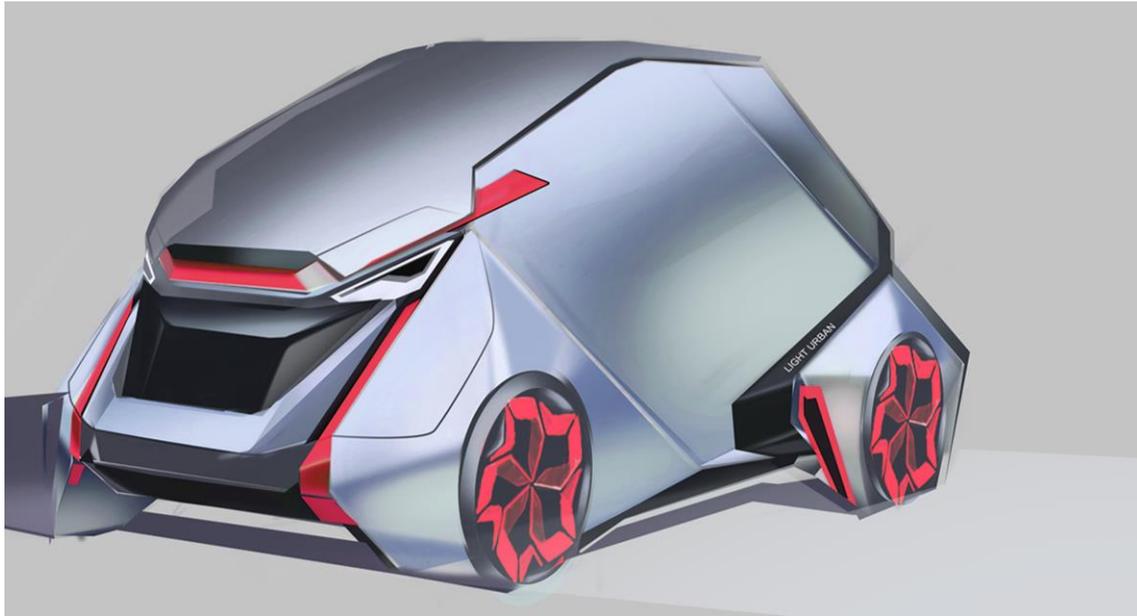


CHALMERS



Electric Smart Vehicle Design for the Suburban Area of Shanghai

Master of Science Thesis in the Master Degree Program, Industrial Design Engineering

Han Xingmou

Master of Science Thesis

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Master of Science Thesis PPUX05

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Chalmers University of Technology

ABSTRACT

Public transport service is a prevailing assistance for peoples' daily traveling, and however numerous residents are confronting the unsatisfied traffic situation in Shanghai, particularly in suburbs which has not been holistically covered by public transport network. As one of the biggest metropolis in China, Shanghai will constantly absorb migrate residents, and the emerging population often distributes in suburb. While, that unbalanced distribution require more improvement on public traffic, especially the promotion on daily commuting for the migrate workers.

The idealized aim of this master thesis project was to alleviate the constantly increased traffic pressure, and to optimize the current public transport system in order to cope with the upcoming population and urbanization. The concrete goal in this thesis was therefore to develop a more appropriate transportation and corresponded service for commuters in suburbs.

Advantages and deficiency of current public traffic service were investigated through literature studies, and the survey on intended users had indicated the features and essential requirement. The design research had established the intended product and its specification. Subsequently, concerned the knowledge on automotive manufacture, a conceptual urban transportation was generated according to the insight of intended users and limitations.

In the end, the ultimate conceptual vehicle was tiny vehicles that worked in a renting service system. These vehicles would be served dedicated for the residents, in particular the commuters in suburbs of Shanghai. The final result served more flexible, reliable vehicles that extended the service for current public transport system. A final conclusion was enhancing the diversity in public transport service with merging smaller, flexible and sustainable alternatives would be beneficial for the dense city in the future.

Keywords: public transport system, user experience, user need hierarchy, transportation design.

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01/ INTRODUCTION

This chapter indicated the starting point of this thesis through describing the overview on the background, the aims and intended achievements in this project.

1.1 Background

Shanghai is one of the biggest metropolises in China, which is constantly absorbing new immigrants as dynamical resources for its rapid development. Under this macro background, the local government is confronting a potential crisis regarding the difficulties to provide adequate public traffic resource. Despite the shortage of land in the central region, the suburbs emerges more issues derives from incomplete public transport service and the growing residents.

Currently, Shanghai has established its multiple traffic modalities. In this system metro system, bus system, taxi, private car, electronic moped and bicycle constructs the overall traffic structure in this big city. The local government also starts to concentrate on the significance of public traffic system, which is more beneficial to the sustainability in the modern city. According to the official data, so far Shanghai contains 12 metro lines with 452.6 kilo meters metro trails. Moreover, 1156 bus lines are playing crucial roles in the secondary transport network. The official documents also indicated that the local government will enhance the service of public transport and prompt its utilization in order to release the traffic pressure.

However, the commuters who live in suburbs cannot enjoy the public traffic service conveniently. On hand, due to the less rent in suburbs, most of migrate workers choose to live in those area and even satellite towns; on the other hand, the existing public traffic network has not totally covered this area where large amount of people have to resort to three wheel mopeds and unlicensed cabs. The suburb buses without comfort, punctuality and efficiency always annoy commuters, so people prefer to take other transportations, like private cars, which will not be an appropriate choice in long term.

The lack of public traffic resource in suburbs is one of the most significant reasons that blocks the daily traveling for commuters, and most of them cannot afford to the private cars. Most of the suburbs in Shanghai do not have metro service, and only a few of bus lines are operating in those areas, and normally those areas are enclosed by multitude enterprises, which means thousands of passengers are flowing during work days.

So far, suburbs do not have adequate feasible alternatives for urban transport. Three wheel mopeds and unlicensed cabs cannot grantee the safety those commuters, and those embarrassed alternatives will threat the passengers' live and security. According to the official statistics...

In this case, in order to release this issue, elevating the attraction of public transport is becoming crucial increasingly (Shanghai Municipal Government, 2012). An effective, desirable, safe and sustainable ground public transportation therefore will be valuable to be developed in Shanghai.

1.2 Project Description

This master thesis project in Chalmers University of Technology focused on the Chinese circumstance, and it has been performed with the assistance from department Applied Mechanics in Chalmers and College of Design and Innovation in Tongji. The project used current traffic issues as the input, and it investigated the user experience on existing mainstream public transport mode in suburbs of Shanghai, particularly in Zhangjiang Hi-tech Park. The concepts were extracted from the insight of users and developed with the limitation in terms of automotive manufacture and safety. T

The main focal point is looking for a more optimized ground public transportation in suburbs of Shanghai, and a corresponded service system were proposed to make this service more holistic. In addition, the investigation indicated the proportions of each type of user needs, and proposed how to attract more passengers to use public transportation. Ultimately, with the outcome of primary research, a conceptual

transportation with a brief service would be developed in the intended context, and the design would make the concept functionally realizable as much as possible.

Hence, user experience, user characteristics, ergonomics and transportation service were essential basis in this project.

1.2.1 Aim and purpose

The aim of this project is primarily to develop an innovative, flexible and safe urban transportation with reasonable usability, which enables the intended passengers to have additional alternatives to travel more conveniently.

The secondary goal is exploring the potential probabilities to complement current public transport system in the surrounding area of Shanghai. From a macro perspective, the vehicle will serve as a tangible element within the secondary transport network, which enables the public traffic improving its service quality.

In addition, through the investigation of public bus, this thesis also indicated the users' attention distribution on different layer of needs in the user needs hierarchy of Jordan (2000). The distribution could help designers to concentrate on essential focal points rather than all relevant aspects.

1.2.2 Deliverable

In this thesis, the main deliverable was a thesis report that record the entire process of this project, and the investigation and its findings were demonstrated to probe how people's attention distributed on different layer of needs when it came to sharing product, like public bus. A conceptual transportation on design stage would be indicated as well. The outcome included a transportation design and a brief service system, and the transportation design included package design, exterior design and interior design. At last, the concept was presented the service map, sketching and rendering.

1.2.3 Delimitations

There were some aspects not being covered or fixed in this thesis. The holistic urban traffic planning was not included in this thesis, and the manufacturing design to realize the concept was not covered as well. The final conceptual transportation would be an available alternative for current ground transportation in short journey. The corresponded consideration on urban planning, specific financial investment and maintenance were generally concerned. The concrete framework, manufacture and realization were also standing on the initial stage in this thesis. Moreover, there are some other delimitations emerged in the process, which would be listed later in corresponded chapters.

02/ PROBLEM DEFINITION

This chapter described the macro and concrete problems that this thesis was intended to solve. Its context and the significance were interpreted as well.

2.1 The issues of public urban transport in Shanghai

Public urban transport is an effective assistance for accelerating people's traveling efficiency. On one hand, operating public transportations facilitate people's live quality, which solves a critical aspect in people's daily life; on the other hand, the utilization of public transport system has optimized the urban structure which means enhancing the connection among different districts and allocating extra spatial resource for other usage.

The current public transport system consists of city metro system, ground bus system, cob service and ferry system. According to the authoritative report, so far, Shanghai has 12 metro lines with 452.6 kilometers railway length, and this city contains 1165 bus lines. Moreover, the local government is supposed to establish more than 60 traffic hubs in the city, and there are 50 traffic hubs are completed already.

The dwindling utilization of public transportation made the local government stuck in the middle. However, since the rapid development is constantly compressing spaces for urban traffic and the emerging private cars is aggravating this dilemma. Based on the official report, some essential issues emerged in last fifteen years have to be solved in the upcoming period.

A. The inadequate public transport attractiveness and the incomplete overall level of service could not fully meet the requirement of social development in Shanghai.

B. The shortage of land restrains the growth of Infrastructure; the existing facilities cannot catch up with the rapidly city expansion.

C. The integration of different transportations has not been completed.

D. The unbalanced distribution of passenger flow makes more congestion in central city but few in suburbs.

E. Most citizen regard bus service as a selection lack of reliability, and existing service mode cannot fix the issue about "the last one kilo-meter".

F. Current service structure is lack of holistic information integration and the capacity to analyze instant information.

The official report has indicated the government's ambition on prompting the public traffic service. However, increased amount of people prefer to choose private cars instead of public transportation. In this case, how to elevate the attractiveness of public transportation is the most pragmatic issue to be fixed currently.

2.2 The "last one- kilometer"

Compared to traveling with private car, existing public transport service contains some kinds of inherent deficiency. One problem is cannot carry passengers "from point to point", which requires extra effort on foot traveling. To be concrete, the passengers' traveling quality relays on the coverage of the service network from public transport company. It is a passive process for passengers. The other problem is the bad traveling experience on public transportation, particularly the ground transportation. That negative experience mainly stems from the lack of reliability and punctuality. Hence, the dwindling attractiveness of public transport is becoming an inevitable fact.

The "last one-kilometer" means the distant gap between passengers' home and the nearest transport station. Since the coverage of existing transport service cannot meet the needs for the most, so some authorities started their investigation on how to fix the issues caused by "the last one- kilometer". In fact, the people with physical limitation or heavy luggage do not regard public transportation as a prior choice. At

the same time, most private car could provide more efficient, more punctual and more comfort service rather than bus did. The service for the last distance after bus will be an effective strategy.

2.3 The secondary transport network in suburbs

In the suburbs of Shanghai, its corresponded public transportation has not been completely established. Taking Zhangjiang district as an example, the metro lines only approaches the Hi-tech Park, and the bus service with long departure interval led people to resort to other alternatives, which were irregular and even dangerous.

Based on the official data, many office workers and migrate workers are now living in the suburbs, however most job opportunities are provided in the central city. In this case, numerous commuters have to travel through the central city every day, but the coverage of metro were limited, so many commuters live in suburbs, particularly in outer suburbs will encounter more difficulties. If the commuters started to resort to private cars, these so-called convenient vehicles might exhaust more urban space in the central city and produce more inconvenience for other people.

Hence, associating traffic hub with commuters' residence will be a tendency and essential method when trying to modify the attractiveness of public transportation.

2.4 Conclusion

The essential causes of fading concentration on public transportation can be generalized into three aspects. Firstly, compared to driving private car, existing service do not has adequate coverage in this city, so this service cannot take the passengers from their living place directly to their destination. Secondly, so much negative experience makes people resort to other transport modality. At last, the unbalanced residents' distribution generated more requirements for public transport service, especially in the suburbs.

Hence, this project aims to answer following questions;

- Could the government switched to utilize better user experience and product usability to engage more passengers in public transportation.
- What is the key factors that the passengers really care for, and how to approach to a neutral solution in this unbalanced situation?

03/ THEORETICAL APPROACHES

This chapter introduced the relevant design theories and its corresponded theoretical basis.

3.1 Approaches

A public transport service is a complex system that is highly integrated with system operation, the concrete transportations and intangible service. The holistic system was customized according to the macro prerequisite and the circumstance in its intended city. As a sharing product, the public transportation was merged in a reasonable service system, and the comprehensive customer journey contains diverse section. All the components from the overall system to specific product would interact with users and generate user experience to fit different types of user needs, and affluent inclusiveness would be the principles when design for the public. In addition, the novel conceptual solution should contain a value proposition with novelty, which would be implemented with product value proposition canvas that allowed people to zoom into the details of product value proposition and customers' segment (A. Osterwalder, 2012). As a result, the project has selected following approaches to support its advancement.

3.2 System theory

As a type of framework that enabled people to cope with complex situation more holistically, system thinking was playing a crucial role in the design process (R.L Flood et al., 1993). The isolated concentration on single structural component could not comprehensively reveal the essential matter of existing issues. Likewise, when people encountered particular situation that blocked their traveling experience, they often traced the issues backward to the facilities closest to them. In fact, the more substantial causes sometimes were associated with the system structure or arrangement it belonged to, rather than the superficial issues caused by unsuitable product design.

According to the study of R. L Flood, a system was defined as an aggregation of structural elements, their mutual relationship, the boundary and the attributions of each element. In this case, from a design perspective of view, the public bus system can be therefore deconstructed as a combination of different tangible products and intangible services, in addition, the customers and the bus companies play a critical role as a wider system. Likewise, the external influential aspects, like commuter population or transportation amounts, can serve as the environment that enclose and affect the internal system.

Figure 3.A The definition of a complex system (R. L Flood et al. , 1993)

Based on the study of Flood, a complex system always comprised of narrow systems, wider systems and an outside environment that enabled the components to directly exchange material, information and energy. While, other influencing factors that affected the system indirectly via the environment had formed the wider environment. Hence, the public traffic system can refer to this model, and deconstruct into these four clusters.

The public transportation is a complicated service system with different components. A holistic product design development process should contain adequate consideration from a systematical perspective. The urban planning, population distribution and city structure could be the environment for the public transport system. The bus line planning and resource allocation were working as a wider system, at last, the system in the transportation was the narrow system in this mode. The system theory had played as a dominated guideline in this study.

3.3 User experience

Desmid and Eckert (2007) defined product experience as “the entire set of affects that is elicited by the interaction between a user and product. According to their study, the user experience or product experience consisted of three distinct components: the experience of meaning, the aesthetic experience and emotional experience.

The aesthetic experience was generated from the physical interaction between users and products, which included users’ specific stimulation from tactile and visual aesthetics (Overbeeke and Wensveen, 2003). The experience of meaning related to the attachment and symbolic value, in other words, it meant the experience or pleasure from the product’ s personality, the users would achieve additional value rather than functional feedback. At last, the people’ s personal appraisal on the product significance generated the emotional experience for the users, this subjective judgment established the mutual association between the users and environment. For product design development, it is essentially important to let the emotions from product in accordance with users’ emotional anticipation.

However, the significance of user experience would be discussed later in the study, because the proportion of these three components is different with in different product design process. Public transportation service is more close to a sharing product rather than a private asset, in this case, its user interaction is limited. Hence, their proportion will be refined after the user research of this study and be matched with the corresponded position in Jordan’ s user need hierarchy.

