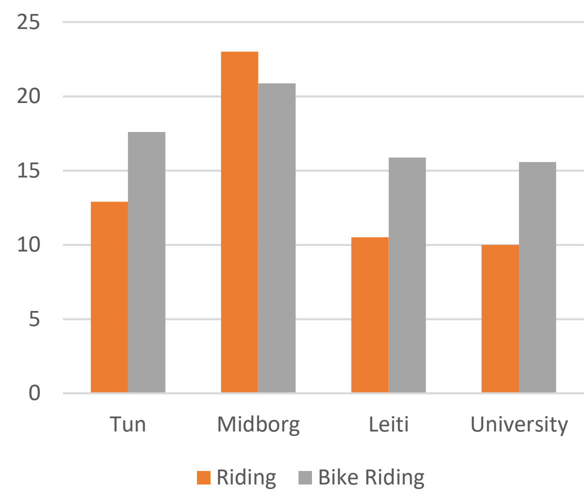


Figure 10: Comparison of scooter and bike usage in each zone

3.1.4 Weather and Seasonal Effects

Given Reykjavík's less than ideal weather conditions for riding e-scooters, one might assume that e-scooter usage would be rare during the cold, windy, and/or rainy days in Iceland. Our team instead found that weather conditions did not significantly affect the usage of e-scooters. Of the 32 respondents who had rented e-scooters, 84% had rented in "cold" and "windy" conditions and 78% in "rain". A very surprising 30% of respondents indicated that they had even ridden in "snow/ice", which at first glance may seem implausible, but Reykjavík is well setup for inclement weather, such as heats some of their roads during winter weather, and the residents are used to the poor weather conditions. This again reinforces the importance of a city's infrastructure, as well as the population's expectations surrounding conditions.

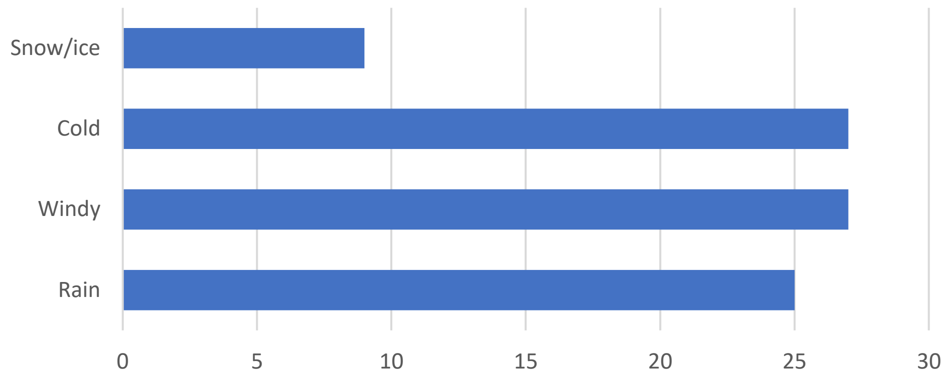


Figure 11: Weather conditions that scooter users rode in

Furthermore, each respondent was asked to give an approximation percentage when they have ridden e-scooters for each season. Respondents provided a value between 0 and 100 for each season, with "never" being 0, and "often" being 100. This data shows that in the winter the average respondent riding an e-scooter was "rarely", spring and summer being just under "often", and fall at "sometimes". Even though it may be rare, there is not a "never", so a Reykjavikian is always riding at any time of the year, in any weather.

Season	Minimum	Maximum	Mean	Std Deviation
Winter	0.00	100.00	34.44	30.99
Spring	0.00	100.00	72.05	29.12
Summer	0.00	100.00	74.52	32.03
Fall	7.00	100.00	65.83	27.22

Table 1: Seasons slider data

3.2 Urban E-Scooter Landscape

3.2.1 E-Scooters Presence in Reykjavík

Our first and most significant expert interview was with the CEO of ZOLO here in Iceland, Adam Helgason, who gave our team an understanding of how Zolo interacts with Reykjavík's environment. One concern Zolo expresses about e-scooters is with designated parking spots, called drop off zones, in cities. They stated that the worry lies in the possibility that the zones could take away the convenience of leaving an e-scooter where you want, whenever you want, which is why they (as well as Hopp) implemented *dockless* e-scooters. Despite this Zolo still has incentivized drop off zones, to encourage better e-scooter placement practices. After the interview, Adam gave our team the following useful data.

- The average trip length is 4.9km, the average daily trips are 2.1.
- The hotspot locations are all mainly downtown, from Lækjatorg up to Hlemmur.
- December, January, and February are the lowest months for usage, then it gradually builds up before peaking in September. Then it slowly goes down again at the same pace as it went up, reaching the minimum use in January.

The first winter that Zolo was operational, they had to bring in all their e-scooters in because they knew the early models could not handle the Icelandic winter weather. Zolo has upgraded their e-scooters to a newer model designed to be much tougher and consistently handle the harsh weather, and as such they leave between 20-30% of their entire fleet out during the winter.

When Zolo first started to roll out their e-scooters, there was mixed feedback from the public. Zolo received many calls from residents saying that e-scooters were being left in front of their house, not knowing they were dockless and could be left anywhere. It took two years for the locals to understand the e-scooters and their purpose in the Icelandic environment. After that time, they started to use them quite often, to the point where locals ride the e-scooters more than tourists.

3.2.2 Landscape Conflicts

The prevalence of some issues relating to the environment of e-scooters were directly collected in the surveys. Notably, 38% of riders reported "poor/dangerous road conditions" as one of the issues they ran into when riding e-scooters. Some individuals also mentioned feeling unsure of the laws and regulations surrounding e-scooters.

Looking at the issues reported when not riding e-scooters, 41% of respondents indicated that they felt pathways being obstructed by the e-scooters was an issue. This was the most common issue for non-riders and is one of the issues Reykjavík has had trouble addressing. This is partially due to the e-scooters being dockless, but all experts interviewed pointed out the issue lies within the users of the e-scooters and not the company or government's policies. Observations revealed that only 3% of all parked scooters were knocked over, and so the poor placement of e-scooters is the core issue, and not whether the e-scooter is upright. This is a very hard issue to address, but despite many people mentioning it as an issue, many survey interviewees mentioned that the poor placement was an annoyance, not a critical issue.

DISCLAIMER Every member of our team, when encountering a knocked down e-scooter, put it back upright in a suitable area 24/7, 7 days a week, for 8 weeks.

3.2.3 Lost E-Scooters

Figure 12: Scooter left in the Tjörnin pond.

Both Adam and the Zolo employee talked about retrieving e-scooters from oceans and lakes having to use hooks and ropes to pull them out. Adam stated that every e-scooter that was possible to retrieve was retrieved, as having an e-scooter littered into the environment is not environmentally friendly.

When our team casually interviewed a Hopp employee, they said the pictures that users must take at the end of a ride help locate the scooters if they are in a weird space. The employee also showed our team a ringing sound that the e-scooter can make if Hopp has trouble finding it. Due to these measures, e-scooters do not provide a significant risk to the Reykjavík environment.

3.2.4 The Governments' Input

The CEO of Zolo described a contract with the government providing rules regarding the population of e-scooters (SA). Provided by the Icelandic Government, the *Service Agreement Contract* summarizes at section *4.2.3* that an average of 2 rides per e-scooter per day for 3 months, as well as an average of 0.5 rides per day for any 1 month period is minimum for all companies. The contracts are negotiated year by year, so any e-scooter company failing to fulfill their end of the bargain could be swiftly terminated.

The government of Iceland was in favor and supportive of e-scooter services in Reykjavík. The CEO of Zolo, Adam, said that the startup process for Zolo went smoothly because of the new clean travel goals set by the government as seen in The Green Deal, an agenda focused towards improving the city's environment, economy, and society. One of their stances is to put more pedestrians on the road using eco-friendly methods of transportation like bikes, e-scooters, and public transportation (GD). The government saw e-scooters as a clean energy alternative to the current cars and system they had.

3.2.5 City's Environment and Infrastructure

The Government also provides clear directions as to park e-scooters in a manner that does not impede the movement of other road users (S&U). Some areas of concern include parking in the middle of pavements, footpaths, ramps, in front of houses, or pedestrian crossings (S&U). Another push for safety is in the Governments Traffic Act, Article 46 stating that if a bike lane is parallel to a footpath, you may only drive on that bike path (TA). Furthermore, there are specific "drop off zones" for any e-scooter seeking to reduce clutter, but they are not mandatory. Although, as previously mentioned Zolo has implemented a feature giving a user incentive to park in certain drop off locations, where they get a free unlock on their next ride.

Zolo and Hopp both implemented a feature on their apps that requires a user to take a picture of their scooter. After a user ends their ride, the camera will activate with an e-scooter image on it prompting the user to take a picture of their e-scooter parked. If an e-scooter is deemed not parked in a suitable place, including private property or damaged in any way by a user, a charge fee will be ensued to the user as found in the Zolo app's help and FAQ section. These conditions follow along the lines of parking inside the zones specified on the apps map, upright, and out of the way. This feature is an attempt to help mitigate some issue with dockless e-scooters in an urban environment,

From our expert interview with the CEO of Zolo, Adam, and the Zolo employee, they both mentioned having interesting experiences retrieving scooters in strange places. The wildest place Adam said they found an e-scooter was atop a six-story high school building. This topic of e-scooters ending up in strange places is an area of concern for e-scooter companies and relates directly to the demographics who use them.

3.3 Safety (Issues) Dangers, Concerns,

3.3.1 Helmet Use

Helmet use was seen rarely during our observations, with only 10 of 467 riders wearing a helmet while on a rented e-scooter. This is significant since both the Government and the e-scooter services in Reykjavík highly advise wearing a helmet, and if you are under sixteen years old, it is mandatory (S&U). This indicates a lack of awareness of the recommended practices for safe e-scooter usage, but the number of hospitalized injuries in Reykjavík remains quite low and is most often due to intoxication (Pétursdóttir et al., 2021).

3.3.2 Recklessness

Throughout our teams' observations, any reckless occurrences were noted down while walking the paths in the zones. The most notable and most common issue was multiple users (2-3) on a single e-scooter. One of these instances being two girls drifting off the sidewalk and falling into the road near oncoming traffic. Some other observations saw riders doing wheelies, speeding, blocked pathways, and fishtailing/drifting. There was only a total of 10 instances of recklessness of the 467 riders observed, which reflects a relatively safe overall usage.

3.3.3 Issues Riding

One of the most important questions to look at is the issues participants had when riding an e-scooter in Reykjavík. Of the 32 respondents, 41% “other”, and described situations such as almost falling, maintenance mode being activated, or other personal issues. 38% indicated that a “battery died un-expectedly” and 38% mentioned “poor/dangerous road conditions,” which were the most prevalent issues in the data. Having an e-scooter “breakdown/stop working” and “encountering an accident” were both only indicated for 9% of riders. These are issues e-scooter companies would do well to look into and solve.

