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OPTIMISING THE PRODUCT-SERVICE SYSTEM FOR SCOOTER-SHARING IN CITIES

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ABSTRACT
Over the last few years, electric scooters have become a fundamental part of our cities as they pop up at every street corner people pass by, unfortunately creating more obstacles than possibilities. As part of the so-called micro mobility, they provide a solution for the ‘last-mile,’ the distance you cover between your drop off and destination in the city. Although they seem like an ideal solution, never has a product-service system been so controversial. This paper focuses on the combination and integration of other sharing platforms, new innovations, and insights to improve the overall quality of this product-service system. This paper provides a design tool and first concept to generate a new kind of sharing platform, based on safety, quality, better lifespan, and convenience.
Many attempts have been made to improve the overall ride and use of this concept. However, these small optimalisations will not solve the bigger problem. Companies have not actually changed the general mode of use, rather smaller profit margins inhibit them from resetting the current usability, leaving them with less room for innovation/improvement.
This article focusses on the design of a new platform to optimize user experience and quality. The platform be built up from scratch to have total freedom and control to reimagine the way users acquire, use, and drop off sharing scooters. Using in-depth qualitative research and knowledge of product-service innovation, micro mobility and sharing economy, we will try to solve the most critical problems and controversy on the phenomenon. The goal is to deliver a methodology and product-service system that serves as a benchmark and provides solution for cities and new or existing providers.

Keywords: Electric scooter, micro mobility, last-mile, sharing economy, product-service system

Figure 1. Multiple sharing scooters in the city of Antwerp (Vervoort; 2022)

1 INTRODUCTION
Summer 2017, some students from Singapore manage to create a successful, innovative transport medium for commuters, tourists, and city dwellers [1]. An electric scooter, ground zero for a new

product-service that will be positioned within the sharing economy for micro-mobility (small electric vehicles intended for travelling a short distance by one person).

It doesn't take long before technology companies from Silicon Valley jump take note of this new phenomenon. This is how the companies Bird, Lime and Lyft, among others, arose. After a successful implementation in dozens of American cities, in 2019 the crossing to Europe followed. With active providers and users in multiple countries and cities. Now, a few years have passed, and the electronic shared scooter has become a fundamental part of our major cities and their mobility offerings.

It quickly created a competitive market and extensive offer for the user, even before governments and cities could impose clear rules [2]. In addition, it soon became apparent that the electric scooters used did not meet the expected requirements in terms of ride quality and service life. This requires the exposure of the main problems and appropriate intervention. Both provider and user benefit from an improvement of the system, at product and service level.

2 THE PROBLEM

2.1 Design problem

Although this new platform could perfectly respond to the increasing demand for mobility solutions and the filling in of the 'last mile', both provider and user are experiencing too many problems. This means that a long-term success story might not happen. The quality of the shared, electric scooter does not meet the user's expectations and creates dangers for both them and other road users. The providers are also experiencing problems with the longevity of their product, leading to minimal profit margins and a possible breach of trust. In addition, the host cities are also increasingly questioning whether this new feature contributes to the vision on sustainability and mobility of the future that they want to represent. Before they could determine the impact of this subsystem and the additional necessary rules, the mobility solution was already in place. Clear, communicated legislation and guidelines for the providers are still lacking [3].

2.2 Design opportunity

As a product developer, it is interesting to be able to zoom out and find a coherent solution to the whole of the above design problems. Subsequent research and analysis try to proof how a restructuration of this service in combination with an optimization of the current product can lead to a better product-service for all possible stakeholders. The weaknesses of the subsystem are highly topical. Reports and our own experiences show that interventions can and must be made in several areas.

Firstly, keeping the scooters neatly distributed proves to be very problematic. The strength of shared scooters lies precisely in the 'free float' nature of this mode of transport. The user leaves the scooter where it is most convenient. However, this may create an extra obstacle for other road users [4]. An electric scooter that is insufficiently resistant to incorrect use, vandalism and wear and tear does not fit in with the long-term goal of this system. The lifespan of the shared scooter is significantly lower than hoped for and promised by the providers. This has a negative impact not only on the revenue model but especially on the safety of the user, the point of intervention with the highest priority. The low quality of use and the ignorance of inexperienced and occasional users cause more than two hundred serious accidents every year, including accidents involving children [5].