3.4 Jordan’ s user needs hierarchy

Linden and Brendle (2012) indicated that the emotional design can positively influence the development of products that promote inclusion. There is an extreme case which is that some normal users, who cannot afford to private vehicles, will encounter frustration as the usages of public transportations represent their social classes.

Whereas some dedicated equipment in public product has been delivered to support the special users, this assistance still contains lack of cares on users’ psychological level. In order to comprehensively fit users; need through inclusive design, the product should fulfill user’ s needs in different psychological levels. P. Jordan(2000) revealed the hierarchy of customers’ needs that comprised of functionality, usability and pleasure, later Linden and Brendle added dignity into the hierarchy as a holistic structure of users’ .

At the top of Jordan’ s hierarchy of customer’ need (P. T Jordan, 2002), the pleasure extracted form products can be subdivided into four categories. Normally, in product design, there are hierarchically multiple needs arise from the interaction between the products and users. Generally, all these needs can be fitted by different types of product experience, and experience can be convinced as a key factor that impacts the attractions of bus system. Moreover, basing on the study of P. Desmid and P. Eckert (2007), product experience can be defined as a change in core affect that attribute to human- product interaction. In this case, the pleasure can be treated as a positive emotional reaction arises from the interaction between users and products.

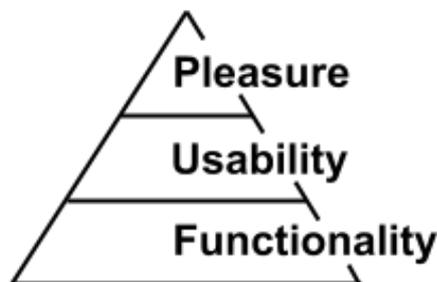


Figure 3.B Jordan’ s user needs hierarchy.

Normally, users and their private product can establish some special emotional association, which is able to enhance the relationship between the products and its users. Moreover, this emotional association is not extracted from the functional satisfaction, rather the additional satisfaction in psychological level. One idealized situation is fulfilling all the needs within this hierarchy, in other word, generating underlying psychological functions for user is a mainstream strategy for product design development.

In addition, holistic product design strategy does not mean more cost or additional investment, it is a process of rearrangement or optimization, which requires design to balance the profit of diverse groups. Similarly,

making a product or service be inclusive, can be also considered as a reasonable allocation for people's needs within different aspects in this hierarchy.

Jordan's need hierarchy would be a significant fundamental detector or reference to probe the distribution of users' needs in different level. The inherent attribute of different products has determined what type of requirements the product would or should fit. It also means, in the real context, different types of product have different purpose, in converse, the anticipations from the consumers are different as well, according to the natural attribute in the product. Hence, this distribution of need would clarify the speciation of inclusive design, and specify the purpose of design.

3.5 Conclusion

Understanding this system structure of public transport service will board the perspective for analyzing the issues of current service, and the environment and prerequisite must be the essential input for the initiation in this project. Moreover, a deeper comprehension of users' experience will contribute to insights collecting in this study, and combination of user insight and the design context will generate reasonable touch points for the innovative solutions.

The user need hierarchy constructed a blueprint for the selection of insights and touch point, since the user research can declare the significance of every type of user needs. This appraisal will guide the allocation and compromise among different type of intended users. Ultimately, the framework will be refined dedicated for the public transport system after the user research.

This theory framework is the dominated guide in this study, moreover, some concrete design methods and approaches will be introduced as a reference for the research design and concept evaluation. These approaches will be later described in next chapter.

04/ Literature Study

4.1 Traffic environment in Shanghai

[Shanghai, as one of the biggest metropolis in mainland China, is confronting the deterioration of the urban public traffic environment. Optimizing the transport efficiency and maximizing the utilization ratio for its PTS are the two potential approaches to fix the terrible situation, thereby release the pressure for public spatial resource.](#)

Shanghai has established the multiple public transportation system which served metro system as dominated solutions and ground transportation as supporting solution. So far, the overall system contains 12 metro lines, approximately 490 bus lines, and basically, these service network has covered the city's central part and suburbs, and so far the city center are working as a traffic hub that links the traffic resource between different suburbs.

Since the distribution of residence and companies were severely unbalanced. Even if the city center could provide sufficient job opportunities, but subsequently the resident space will be reduced. This fact led the people switch their residence to suburbs, and there are large amount of commuters who have to travel from suburbs to city center every day. These commuters will improve the pressure to the public traffic. In this case, the local government allocates more transport resource in the city center, which contains the associations to each suburb, but among the suburbs, they did not arrange mutual traffic lines. As a result, the requirement to be associated with central city is deteriorating the bad traffic condition in Shanghai.

The following picture implied the population distribution and the passenger amount in Shanghai. The picture in the left demonstrated the population growth from 2003 to 2008, which implied the population in the city center was negative increasing. However, and the same time, the suburbs had generated a tremendous population growth. Likewise, the right picture implied the growth of resident trips from 2005 to 2009, and the picture demonstrated the suburbs have more resident trips which are growing rapidly. In this case, the requirement in suburbs is considerable, but actually, the public traffic service in suburbs was not sufficient right now.

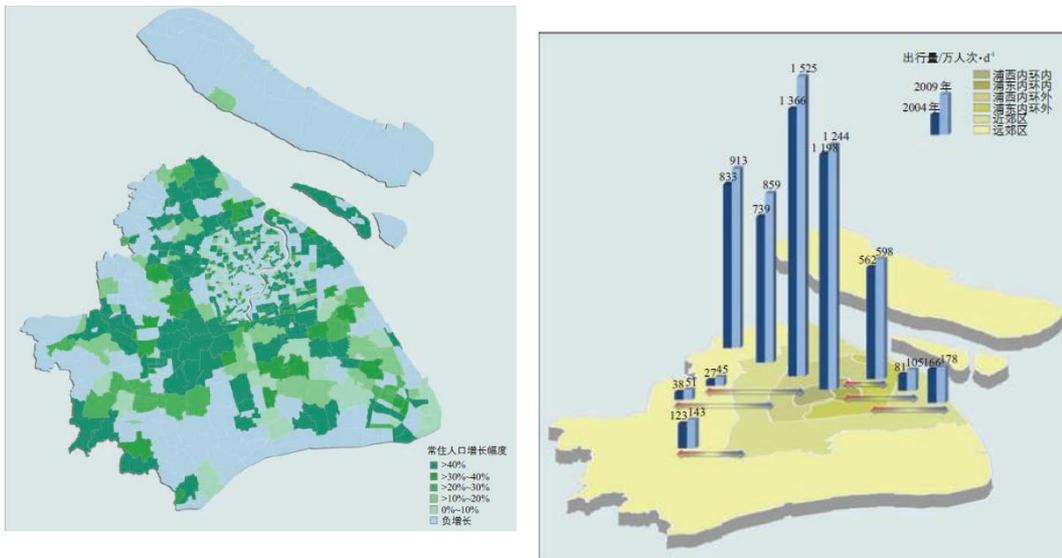


Figure 4.A The distribution of population growth(left) and amount of trips(right)

From the other aspects, compared to other Asian metropolis cities, Shanghai does not contain higher population density on average. However, in the rush hours, the traffic condition cannot work well, and perform more badly than any other Asian metropolis cities. The following pictures indicated the comparison among four representative big cities in Asian. It is clear that in the rush hour, there are a large amount of traffic congestions in the middle due to many private cars have occupied the urban spatial resources, and people do not want to take public transportation. However, other cities like Hong Kong, Tokyo and Singapore, their utilization of public traffic transportation are much higher than Shanghai, so their traffic performance in rush hours is comparatively better.

Moreover, according to the official report. The proportion of bus has decreased from 61.3% to 47.7%, and the auto trips quantity did not increased so much. The reason for this phenomenon stemmed from two aspects. On one hand, the local government constantly enhanced and developed the infrastructure of metro system, many residents started to choose metro system which contains more comfort and efficiency; on the other hand, the government might not have adequate budget to development ground public transportation service.

However, the previous data still indicated people's reliability from ground public transportation, since so far, metro is only suitable for long distance travel, and its service could not reach the trivial places like users' community. In that sense, the development of ground public transport, particularly in suburbs of Shanghai where the residents have much more requirements should be improved and focused on.

4.2 Public traffic services in suburbs of Shanghai

The previous chapter described the unbalanced development between central city and suburban areas in terms of their population growth, resident trips and traffic condition. However, to be specific, the public traffic service in suburbs are not complete, and there are many modalities that could help the residents approach to the metro stations or traffic hubs, hence, these supporting transportations includes public bus, taxis and unlicensed cobs.

Firstly, as it mentioned before, the local government did not allocate adequate buses in suburbs. For instance, in the Pudong area where many multinational enterprises are, however, even if this area has dome dedicated bus lines and public traffic infrastructure, but the overall planning was rigid without the consideration of population distribution, commuter's distribution and other specific issues.

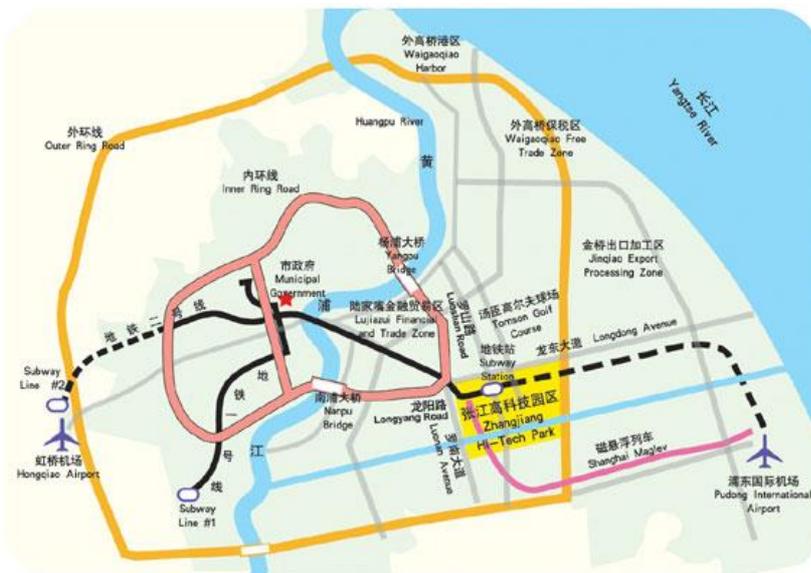


Figure 4.B The public transport service around Zhangjiang Hi-Tech Park (Zhangjiang InnoPark. Introduction, 2014).

The following picture depicted the public traffic planning in Zhangjiang Hi-Tech Park which is marked by the yellow color. However, it only has 4 major bus lines working there, which always starts from 5 am to 22 pm, and normally. Four bus lines are much less than the residents' real required amount in that area, and normally, the interval time is much longer than the bus in city center. Moreover, its ticket price is 2 RMB for each time, which is acceptable for most commuters, in that sense, it is an advantage for current bus.

The second travel mode is taxi, but obviously, its higher price makes it not acceptable for normal commuters. Nowadays, for the taxis in Shanghai, its starting price is 14 RMB and additional 3 RMB for each kilometer. In addition, not everyone can seek for a taxi instantly when the users made their decision. In this case, taxi could not be served as an effective alternative for daily traveling.

At last, the most effective alternative and assistance are the flexible unlicensed cabs, which include three wheel mopeds, motorcycle and mini vans. Obviously, they are not safe options, and the most of them are operating illegally. Hence, usually the customer's right cannot be protected, some scandals and accidents indicated that many customers encountered crash or swindle in this area. However, this is the only one option for the people who will be late but cannot afford to the taxi ticket. On average, the "ticket" is 5 RMB for each time, and the illegal vehicles often works for a temporary but dedicated line that take the passengers from their residence to the working place directly, which cannot be realized by public buses.

Therefore, to make more resident choose public transport, the coverage of public transport service should be holistic and accessible. For the residents in suburbs, trying to link them from their living place to the traffic hubs would be the essential issue to be fixed.

4.3 The usability and inclusiveness in public transportation design

As one modality of public transporting, public transportation is often designed with the aim of providing adequate services, which intended to cover users with diverse physical and cognitive preconditions. In this case, as a routine, inclusive design is a design tenet with the principle of considering the needs and capabilities of different user as much as possible (J Clarkson et al., 2010). Consequently, the traditional inclusive design or universal design constantly emphasized the significance of eliminating physical and cognitive barriers, in order to generate "an inclusively designed product that only exclude the user that the product requirements exclude" (S. Keate and P. J Clarkson, 2003). Hence, these outcomes always engender great inclusiveness within the product using process with its modification or promotion laying on the functional improvements in tangible products.

As a stereotype thinking, the current public bus service should be upgraded through inclusive design approach as well. In fact, an increased numbers of developing countries started to switch their service concentration regarding public transport. In some countries with large amount of traffic congestions and commuters, the government had implemented some novel tackles to show their care to the abnormal user group, such as bus rapid transit with dedicated facilities, to cover more people. Indeed, some cases had

demonstrated the benefits from inclusive design, which was obviously in consequence of considerable efforts on facilities' upgrading. In this case, the extended inclusiveness in facility design stems from additional physical assistance for marginalized users, hence, better tangible facility design and special equipment had been the effective method of optimizing one system from normal to inclusive.

However, despite the current effort they had made, the intangible reason for "exclusiveness" should be considered as well. According to the study of previous researchers, it indicated that the fit from the products to a person is dependent on far more than the physical or cognitive usability, and the users should be considered holistically as people, the ones who have diverse emotions and psychologies. (P. W. Jordan, 2000). From this point of view, the users in PTS, especially the handicapped users, should be respected more profoundly rather than providing the simple physical or cognitive assistance for them. Inclusive design could be treated as a complementation, and reminded the designers to think more holistically rather than focusing on specific or superficial issues.

However, currently most public transport services did not comprehensively merged the reasonable product usability or inclusiveness into the corresponded service design or product design. As a result, people with handicap are always excluded by the product and feel frustrated, even the normal users would encounter some uncertain barriers caused by the neglecting of usability or inclusiveness.

Some countries are implementing inclusive bus system with adding additional equipment, which covers more users, in particular the handicapped users. In Bogota, the capital city of Colombia, government achieved cogent improvement from the establishment on inclusive BRT system, which enabled the novel bus system to include the people with different degrees of impairments (Wu Yaguang et al., 2010)

However, sometimes being over inclusive would lead the product to a situation which may be accessible to disabled people, but in practice unusable (A. F. Newel et al., 2010). In this case, making sure the usability and attractions for normal users should be prioritized.

Moreover, in the existing traffic issues of Shanghai, the inclusiveness may not be the most critical causes of the declining attraction of public bus system, rather the bad user experience for common users, including the special users as well. Through the previous study of the authors, the investigation has unveiled the influencing factors relate to user experience, but modifying all the deficiencies cannot be the key to attract customers' preference. In order to achieve more holistic inclusiveness, study should extend its scope to the concrete types of experience that users really need.

In this case, the inclusiveness in public transportation design is an essential factor that determines the scope of product' s intended users. However, nowadays, the decreasing attraction of public transportation needs to fix the usability and user experience in the beginning, but the inclusiveness should be considered in the design process.

This project did not particularly focus on the handicapped people, but the solution would consider the needs of marginalized people. The specific analysis of product inclusiveness and usability would be discussed in next chapter.

4.4 Existing products analysis

The previous two sections discuss the result of literature study from two perspectives. Firstly, it discuss the overall external traffic environment in Shanghai and the macro cause of current traffic issues, which indicated that a holistic service requires a systematical consideration from the beginning. Later, the discussion depicted the relationship between public facility design and product inclusiveness, which implied the scope of intend users and the priority in public product design.