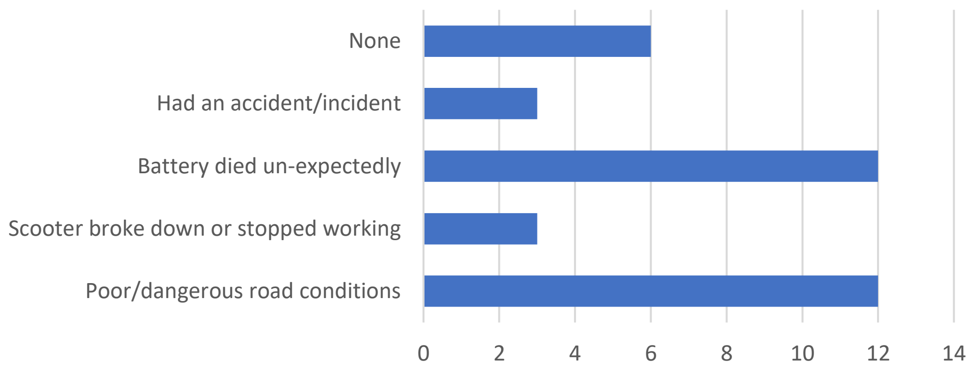


Figure 13: Issues riders had while riding an e-scooter.

3.3.4 Issues Not Riding

Another important question is what issues participants encountered when not riding an e-scooter in Reykjavík. Of the 54 respondents, 33% mentioned “Speeding/reckless near pedestrians” and 22% “not following traffic laws”. These issues pose both a great risk for the e-scooter riders, but also pedestrians, which is a known issue with e-scooters. This reflects a need for more education for e-scooter riders to ensure they understand the laws which they must follow. As stated by the Icelandic Government, a rider needs to keep in mind pedestrians do not expect a fast scooter flying from behind them, so a bell must be used in advance and to slow down when passing (S&U).

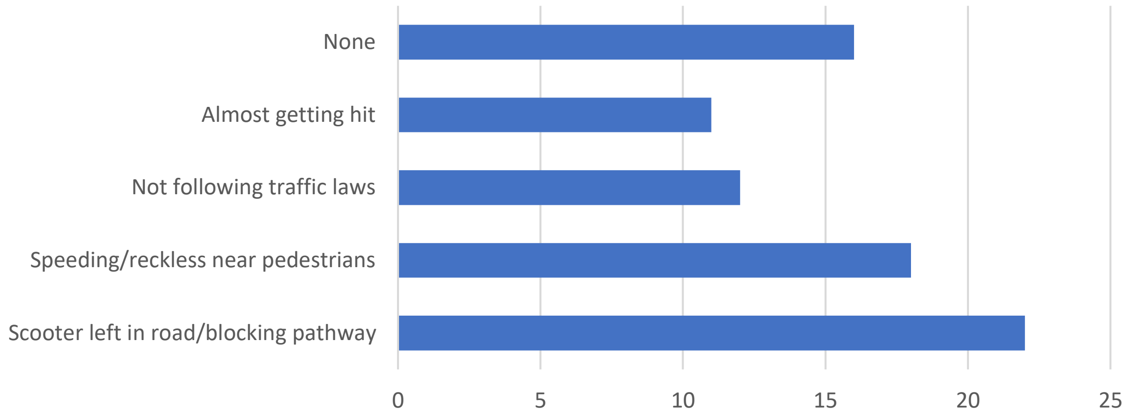


Figure 14: Issues riders had while not riding an e-scooter.

3.4 Deliverable: Sharing the Online Resource

The deliverable our team produced was an online resource (Appendix F) summarizing our case study in a more sharable and digestible format. In the resource our team discusses common e-scooter issues related to infrastructure and safety, blocked sidewalks, and distribution, followed by Reykjavík's approach to said issues and the remaining issues still in the city. Our online resource is targeted towards micro-mobility specialists and prospective city planners that want to implement e-scooter rental services in their city.

4 Conclusion: Looking Towards the Future

Over the past four years, the increased usage of e-scooter services has impacted Reykjavík and its population, culminating in a more accessible and versatile transportation ecosystem. The research described in this paper has given our sponsor and readers insight on critical aspects of e-scooter services in Reykjavík, including temporal, geographical, and demographic usage patterns, rider habits, and the impact of the urban landscape.

The *Icelandic Scooter Squad* had a few thoughts for the future extending from our project. There is a possibility of an e-scooter implementation at WPI using our case study and findings to help ensure that common issues are addressed, given WPI's similar challenges of weather and a dense urban landscape. Our team had also talked with individuals within the e-scooter companies in Reykjavík who expressed interest in our unique data that was collected. Our team can confidently say there is potential for a future sponsorship with an e-scooter company in Reykjavík. Finally, *ISS Tools*, the tool our team created to help data collection, has potential to be a future MQP. The goal of this MQP would be to help any future IQP group gather their data more effectively and efficiently by the continued development of the tool to a more polished and modular application. Our tool is an excellent proof of concept, and it would be very useful for future IQPs.

References

Andie Sophia Fontaine. (2019, October 1). Electric Scooters Get Rolling In Reykjavík. *The Reykjavík Grapevine*. https://grapevine.is/news/2019/10/01/electric-scooters-get-rolling-in-Reykjavík/

Blomberg, S. N. F., Rosenkrantz, O. C. M., Lippert, F., & Christensen, H. C. (2019). Injury from electric scooters in Copenhagen: A retrospective cohort study. *BMJ Open*, *9*(12), Article 12. https://doi.org/10.1136/bmjopen-2019-033988

Carrignon, D. (2020). Connected and Autonomous Vehicles, Electric Scooter and Their Implications for Road Network Design. *Transportation Research Procedia*, *49*, 160–169. https://doi.org/10.1016/j.trpro.2020.09.014

Christoforou, Z., de Bortoli, A., Gioldasis, C., & Seidowsky, R. (2021). Who is using e-scooters and how? Evidence from Paris. *Transportation Research Part D: Transport and Environment*, *92*, 102708. https://doi.org/10.1016/j.trd.2021.102708

Evans, J., & Jones, P. (2011). The walking interview: Methodology, mobility and place. *Applied Geography*, *31*(2), Article 2. https://doi.org/10.1016/j.apgeog.2010.09.005

Fitt, H., & Curl, A. (2019). *E-scooter use in New Zealand: Insights around some frequently asked questions*. https://doi.org/10.13140/RG.2.2.13510.93761

Ignaccolo, M., Inturri, G., Cocuzza, E., Giuffrida, N., Le Pira, M., & Torrisi, V. (2022). Developing micromobility in urban areas: Network planning criteria for e-scooters and electric micromobility devices. *Transportation Research Procedia*, *60*, 448–455. https://doi.org/10.1016/j.trpro.2021.12.058

Interviews in the social sciences. (2022). *Nature Reviews Methods Primers*, *2*(1), 74. https://doi.org/10.1038/s43586-022-00166-y

James, O., Swiderski, J. I., Hicks, J., Teoman, D., & Buehler, R. (2019). Pedestrians and E-Scooters: An Initial Look at E-Scooter Parking and Perceptions by Riders and Non-Riders. *Sustainability*, *11*(20), Article 20. https://doi.org/10.3390/su11205591

Jibril, A. (2018). *Observational Research in the Social Sciences: A Neglected Qualitative Research Technique*. https://doi.org/10.29816/sjss.8.3

Kim, W. C., & Campbell, A. R. (2021). Common Injury Patterns from Standing Motorized Scooter Crashes. *Current Surgery Reports*, *9*(4), Article 4. https://doi.org/10.1007/s40137-021-00283-9

Kimpton, A., Loginova, J., Pojani, D., Bean, R., Sigler, T., & Corcoran, J. (2022). Weather to scoot? How weather shapes shared e-scooter ridership patterns. *Journal of Transport Geography*, *104*, 103439. https://doi.org/10.1016/j.jtrangeo.2022.103439

Li, A., Zhao, P., Liu, X., Mansourian, A., Axhausen, K. W., & Qu, X. (2022). Comprehensive comparison of e-scooter sharing mobility: Evidence from 30 European cities. *Transportation Research Part D: Transport and Environment*, *105*, 103229. https://doi.org/10.1016/j.trd.2022.103229

Mansky, J. (2023, April 7). The Motorized Scooter Boom That Hit a Century Before Dockless Scooters. *Smithsonian Magazine*. https://www.smithsonianmag.com/history/motorized-scooter-boom-hit-century-dockless-scooters-180971989/

Murphy, A. T. (2020). Listening in, listening out: Intersubjectivity and the impact of insider and outsider status in oral history interviews. *Oral History*, *48*(1), Article 1.

Pétursdóttir, S. G., Kristjánsson, J. M., & Björnsson, H. M. (2021). Rafskútuslys á höfuðborgarsvæðinu sumarið 2020. Læknablaðið. https://doi.org/10.17992/lbl.2021.05.635

Ponto, J. (2015). Understanding and Evaluating Survey Research. *Journal of the Advanced Practitioner in Oncology*, *6*(2), Article 2.

TAUR. (2020, June 29). The History of Electric Scooters. *Lotus Fruit*. https://medium.com/lotus-fruit/the-history-of-the-first-electric-scooter-5c00e0053468

Tian, D., Ryan, A. D., Craig, C. M., Sievert, K., & Morris, N. L. (2022). Characteristics and Risk Factors for Electric Scooter-Related Crashes and Injury Crashes among Scooter Riders: A Two-Phase Survey Study. *International Journal of Environmental Research and Public Health*, *19*(16), Article 16. https://doi.org/10.3390/ijerph191610129

Umferðarlög. (2019, June 25). https://www.althingi.is/lagas/nuna/2019077.html

Zubenko, I. (2022, July 22). New Hopp Scooters Arrive in Reykjavík, Service Area Expanded. *The Reykjavík Grapevine*. https://grapevine.is/news/2022/07/22/new-hopp-scooters-arrive-in-Reykjavík-service-area-expanded-0/

Appendix A: Interviews

Interview Script

Hello, and thank you for taking the time to talk with us today. We are students from WPI in Worcester, Massachusetts, and we're conducting research on e-scooters. Our goal is to gather valuable information about people's feelings and experiences with e-scooters here in Reykjavík, Iceland. This interview is part of our research project, and the results will be published. We're hoping to learn about your experiences with electric scooters in Reykjavík and the impact they have on you. This interview should take about 15-20 minutes of your time. Participation in this interview is entirely voluntary, and you can choose to skip any questions or end the interview at any time, for any reason. Rest assured that we will protect your privacy and confidentiality to the best extent possible.

(*After turning on recorder*) Before we can start this interview, we will need you to give verbal consent to have your voice recorded. Thank you, let's begin.