2.3 Perspective

Product-service system design (PSS-design) is an ongoing discussion and convergence to understand, explore and define the different value perspectives of those who influence the context and others who are affected by it [6]. The knowledge of this matter, creates opportunities to approach and then solve the mentioned, overarching problems. This involves looking at the product offered as well as the service associated with it to offer and use the product. The breadth of PSS design allows for a coherent solution to a multidisciplinary problem.

3 ANALYSES

3.1 Research method

To analyse the problem as thoroughly as possible, extensive research was carried out through various channels and search fields. The current situation was mapped out with an exploratory multidisciplinary analysis, the monitoring of current affairs and accompanying field research to be able to frame the problem as good as possible. Next, an attempt was made to converge on solution-oriented research through discussions with experts and stakeholders. Problems and opportunities were substantiated as much as possible by scientific literature studies.

3.2 Context analysis

The context analysis was carried out to be able to locate the problem of shared scooter systems within the context of (micro) mobility in the city. By ‘zooming out’ and looking at other mobility solutions, one obtains a better overview of the entire situation and the plan of approach that other providers might use. This makes it possible to gather an extensive file of stakeholders, which can be useful in the further course of this research.

The most important stakeholders are the users, the providers, fleet managers, the city council, other road users, competitors and medical staff.

3.3 Field research

To carry out a thorough human analysis, the user journey was mapped out. This makes it possible to locate critical points in the process and to see how this creates opportunities in the design process. The drafted trajectory was tested in practice to determine the points of intervention. It can be concluded that there are several steps within the usage process where intervention is possible. This can be done both in function of the user and the provider. The most important intervention points are raising awareness beforehand, accompanied by extensive legislation and monitoring. In addition, the general ride quality and safety risks during the use of the shared scooter and finally the ending of a ride and the correct disposal of the shared scooter. In the next part of the analysis, it will be shown, among other things, how targeted research can lead to specifications that can bring improvements for these intervention points.

3.4 Technological analysis

The technological analysis is based on a detailed analysis of the shared scooter itself. By defining the strengths and weaknesses of this vehicle, it is possible to create a set of specifications and intervention points. These form a basis for developing 'the shared scooter of the future', which will contribute to the needs of the user and the requirements of the provider. The shared scooter has already evolved greatly over the past few years. A wrong estimation of the life span of a shared scooter, made it necessary for providers to make fundamental adjustments to their product. To be less polluting than other means of transport, the shared scooter should be used for an average of 9.5 months. In practice, this is only 7.5 months [7]. In general, the partial scooters are not sturdy enough. This is because most providers chose to buy the basic product, the electrical scooter, from a specialized manufacturer like *Xiaomi* or *Okai*. However, these scooters were originally designed for private use. Consequently, they are often unable to withstand the extensive use, weather elements and vandalism associated with this sharing platform.

3.5 Human analysis

It is important to find out from the end user why they would use this mobility solution and what their expectations are. In addition, the user journey already showed some critical intervention points.

The most important reason for the use of subsystems within micro-mobility is convenience. In a survey conducted by McKinsey ACES(n=7000), this came with more than 50% for being cheaper than a private car or taxi. Followed by a possible company fee, not having to carry cash, and not having a driving license. The most important requirements that a consumer expects are as follows; safety, followed by a competitive price and in third place the availability and reliability of these sharing systems [8]. This research supports the findings observed after own use and questioning by other users.

The fleet managers were questioned by means of qualitative research (n=26). A survey of the most important tasks on the one hand and most frequent problems on the other led to the following conclusion. The most important tasks they must perform daily are charging the shared scooter or replacing replace replaceable batteries, moving and rearranging the shared scooter outside the user's hours and finally the maintenance of this means of transport.

Figure 2. A fleet manager blocking the passage for pedestrians (Vervoort,2021)

3.6 Economical analysis

Within the problem definition and context analysis, the economic size of this billion-dollar industry was already briefly explained. With an estimated European market size of one hundred billion dollars by 2030, it is no secret that this market is proving to be very attractive to startups and investors [9]. The technical analysis already mentioned that the lifespan of a shared scooter does not meet expectations. This has major economic implications. Companies must continue to innovate and analyse to keep their product alive and remain financially healthy as a provider. Also, the revenue model is currently too limited to be able to speak of a success story. The past pandemic and ongoing war between Russia and Ukraine are still affecting the market. The choice for a private mobility solution because of the infection risks prevails over cost and convenience for the time being [10]. When looking at the cost distribution per sub-step, one can also speak of a story before and after the pandemic. It can be concluded that the largest part of the cost is in moving the sub-step. This is due to the fees that providers owe to the fleet managers. An optimization or adjustment of this component could lead to higher profit margins for the providers.