This section would discuss the pros and cons of existing ground traffic transportation in suburbs of Shanghai from a macro perspective, which aimed to discover the advantages of each traffic mode and avoiding their deficiencies

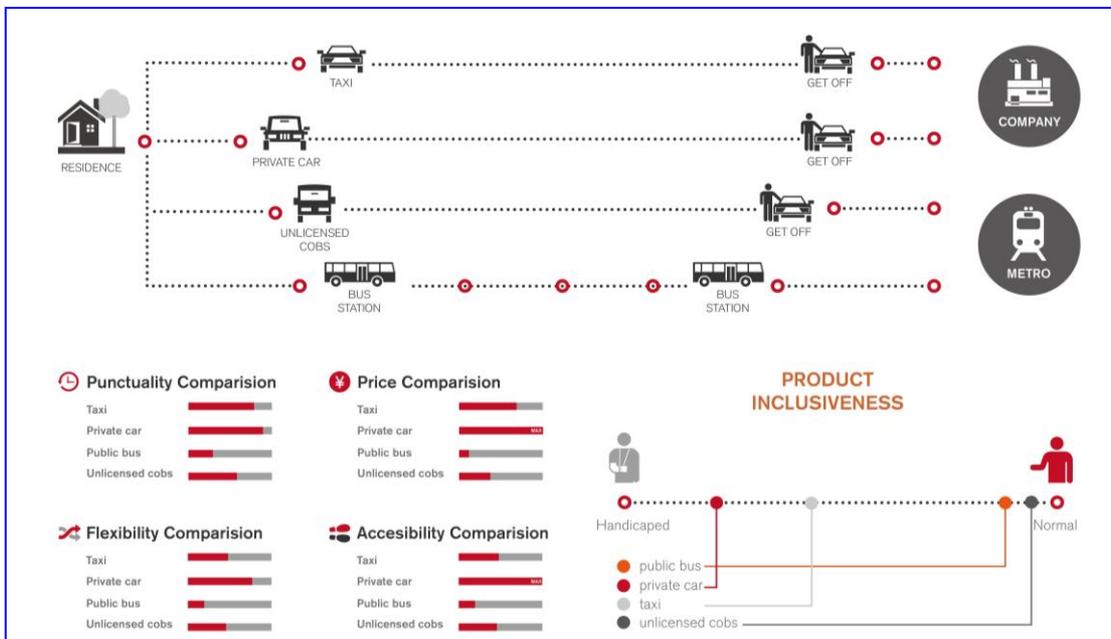


Figure 4.C The Comparison among different traffic modalities.

Normally, the public transport system can be regarded as an integration of structural elements which forms the system with particular principle, and in converse, their relationship generates the effects and interaction within a dynamical ensemble. In that case, there are two main advantages of systematical perspective of view. On one hand, the issues in particular appears in real life can be regarded as specific reflections from essentially systematical issues, which enables the researchers achieve holistic comprehension; on the other hand, customers often encounter some issues concerned with product due to the incomplete service arrangement, and systematical thinking enables the people to relieve such issues with boarder horizon.

- The information graphic indicated the comparison of different traffic modes. The first picture briefly illustrated the traveling distance in four different traveling modalities. Among the four alternatives, it was clear that private car and unlicensed cobs were more accessible, as mostly, the unlicensed cobs gathered at the entrance of each community which is closer to passengers compared to bus stations. In this case, passengers were more likely to choose unlicensed cobs rather than public bus. Likewise, taking taxi requires abundant time and patience, because those who decided to take cobs would have to wait and call for a vacant taxi randomly, in that sense, taxi is efficient but not reliable.

- Afterwards, these four alternatives still performs differently, the information graphic implied the bus has to cease for many times and pick up more passengers. Moreover, its regulated line increased its probability to encounter traffic congestions. Adversely, unlicensed cobs could adjust their traveling line to the streets with better traffic condition, which would be a critical advantages compared to public bus.

- Ultimately, after the passengers get off their transportation, they would walk to their destination normally, and these passengers would continue flowing to their working place or the city center. In general, unlicensed car was more flexible and efficient.

The diagrams in the information graphic depicted the comparison in terms of punctuality, cost, flexibility and accessibility. However, the illegal transportation still performs well according to the author's experience and observation. The divergencies between these two traffic modes took place from their cradles. In other words, the unlicensed cobs had a systematical advantage which could not be realized by public bus system. In this case, it could be a suitable solution to extract the advantages from unlicensed cobs and merged these merits into public transport system.

The last section is the analysis of the product inclusiveness and usability. The following illustration indicated the HTA maps for these traffic modalities. Hierarchical Task Analysis (Annett, 2003) was a model to describe the overall using process for a selected product, which implied the necessary action sequence in the interaction process with certain product.

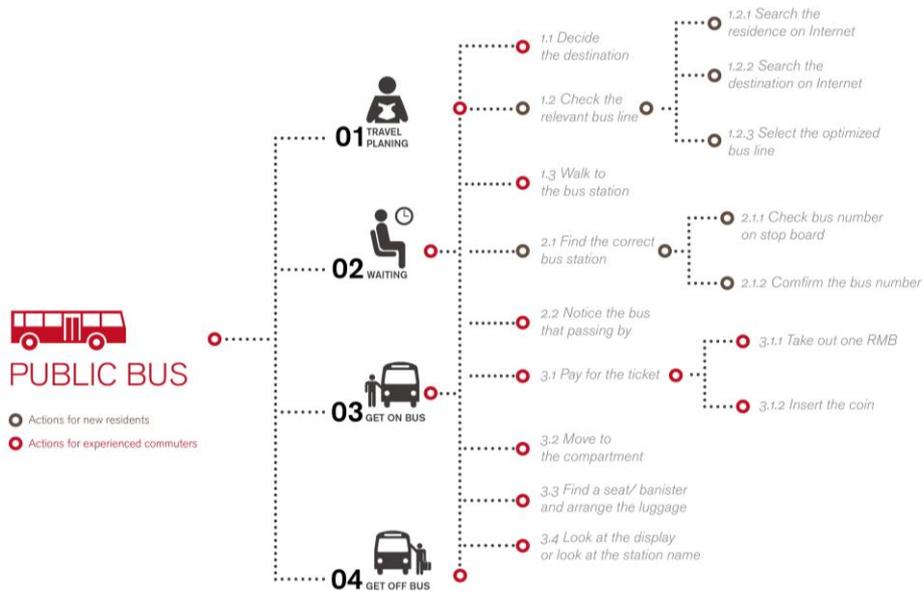


Figure 4.D The HTA map of public bus in Shanghai

The picture above is the HTA map indicated the action sequences. From the beginning, passengers should check the traveling information online and look for the most suitable bus line. Some elder people or customers who did not have Internet will check the traffic information on the information board in the bus station. Subsequently, the passengers have to wait for the bus and focus the numbers of bus that passing by. The other issue is the reminding system, since in current China, most buses does equip qualified reminding system to indicated the exact position, the next station and other relevant information to passengers. In this case, people on the bus have to pay their attention on the bus board outside the window.

According to the HTA map for current public bus system, other usability issues were probed. The table implied some usability issues generally, for the luggage taking passengers and elder people. However, in this study, the research only concentrated on the potential users of ground transportation. The other type of marginalized people like dwarfism people, gigantism people or pregnant women was not included in this discussion.

Preconditions	
Elder passengers	<ul style="list-style-type: none"> - Difficulty in checking information online. - Difficulty in squeezing in the bus. - Difficulty in entering the bus through the stairs.
People with luggage	<ul style="list-style-type: none"> - Difficulty in inserting the coins with luggage on hands. - Difficulty in entering the bus through narrow entrance. - Difficulty in walking into the compartment due to the burden from luggage.

Figure 4.E The difficulties for particular users

The next section demonstrated the action sequence of taking unlicensed cobs. Obviously, the HTA map was simplified due to the more flexible service of these illegal transportations. Compared to public bus service, this service is dedicated for commuters, as a result, its target users did not have to check the relevant traffic information in advance. Most of them had a clear destination from the beginning, the only additional effort was consulting the price with car drivers and the extra waiting time. Many car drivers preferred to drive with a completely loaded car, which enabled him to maximize his interest.

However, the unlicensed cobs were not suitable for elder people and people with luggage. Normally, the drivers would refuse these types of customers, because the operator knew the security hazard would produce vital dangers for those special people.

The last HTA map was the process of taking taxi. Not like what it was in European countries, it was impossible to order and call for taxi by telephone, particularly in the rush hour. The people who intended to take taxi needed to wait and wave their hands constantly in the big route where there was more probability to meet vacant taxis. Moreover, they need to pay much more money for it.

The comparison of these HTA maps declared the action sequences and potential issues caused by incomplete usability. Moreover, the comparison implied the pros and cons of each traffic modes in terms of its service system and product usability. Obviously, as commuters, the smaller and flexible vehicles would have more attractions to them.

At last, the cooperation of different transportations was not fluently, and passengers would encounter more barriers to transfer their vehicles from one system to another. Sometimes, since these transport service were working respectively, so during their working time, different transportations would confront some conflicts. The local government even did not have a rational systematical planning to joint different transportations. In this case, the transportation transferring had become a crucial issue that annoyed the passengers constantly.

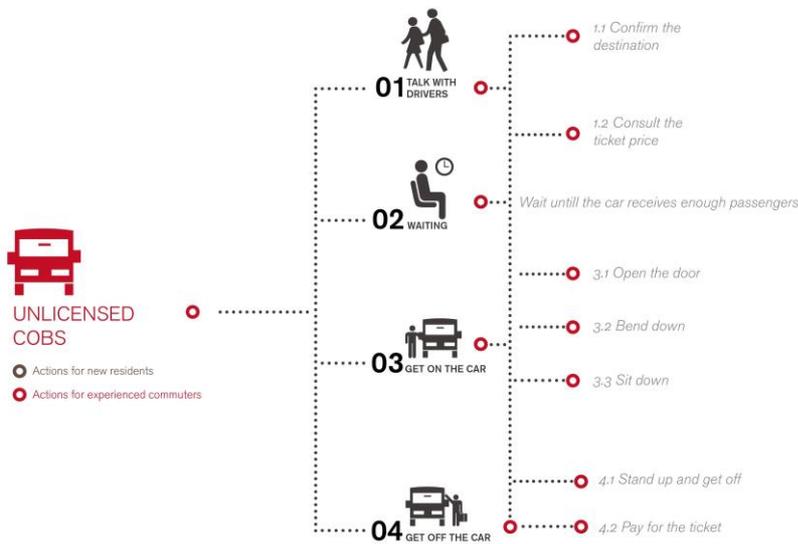


Figure 4.F The HTA map of unlicensed cobs.

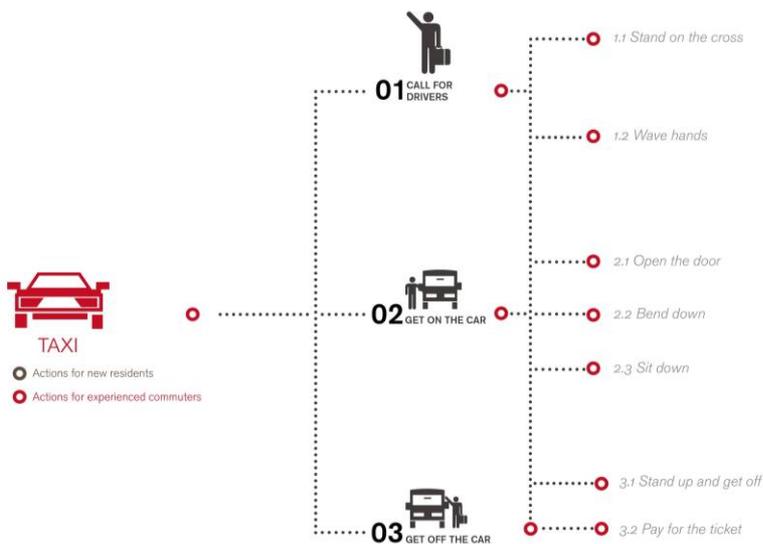


Figure 4.G The HTA map of Taxi

4.5 Conclusion

Accordingly, the public transport service in suburbs of Shanghai required more flexible and efficient solution. The traffic issues in suburbs were caused by the macro circumstances. The outcomes of this literature study would produce some initial direction to the later research and design work.

Firstly, from a large perspective, the government should allocate more public transportations in the suburbs. In the suburbs, the bus company had to allocate some dedicated bus for the commuters to take them approaching to their working place and traffic hubs. The service should have concentration or focus point. During the rush hour, the bus would be overloaded easily in one station, which is unfair for the people waiting in the subsequent stations. So the point to point service would be more efficient, otherwise, it would be impossible to increase the service efficiency.

Secondly, the diverse alternatives would be useful when the public transportation did not work. For the people who were living separately, the effective alternative would be valuable. The large ground transportation like bus, sometimes could not reach the trivial area or streets, in this case, the smart and flexible transportation like unlicensed cobs could generate more convenience for commuters.

At last, the information, such as time and bus position, the arrival and departure time should be shared instantly. This is a supporting service in the overall system, which could be regarded as a strategy to promote the reliability of public transportation. Once the passengers noticed the product or service was reliable, they would merge this product into their live schedule and become the royal customers.

05/ User Research

5.1 Context of use

Most of the intended users are living in the suburbs, since compared to the vacant flats in central area, this area contains more flats with cheaper price. Normally, the population density and pedestrian volume are less than central city. There is an essential conflict between traffic condition and the rent of surrounding flats. The area with better traffic condition, which means being covered by sufficient metro and bus lines, normally does not have suitable rent for migrate workers.

The fact is that, in suburbs, ground transportations are the major traveling mode. Normally, the transport structure in suburbs consists of buses, three wheel mopeds and minivans(often used as unlicensed cabs), and the passengers often take those vehicles to closest traffic hub, which always locates in metro station. Subsequently, they would take metro to the central city.

According to the observation and authors' previous experience, most users takes ground traffic as a commuting way cannot perform well, especially in the morning and the period after work. Around the current bus stations, there are some breakfast carts and lots of people prefer to take instant food and finish them on the transportation.

Normally, a commuter might cost 20 minutes on bus, which is a short interaction between users and product.

5.2 Intended users

The intended users were people who live in suburbs of Shanghai, to be concrete, in China, that group of people were commonly called as "ant tribe". Most of them were low income university graduates who settled for a poverty- level existence, however, many graduates with comparatively high income were living in this area as well, due to the mortgage in the future. This group of people was also included into our intended user group, since like "ant tribe", they have the similar lifestyle.

Due to the complexity of the user group in this project, there were some personas extracted from the real interview and observation in order to holistically portrait the diverse identities of these people.

Even if the people have different income, family background or future, but within the overall society structure in China, they can be categorized into same social class. Here are some personas that represent the identities of them, and their characteristics would be generalized at the end of this section.

PERSONA

Lucy Chou 23 - Lively and enthusiastic (Potential user)

Lucy Chou has already been in Shanghai for one year, and she is supposed to study in Sweden next year. She is engaging in the study of compulsory lectures in her first year, and allocates some spare time to work for her supervisor. She is exactly satisfied with her situation now, since she enjoys her study in this celebrated and charming university. She met numerous interesting people here, and she was fond of these people who gave her positive effect all the time.

She is a girl with considerable ambitious and working hard to catch the pace with others. After one years' study, she achieved affluent effort. Despite the study about her major discipline, she prefer to go out and participate some social activities to broad her horizon and perspective, and take part in some additional lectures in terms of management and other domains she interested in. She felt her live and study promising, and prefer to keep this pace into her future.

Actually, she always went out by public transport service in Shanghai. She was quite dissatisfied with the chaotic passengers on bus, and sometimes in the rush hour, she is a girl who cared about her identity of appearance, in this case, the crowded people on bus or metro would mess her hair or makeup. This issue will be amplified, in particular when she was attending to some formal occasions. However, compared to the

large public transportation, she thought taxi cannot grantee her security, particularly at late night. She hopes to have a safer alternative of public transportation at night, and this idealized transportation should keep her decent dressing during the short time traveling.

Johnny Jiang 25 - Mature and honest (Potential user)

Johnny Jiang is looking for his internship these days, at the same time, he is doing his master thesis which is full of complicated and theoretical knowledge, now he is looking forward to achieving some offers from companies he applied before. Now he is living in a renting room not far away from his university, and his girlfriend who is also working in Shanghai, which enables them to company mutually.