Interview Guide for E-Scooter Experts

1. What made you want to start an electric scooter company?
    a. What made you want to bring electric scooters to Iceland?
2. What difficulties have you faced while deploying scooters in Reykjavík specifically?
    a. How did you overcome those difficulties?
    b. Was public opinion good, bad, fluctuating, constant throughout the integration process?
    c. Have you received any negative feedback about the e-scooters? Positive feedback?
3. How has your company been affected by regulations or policies?
    a. Do you believe there should be a change in these regulations or policies?
4. Which charging method did Zolo choose, and why?
5. What are the advantages and disadvantages of different charging approaches?
6. Have there been any logistical challenges with your company's approach to recharging scooters?
7. Any notable instances where scooters were not where you expected them to be?
8. How is Zolo impacted by other companies such as Hopp?
9. Who is the main group you decided to target when starting the company?
10. Where did you get inspired from to target them specifically?
11. (Ask if comfortable with sharing usage data) How do the seasons and weather here in Reykjavík affect the usage of your scooters?
12. How do the seasons and weather affect the company?

Interview Guide for Tourists/Locals

1. What was your experience with electric scooter rental services in Iceland?

   a. Liked: Why did you enjoy them? What aspects did you appreciate most? (mobility, entertainment, etc.)
   b. Disliked: What key issues do you feel made your experience with them poor?
2. Have you ridden scooters elsewhere?
   a. Yes: Where else? How did your experience differ?
   b. No: Is there a particular reason you haven't, or is it just happenstance?
3. Do you notice any differences in perspectives between what locals vs tourists on electric scooter usage?
   a. Were there any standout events that you remember whether they are good or bad?
4. What was your primary use of the Eletric scooters. For fun or something else.
   a. Transportation: Did you end up relying on them for transportation?
   b. Fun: What made them fun? how
5. Is the electric scooter culture in Iceland different than other cities that you have been to with electric scooters, especially in the US.
   a. Little to no experience with other cities, move on.
   b. Otherwise
6. What were some challenges that you ran into when using the electric scooter service?
   a. Yes
      i. Were there any hardware issues?
      ii. Were there availability issues?
   b. No
      i. Do you feel like they could have improved some aspects, even if they weren't "issues"?
7. What is your prior experience with riding electric scooters?
   a. How was the learning curve when beginning to ride it?
      i. Why do you feel that was the case?
8. What do you know about the regulations and laws regarding e-scooter use?
9. What kind of laws or regulations do you think would be useful regarding e-scooters in Reykjavík?
   a. Driver's license/age limit
   b. Punishments for intoxication
   c. Do you think there needs to be any change with either the culture or the laws of e-scooters?
10. How have others (tourists/locals) responded to your e-scooter use?
   a. Annoyance: What are the main reasons in your view that the people are annoyed?
   b. Positive: What do you think contributed to your positive experiences?

Appendix B: Surveys

Survey

Age

- ○ <18
- ○ 18-25
- ○ 26-35
- ○ 36-55
- ○ 55+

Gender

- ○ Male
- ○ Female
- ○ Non-Binary
- ○ Prefer Not to Say
- ○ Not Listed: ________

Are you a resident or currently travelling through Reykjavík?

- ❑ Resident of Reykjavík
- ❑ Visitor or tourist

Have you used an E-Scooter before? (Required)

- ○ Yes
- ○ No

If "Yes" to previous question

Roughly how many times have you used electric scooter rental services?

- ○ 0-2
- ○ 3-5
- ○ 6-10
- ○ 11-20
- ○ 21+

What do you typically use an electric scooter for?

- ❑ For fun
- ❑ To commute to work
- ❑ Late or in a hurry
- ❑ To commute to school
- ❑ Tired/Didn't want to walk
- ❑ Other:

Have you had any issues while riding an electric scooter? (Select all that apply)

- ❑ Poor/Dangerous Road conditions
- ❑ Scooter Broke Down or Stopped Working
- ❑ Battery Died Un-expectedly
- ❑ Had an accident (Explain if Chosen):______________
- ❑ None
- ❑ Other:_______

Which of the following conditions have you ridden in? (Select all that apply)

- ❑ Rain
- ❑ Windy
- ❑ Cold
- ❑ Ice/Snowy
- ❑ Sunny
- ❑ None
- ❑ Other:_____

How often have you ridden in the following seasons? (0-100 for each)

(0 – Never) (25 – Rarely) (50 – Sometimes) (75 – Often) (100 – Always)

- ❑ Winter
- ❑ Spring
- ❑ Summer
- ❑ Fall

Have you had any issues while NOT riding an electric scooter? (Select all that apply)

- ❑ Scooter left in road/blocking pathway
- ❑ Speeding/Reckless near pedestrians
- ❑ Not following traffic laws
- ❑ Almost getting hit
- ❑ None
- ❑ Other:__

If you would like to further elaborate on any of the previous questions or talk with us, feel free to leave your contact information below: (Optional)

Fill in contact information:

QR Codes

Figure 15: Printed and lamented QR code

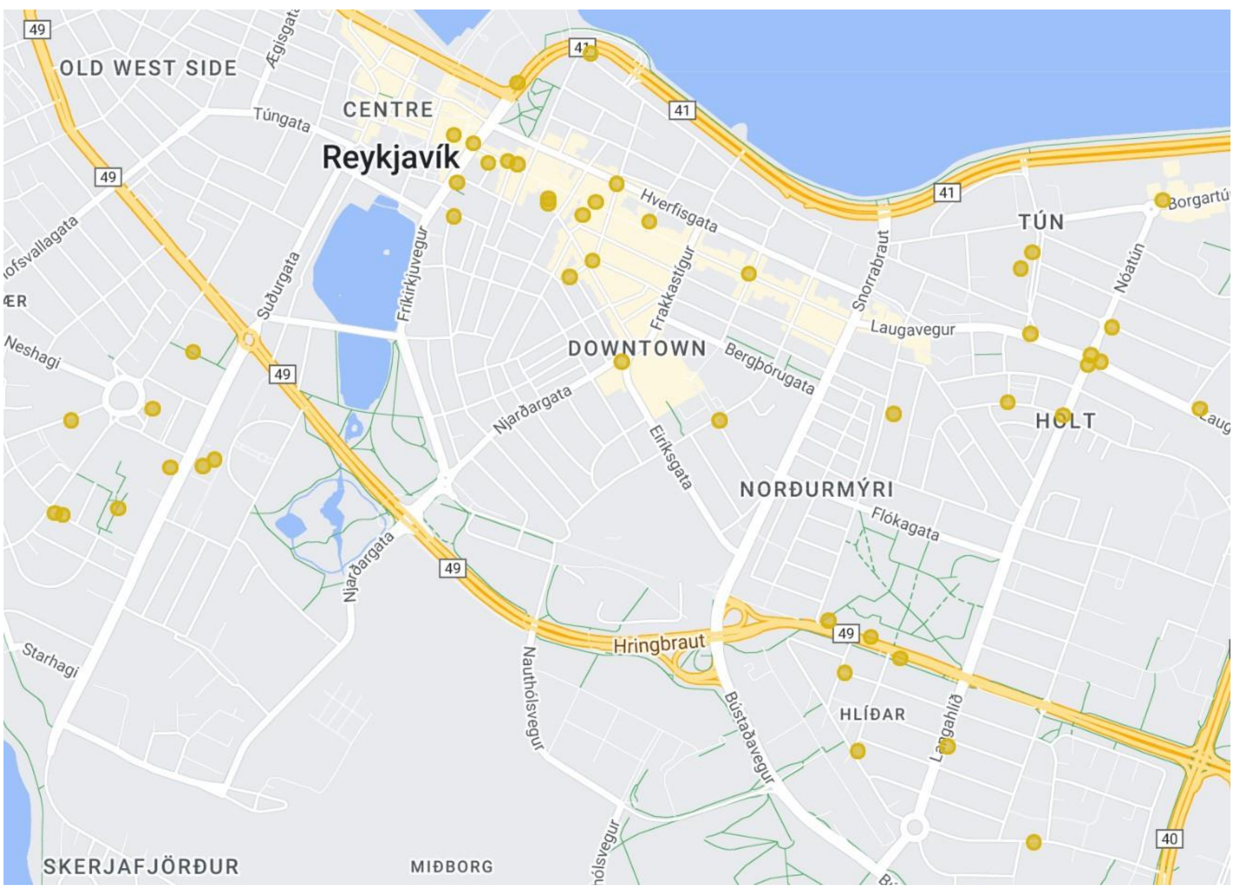


Figure 16: Map of QR code placements

Data

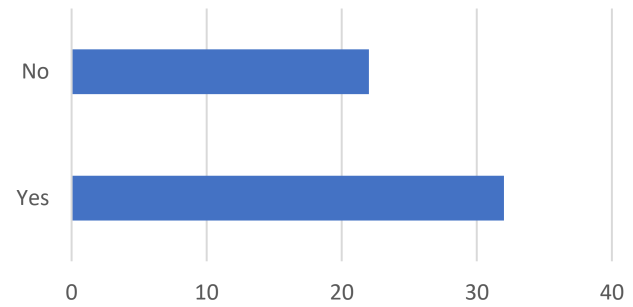


Figure 17: Respondents who have and have not ridden a scooter.