3.7 Comparative study of product sharing systems

After this analysis, the decision was made to also conduct a comparative study between a provider of shared-steps, *Bird*, and a competitor within shared mobility, *Blue-bike*. The study is based on a comparison between the usage method on the one hand and the business models on the other.

The study makes it possible to look at what elements in both providers determine their success and where the problems and opportunities lie. In this way, it is possible to zoom out and examine whether it might be interesting to combine certain characteristics into a new product-service that could provide a favourable share-step system in the long term. The analysis has shown that the product-service system of Blue-bike better meets the intended lifetime of these mobility solutions. The addition of an access point creates the possibility to better monitor and guarantee the condition of the rental bikes to the next user. The maintenance and management of the shared bicycles will be simplified because of the fixed location of these lending points. For the shared-steps, this could mean that the main problems raised in previous analyses could find a possible solution in the implementation of some elements of the product architecture used by Blue-bike.

4 CONCLUSIONS

4.1 Critical aspects and trade-off parameters

This paper contributes to the improvement of mobility solutions for smart cities by identifying the major concerns for users as well as distributors and providing matching product-service system concepts.

The most important critical aspects were synthesized from the analysis. These aspects are technical, human, ecological and economically related to the product and service provided. They form a base for defining a new product idea or improving existing goods.

The sharing-scooter that is currently on offer is an iteration of a product that was developed for private use and therefore does not meet all the essential requirements. Providers need to commit to adapting their scooter to a suitable model. They could and should focus on modularity, stability, safety, and connectivity. These factors all contribute to a higher quality product-service and should prove their economic added value in the longer term.

The necessary sensitization and prior knowledge of the user is lacking. This can lead to incorrect use and accidents as a result. To this end, providers and local legislators should cooperate more closely. These verifications can increase the overall reliability.

Companies must continue to innovate and analyse to keep their product alive and remain financially healthy as a provider. Optimizing this product service can certainly help. The overall analysis of this promising form of mobility has shown that there is room for improvement in several areas. Providers should dare to zoom out to better locate their offered product within the current mobility offer.

To generate a new product system, the following questions were asked. In this way, possible design routes for the new PSS emerge. A few examples are given:

What can be changed/obtained if one:

- Tries to combine/merge the advantages of different product-service systems?
- Moves away from the existing free floating approach?
- Focusses on the last mile principle? Rather than replacing public transport?

Can we improve quality and durability of this product-service by:

- Exposing the weaknesses of the electric scooter and provide them with appropriate, innovative solutions?
- Designing and producing modules that each tackle a specific problem? After which they can be added onto existing scooters and increase product lifetime.

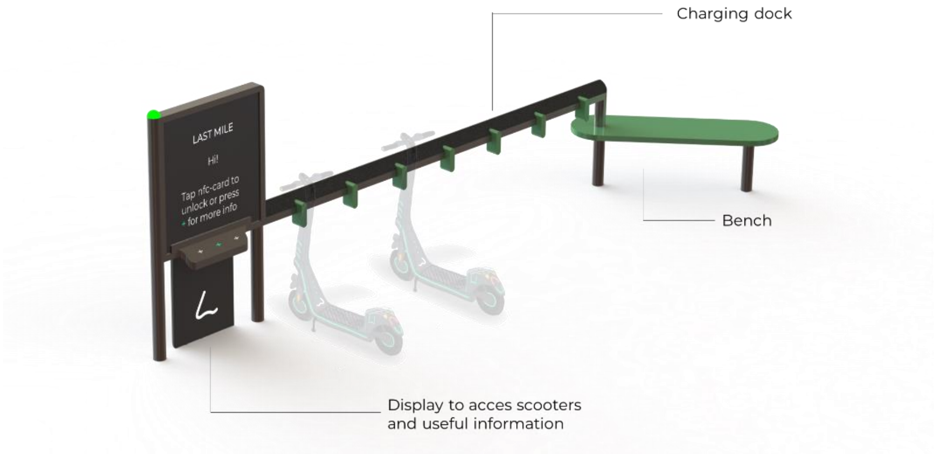

Figure 3. Concept for a new approach to share and charge electric scooters (Vervoort,2022)

In the next phase of this study and design process, the most important problems and opportunities will be converted into real products and services to improve the current situation. Aside from being a useful guide for new and existing providers within this niche, this study also contributes to product development, design and education in general. The approach used in this research may be acquired in other, design related studies.

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