As a graduating student, he decided to work and live in Shanghai, he must make up his mind to stand the approaching pressure at the beginning of his carrier. Future seems to be a terrible thing for him, but he thought that he would fix this issue.

This is his second year of master, and he consumes most of his time on assisting her supervisor, and this process helped him accumulate a plenty of experience regarding design theory. He prefers to complement this knowledge from the lecture to be more pragmatic.

Even if his financial income is not affluent as he expected, but this does not prevent him to pursue the fashion consuming products, such as the frontal electronic. This hobby has enhanced his eagerness to better live. In order to allocate more expense on the valuable thing, he always deduced his cost on daily basis, such as food and traveling cost. In this case, he bought a bicycle, and even this bicycle is costly as well. He regarded this bicycle as a vehicle to experience and comprehends the city gradually, which seemed to be a romantic journey for him.

When it concerned with current transport service, he thought it was a kind of suffering, and the service does now indicated adequate respect to its clients, let along the elder people or pregnant ladies. Form his perspective, he thought enhancing the inclusiveness of current service or facilities could be an available approach.

Wu Jing 26 - An aspirant single lady (Current user)

Wu Jing, a master student in Shanghai, is a hardworking lady with extreme ambitions. Currently, she is confronting a critical turning point in her life, as she has to look for a suitable occupation after the graduation which is approaching to her. She is doing an internship in a transnational enterprise, which helps her to accumulate some advantages for approaching carrier selections.

As a non-Shanghai student, the repression of living cost makes her future enclosed by uncertainty. In this case, she has to work harder compared to other students, which would be the reason for allocating extra time on working rather than relaxing.

Sometimes, she felt difficult to eliminate her repression due to the heavy workload from her company, her supervisor and her study. The chaotic work made her irascibility increasingly, so she kept a healthy schedule seriously, to resist the constantly emerging busy. Hence, she protected herself far away from the bad living habit. Moreover, the emerging knowledge related to Internet technology could easily draw her attention, and conversely, she thought it would be beneficial to her work. She is exactly passionate to the tendency of the development concerned with interaction design, which is one of the branches of IT.

During her days for internship, she had nothing different with commuters who have to experience the suffering bad urban travel every day. Normally, she thought taking trams or buses is a reluctant alternative because of the bad experience. In her eyes, some social routine restricted her behavior, for instance, she had to offer her seat to the elder people even though her was exhausted in the morning or after work. The idealized public transportation should be a place enclosed by sufficient comfort and a vehicle to energize their passengers instead of annoying them.

Dui Lihao - A Ambitious Student with Few Words (Potential user)

Now, Dui Lihao is exchanging in German, study and traveling have become the two dominated activities during his current days. He is a master student on architectural design, and he was sharing a flat with his classmate in Shanghai. After his whole years' studying and working, he chose to take this opportunity to go aboard instead of doing an internship. After this half year's study journey, he has to go back to Shanghai and think about his future.

Before his master study, he had been Shanghai for two years for working and preparing the master education as well. After few years' preparation, he did achieve this precious chance to polish himself and add more accumulation for his future carrier. In that sense, he is an ambitious person, who won't give up until he approaches to his target. However, this affluent ambition did not lead him to be over haughty after he accomplished his target. In converse, he prefers to be honest person, doing everything that fit his current identity, rather than doing something flatulently.

In his friends' eyes, he is a typical Otaku, which means the man who prefer staying at home instead of participating in social activities. In other words, he prefers to stay alone, since he thought it provided lots of time to thinking the life and himself. In this case, compared to other fashion students in his class, his life seems to be a little bit simpler.

He always released his mind on bus, he regarded this behavior as a kind of meditation or a place to viewing the moving cities outside the window. In his world, this is a world consistently accelerating its pace, as a human being, he has to slow down the speed of his own world. Hence, he merely cared about the physical suffering, rather concentrate on the positive enjoy provided by current bus service.

Zhang Fang - A game designer with rational thinking (Current user)

Last week, Zhang Fang, who is doing an internship as an assist game designer, has finished the primary tutorial about computer game design. After this period for accumulation, he has to continue his internship for his supervisor as before, which means he requires picking up the previous schedule of regular live rhythm.

He used to be a student of engineering, which nurtured his rational thinking habit, and during his master study, he switched his concentration from engineering to design, which was a radical change but exactly fit the other facet in his personality. He is quite fond of this mixture of multiple disciplines, and he thought the design education helped him to extend his horizon, and made him consider holistically when fixing complicated issues in his work and life.

People can hardly judge his personality through his common clad style. In fact, he is a man of curiosity, and he prefers to novel things which inspires his work. In general, going after a gentle pace of live is his dominated living philosophy, and he does not want to miss the idealized living purpose in this cruel world.

He prefers to be a cyclist, rather than commuters in the crowd compartments. He thought, on one hand, being a cyclist can grantee the transport efficiency within the chaotic urban environment; on the other hand, the choice to taking bicycle contains some symbolic significance for him, a young man with energy and ambitions. However, he also thought that public transportation is a romantic place where allow people to sit in a Conner and release his/her mind alone, but in his mind, most of time, public transportations are only playing the role as a transit media without so much attractions for residents in Shanghai.

He Chengyuan (Current user)

He Chengyuan is one of commuters in Zhangjiang district, where there are thousands of IT practitioners. He is now sharing an apartment with the other three colleagues respectively, and he got a single room with 15 square meters approximately. So far, his working age is approaching to two years, and he is confronting his bottleneck for the future development in his career. Therefore, the repression of his career prospect frustrated him a lot, but he is confident enough to overcome this crucial running point.

He is working in a mobile phone company as a product designer, and his life mainly focuses on his career. Normally he allocates most of his spare time on thinking how to polish up his capacity and how to make his design looks perfect. However, sometimes his work had to be modified due to the request from clients, this overtime always disrupt his regular schedule. In this case, he started to care about the health situation and

keep a reasonable schedule for his life. He bought a bicycle to take the place of taking bus, and this will be beneficial to his health, as a way of exercising.

He is quite worried about the traffic condition in his live area because of the uncertain departure and arrival time. He is a person who requires high sleeping quality, but he has to wake up and go to the bus station in case of losing the bus. In winter, especially on the rainy days, he has to wait in the strong wind even he does not totally wake up his mind. This bad experience always gave him “negative energy” in the beginning of the hopeful day, which often affect his mood and work efficiency.

Lee (Potential user)

Lee is now working in Shanghai, and he is supposed to stay here for several years. Now, he lives alone in a small renting room, and he has to use the public kitchen and bathroom with other tenants. Even this living situation is worse for him, compared to living and working at home. Another reason of choosing a frugal live is the constantly elevated house price in Shanghai, person who wants to get a private estate has to save money for it, if he/ she could not get adequate financial support from his/ her family.

His personality is a mixture of rigidness and enthusiasm, which always makes his mood varies radically. He was graduated from university last summer, so he had to adjust his attitude from a student’ s perspective to an eligible employee’ s perspective. Moreover, his life is becoming increasingly busy and regular, he started to cultivate a better living habit, for instance, keeping a time schedule, going to gym and looking for a girlfriend.

However, he does not have so much anticipation on current public transport service, because in his point of view, this is only a sample product that only help passenger to saving time and money for daily traveling, and he is glad to take bus instead of maintaining a private vehicle, even though he could accord to it. Saving money for his future, is one of his live philosophies, and public buses can fit his need.

5.3 Traveling habit

This section mainly stems from authors’ former experience, since the author used to live and work in focused area for two months. In this section, it would mainly describe passengers’ life style, traveling habit and generic attitude on current public bus service.

5.3.1 Users’ life style

Most of the commuters’ life is sample and intense, at the same time these energetic young people are full of hope and ambition. For the graduates, normally the intensive schedule accelerated their life speed, and people under mortgage had to be frugal. They always dine in the small restaurants closed to their community, sometimes even taking street food.

On the weekend, mostly their entertainments are monotonous compared with mid class people, and the distant limitation made them far away from mainstream entertainment activities in the central city. Commonly, the residents in suburbs would cost 4-5 hours on commuting from their living place to downtown. In this case, staying at home or communicating with friends is always what they did during the weekend.

In addition, this user group contains multitude well- educated graduates, the live quality is a main focus point in their live, which means the economic limitation cannot restrain their life sentiment. For instance, some people even contribute 2 months’ salary to the new i-phone. In other words, the object conditions cannot limit their curiosity on novel things.

However, this group of people is experiencing a period of social transition, and large amount of them thought the ceased class mobility does not provide adequate opportunities for them, which makes them feel desperate.

The financial limitation led the users to a simplified life, and public transportation has certainly become their major travel tools.

The following scenario has concretely depicted the typical life style of intended users.

5.3.2 Users' attitude on current public transport service

Many people dream about possessing a car, but they have to make compromise to the fact and taking public transportation. According to the interview, most of the people only regarded the bus as a type of travel tools, and do not have additional anticipation on this sharing product as long as the products can carry them to intended destination punctually.

According to the previous online survey about peoples' attitude on existing public traffic service in Shanghai, bus service was still dominating the overall structure of public transport network, which was reflected in the online survey previously. The reason would be the wide coverage of bus service network, and most people used it only for short-term journey. In the suburbs, public bus is as secondary public transportation that links the discrete residents to the traffic hubs, like metro station, since bus is not a convenient and comfortable transportation in people's common notion.

Even if there are some negative impression on bus, but people have to take it, and most of them do not care about the negative impression. The objective and subjective condition forced them to make this selection.

However, according to the official data and interview, if people were provided some alternatives, they prefer to take metro or private cars, which could provide better punctuality and comfort. Particularly the one generation, they contain more desire on comfort and efficiency, in this case, the existing bus service was not their prior choice.

5.3.3 Diverse combinations for daily commuting

For most of the commuters there are some types of strategies for daily traveling, and the strategy are decided based on the distance between their homes to their workplace. According to the previous online investigation, even if commuters' traveling combination are diverse, but normally their universal major transportation is metro system, particularly for the suburbs commuters who work in city center. In this case, how to approach to the nearest metro system has been a critical issue for them. For the people who work in suburban areas, their combinations will be more diverse compared to the former group.

So far, the bicycle, public bus, three wheel cobs, unlicensed minivan cobs are the mainstream candidates for daily transport that take residents to the traffic hubs. The different types of transportation will be feasible in different context and purpose. The following description depicted the corresponding context.

Bicycle is only available for the short journey. Normally, almost every metro station contains the dedicated area for bicycle parking near the entrance. The advantage of bicycle is flexible, and it enables the users to avoid the loss from traffic congestion. However, the high loss rate in current China cannot make bicycle to be a popular alternatives.

The public bus can be regarded as the extension of metro service, which is playing an important role in peoples' daily life. In suburbs, bus service is the major transportation mode, but currently, it is not working effectively. Nevertheless, as a habit, most people prefer to give more patients on bus, even if sometimes its experience was terrible for them.

Moreover, there is some irregular transportation that is supporting the incomplete public transport service in suburbs. During the work days, numerous minivans and three wheels are parking closed to the residential area in suburbs, and normally, these are not well covered by bus line. With these irregular transportations, people could consult the price and customize their personal travel line. In this case, this irregular transportation is more flexible than buses with fixed traveling routes. However, these irregular transportations often contain underlying threaten for its passengers, because these illegal service don not have regulations in terms of speed limitation, maximum passengers etc. However, many people still choose this uncertain transportation, since the bad punctuality of bus has made them totally disappointed.

The most common traveling combinations are depicted in the picture below. Moreover, the users often have additional actions, like shopping, going to gym and other activities.

5.3.4 Deficiency of current public traffic service in suburbs.

The deficiency of current public transport service consists of three level, in other words, the diverse deficiency can be categorized into three levels: macro level, which is related to the systematical arrangement

of overall service in suburb area; the micro level, which contains the specific facilities that directly interact with users; at last, the information level focused on the information transformation between service company and users.

The authors' previous study indicated the deficiency of current public traffic service in general. The following description depicted the disadvantage of current public traffic service for the suburbs in Shanghai.

In the systematical level, the coverage of service network is not reasonable. For instance, the *Pudong 12* bus services for approximately 34 point in the city. The more area it covered, the more traffic congestions it might encounter. However, for the commuters who live in *Zhangjiang Hi-Tack Park*, *Pudong 12* is a major choice that linked their living place to work places. Another major problem is the incomplete connection between different types of traffic modalities.

In the micro level, most facilities cannot grantee the fluent usability. One aspect is related to the physical barriers for users, for instance, the uncomfortable seat, the shaking compartment and bad air quality etc. Moreover, the other aspect is cognitive barriers, most people cannot understand the information on bus stop or plan their traffic lines accurately in advance. These issues happened more obviously in suburbs of Shanghai, since the government do not invest adequate budget on these area.

In the information level, the instant information cannot be achieved by the users, which does not enable them to manage their time. The terrible information also kept users waiting on the bus station when the bus is fully loaded.

In this case, the users could encounter many barriers caused by different factors, some of them can be eliminated by upgrading the physical product, and some of them need the effort on a systematical level. For the ground transportation, the identity of bus cannot satisfy the users, since many users regard bus as a carrier of negative experience. The investigation on users experience will serve bus as a referenced product to test the positive and negative experience from users. Through the research on referenced public transportation, the idealized alternatives will be clarified.

5.4 Passengers' Experience

This section depicted the passengers' experience in current ground public transportations. The overall research was based on the remote interview and online questioner with different types of users. Moreover, the main theoretical basis in the interview is product value proposition and product experience, which functions to solve following issues:

1. The tasks that product helps users to accomplish.
2. The negative experiences generated by current product/ service.
3. The benefits/ profits that can be achieved by users through the product/ service.
4. The extent of each negative experience from users' perspective.

Through the evaluation of these issues, the identity of idealized product/service can be profiled. At least, the result indicated sufficient insight from intended users and clarified the attribute of an idealized product. Moreover, this section portrayed the limitation for further ideation, and enhanced the relationship between the concept and users later on.

The evaluation served public buses as the referenced product to test the user experience, since the current public bus service is one of the most representative public transport vehicles in Shanghai with most residents having the experience of being involved.

The overall evaluation is

5.4.1 The expected functionalities of public transportation

The initial interview elicited the functionalities of current bus service, which indirectly reflected the identity of the referenced product and its significance in people's life.

Most interviewees regarded bus as a normal equipment for delivery with cost saving, effort saving and money saves. This benefit in terms of investment economizing was the main motivation for people to choose bus. Moreover, buses sometimes could function like a relaxing space for commuters, which enabled

passengers to take naps and see the sight out of the window. In this case, relaxing is the other major functions provided by bus.

Among the participants of interview, some people extracted some special experience that can be treated as additional functionalities. For instance, most people prefer to read news on smart phone or playing games. Likewise, eating breakfast on the way to work is another behavior that made their life more efficient.

Other than physical functions, the participants also depicted little pleasure in terms of social activities and psychology. Passengers prefer to meet new people randomly to be an interest complementation for their interpersonal circle. Moreover, they might meet more elder people who need assistance, in this case, most people were glad to help them, as a result, the positive feedback made them feel comfortable and valuable.

For most interviewees, taking public bus was not a face losing choice, since most young people were living in a frugal life. They thought the public transportation is equal for everyone, which was corresponded to the identity of young people in current Shanghai.

5.4.2 The negative experience in current public bus service

Majority of negative user experience were elicited through the interview, which intended to probe the factors that caused negative effects. The original questionnaires consisted of the different aspects in terms of users' physical difficulties, spontaneous reaction, deficiencies in current bus service etc.

1) *The cost in prevailing public bus system*

The initial result implied the current public bus service exhausted more investment in terms of time and effort. To be specific, normally people require cost time on waiting or walking to the nearest station, which is determined by its inherent attribute. Moreover, the traffic congestion was another potential source for time costing, because many interviewees stated waiting in the traffic congestion seemed like a common job for them.

Likewise, the effort cost mainly stems from the limited amount of transportations working in suburbs in Shanghai, since currently the bus allocation between city center and suburbs was seriously unbalanced, which lead people had to squeeze in the bus through the crowds. As a result, an increasing number of people resort to private cars and unlicensed cabs to avoid the intangible fighting with other passengers.