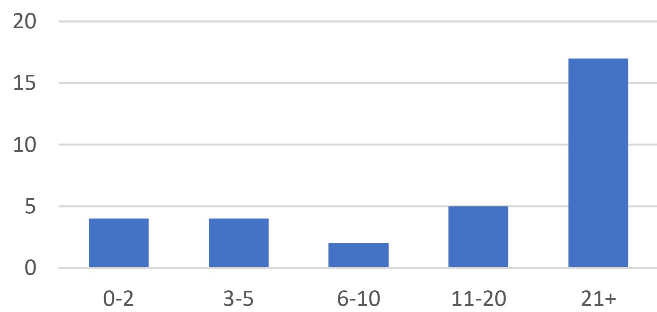


Figure 18: Number of times a rider rented a scooter

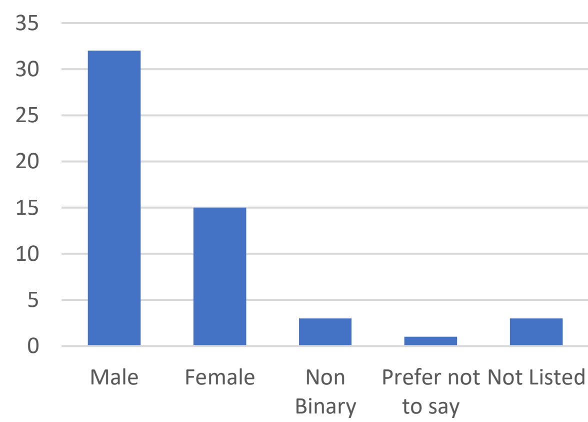


Figure 19: Rider gender

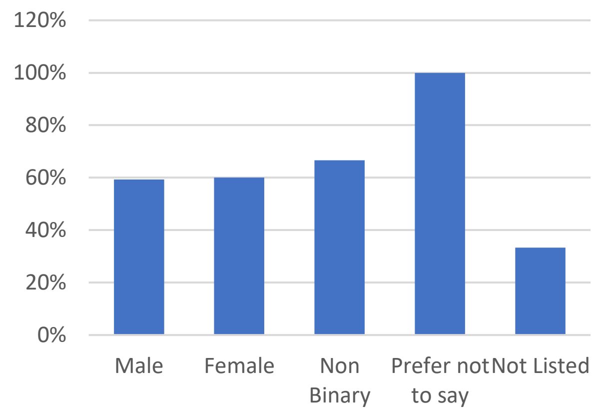


Figure 20: Percentage of riders by gender category

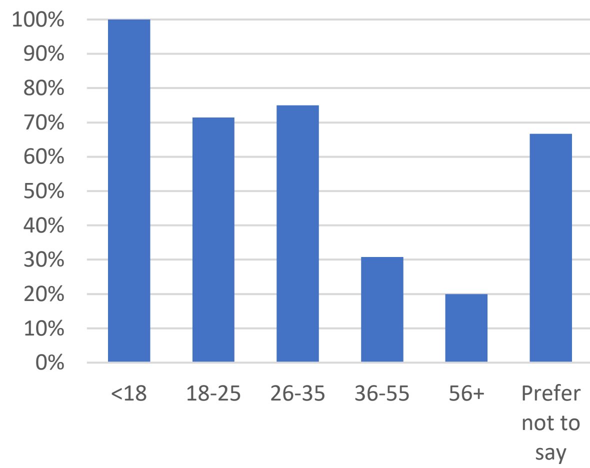


Figure 21: Percentage of riders in each age bracket

Location	Riding	Parked (Upright)	Parked (Fallen)
Tun	18%	80%	2%
Midborg	29%	70%	1%
Leiti	31%	66%	3%
University	32%	65%	4%

Table 2: State of e-scooters broken down by region and overall.

Appendix C: Observation

Data

Location	Riding	Reckless	Helmet	Parked (Upright)	Parked (Fallen)	Bike Riding
Tun	9	0	0	48	0	28
Midborg	28	0	2	59	0	61
Leiti	12	0	0	31	0	20
University	24	0	2	29	2	37
University	15	0	0	28	1	18
Midborg	18	0	0	46	0	17
University	6	0	1	22	0	11
Midborg	22	0	0	49	2	24
Tun	16	0	1	57	3	26
University	12	0	0	32	4	11
Midborg	41	2	0	40	0	11
Tun	13	0	0	55	1	16
Midborg	35	3	1	81	1	14
Leiti	9	0	0	21	0	17
Midborg	6	0	0	52	1	11
Tun	20	0	0	73	3	9
University	4	1	0	13	0	11
Leiti	3	0	0	34	4	9
Tun	7	0	0	97	2	13
Midborg	15	0	1	68	1	17
Leiti	10	2	0	13	1	6
Tun	13	0	0	56	1	17
Leiti	10	0	0	19	0	25
Tun	7	0	0	24	1	22
Leiti	8	1	0	12	2	4
University	6	0	0	12	1	10
Leiti	22	1	0	27	1	14
University	3	0	1	6	0	11
Tun	17	0	0	32	0	23
Tun	16	0	1	48	1	9
Midborg	19	0	0	73	0	12
Leiti	10	0	0	21	3	32
Tun	11	0	0	54	0	13

Table 3: Raw data from observations with all measured categories.

Location	Observations	Riding	Helmet	Parked (Upright)	Parked (Fallen)	Bike Riding	Bike Parked	Reckless
Tun	10	12.90	0.20	54.40	1.20	17.60	10.50	0.00
Midborg	8	23.00	0.50	58.50	0.63	20.88	6.88	0.63
Leiti	8	10.50	0.00	22.25	1.38	15.88	16.50	0.50
University	7	10.00	0.57	20.29	1.14	15.57	11.86	0.14
Total	33	14.15	0.30	40.36	1.09	17.55	11.36	0.30

Table 4: Data Collected by grouped by each location

Map

Figure 22: Each blue region represents the area in which the above variables were measured from, and the yellow path represents the path the observed would walk complete each time observation was performed.

Appendix D: Government Documents

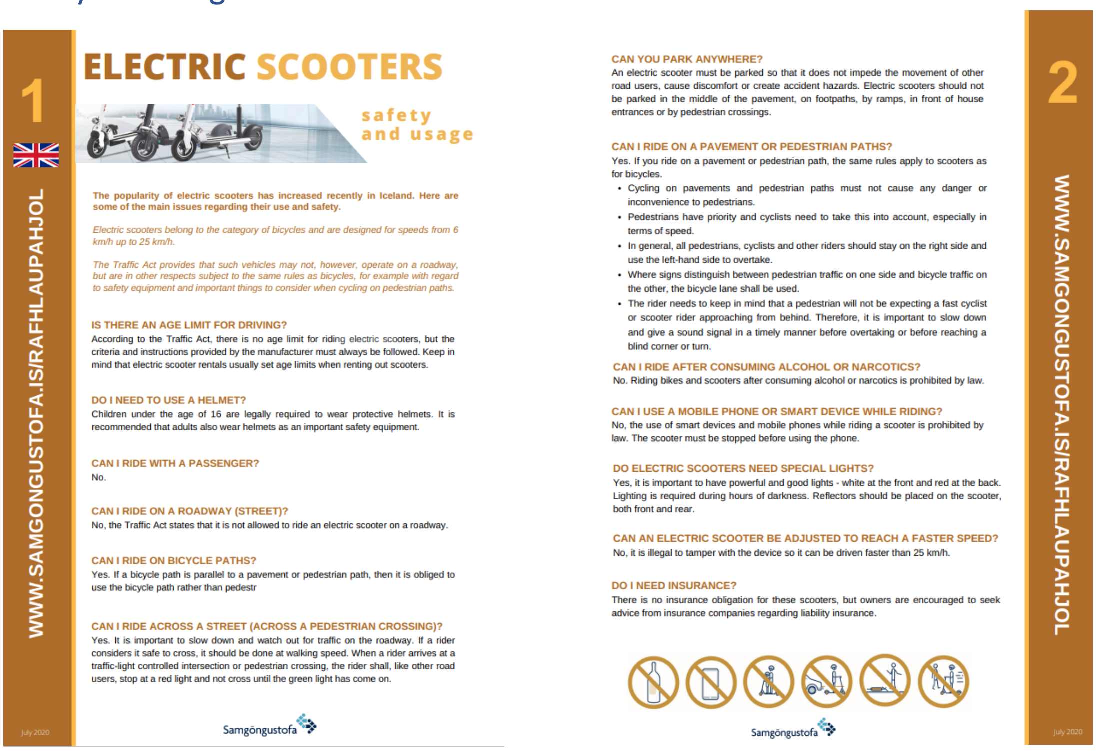
Green Deal

https://Reykjavík.is/en/green-deal

Traffic Act

https://www.althingi.is/lagas/nuna/2019077.html

Safety and Usage



1

WWW.SAMGONGUSTOFA.IS/RAFHLAUPAHJOL

ELECTRIC SCOOTERS

safety and usage

The popularity of electric scooters has increased recently in Iceland. Here are some of the main issues regarding their use and safety.

Electric scooters belong to the category of bicycles and are designed for speeds from 6 km/h up to 25 km/h.

The Traffic Act provides that such vehicles may not, however, operate on a roadway, but are in other respects subject to the same rules as bicycles, for example with regard to safety equipment and important things to consider when cycling on pedestrian paths.

IS THERE AN AGE LIMIT FOR DRIVING?

According to the Traffic Act, there is no age limit for riding electric scooters, but the criteria and instructions provided by the manufacturer must always be followed. Keep in mind that electric scooter rentals usually set age limits when renting out scooters.

DO I NEED TO USE A HELMET?

Children under the age of 16 are legally required to wear protective helmets. It is recommended that adults also wear helmets as an important safety equipment.

CAN I RIDE WITH A PASSENGER?

No.

CAN I RIDE ON A ROADWAY (STREET)?

No, the Traffic Act states that it is not allowed to ride an electric scooter on a roadway.

CAN I RIDE ON BICYCLE PATHS?

Yes. If a bicycle path is parallel to a pavement or pedestrian path, then it is obliged to use the bicycle path rather than pedestr

CAN I RIDE ACROSS A STREET (ACROSS A PEDESTRIAN CROSSING)?

Yes. It is important to slow down and watch out for traffic on the roadway. If a rider considers it safe to cross, it should be done at walking speed. When a rider arrives at a traffic-light controlled intersection or pedestrian crossing, the rider shall, like other road users, stop at a red light and not cross until the green light has come on.

July 2020

Samgöngustofa

2

WWW.SAMGONGUSTOFA.IS/RAFHLAUPAHJOL

CAN YOU PARK ANYWHERE?

An electric scooter must be parked so that it does not impede the movement of other road users, cause discomfort or create accident hazards. Electric scooters should not be parked in the middle of the pavement, on footpaths, by ramps, in front of house entrances or by pedestrian crossings.

CAN I RIDE ON A PAVEMENT OR PEDESTRIAN PATHS?

Yes. If you ride on a pavement or pedestrian path, the same rules apply to scooters as for bicycles.

- Cycling on pavements and pedestrian paths must not cause any danger or inconvenience to pedestrians.
- Pedestrians have priority and cyclists need to take this into account, especially in terms of speed.
- In general, all pedestrians, cyclists and other riders should stay on the right side and use the left-hand side to overtake.
- Where signs distinguish between pedestrian traffic on one side and bicycle traffic on the other, the bicycle lane shall be used.
- The rider needs to keep in mind that a pedestrian will not be expecting a fast cyclist or scooter rider approaching from behind. Therefore, it is important to slow down and give a sound signal in a timely manner before overtaking or before reaching a blind corner or turn.

CAN I RIDE AFTER CONSUMING ALCOHOL OR NARCOTICS?

No. Riding bikes and scooters after consuming alcohol or narcotics is prohibited by law.

CAN I USE A MOBILE PHONE OR SMART DEVICE WHILE RIDING?

No, the use of smart devices and mobile phones while riding a scooter is prohibited by law. The scooter must be stopped before using the phone.

DO ELECTRIC SCOOTERS NEED SPECIAL LIGHTS?

Yes, it is important to have powerful and good lights - white at the front and red at the back. Lighting is required during hours of darkness. Reflectors should be placed on the scooter, both front and rear.

CAN AN ELECTRIC SCOOTER BE ADJUSTED TO REACH A FASTER SPEED?