Some interviews indicated the attention cost also happened, which means people always had to allocate extra attention on looking after their wallet or smart phones due to the threaten of thieves.

2) *The physical difficulties for passengers*

When it came to the factors that produced negative experience, the participants demonstrated a number of aspects related to the deficiencies in current bus service directly or indirectly.

The major factor was the crowds in compartment, and most people regarded *crowded* as the most vivid word to represent their first impression on current bus, even on public transportation.

Another negative experience was the uncertainty in bus service. On one hand, the lack of punctuality often made passengers frustrated with forcing them wait in the station; on the other hand, the waiting people were not able to know if the approaching bus was overloaded or not, in other words, this type of uncertainty would probably made their effort in vain. In this case, many interviewees indicated current bus service was not sufficiently reliable, let alone the accuracy in its service.

Furthermore, the spatial limitation in the compartment aggravated the negative user experience in compartment, some interviewees mentioned that bad atmosphere that sometimes blocked their breathing. For instance, the static air in compartment might produce vertigo for passengers, and people might encounter more body contact on the bus, which might be the dangers regarding stealing and sexual harassment.

In addition, the facilities in compartment also contain disadvantages, which related to the height of banisters, the amount of seat and the narrow passage right in the middle. Most interviewee had the experience of being difficult to keep balance, since they had to stand on the aggressive drove cars without suitable supporter like banisters or handles. Moreover, as routine, young passengers mostly had to offer their

positions for elder passengers, otherwise they might face extra moral pressure, even if sometimes the young commuters were exhausted after work.

At last, from a users' perspective, the action sequence were not comprehensively optimized. For instance, people had to prepared one RMB and insert this coin to the machine at the entry. Moreover, people have to pass the stairs that was higher than sidewalk, which might be difficult for elder people or passengers with other temporary handicap.

3) The information chaos or barriers for passengers

Many interviewees implied the barriers on receiving their intended information. Once people cannot achieve their intended information, they would not be able to merge their traveling time on their schedule accurately. In this case, for most interviewees did not regard public bus service as a reliable transportation.

Firstly, current bus service could not grantee the punctuality due to the uncertain traffic condition in Shanghai. Even if the bus company allocate some dedicated bus lines for suburbs, the buses would not be able to overcome the disadvantages derived from its coverage were too board and longer station gaps. Most participants did not dare to manage public bus as an effective transportation for important arrangement, for instance attending a significant conference or going to the airport in time.

Secondly, the instant information support had not been totally unfolded. The participants indicated the chaotic information often mad them confused about travel planning. Due to the uncertainty of current bus service, passengers would not be able to get instant traffic information online and this always distracts the time schedule for commuters. In that sense, public bus was not regarded as a reliable choice.

Some phenomenon' s were implied through the interview, numerous participants stated the prevailing information on information board were not easy to comprehend, because most of the information board only implied the names of each stations instead of exact location of it(Since in China, bus companies could trade the naming right to commercial enterprises). Moreover, even though the station was named with its corresponded location, it still contained large deviation when people were approaching to their destination.

4) The issues regarding unreasonable system arrangement.

Moreover, the arrangement of infrastructure in public bus service was problematic, at least not holistically reasonable. These issues could not be fixed through partial modification or improvement. These fundamental issues had covered numerous aspects in terms of resource allocation, arrival/ departure time and other issues concerned with systematical messy.

Therefore, the arguments from participants mainly concentrated on these aspects:

- The stations had not been located in suitable places, to be specific, people who need transferring always required too much additional effort on seeking for the next station, and this issues would be more serious when it came to bus- bus transferring.
- The bus company seldom dispatches adequate service at night. For people with overtime work, obviously the bus company does not include that option for night traveling. In fact, many residents in suburbs need a suitable solution for this case.
- People would not be able to judge the amount of the bus. If people could judge whether the approaching bus was overloaded, they might resort to other options in advance, rather than being disappointed about their former effort which did not make sense.

5) The common mistakes within the using process

This section included the objective mistakes caused by users. Most interviewees implied miss their destination was the most common thing happened in their life. Some people even took the incorrect bus from the beginning. These accidents always happened because no alarming equipment was installed on the bus, which did not enable confusing passengers to get essential information.

Few interviews indicated missing luggage on the bus or station might happened when they were stuck in the hurry.

6) Other factors caused negative experience.

Besides the essential issues mentioned previously, some participants pointed out the moral sense on bus would be another latent factors led to bad experience. Since for many years, there was a common notion implying that young people have to offer their position for elder man. In other words, elder man had more privilege in the compartment, and most of them could take bus for free. In this case, the young commuters and the elder residents had an intangible conflict, and many young people would feel bad to comply with these routine.

5.4.3 The gains and anticipation on public ground transportation

This section described the benefit of current bus service and the anticipation from the perspective of users. The interview in this part were concerned with the physical and psychological benefit from prevailing product, at last, the participants implied their idealized product and expected functionalities in the future public transport solutions.

1) The physical and psychological gains or interests from current solution

For many people, bus is the comparatively available option them, but they prefer to purchase private vehicle once they got sufficient economical ability. However, the commuters in suburbs of Shanghai, in particular the young people in Zhangjiang who were living frugally.

The cheap ticket price or traveling investment was the only one advantage in this type of transportation. Many interviewees was likely to choose bus due to it's comparatively board coverage and its cheaper ticket price. Most young commuters in Zhangjiang were "fresh grads", and most had to live and working hard under the pressure from mortgage and heavy rent.

Unfortunately, no psychological gains were proved to be attained by passengers, in other words, taking bus or not would have nothing to do with their mood or social standard.

2) The anticipations for future solutions

The result of this part could be divided into two categories. One category was the anticipation with strong relevance, which could be realized currently. The other sort of expectation was idealized solution in the future. Both of them would be utilized for upgrading current product.

Numerous participants seemed like more spacious compartment space, likewise, ample seats or banisters would be more convenient for those who were inability to constantly standing or keep balance on bus. Moreover, One participant mentioned that the airport shuttle bus was an exemplary template for future solution, since it was efficient and convenient even if normally people were standing without our seats.

Those participants who annoyed the disgusting smell were hope some dedicated equipment could emerge and refresh the air in compartment. Normally, the physical and psychological atmosphere on bus always made them doze off.

In addition, participants thought the bus should provide more interesting programmer on its display rather than boring commercials. Likewise, the content of bus magazine would better to be refreshed as an entertainment for passengers. These exceptions could be generalized as adding more attachments for amusing passengers or helping passengers releasing themselves.

Practically, allocating or adding more spaces for storage was another critical aspect. For those who took heavy luggage and fatigue, keeping luggage on hands would extremely reduce the user experience and mood. Many interviewees indicated this exception would be the most essential modification if it had been unfolded.

The other anticipations were concentrated on how to fix or modify the issues described in previous phase. Hence, fixing current deficiencies was what participants expected to accomplish primarily.

There were some radical anticipation from the interview, which seemed like unreliable currently, but this result could direct for future solution. There were some interesting concepts among the results, for instance, online shopping on the bus, which meant people could finish their after work shopping on their way back home. Another interesting concept was adding some interesting social medias on bus and acquaints random strangers, because many young commuters in suburbs were single, and this association could help them board their friend network.

3) The barriers and likelihood for adopting new solutions

At the end of this section, participants listed some barriers and lubricant for adopting new products and solutions. The results had been generalized like this.

The barriers for adopting new solution were mainly the habit of users. Since most had accommodated themselves to the prevailing solutions. Another factor was the additional learning efforts. Most participants did not want learn additional operations and actions, they said designers should consider the balance between learning cost and its feedback. Likewise, some participants pointed out the extra accounts or pin-codes would make them annoyed for new products.

Moreover, the suspicion on novel solution would block people to accept new products, while nowadays, most Chinese people did not have adequate trust degree.

When it came to how to accelerate the process of adopting new solutions, a number of participants mentioned emphasizing the benefit of new products and make it friendly could increase its likelihood. The other recommendation was made the new solution as close as possible to the customers, the novel solution should not be too radical.

5.5 Result of online survey

The result of interview had probed different type factors that affected user experience. Subsequently, the factors were extracted and clarified for ranking according to the significance. In this ranking section, the participants consisted of two groups, the first group was the previous interviewees, and the second group was chosen randomly online with being asked through an online questionnaire. The result were described respectively but integrated ultimately, which could construct the value proposition for our idealized product.

5.5.1 The factors and its corresponded rank of significance

Based on previous solution, the affecting factors could be generalized into three categories: the basic functionalities, the negative experience and the positive benefits. The result of the rank was depicted respectively, and it indicated the degree of significance for each attributes.

1) *The basic functionalities of ground public transportation*

According to the result of interview, the major functionalities were traveling transportation, communication, sightseeing, relaxing and platform for behavior. Subsequently, these attributes were merged into the online questionnaires as diverse options. The result was concluded in the following table.

Functionalities	Very Important	Important	Neutral	Trivial	Very Trivial	Average Rate
Basic traveling	14(66.6%)	7(33.3%)	0(0%)	0(0%)	0(0%)	1.33
Communication	5(23.81%)	3(14.29%)	4(19.05%)	9(42.86%)	0(0%)	2.81
Sighting	4(19.05%)	5(23.81%)	9(42.86%)	3(14.29%)	0(0%)	2.52
Relaxing	4(19.05%)	8(38.1%)	2(9.52%)	7(33.33%)	0(0%)	2.57
Platform for behavior	3(14.29%)	0(0%)	9(42.86%)	8(38.1%)	1(4.76%)	3.19

Figure 5.A The result of question on *Please ranks each function of bus on its significance.*

As it depicted in the statistical result, the traveling had the dominated significance compared to other extensions. Communication, sighting and relaxing were secondary effects, which means people focused on the basic function rather than additional experience in current ground traffic solution. Some former

interviewees implied helping others or well behaving could gave them sense of achievement, but obviously online participants did not cared them so much.

The average rate in each for each category had accurately indicated the intensity for each option.

2) The negative experience in current solution

All the negative experience were extracted from the interview, which was the input and options for online questionnaire. This negative experience could be also subdivided into four categories: the affecting factors, the deficiency of current solution/ product, the usage barriers/ difficulties and operation mistakes.

Factors	Very Significant	Significant	Neutral	Trivial	Very Trivial	Average Rate
The repulsive smell in compartment	13(61.9%)	8(38.1%)	0(0%)	0(0%)	0(0%)	1.38
The uncertainty(did not know if the approaching bus was overloaded or not)	13(61.9%)	5(23.81%)	2(9.52%)	1(4.76%)	0(0%)	1.57
The lack of reliability	14(66.67%)	5(23.81%)	2(9.52%)	0(0%)	0(0%)	1.43
The crowds on bus	9(42.86%)	8(38.1%)	3(14.29%)	1(4.76%)	0(0%)	1.81
Drivers' aggressively driving	7(33.33%)	10(47.62%)	3(14.29%)	1(4.76%)	0(0%)	1.9
The chaos and noisy	4(19.05%)	12(57.14%)	5(23.81%)	0(0%)	0(0%)	2.05
The Routine of offering seats to the elders.	6(28.57%)	9(42.86%)	5(23.81%)	1(4.76%)	0(0%)	2.05
The lack of storage space	2(9.52%)	6(28.57%)	9(42.86%)	4(19.05%)	0(0%)	2.71
The latent threaten from themselves	11(52.38%)	5(23.81%)	5(23.81%)	0(0%)	0(0%)	1.71
The lack of seats and comfort	6(28.57%)	9(42.86%)	5(23.81%)	1(4.76%)	0(0%)	2.05
Other passengers' bad behavior	4(19.05%)	9(42.86%)	7(33.33%)	1(4.76%)	0(0%)	2.24

The unsuitable temperature in the compartment	5(23.81%)	9(42.86%)	6(28.57%)	1(4.76%)	0(0%)	2.14
The uncertainty of traffic congestion	7(33.33%)	9(42.86%)	5(23.81%)	0(0%)	0(0%)	1.9
Inability to know the arriving station and instant position	6(28.57%)	12(57.14%)	3(14.29%)	0(0%)	0(0%)	1.86
	1(4.76%)	9(42.86%)	7(33.33%)	3(14.29%)	1(4.76%)	2.71

Figure 5.B The result of question on *Please ranks each negative experience on its significance.*

The factors were affecting factors that often generated bad user experience for users. Many participants declared that the repulsive smell in the compartment would impact their impression on public bus service. Moreover, the reliability and punctuality were another two aspects associated with user experience, and ultimately, the threaten of thieves made people annoyed, since those which i-phone or i-pad could not totally released on bus, mostly they had to pay attention to their property on hands.

The other factors like the amount of seats, the external disruptions and temperature on bus were secondary affecting factors for most participants. However, when it came to the storage space and check-in process, participants did not have obvious reaction.

The result of this round of survey declared that people paid their attention much more on the factors that interact with them directly. Hence, the performance of public bus service was determined by its degree of accomplishment related to basic functionality.

Subsequently, the questionnaire probed the deficiency of current public bus service, and each type of disadvantages was tanked based on its importance. The following table depicted the result of this question.

Deficiency	Very Important	Important	Neutral	Trivial	Very Trivial	Average Rate
Lack of information assistance	10(47.62%)	10(47.62%)	1(4.76%)	0(0%)	0(0%)	1.57
Inconvenient interior space	7(33.33%)	5(23.81%)	8(38.1%)	1(4.76%)	0(0%)	2.14
The confusing station names	6(28.57%)	13(61.9%)	2(9.52%)	0(0%)	0(0%)	1.81
The unreasonable network planning	7(33.33%)	8(38.1%)	6(28.57%)	0(0%)	0(0%)	1.95
No storage room	2(9.52%)	7(33.33%)	10(47.62)	2(9.52%)	0(0%)	2.57

			%)			
No suitable banisters	4(19.05%)	10(47.62%)	7(33.33%)	0(0%)	0(0%)	2.14
Lack of punctuality	10(47.62%)	9(42.86%)	2(9.52%)	0(0%)	0(0%)	1.62
The unfriendly stairs at the entrance	5(23.81%)	9(42.86%)	5(23.81%)	2(9.52%)	0(0%)	2.19
Only 1 Yuan was acceptable	5(23.81%)	8(38.1%)	6(28.57%)	1(4.76%)	1(4.76%)	2.29
The commercials	2(9.52%)	4(19.05%)	11(52.38%)	2(9.52%)	2(9.52%)	2.9

Figure 5.C The result of question on *Please ranks defects of current service on its significance.*

Obviously, among these data collection, the lack for information assistance, confused station name, network planning and punctuality were proved to be the most important disadvantages in current public bus service. However, these disadvantages stem from the incompleteness in macro and systematical design, which had more dominated effects compared to the defects of concrete tangible facilities. Moreover, the inconvenience, the entrance stairs, check-in process and the banisters were also considered as the barriers for most passengers. Ultimately, participants only showed a few of consideration on their luggage space, in particular the TV commercials.

The third section was physical and cognitive barriers, which related to the inclusiveness of prevailing product/ service. In other words, this section evaluated the essential issues in product design that would block users' normal operation or interaction. The following table listed the potential difficulties of users and its corresponded intensity.

Difficulties	Very Difficult	Difficult	Neutral	Easy	Very Easy	Average Rate
Difficulty to confirm the exact location of each bus stops	3(14.29%)	6(28.57%)	9(42.86%)	3(14.29%)	0(0%)	2.57
Difficulty to keep balance on the running bus.	2(9.52%)	4(19.05%)	12(57.14%)	3(14.29%)	0(0%)	2.76
Difficulty to get useful travel information and manage my traveling plan	3(14.29%)	8(38.1%)	3(14.29%)	7(33.33%)	0(0%)	2.67
Difficulty to operate slot machine with luggage on hand	7(33.33%)	10(47.62%)	3(14.29%)	1(4.76%)	0(0%)	1.9

Difficulty to protect yourself from steal or sexual harassment	7(33.33%)	8(38.1%)	5(23.81%)	1(4.76%)	0(0%)	2
Difficult for wheel chair users	10(47.62%)	7(33.33%)	4(19.05%)	0(0%)	0(0%)	1.71
Difficulty to get through the crowds on bus	11(52.38%)	8(38.1%)	2(9.52%)	0(0%)	0(0%)	1.57

Figure 5.D The result of question on *Please ranks each difficulty on the difficulties.*

The result demonstrated an obvious fact that the existing product cannot generate too much physical barriers for normal users. However, for the people with luggage, the wheelchair people, existing service could no fit their need comprehensively. In that sense, the inclusiveness and usability of current product were not complete. These issues regarding usability and product inclusiveness will be presented and discussed in the later section.

The last question in this section was common operation mistakes, and the questionnaires had probed the occurrence of selected mistakes. The following table declared the result of this question.

5.5.2 The factors and its corresponded rank of significance

Mistakes	Very Often	Often	Neutral	Rarely	Never	Average Rate
Take the bus to incorrect direction	1(4.76%)	1(4.76%)	4(19.05%)	9(42.86%)	6(28.57%)	3.86
Missing the right station	0(0%)	5(23.81%)	3(14.29%)	9(42.86%)	4(19.05%)	3.57
Left the luggage on bus or station	0(0%)	0(0%)	5(23.81%)	7(33.33%)	9(42.86%)	4.19
Mistake other innocent passenger as thief.	0(0%)	1(4.76%)	5(23.81%)	3(14.29%)	12(57.14%)	4.24

Figure 5.E The result of question on *Please ranks each operation mistakes on their frequency.*

In fact, these common mistakes did not happen frequently, and it indicated that as users who followed the instruction passively, they did not have active operation mistake. However, these mistakes were extracted from the basic functionality of public bus, and in this context, people only needed to interact with the product passively. Hence, the result only implied the occurrence of mistake in normal context, for some specific context, like operating the emergency equipment, the result would not be available.

3) The benefits and expectations for future solutions.

Initially, among the four major saving functions, the online questionnaire explored their ranking based on each importance and users' expectation. Obviously, Saving time, money and effort was the key factor that users

really cared about. Unfortunately, a few number of participants regarded relaxing as a motivation. The result was presented in following table.

Savings	Average Rate
Saving Time	2.76
Saving Money	2.76
Saving Effort	2.67
Provide relaxing space	1.43

Figure 5.F The rate of merits in existing service.

Subsequently, the question was related to the expectation on future public traffic solution. These options drove from the content in previous interview. The following table indicated the result of this question.

Expectations	Average Rate
More accurate punctuality of departure and arrival time	11.48
More effective network planning, more affluent information service	10.71
More fluent association with other public transport service. Modifying the barriers of transportation transferring.	9.48
More spacious interior space	9.1
More comfortable seat	8.9
More broad service coverage	8.24
More peacefully driving	7.52
Free WIFI internet service	7.43
Cheaper ticket price	7.43
Charging machines for mobile phones and laptops	4.43
More elegant interior design	4.05

More engaging TV commercials	3.19
More interesting books or magazines	2.24
Some dedicated space or equipment for breakfast	1.67

Figure 5.G The rate of anticipations on future solutions

The ranking clearly demonstrated most people put their eyes on the macro and systematical issues rather than specific defect on concrete design. The top three anticipations were related to the initial planning in public transport service, which would be difficult to be fixed through partly modification. The secondary aspect contained more anticipation was the improvement for interior design, for instance, the comfort in the compartment. At the bottom, people were not passionate about merging additional functions in terms of relaxing and entertainment.

5.5.3 The result of other questions

Except the evaluations above, the questionnaire also contained a few questions in terms of passengers' behaviors and accessible alternatives.

The first question was what were you doing when you were on the bus? This question aimed to probe some potential insight and inspirations from users in order to detect their real needs indirectly. The result demonstrated playing mobile phone, communication, sightseeing and relaxing were the main activities on bus. Obviously, the activities on bus were restrained by the inherent structure of current bus design. However through the observation on focused area, many commuters would take their breakfast from street food shop. The result could reflect the fact that the basic function were performing badly, in this case it could not provide stable platform for additional actions to the users.

Actions	Rate
Reading for entertaining	7
Playing mobile phone	20
Communication/ Chatting	15
Eating food	2
Learning	5
Sightseeing	16
Relaxing	15

Figure 5.H The frequencies for other activities on bus.

The second question probed what the proffered alternative was. The result indicated taxi, private car and bicycle. However, for most commuters in focused area, taxi could not be an economical choice, but it indicated that the more flexible and tiny transportation could attract more people and produce more

efficiency. Nowadays, the unlicensed cobs and three wheel mopeds were acting as major alternatives, and their flourish implied the competitiveness of flexibility and customization.

Alternatives	Rate
Private car	9
Taxi	17
Sharing car	5
Unlicensed cobs (minivans)	5
Unlicensed cobs (three wheels mopeds)	3

Figure 5.1 The rank on expected alternatives.

The open-ended questions collected a number of users’ recommendations. Except the recommendations overlapped with options in previous survey, some result were novel and valuable.

- *“ The ground transportation could have some customized service for different people, and the transportation do not need to cease on each stations. I think the information service should be complemented, and it would be better to have a dedicated transportation to carry passengers to city center efficiently. ”*
- *“ Enabling us to know the arrival time in advance, and I would say the negation for bus transferring could be a helpful point. Moreover, for the passengers without seat, could we come up with some new solution in the middle of sitting and standing. I think for the future public transportation, the fluency will be the most essential factor that affects user experience. ”*
- *“ Obviously, many bus lines were overlapped, it doesn ’ t make sense. As commuters, if I had other alternatives, I would not take public bus because of its terrible uncertainty. It would be better to have some short-distance transportation that links surrounding regions to the traffic hubs or shopping center. The bus line should refresh constantly based on the changing environment. Otherwise, the bus always works in the old lines which are not rational for new residents. ”*
- *“ I hope the government could allocate some dedicated public transportation with well-trained conductors or servers in order to differentiate with the transportation for commuters. Moreover, I hope the bus company could allocate more buses in suburbs. ”*
- *“ More specious environment, and please eliminate the stairs, I would like to enter the bus on a flat ground. And the information board should remind the passengers where the bus was at that moment. It would be better to optimize the overlapped bus lines, and give passengers ’ the information of traffic congestion in advance. For the crucial areas, bus company should allocate more resources there. ”*

Obviously, these open-ended answers implied people’ s idealized solution in the future, and most people hope the public transport in the future could be more intelligent, which means it should have a capacity to analyze the instant distribution of passengers and traffic conditions, then optimized their service and system subsequently. In other words, current service was too rigid, it always neglected people’ s real but made people to follow their regulation, even if sometimes their regulation were not rational.

However, there must be some reasonable factors in current service, the stable but inefficient bus line could enhance the reliability of current service, since people could memorize the service net gradually. Moreover, the area covered by public traffic service always meant higher house price or rent, but most commuters often distributed in the cheaper area with impoverished public traffic service. The discussion would unfold later in chapter of product development.

5.5.4 The product value proposition

Based on product value proposition canvas, the product value proposition consisted of three components, which were the customer jobs, the pains and the gains. These three components were the fundamental guideline for previous evaluation. The research extracted the corresponded factors from interview, later the questionnaire tested these factors and ranked by their significance. In this case, the factors in those three categorizations were more holistic than testing with only one method.

The concrete product value proposition would be declared later in the conclusion of this chapter, and the specific contents were presented in the appendix.

5.6 Product Experience

Among the questions, there were some questions related to product experience. To be specific, those questions aimed to probe the users’ objective feeling when they were interacting with concrete product or service.

The input of the questions was based on product experience, and the specific attributes stem from Kansei engineering. This section would initiate by exploring users’ feedback from five basic senses, and subsequently the questions intended to test users’ physiological reactions. Ultimately, this question ended with testing users’ satisfaction in terms of product usability, users’ social activities and design rationality.

The initial phase was concerned with users’ sensing experience, and its result was indicated in the following table.

Questions	Score
The product/ artifact is nice to see?(Visual impression)	52.71
The product/artifact is nice to touch?(Tactile impression)	41.62
The product/artifact is nice to hear?(Auditory impression)	34.76
The product/artifact is nice to smell?(Olfactory impression)	33.38

Figure 5.J The product experience of five basic senses.

Among the result, most participants selected a comparatively neutral score for their experience in terms of sense. However, the sense of auditory and olfactory experience was not as good as visual and haptic sense.

According to authors’ empirical knowledge, generally most public transportation did not have a decent identity, its visual identity were inert and ponderous. While, the sanitary condition in the compartment was not eligible, the banisters and seats were covered with dirt and oil from other passengers, in this case, the haptic experience could not satisfy the passengers either. At last, due to the crowds and the bad smell in the compartment, as a result, these two senses were not performing well.

The second phase was the testing regarding the emotional reaction for passengers, and the dimensions included positive mood and negative mood , and these options were selected from the toolkits of K. R. Scherer (2005). In the testing product, normally passengers were playing a role as consumer who accepted the service passively. Hence, the more positive reaction they had, the more probability for choosing certain transportation. The table declared the result of this phase which was passengers’ emotional feedback.

Emotions	Score
Exited	41.43

Interested	52.9
Enthusiastic	43.71
Happy	51.81
Relaxed	52.95
Bored	32.81
Sad	28.71
Guilty	19.05
Lonely	28.48
Frustrated	23.05
Anxious	30.71
Disgusted	26.57
Angry	24.95
Afraid	35.14

Figure 5.K The product experience testing regarding emotions.

The result implied that passengers' emotional reaction were stable and neutral, and it seemed like their emotion could not be affected by the product seriously. Among these options, interested, happy and relaxed had a comparatively higher score, which means these three types of emotion could be generated through users' interaction with product. For the options regarding negative moods, bored and afraid had a higher score compared to other dimensions, which proved the passengers' annoyance for the uncertainty of public bus service. Generally speaking, the later concepts should enhance the three positive emotions and reduce the bad ones as much as possible.

At last, the questions probed the additional functionalities of the product in terms of users' behavioral experience, social experience and intellectual experience. The result was corresponded to the users' feedback previously, which means the prevailing service contains numerous issues waiting for fixing.

Questions	Score
The product/artifact is easy to use.	50.1
The product/artifact is good for my social relations.	48.81

The product/artifact has the functions I need.	46.48
The product/artifact is designed in a logical manner.	48.86

Figure 5.L The test of other attributes of existing bus service.

5.7 Conclusion

The following description summarized and concluded the major implication of user research, which formed the basic product value proposition and specification. Moreover, the critical insights and findings were listed below. The outcome of this section could be utilized as the input for idea generation later.

5.7.1 Specific portrait for user group

- Many users in suburbs were living singly and frugally, the key matter was how to link them to traffic hubs like metro stations. The motivation for choosing bus is the economical price. That meant economic level was the major limitation involved with their choice among different alternatives. Many users had bonus from the companies that hired them, which intended to subsidize them for commuting investment. In this case, those loyal customers normally had an economic restriction.
- Those commuters always had an ambivalent attitude on public bus. On one hand, they were frustrated due to the chaotic bus service, on the other hand, bus it was the only reliable transportations for them. The unlicensed cobs could help commuters when they missed the bus, but these irregular alternatives have latent threaten for passengers.
- Many people were working under heavy pressure. Since these people were lack of work experience but always energetic. Normally, these people had to extend their working time. Those who worked for IT company were in the majority and often lived with a rigid time schedule. The uncertainty of current ground public transportation cannot meet their need. For instance, in the morning, the intended users had to allocate their sleeping time to wait for the bus in advance.
- Once these people switching their residence from renting flat to their private house. They might be supposed to purchase a private car, that means among the intended users, a large amount of them, in particular the males had their personal driving license before they came to carrier.

5.7.2 Use context

- There was a tough conflict between the bus coverage and users' residence. The intended users always chose to live in the area with cheaper rent. However, the area with cheaper rent was not always covered by the bus service completely. For this reason, once the bus company adjusted their service net and bus lines, it would affect the house renting market. In this project, this probability was not included as an affecting factor in this study.
- The intended users live in the suburbs of Shanghai, to be specific, these area were closed to the IT companies and the outermost scope of public metro service. In Shanghai, the area like Zhangjiang, Songjiang and Caohejing could be served as the template of the focused area where not the central part of Shanghai with majority was migrate labors as flowing population.
- Normally, in the morning, the passenger commuting flow would start from 6 o' clock to 9 o' clock. According to the author' s experience, normally the commuters would spend less than 20 minutes on the way from their residence to working place. Most users spend their lunch time in their company, the other rush hour after work always started from 5 pm to 7 pm. However the intensity of passenger flow in the afternoon were much lighter than the flow in the morning, since company did not have unified quitting time, and the previous passengers diverted to market, entertainment place or city center, for many intended users, they prefer to have some additional activities after work.
- For the commuters, traveling was their major purpose, but the secondary purposes were different between the morning time and after work. Obviously, in the morning, it was a process of energizing the commuters and adjusting their status for working. Likewise, after work, their subsidiary purpose was relaxing or

something related to entertainments. In this case, the additional service on ground public transportation should contain the functionalities covered these two aspects.

5.7.3 Usability

- The issues concerned with usability could be tested through the HTA analysis, the following HTA map indicated the latent barriers for normal users, and the picture highlighted the potential blocks for special users who had innate deficiencies or temporary handicap as well.

5.7.4 Expression

- The alternatives should be a highly integrated service system with a cooperation of multiple transport modalities. In this case, in the suburban area, except the bus system, the government or bus company could merge additional vehicles into these systems, and these emerging vehicles could take the place of three wheels mopeds and minivans.

- The product should shorten the distance between commuters' cluster and the metro station or their working place(mostly the users' working place has better traffic condition, and the technology park was often closed to metro station) , which could work in the community flexibly.

- The product should have accurate instant information service, which enables the users to know the instant position of the bus that they were waiting for, the exact stopping location, the specific routes in the bus line and the instant traffic conditions.

- The product design should obey to the product value proposition and the fit the identity of intended users.

- The product should work as a supporting transportation that support current ground public transport system, it cannot take place of current bus, but it could be an effective regular complementation.

5.7.5 Product value proposition canvas

- Product value proposition canvas is a business mode which could be utilized in this design project as well. The previous user research served this tool as a major method which tested the customer jobs, pains and gains from the interviewees. Likewise, the corresponded countermeasure includes gain generator, pain reliever and its product or service.

- Customer job: The customer job for ground public transportation should be an effective ground transportation that conveys passengers from their residence to the traffic hubs. The major aims of the service/ product is reducing the traveling time for users and guaranteeing the punctuality. The outcome of its service could help the people to saving time and effort. This is the most critical purpose and functions that the user did really care. Other customer jobs like relaxing and entertaining could be served as secondary function and radical concepts for the future solution, but these functions could not influence the performance of major customer job.

- Pains: The pains of current ground public transportation mainly concentrated on its uncertainty and lack or reliability. Moreover, the bad environment in the compartment was the major generator of negative experience. Most users implied they could not suffer the uncertainty of current service and normally the compartment was too crowded, they did not have any respective space. Obviously, the uncertainty was caused by diverse factors:

1) The overall traffic conditions in Shanghai is deteriorating, as a result, bus might encounter more traffic congestion. The various traffic conditions made the bus difficult to arrive in every station punctually.

2) The bus line in suburbs was too tortuous. On one hand, this tortuous service line elevated the probability to encounter traffic congestion, since the bus had to pass through different areas. On the other hand, this type of arrangement did not have service concentration, in this case, once the bus stopped in the technology park or shopping center, it would be overloaded soon, which would be disaster for the people waiting in the next stations.

3) The systematical issues caused those issues regarding crowded, smelly and stealing, which could be partly relieved but not essentially.

- Gains: The interests generated by current product were listed in previous chapter. However, the acceptable benefits now is saving money, partly saving effort. In fact, the users still have so much anticipation to be realized.