No, it is illegal to tamper with the device so it can be driven faster than 25 km/h.

DO I NEED INSURANCE?

There is no insurance obligation for these scooters, but owners are encouraged to seek advice from insurance companies regarding liability insurance.

Samgöngustofa

July 2020

Service Agreement

City of Reykjavík

The City of Reykjavík, ID-number 530269-7609, Department of Environment and Planning (here after named "The City of Reykjavík") and [name of service provider], ID-number [ID-number/social security number/Organizational number], [address], [zip code] [community], [Country] (here after named "service provider") hereby adopt the following:

SERVICE AGREEMENT

for a free-floating bike rental system in Reykjavík

This is the English version of the Service Agreement, which also exists in Icelandic. If there are any discrepancies of the agreement´s content, the Icelandic version will be decisive.

1. Aim

1.1. The aim of this Agreement is to establish the duties of the parties related to the intention of the service provider to operate a free-floating bike rental system in Reykjavík.

2. Definitions

2.1. *Bike* – Means of transportation operated by service provider for renting out to individuals for transportation and which falls under the definition of a bicycle according to the Icelandic traffic Act.

2.2. *Fleet* – Refers to the means of transportation that is a fully operational and active part of the supply of the service provider.

2.3. *Bike dock* – A predetermined place where users are expected to return or pick up *Bike*, e.g. using a fixed rack, frame or stand etc.

2.4. *Geofence* – A digital demarcation of space where it is possible to return a *Bike*.

2.5. *Trip* – The use of the *Bike*, where the user pays for a *Bike* and returns it after having travelled at least 200 meters.

3. The City of Reykjavík's contractual duties

3.1. The City of Reykjavík is responsible for the main roads (highways not included) and public paths within city limits that are intended for the general public.

3.2. The City of Reykjavík will fulfil its informational duties by mediating information to the general public about the use of bicycles, using designated channels.

3.3. The City of Reykjavík is free to make a comparable service agreement with other service providers who express the will to operate a free-floating bike rental system within the City of Reykjavík.

4. The service provider's duties

4.1. Laws and regulations

4.1.1. The service provider will at each time make sure that the condition of the *Bikes* in the *Fleet* is sufficient and that the *Fleet* meets all legal requirements, such as traffic law and regulations on structure and mechanisms of bicycles.

4.1.2. The service provider shall follow traffic law and regulations regarding the operations of the rental service, and shall for example not park vehicles on pavements or roadsides, or drive vehicles through restricted areas etc.

City of Reykjavík

4.2. Use and operations

4.2.1. The service provider's contact person is [name], [phone number], [e-mail]. The contact person shall handle all communication with the City of Reykjavík. If the service provider changes its contact person or contact information then he shall inform the City of Reykjavík about it.

4.2.2. The service provider will inform the City of Reykjavík about the estimated number of *Bikes* in the *Fleet*, how the service provider intends to distribute *Bikes*, i.e. placements and number of *Bikes* per placement, and make changes in collaboration with the City of Reykjavík if needed. In the event of any estimated changes the service provider should inform the City of Reykjavík about them as soon as possible.

4.2.3. To guarantee sensible use of city land, the City of Reykjavík finds the following conditions not acceptable, in which case the service provider shall make necessary arrangements in order to increase usage:

a) Average usage per *Bike* in *Fleet* is less than 2.0 trips per day on average for more than three months without reasonable explanation.

b) Average usage per *Bike* in *Fleet* is less than 0.5 trips per day on average for more than one month without reasonable explanation.

If either condition a) or b) are not met and the service provider does not provide a solution for how the average usage of the *Bikes* will be increased, the City of Reykjavík reserves the right to terminate the service agreement.

4.2.4. The service provider will, in cooperation with the City of Reykjavík, use geofencing to direct where it will be permittable to return *Bikes*, e.g. not within graveyards or conservation areas. If the City of Reykjavík deems it necessary to change any particular geofencing during the course of this agreement, the service provider should be ready to meet those wishes.

4.2.5. If the service provider wishes to establish a fixed location for the services, a permit should be filed with the City of Reykjavík.

4.3. Safety and accessibility

4.3.1. The service provider should inform that they should:

- Limit their traveling speed to normal walking speed when biking in pedestrian zones, e.g. on sidewalks and walking paths.
- Leave *Bikes* in such a way that they do not hinder other traffic, especially for those with limited eyesight or mobility.
- Not leave *Bikes* in flower beds, on private land, graveyards or conservation areas.
- Follow the general rule of common consideration and sense when returning or leaving *Bikes* unattended, as well as following laws and rules, by e.g. not leaving *Bikes* in places in areas closed to the general public.

4.3.2. The service provider shall provide contact information for users and the general public (a phone number and e-mail address at the very least). The information should be available in both English and Icelandic.

4.3.3. The service provider shall be proactive in the maintenance and operation of bikes. This includes responding to suggestions as quickly as possible, and e.g.:

- Remove, fix or replace broken bikes.
- Remove bikes that have been left unattended in such a way that they hinder general traffic or otherwise cause inconvenience.
- Remove bikes that have been left unattended in undesirable locations, such as in or near the ocean, lakes, gardens, flower beds or closed areas etc.
- Remove bikes during street cleaning.

4.3.4. If the service provider does not respond to suggestions according to point no. 4.3.2, the City of Reykjavík reserves the right to remove said bikes. All expenses paid by the City of Reykjavík, or other governmental agencies in collaboration with the City of Reykjavík, related to the transport, disposal or storage of the bikes shall be reimbursed by the service provider.

City of Reykjavík

4.4. Data

4.4.1. In order for the City of Reykjavík to evaluate the success of free-floating bike rental systems in Reykjavík and make informed decisions about the future of the project, the service provider shall collect data about the average usage per bike in fleet (see 4.2.3) and send it to the City of Reykjavík. For reference, the service provider could quarterly send the following information to the City of Reykjavík:

a. Average number of bikes being used per month.
b. Total number of trips/bookings per month.
c. Average length of trips (km) per month.
d. Average length of trips (minutes) per month.
e. Number of monthly users.

4.4.2. The service provider will inform its users about the collection and usage of data that contains any personal information about the users and, if required by law, get consent for any processing in advance.

4.5. Promotions

4.5.1. The service provider is responsible for all marketing of the service.

4.6. End of service

4.6.1. At the end of service, the service provider shall remove all bikes and other objects related to the service and guarantee the appropriate handling of said bikes and objects (e.g. disposal or storage). Toxic waste, such as batteries, electrical components, oil etc. should also be handled in the appropriate manner. The City of Reykjavík will not be held responsible for any abandoned/unclaimed bikes and reserves the right to remove and dispose of them at the service provider's own cost.

5. Insurance and liability

5.1. The service provider shall have liability insurance that covers any damage or loss that users or other parties may encounter or sustain because of the service.

6. Cooperation and follow-up

6.1. By signing this service agreement, the City of Reykjavík and the service provider proclaim that they will work closely together so that the effects of the service will be as positive as possible and that any suggestions and comments that may affect the service or image of either party negatively will be responded to promptly. The City of Reykjavík will place emphasis on good cooperation with the service provider and will call a meeting at least once per year to discuss the project's progress, new solutions and ways to innovate etc.

7. Data protection

7.1. The City of Reykjavík aims to guarantee the reliability, confidentiality and safety of all personal information that is processed by the city. The City of Reykjavík's data protection policy has been set in accordance with Act no. 90/2018 on data protection and processing of personal information, and is available on the city's website.

7.2. The service provider is the controller of the personal information that is collected during the operation of the service. The service provider is as a controller responsible for ensuring that all processing of personal information, systems, providing information to the data subjects and storage of data is in accordance with current legislation on data protection.

7.3. The service provider may process personal information that the City of Reykjavík calls for. If any sharing of personal information occurs, the parties of this agreement will be joint controllers of

City of Reykjavík

that processing in relation to to data protection legislation (article 23). In this case the parties will sign a written agreement that details their common and individual responsibilities before any sharing of data takes place. The agreement will be an attachment to and a part of this service agreement.

8. Agreement validity and revision

8.1. This agreement will be valid for two years, starting from its signature date. The City of Reykjavík may terminate this agreement, pending a three month term of notice, at any time during the agreement period. The termination must be in written form and should be presented to the service provider in a provable manner. If the service provider plans to close down the free-floating bike rental system before the end of the agreement period he must officially notify the the City of Reykjavík, Department of Environment and Planning, in in written form. The reception of said resignation marks the official termination of this agreement, unless otherwise stated. Two identical copies are made of this agreement, one for each party. The City of Reykjavík reserves the right to revise this agreement and make changes to it within its agreement period if the trial period warrants so. Any imminent changes should be reported to the service provider at least two weeks in advance.

9. Confirmation and treatment of controversial issues

9.1. Should any dispute arise in connection with this agreement, the parties will strive to jointly resolve those issues. If that proves to be unsuccessful, the matters may be resolved in the District Courts of Reykjavík. In case of any discrepancies or difference in wording between this English version of the agreement and the Icelandic version, the Icelandic version shall prevail.

Reykjavík, DD.MM.YYYY

________________________ On behalf of The City of Reykjavík

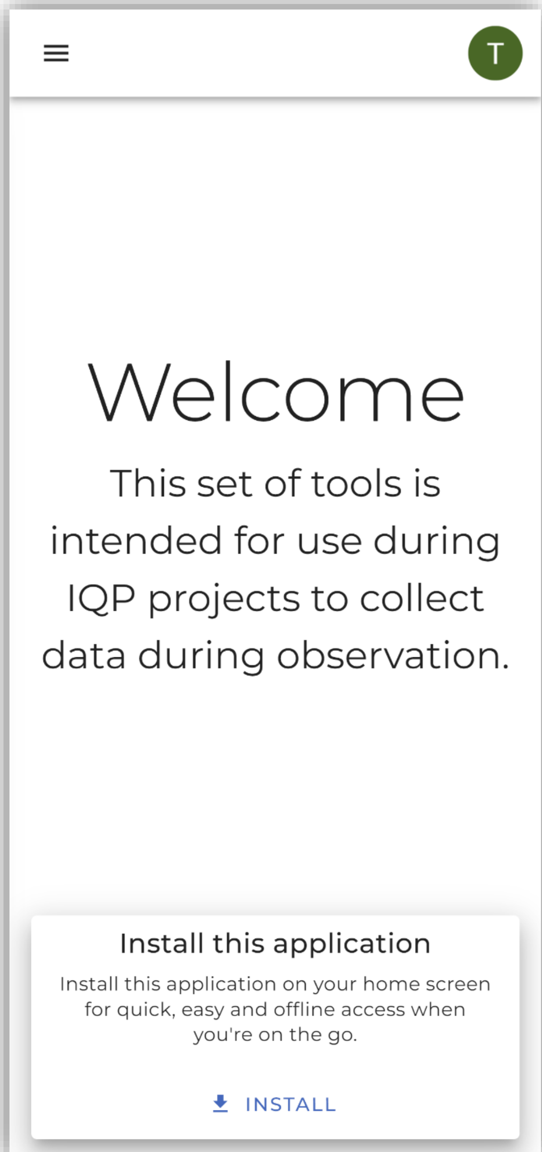
________________________ On behalf of the service provider