- Product/ Service: The product could be an effective system with comprehensive service. Moreover, this system should be highly integrated with the cooperation between different types of transportation, rather than only one modality.

- Pain relievers: The pains could be relieved by many factors, and these factors could be categorized into three aspects.

1) From a systematical perspective of view, the service should be holistic, which means utilizing Internet, existing public bus, other secondary vehicles to enhance the working efficiency of current public transport system. Hence, the bus company or local government should adjust and optimize the traffic lines according to the distribution and feedback from users.

2) Enhancing the instant information service. In many European countries, the bus company had adequate information about the arrival/ departure time. In this case, the passengers could modify their planning in advance if some congestion happened for the buses they were waiting for.

3) Expanding the interior space or reduce the passengers could be an effective way to increase the user experience. Currently, the amount of commuters was much more than the capacity of public transport.

- Gain generators: The specific gain generators could be discussed later in the ideation chapter, the guidelines will later depict in the product expression.

The product value proposition canvas constructed a core value for the idealized public traffic solution in suburbs. The final conceptual solution should contain these values.

- Punctual: Having a stable and accurate time schedule.

- Reliable: Believable, accessible and easy to use.

- Flexible: Smart and fast, which has the capacity to run in the narrow streets or community.

- Efficient: To functions with qualified performance, the new solution should work in a fluent process and service stable and fast service for commuters. Shorten their distance from home to work place.

5.7.6 Users' need hierarchy for public transportation

The users' anticipation could be categorized into the corresponded class in Jordan's user need hierarchy. It purposed to probe users' subjective requirements and its corresponded position in the hierarchy. The result might help designers to know where the users' concentration was, and they could precede their design work with correct prerequisites.

The following picture declared the relationship and mutual affects among user's anticipations, its potential generator and its position in Jordan's user needs hierarchy.

Obviously, most users' requirements were directly distributed on the functionality class, however the needs concerned with usability started to decrease as the users deepening their requirements. Ultimately, users did not have any exception regarding their psychological actions. These distributions were confirmed in the interview as well, generally, no body stated the public transportation could give any good or bad influence on their psychology or social status.

In this case, as a sharing product, the tangible product should focus on fixing fundamental issues and providing better usability for customers.

06/ IDEATION

This chapter described the process of converting the research result to the design ideas that were in accordance with the design context, product core value and its specification.

6.1 Idea generation

This section records the process of idea generation and the subsequent evaluations that formed the final conception. Basically, the considerations of idea consisted of three aspects, which included the optimization for public traffic service in suburbs, the consideration of intended group and the specific transportation design.

As it depicted in the picture, the core design thinking had focused on the factors in terms of the design motivation, target users, design context, potential solution and its corresponding tangible product, which was called 5W1H. The text below had described the consideration for these factors and the ideas extracted from those thinking.

The early study was based on the evaluation of referenced product, and a vast number of insights appeared which could be utilized to embellish the new ideas in this section. In this study, the solution was not a simply simulation for current public bus service, the ideation process would zoom in to exploit the new concepts without the limitation of current product, but the ideas' basic attributions would be generated from the outcome of early study.

6.1.1 The new solution for ground public transport service

The early study indicated the importance of thinking from a systematical perspective, in this case, the ideation initiated from the service consideration. Through this method, the essential value of insights would be deeply exploited, moreover, the issues deprived from systematical defects could be able to partly fix later.

The previous research implied that the ground public aimed broad the service extent, and mutually the residents served the ground public transport as a transitional vehicle. In this case, as long as the new solution had the capacity to be a proper alternative, the subjects of new solution could be more flexible.

As it depicted before, the rigid service system were conflicting with the residents' distribution in suburbs of Shanghai. Hence, a highly integrated serve that was dedicated for the suburbs residents had become the priority considered in this session, in other words, the new solution should be unleashed from the stereotype forms.

Therefore, besides the existing forms of public ground public transport service, some ideas were generated, for instance shortening the service lines, electric bicycle, vehicle renting system etc. The following text depicted some general ideas regarding system arrangement or service design.

- The new solution could shorten its service extent, which means the bus company could allocate some resource dedicated for the area with a vast number of commuters and residents. As a result, during the rush hour, the transporting efficiency would be enhanced due to the additional transport resource emerged.
- Elevating the flexibility of traveling line would deeply promote the transport efficiency for users. The traveling line of each vehicle could be changed according to the specific requirements of different group of users. The service management could absorb the advantage of taxi service that enables the passengers to customize their dedicated traveling lines. Moreover, when the regulated line was encountering traffic congestion, switching the traffic line would help the users to avoid the traffic jam.
- For enhancing the reliability and punctuality from a systematical perspective, the service must be easy to approach to. In this case, users would be able to take the vehicle as a point to point transportation.

6.1.2 The consideration of intended group

The intended users were profiled in the early study, besides their basic attribute and general features, in the ideation part, some ideas stemmed from the characteristics or personalities of intended users. The following text described these ideas that inspired by the intended users.

- Since most of the intended users had driving licenses before their graduation, it provided adequate probability for establishing a vehicle renting service to be the alternative or complementation for current traffic solution.

- Most of the intended users had an occupation with a comparatively heavy work, and most were working for the IT company. In this case, the vehicle could provide some special functionality that energize or loosen their mind in certain occasion. In addition, the new solution should protect the security for the people who had to traveling at night.

6.1.3 The concrete tangible transportation design

The concrete tangible transportation was the major carrier of the service, which associate the intended users with the new solution. The specific transportation design should be coinciding with the service it belongs to, and the dimensions of the vehicle should in line with the users' preconditions as well.

In this case, the ideas about transportation design were not futuristic and radical, the functions and concepts could be realized by current technology. These limitations contained the dynamic system, the suspension, the wheel selection, and the basic package of the new vehicle. Some ideas were generated from these prerequisites.

- The appearance should be able to represent the identity of the young people. It was not luxury, speedy and clumpy. A smart and sample appearance would generate symbolic sense to this group of people.

- It would be good for the new transportation to be in line with the macro environment of the metropolis city- Shanghai. As an urban public transportation, its appearance and functionalities should have to be corresponded with the features of the city.

- From a large perspective, the new solution should consider the sustainability and environment in the future.

6.2 Macro Ideas

In this session, it would describe the major ideas briefly, and each idea will be evaluated after the description.

6.2.1 The description of the service ideas

The mini bus service.

The first idea was inspired by the community bus in some western countries, which meant the smaller bus that worked for the community. Normally, these community buses were dedicated for the elder people or handicapped users who would not be able to access to the public transport service. The community bus would stop close to the passengers' house or flats and later picked them up to the nearest bus station.

In this idea, the bus company could allocate some particular vehicles for the community with a vast number of commuters or residents. Its service is similar to the current bus system, but this community bus will directly take them from people's residence to the nearest traffic hubs or working place directly (normally, they were in the same area). In addition, the bus driver could help the elder people or handicapped users as well.

The community bus could particularly work for the commuters in rush hour, and it would work as a normal bus in other bus line. When the next rush hour was approaching, these buses will come to the traffic hubs and take the same group of people back home.

The small public motorized bicycle for one

Another idea was like the bicycle renting system, however, this idea would provide a safer and stable solution. People could rent this small vehicle for a whole day, and park it in a certain correct position. This vehicle is an urban transportation with the attribution in the middle of motorcycle and private car.

These small public renting vehicles allowed the users to utilize them as a private car, but its parking space was regulated. In this case, the amount of commuters fighting for bus could be alleviated slightly.

Moreover, the operation for in vehicle would be similar to electric bicycle, which could be easy to acquire. However, an obviously defect of this idea was that it must occupied much urban space than ever before, which would be difficult to evaluate if the traffic condition would be worse or better.

The smart sharing vehicle renting service

This idea mingled with the advantages of the previous two ideas, and it would functions like the current unlicensed car, which were mostly working with mini vans. The idea was providing some small vehicles like minivans, for the residents who were working in the similar area, it could enable them to rent the vehicle and share it dedicated for their universal purpose.

However, the investment of this vehicle would be much more higher than the current public, bus as a sharing product, it could introduced some commercials or other functionalities to supply additional money for the maintenance for the system.

6.2.2 The evaluation of the service ideas.

The idea evaluation will be implemented based on the previous product specification and the comparison between these three major ideas. The pros and cons would be discussed respectively. These ideas would be tested by six dimensions, which included punctuality, reliability, flexibility, efficiency, creativity and sustainability. The first four dimensions stemmed from the product core value in previous user research, and the last two dimensions would be able to test the product value from a design perspective.

The first idea was the direct modification or imitation for current public urban transport, the idea might contain conspicuous efficiency for carry large number of commuters for single trip. However, the deficiency of this idea was also obvious, on one hand, this dedicated bus for commuting had to keep in a static situation until it had been filled up. In this case, passengers who had entered the vehicle would not be able to depart instantly. In addition, this issue would be magnified after work. On the other hand, in the first idea, the dedicated bus did not cover the users who lived in remote areas.

The most critical issues for the second idea were the extravagance for limited urban space. Even if the small and tiny vehicle would enable the users to utilize the public resource as personal asset, the real situation might not been idea as expected. Once this idea had been implemented, a plenty of tiny and smart vehicles would occupy the urban space and deteriorate current traffic situation. Moreover, a couple of few years ago, the vernacular government of Shanghai had unfolded the renting bicycle system, however, this service result to a large number of financial deficits for the government.

The last idea is a neutral thinking in the middle of previous two ideas. One hand, the unlicensed mini vans could be served as an effective reference for the new solution, on the other hand, it would not splurge on the limited urban spatial resource.

Eventually, the neutral idea was selected to be the most appropriate idea in this evaluation. The following picture depicted the performance in each dimension, even if the dimension was not holistic, but it partly reflected the pros and cons for each idea.

6.3 Concept generation

6.3.1 The requirement for a vehicle in renting system

The idea of the renting system of shared vehicles was further developed into some secondary ideas. In the beginning, the fundamental attributes for a shared vehicle system should be clarified and complied to. Some critical factors were depicted in the following text.

- The entire service should contain a comprehensive operation system, which includes all the procedures that constructs the complete actions for product usage.
- The vehicle should have the legal traffic lane for it to belong to, and its operation must be in line with the Chinese traffic legislation.
- The vehicle should be functionally realizable, and it must contain adequate functionally rationality.
- The system should minimize the additional negative affect for the sustainability in the urban city.
- The system should not elevate the traveling cost for each passenger.

6.3.2 Initial concepts.

Based on the input from the ideas and its subsequent evaluation, three concepts were generated. After each brief description, the pros and cons would be listed subsequently.

Concept I: the tiny vehicle for two occupants



Figure 6.A The visualization for the first concept

This concept was inspired by the three wheel mopeds. This is a vehicle with three wheels with its powertrain consisting of several batteries. Since its dynamic system was similar to the electronic bicycle, the powertrain was located in the rear position, and the batteries were arranged right in the middle from the perspective of side view. The drivers could operate the vehicle as an electric bicycle, which was easy to learn.

The two drivers had to straddle in the seat like what they did on the motor cycle, in this case, the width of this vehicle would be effectively limited. The rear seat was located directly behind the driver, which enabled the other person to sit right behind the driver closely.

These tiny vehicle would be parked in a particular area closed to the community, and users could pick it up in the morning and drive it to the intended destination, and park it in another regulated parking place.

- + The vehicle size had been effectively limited, which would be able to travel through the narrow streets or the gaps in traffic congestion.
- + The operation of the vehicle would be controlled, which abbreviate the learning cost for users.
- + The square for parking would not occupy so much public spatial space.
- The users might require a plenty of these vehicles, which might generate partial traffic congestion in the focused area.
- The wheel base was too long, and the track was short. It would turn over when it was crossing the corner in the high speed.
- Moreover, the entire structure did not have adequate protection for passengers under traffic crash, in particular the passive crash form the side direction, which would cause vital damage to its users.

Concept II: Three wheels vehicle for three passengers.

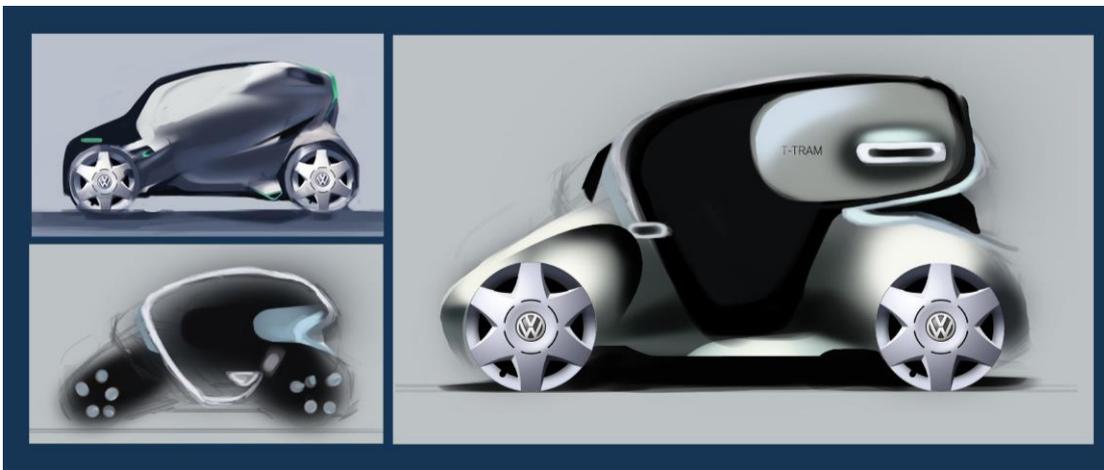


Figure 6.B The initial sketches and visualization for the second concept.

The second idea was a small vehicle that one front wheel and two rear wheels, the entire vehicle were designed for three passengers. The passengers could sit in the vehicle as what they did normally in the car.

It aimed to enhance the attributes regarding the safety for passengers. The width of this vehicle was longer than the previous concept, because the back seats allowed two passengers, and the entire vehicle contained only one driver.

The passengers who had the same destination could form a cooperated group and shared this vehicle. The pros and cons were depicted in the follow text.

- + Compared to the first concept, the vehicle allowed more passengers.
- + The sitting position for passengers was more comfortable.
- + It still had a comparatively smart size, which enabled it to go through the narrow space in the urban city.
- It still contains the problem for turning.
- It would be vulnerable for passive crash.

Concept III: Four wheels vehicle for three passengers.



Figure 6.C The initial visualization for the third concept.

The Last concept was similar to the current small vehicle, which contained four wheels and a stable framework that was like what it should be in current urban transportation design. The unique feature in this concept was its interior design, the seats position would be arranged in a dense layout.

The powertrain was constructed by a plenty of batteries that located at the bottom of chassis, and its operation system was similar to the current car, which would be more convenient for the passengers with driving license.

- + One advantage of this concept was that its attribute for safety was similar to the current car. The exterior design would allow the frame to protect the passengers from active or passive crash.
- + Another advantage was passengers would be easier to accept this new solution due to its similarity with current vehicles.
- + It would be easier to be realized.
- The size was comparatively bigger than the previous concepts, which will higher the probability for traffic congestion.
- The operation for this vehicle required a driving license, which meant its learning cost was much higher than driving an electronic car.

6.3.3 Concept evaluation

The concept evaluation mainly focused on the test and discussion on the rough package and sketch of these concepts. The entire evaluation consisted of self-evaluation, the discussion with project supervisor and the discussion with the experts of automotive engineering. Some additional input for concept development would be introduced in the process of concept evaluation.

Hence, the self-evaluation was performed though checking the relevant literatures and data in order to test the rationality and reliability. A number of part-time presentations were unfolded with the supervisor and some issues regarding human factor were merged into the concept thinking. Ultimately, the experts on automotive engineering gave numerous recommendations in terms of vehicle framework, suspension, the protection from the active or passive crash.

The following description demonstrated the issues that might happen in the real context and the recommendations for the further design development.

The effective ways to from with the reliable persons

The primary issues among those concepts were if it was necessary to set a special driver as what it did in the public bus. Obviously, this arrangement would increase the cost of human resource for the operation company. In this case, for the passengers, driving the vehicle by themselves would be the only one possible solution in this concept.