Appendix E: ISS Tools

Source Code: https://github.com/xyven1/iqp-data-tool

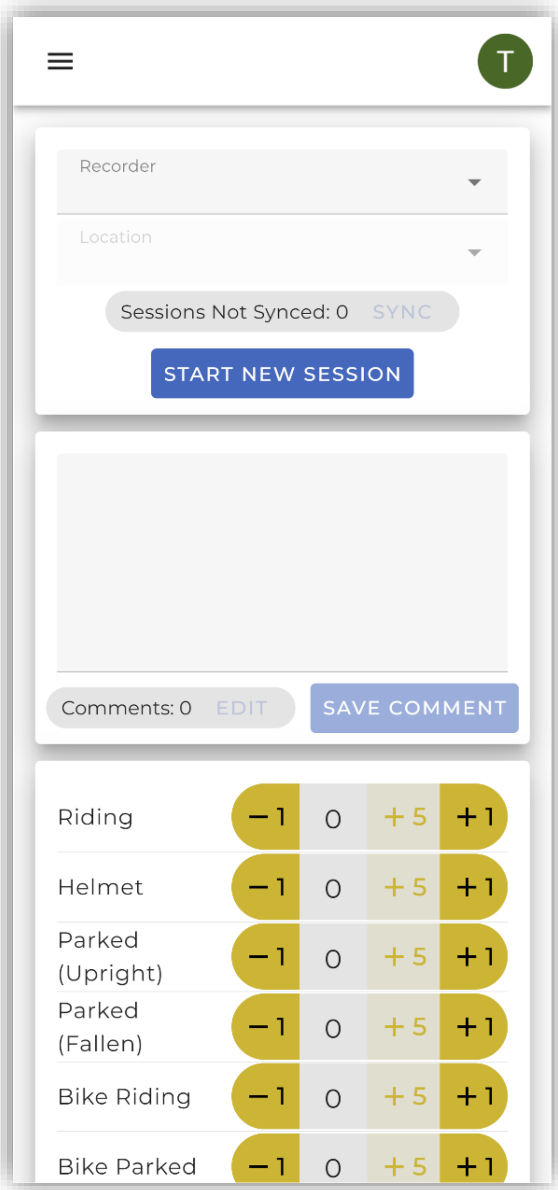
Home page

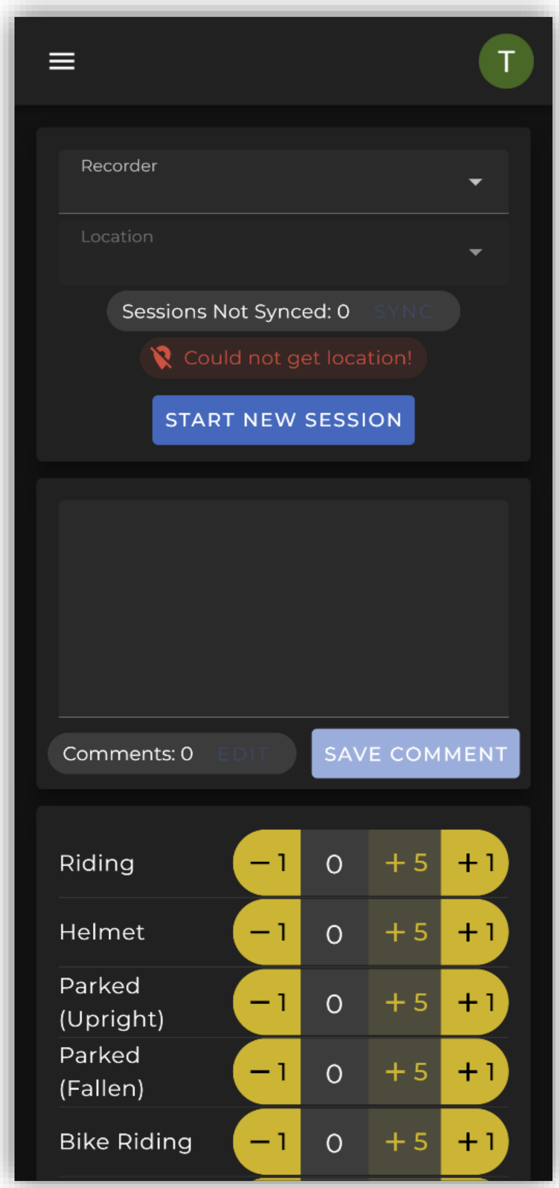
Welcome screen of application with install prompt, and the corresponding dark mode version without the install prompt.



Data Collection

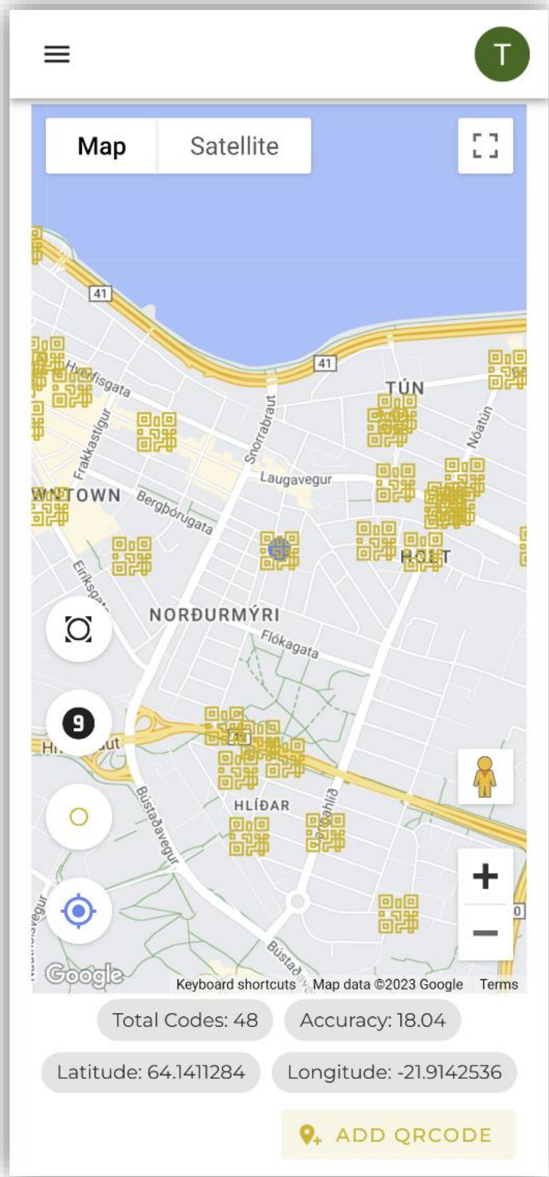
Data collection page of application, responsible for the collection of the data in Appendix C: Observation - Data. Location was used for geotagging comments.

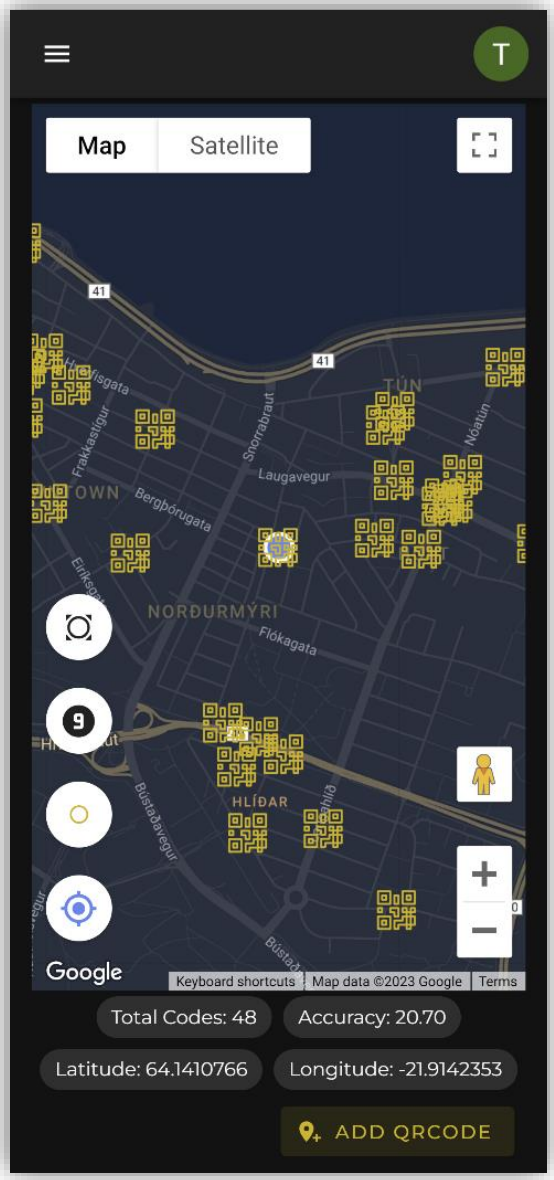




QR Code Tracker

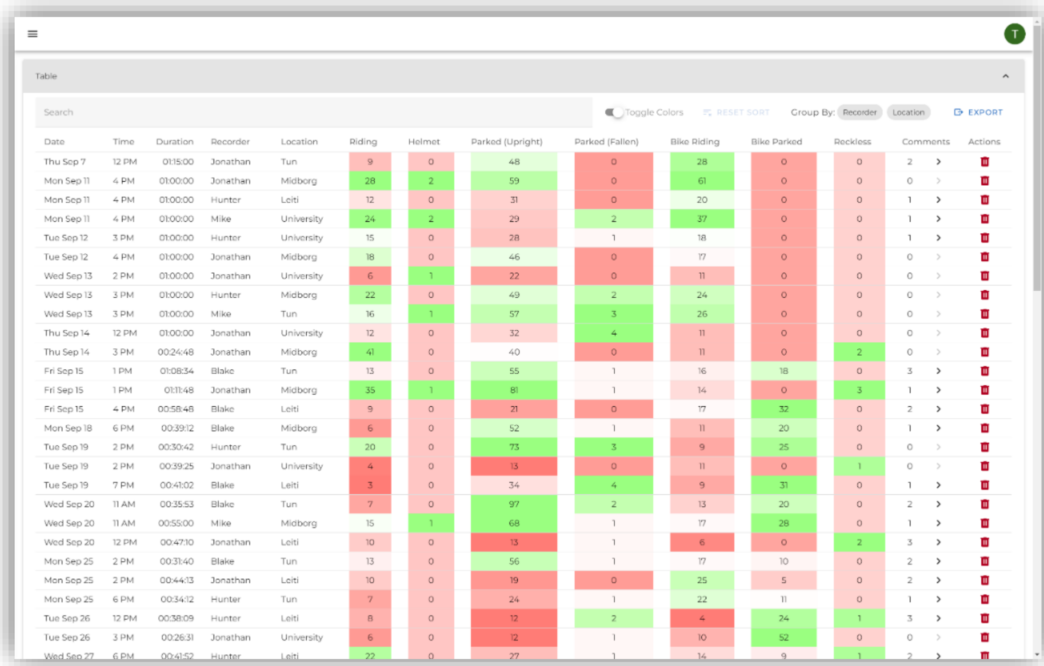
This page was responsible for the tracking of all the QR codes (Appendix B: Surveys - QR Code) that were placed throughout the city.



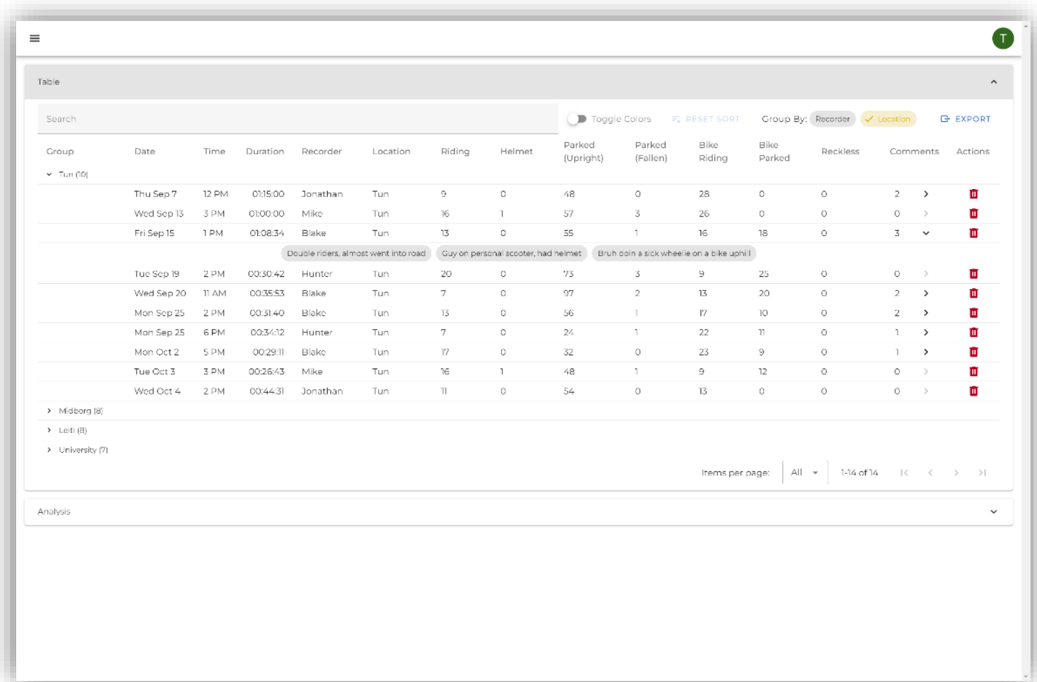


Data Viewer

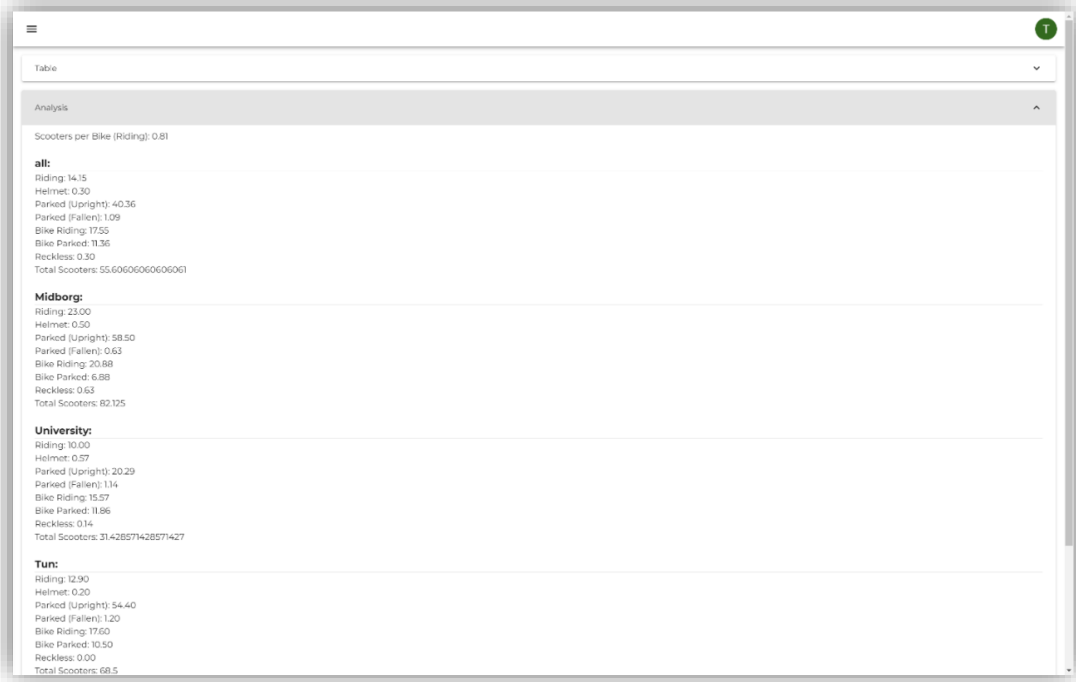
The data viewer page was responsible for viewing the data and performing sanity checks, as well as removing extraneous data points.



Data table with colors enabled, which apply red and green tint to each cell depending on how many standard deviations each cell is away from the mean.



Data grouped by location, and with one row expanded.



Simple data analysis with averages for each region, and averages overall

Appendix F: ISS Online Resource Deliverable

E-Scooter Service Considerations

When introducing an e-scooter service to any city, there are many potential issues and pitfalls, and careful consideration must be given to each to ensure e-scooters can have the biggest positive impact.

Usage

One of the key issues with any e-scooter service is its usage. What type of people ride them? Are there issues with equity? How often are they really used, and how does it compare to other options like bikes? How much does weather affect usage? Answering these questions is key to ensuring that e-scooters are best serving the most common demographics, and can make or break the viability of e-scooters in a city.

Urban E-Scooter Landscape

E-scooters do not exists in a void, and so they must work well with their urban environment. The population of e-scooters can be problematic as overpopulation can cause economic, societal, and/or environmental issues, and so city governments must consider how to address this problem. Dockless E-scooters can also cause issues when not properly parked. Some solutions, such as mandatory drop-off points can be effective but greatly reduce the incentive for people to use them. Other topics that arise include the environmental impact of e-scooters, road conditions, and weather.

Safety

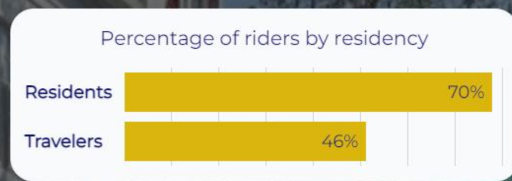
A common issue with e-scooters services is safety. E-scooters are fast, and often used in close proximity with both cars and pedestrians. Cities have to figure out what rules and regulations to apply to e-scooters, and how they will fit in with cars, bikes, and pedestrians. Common issues include poor road conditions, communication between riders and non-riders, and helmet use. Cities without mandatory e-scooter areas often see e-scooters left in places which are inconvenient or even dangerous for other road and pathway users. Injury and accident risks are the main concern and one of the more difficult aspects of e-scooter services to address.

What About Reykjavík?

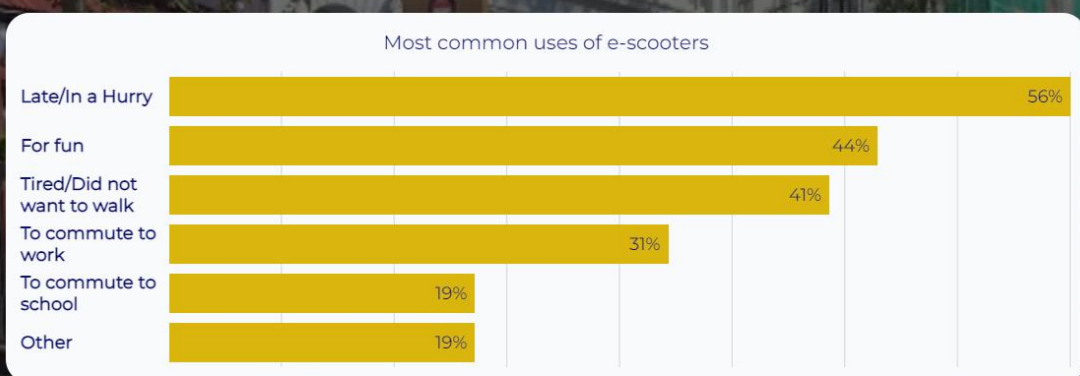
Reykjavík is the capital of Iceland, and the largest city in the country. It is a popular tourist destination, and has a population of around 130,000 people. The city is also the home of the Icelandic Scooter Squad, a group of WPI students who studied e-scooters in during the fall of 2023.

Usage

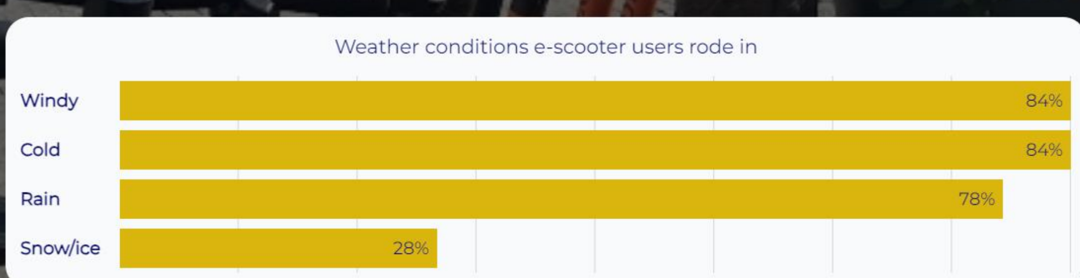
Studying e-scooter usage in Reykjavík, out of 54 survey responses 59% of respondents had said they have ridden e-scooters in the city. Notably, residents accounted for 55% of the responses, and 70% of residents had rented e-scooters before, compared to 46% of travelers. This supports the claim that e-scooters are not just a tourist novelty but a commonly used mobility form of transport for all.



Age was inversely related to e-scooter usage, with older respondents expressing safety concerns, particularly regarding balance. Gender distribution showed 59% male participants, 27% female, and "Not listed," "non-binary," or "prefer not to say" were individually under 5%. The majority of riders, recorded at 53% had taken 21+ e-scooter rides, emphasizing their frequent use, driven primarily by "being late/in a hurry" at 56% and "for fun" at 44%.



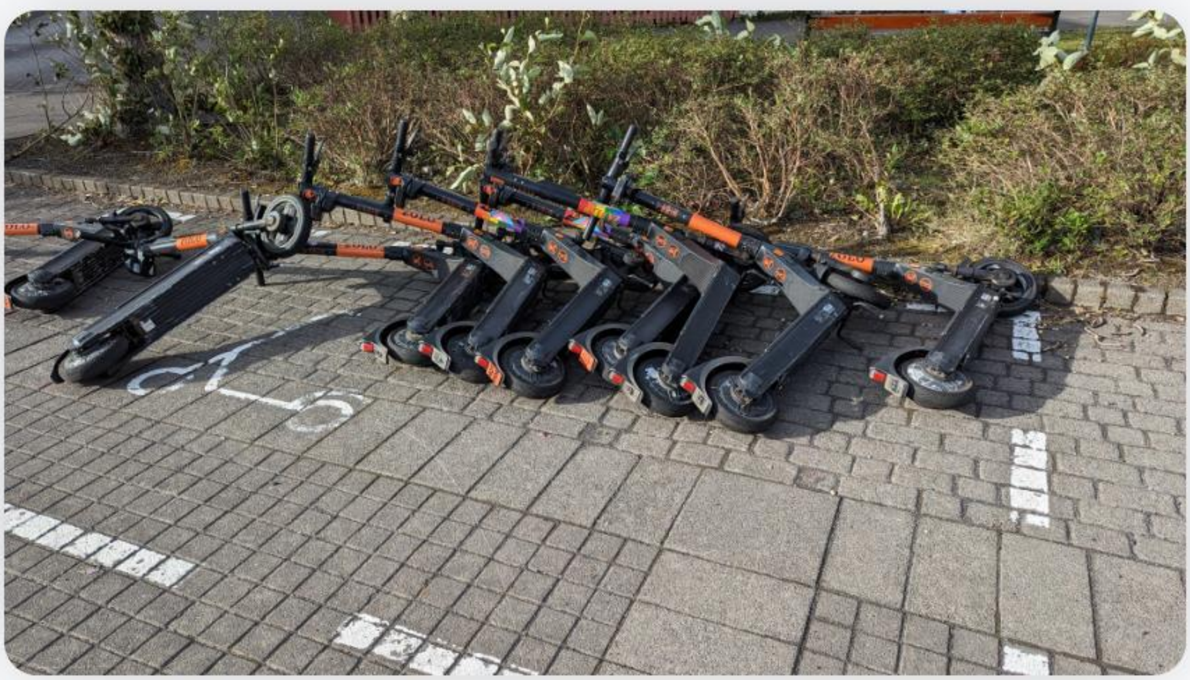
Weather is seen to have little impact on Reykjavikians, with 84% responded to riding in "cold" and "windy" conditions, and seasonal data indicated "rare" usage in winter, "frequent" usage in spring and summer, and "occasional" usage in fall. Overall, e-scooters in Reykjavik seem to cater to a diverse user base, extending beyond tourists, with varying usage patterns influenced by age and little impact from weather conditions.



Urban E-Scooter Landscape

Comments from Zolo's CEO, Adam Helgason, highlighted the idea of designated parking areas called "drop-off zones" and their pros/cons. Further data from the interview revealed that e-scooters cover an average trip length of 4.9 kilometers and see 2.1 daily trips per e-scooter, with hotspots mainly in downtown Reykjavík. Seasonal trends showed lower usage in winter, mitigated by more adapted e-scooter models for Icelandic winters, winds, and roads.

Safety concerns regarding the landscape emerged as some e-scooters were knocked over in different districts, as poor road conditions being reported, affecting user experiences. Obstructed pathways were a significant percentage of respondent's reports, either from bad parking or wind blowing them over. The Government provides clear directions as to park in a manner that does not impede the movement of other road users in the Safety and Usage Government Document. Some areas of concern include parking in the middle of pavements, footpaths, ramps, houses, or pedestrian crossings.



The Icelandic Government created the Service Agreement Contract, which helps address some of the distribution concerns. Section 4.2.3 specifies that an average of 2 rides per e-scooter per day for 3 months, as well as an average of 0.5 rides per day for any 1 month period is minimum for all companies. Furthermore, there are specific "drop off zones" for any e-scooter seeking to reduce clutter, but they are not mandatory. The city of Reykjavík has also implemented the Green Deal which is an agenda focused towards improving the city's environment, economy, and society. One of their stances is to put more pedestrians on the road in eco-driven ways like bikes, e-scooters, and public transportation, as seen in the Green Deal Government Document.

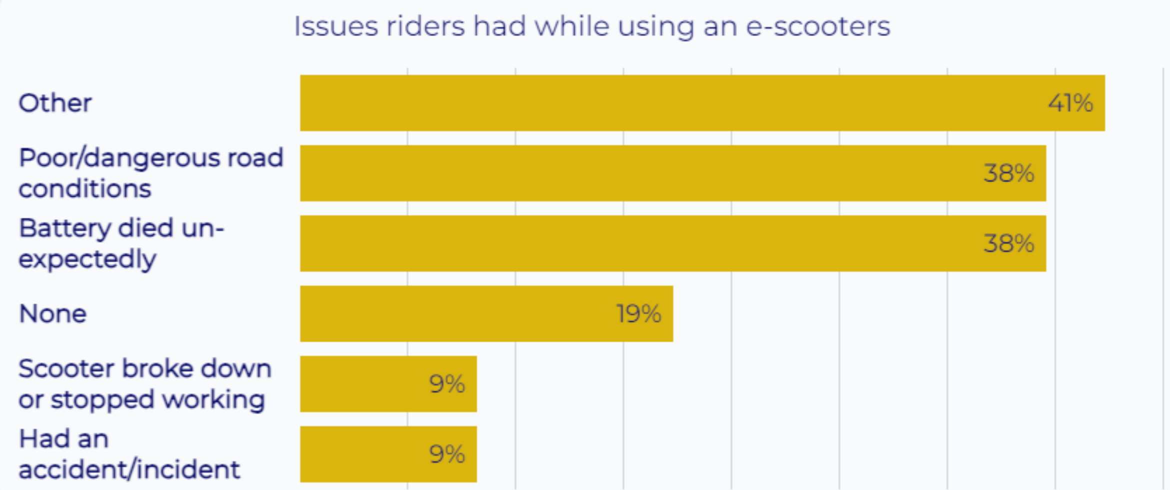
Pertaining to the environment, both e-scooter companies here make maximum efforts to retrieve lost e-scooters, even from unusual places. They do this through using user-provided pictures when users take pictures at the end of their ride, hooks and ropes when in water, and sound signals to locate if not seen nearby.

Safety

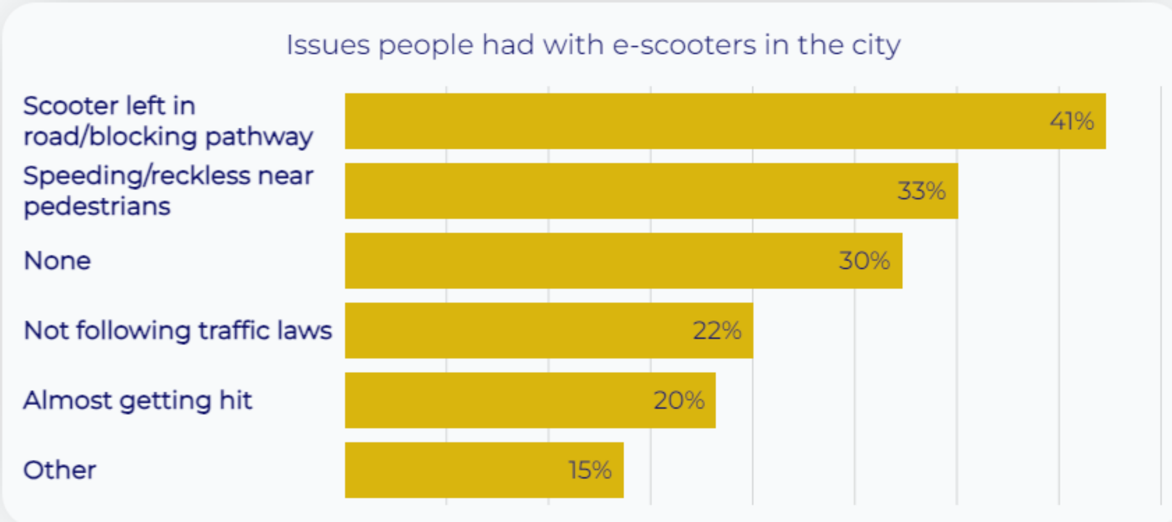
Regarding safety, observations revealed a startlingly low use of helmet use among e-scooter riders, with just 10 of 467 riders from our data seen wearing helmets on a Hopp or Zolo e-scooter. Reckless behaviors were also noted during observations, particularly the very common occurrence of two and even three riders on a single e-scooter, which violates the rule of no passengers in the Safety and Usage Government Document.

To address parking concerns, both Zolo and Hopp implemented a feature in their apps that requires users to take a picture of their parked scooter after their ride. As stated by the Icelandic government, a rider needs to keep in mind pedestrians do not expect a fast scooter flying from behind them. A bell must be used in advance and to slow down when passing as well as the use of turn signals on e-scooters for better communication. Another solution to road user safety is in the Governments Traffic Act, Article 46 stating that if a bike lane is parallel to a footpath, you may only drive on that bike path.

When analyzing issues faced while riding e-scooters in Reykjavík, our data highlighted significant concerns. With the highest issues both being "battery died un-expectedly" and encountered issues related to "poor or dangerous road conditions" being at 38%, other issues included scooter breakdowns or sudden stops, accidents, and various "other" scenarios.



Additionally, issues while users were not riding an e-scooter were recorded. The main issue, affecting 41% of respondents was "e-scooters left on walkways". "Reckless behavior near pedestrians" 33% and "not following traffic laws" 22% were also prevalent issues, with 15% of respondents elaborating on these concerns. These issues pose both a great risk for the e-scooter riders, but also pedestrians, which is a known issue with e-scooters. This reflects a need for more education for e-scooter riders to ensure they understand the laws which they must follow.



Further Details Found In Full Report.

Search for "Sharing the Ride" on https://digitalwpi.wpi.edu/collections/iqp

gr-iss-a23@wpi.edu

Appendix G: Project Timeline

TASK	Week							
	PQP	1	2	3	4	5	6	7
Research								
Interviews								
Observation								
Surveys								
Website/Deliverable								