In this renting system, the passenger group should be constructed in advance in order to save time and promote their traveling efficiency for each passenger. However, some potential issues would appear in certain context.

The second issue was how to establish a platform that enabled people to choose suitable partners. Matching with the right people was the basic function in this service. The most common idea was developing some applications on mobile phones, which allowed people to participate in this service.

The third issues were how to establish the trust mutually. In this solution, the temporary driver had to take the responsibility to the security for the other partners. Hence, it is crucial to driving carefully and avoids the aggressively driving.

The protection for driving

This session briefly depicted the discussion with expert for the rationality in the initial concept. The expert suggested that four wheels would be better than the three wheels vehicle. Moreover, the front and rear part in the vehicle should contain adequate framework to avoid the crash from the front and back direction.

Based on the discussion, the active and passive safety would contribute to the function selection and the material selection. Some equipment's could be merged into the concrete transportation design, liked passenger's safety cell, laminated glass and barrier nets etc.

6.4 Conclusion

Ultimately, after the concept evaluation, the concept that equipped with four wheels was selected to be the concept to be developed. Moreover, during the discussion, a plenty of ideas and new input were introduced for the further design development. These new input were mainly related to the basic constructor on transportation design and brief knowledge on automotive manufacturing.

07/ Concept Development

This chapter aimed to record the concept development from the ideation to the final concept. More concrete design work was implemented including the elaboration of concept and visualization.

After the determination for a clear design purpose, the further concept development was initiated through the form development by a plenty of sketching after the analysis for the mood board.

Later, a brief package arrangement for the vehicle was considered, which meant setting up the rational combination among different types of dynamic system, framework, package, suspension and wheels. Hence, the overall concept development was unfolded through the consideration of form development and package design.

7.1 Initial form development

7.1.1 Sketching ideation on exterior design

In the beginning, the basic form for the intended transportation was extracted from the animals from the nature, which was regarded as a random input for forms inspiration. In addition, the other limitation from mood board and functionalities would affect the form and package for the transportation design.

Since the idea evaluation helped the project to narrow down its focus point, a mood board was created in order to restrict the form and design language close to the identity and core value for the new urban transportation. A plenty of relevant pictures were selected from the internet, which would inspire the specific design language for later project.

The mood board represented the characteristics and core value for intended product, which was utilized for concept visualization. The key words for mood board collection were reliable, efficient, flexible, light, and sustainable. In this case, the following pictures clusters were constructed to serve as the input for later form development and visualization.

The sketches below indicated the initial thinking on the basic forms. There were two animals were selected to be the input of the basic forms. The first one was tree frog, the other inspiration was the sea turtle. From the designers' perspective, these two inspirations had some similarities with the idealized urban transportation that worked in a renting system, and their natural characteristics were close to the expected features of the ultimate product.

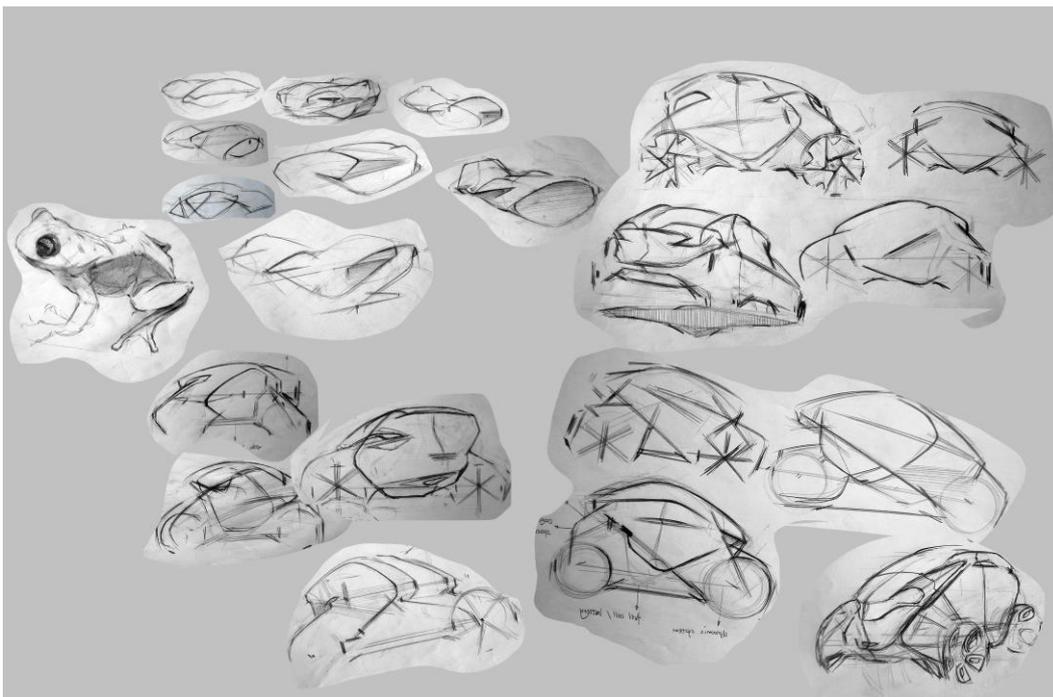


Figure 7.A The initial sketches according to gesture of tree frog.

Two groups of sketching were going on in parallel, basic sketches ideation aimed to refine the natural shape of the selected animals. The major surfaces with concave and convex were profiled and extracted to be the basic gesture of transportation.

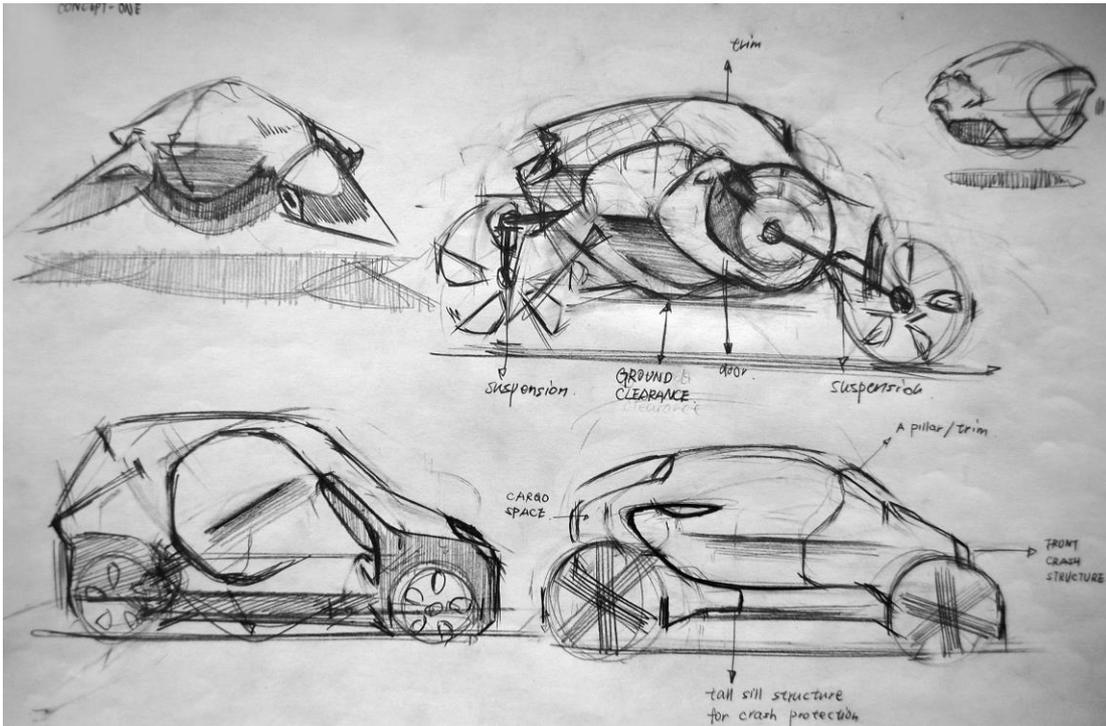


Figure 7.B The initial sketches inspired by the gesture from sea turtle.

Later, the sketches went on to eliminated the sophisticated surface with organic shape, and it tried to transform the natural shape into some simple forms that were belong to product aesthetics.

At the end of this session, some key sketches were selected. However, the forms from the tree frog were chose to be the one that continued to develop, because it' s from was more coincide with the intended

7.1.2 The basic dimensions for the transportation.

After the first round of sketching ideation, the size and basic dimensions should be confirmed, in this section, several aspects regarding the transportation size were developed, during this section, some combination and benchmark study were implemented in order to confirm the most suitable dimensions for the terminal transportation design.

The basic dimensions for the transportation exterior

This session aimed to discuss the overall size for the concept transportation, and the basic dimensions like height, width, length, wheel base, front and rear track would be determined during this section.

According to the ideas, the size of the transportation should be limited. On the other hand, this tiny vehicle enabled three occupants, in this case, it might be similar to Japanese kel car. The following figure had listed the distribution of the existing cars, and the different types of cars were categorized into corresponded clusters by their exterior size.

As it depicted in the map, the vehicle in this project might be in the domain marked by red square, which was in the middle between *Smartand Fiat 500*. Setting our concept vehicle in a smaller size would be beneficial for optimizing the urban spatial resource, moreover, it would decrease the probability of traffic congestion. At last, restricting the length of the car, would make it easier to parking, because in general, many drivers in China were encountering the difficulty to park the vehicle in the right position. In this context, the operation of the vehicle should not contain too much additional effort and time for passengers. In this case, the small size contained conspicuous advantages.

When it came to the weight determination, it required some compromise. In general, the smaller and light vehicle might face more risks. The additional weight would be an indirect protection for the vehicles in traffic crashing.

After the discussion regarding the flexibility, safety, sustainability for the concept car, and the small and tiny car with light weight were confirmed. Even if the light and fragile material would be the latent dangers for them, but its safety could be increased by other protection, for instance the passenger safety cell. Additionally, besides the advantages in previous text, the light weight requires less electronic power, and it was more sustainable.

The occupant position in the interior space.

Normally the drivers and passengers in the small vehicle had the similar sitting posture, and the H-point of passengers were a bit more higher than the drivers' due to the additional seat height elevated by the rear powertrain. However, in the electric vehicle, the full-cell in the chassis would extremely reduce the space that used to be occupied by power train, hence occupants in electronic vehicles would have more interior space comparatively.

Actually, there were several ideas about arranging three occupants. First of all, the height of H-point should be determined. The H-point, which meant the intangible point for occupants' hip from the side view, was a crucial conception in package design, which decided the sitting posture for the occupants. Hence, the height of H-point was the priority for the overall package design, and it would extremely affect the dimensions for other components (Macey & Wardle, 2009). On one hand, the H-point affected the sitting position for occupants, on the other hand, it indirectly impact the overall height for the transportation.

As sharing vehicles that worked in a public renting system, this concept car was defined as public facility. Hence, the design did not emphasize the comfort in the vehicle, so a holistic consideration regarding the efficient, anthropometric limitation, overall size and optimization for interior space were served as the dominated inputs in this selection.

The following pictures indicated the driving height from ground and its corresponding postures of several representative vehicles. Obviously, lowering the occupants' position would descend their central gravity, which would facilitate the speed of vehicle, but it would block the ingress/egress and influence the visibility for drivers. The higher sitting position like what passengers did in SUV would elevate the height of entrance.

Hence, the sitting posture with the dimension similar to minivans was selected to be the proper posture for the occupants. Some issues were considered before the decision had been made.

Firstly, this vehicle aimed to provide a short period traveling for the commuters. For those who had a tough job and required to energize themselves in the morning, their sitting position should not as comfortable as what it like in a relaxing situation. Secondly, the higher H-point would make passengers easier to sit down and stand up, which would facilitate their operation efficiency. At last, many mini vans were working in the suburbs of Shanghai as unlicensed cabs, many people had accustomed themselves to the situation. In this case, the concept vehicle selected the sitting position like what it was in mini vans.

Later, some literature study was implemented to check the approximate reference dimension. The dimension design for this concept vehicle partly modified the reference dimension for small electric car, the modification for the dimension would be performed later in the interior design phase according to the specific design requirements.

The dynamic systems for the concept vehicle

There was a short literature study on the prevailing dynamic system for transportation design. The basic knowledge on the construction of powertrain helped the project to clarify the proper power system for the concept for the concept vehicle.

The priority in this concept was safety, sustainable and interior package space. From the beginning, two types of dynamic system were selected as candidates. One was electric drive system, the other one was hybrid drive system. The powertrain locations and orientation were depicted in the following picture.

As a result, there are a plenty of advantage of choosing electric power.

Firstly, the development of the electric power vehicle is a prevailing tendency in the future. In addition, this concept for urban transport did not require excellent attribute, its speed should be restricted in a safe extent, and the electric vehicle could fit this needs in this design context.

Secondly, normally the fuel cells and batteries were arranged in the bottom of the chassis, and this arrangement saved more interior space for commuters, which will facilitate the ingress and egress for the passengers. It also lowers the central gravity for the vehicle, which would enhance the stability for driving. Moreover, the motors in electric vehicles were much smaller than traditional powertrain.

At last, since it was easier to collect electric power than gasoline, which increased the flexibility for their parking and charging place.

In this case, the electric drive system was selected in the concept vehicle. Whereas, in order to enhance the stability for the vehicle, four wheels drive system was served as a recommended arrangement in this concept. The final powertrain location was depicted in the following picture.

The suspension system

Suspension is the term given to the system of springs, shock absorbers and linkages that connects a vehicle to its wheels and allows relative motion between the two (Reza N. Jazar, 2008). Generally speaking, in this design context, suspension would help the drivers and occupants to keep comfortable when the vehicles were working on the route with diverse condition. Likewise, the function of wheels had the similar significance.

The suspension system was one of the most crucial systems in the automotive manufacturing. A rational suspension design had to balance the requirements from operation and comfort, and these two aspects were usually conflicts mutually. Normally, the perfect comfort experience needed less shock, in this case, the springs should be designed more flexible. However, the soft and flexible springs would impact the barking and turning system, and caused additional issues for operation.

Normally, there were two kinds of mainstream suspensions, which were subdivided into non- independent and independent. For most urban cars, the independent suspension system was more suitable to them, since it enabled the vehicle to provide more comfort. However, the defects of independent suspension were the complexity in manufacturing.

The specific suspension design was not included in this project, but as a part of package design, a rational and suitable suspension system should be discussed and selected. Hence, after a short literature, some major pros and cons were generalized. The following table implied the pros and cons of each types of suspension system.

	Pros	Cons
Independent system	<ul style="list-style-type: none"> - Light, more adhesion to the ground, more stability. - Less vibration, since the wheels will shake constantly. - lower location for powertrain, low center gravity. 	<ul style="list-style-type: none"> - Sophisticated - Expensive - Difficult to maintain and repair - Need more space
Non- independent system	<ul style="list-style-type: none"> - Reduce wear and tear of tires. - More comfortable operation. 	<ul style="list-style-type: none"> - The strong vibration will influence the comfort for the passengers.

	<ul style="list-style-type: none"> - Simple, easy to repair - Need less space. 	
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Figure 7.C The general comparison between independent suspension and non-independent suspension, which was generalized from the study of Wangyu Wang (2004).

In this project, the usability of operation and comfort were significance. Both of the two factors would affect the user experience. On one hand, in this renting vehicle service, the temporary driver was served as users, its operation system would affect the driver’ s moods and experience. On the other hand, the occupants required a comfort and stable feeling in the car.

Ultimately, the study referred to some mainstream front and rear suspension system, and selected the McPHERSON status as the front suspension system and the trailing arm suspension as the rear system.

McPHERSON status was the most popular independent system in current passenger’ s cars, which contained some merits like less vibration. This would be beneficial for the passengers who were sitting on the rear part of the compartment. Implementing non-independent system for the front wheels aimed to enhance the handling performance for drivers.

Due to the consideration on the operating performance and the comfort for passengers, it indicated that utilizing this combination could balance the interest among different affecting factors.

Other dimensions

Besides the dimensions of the major components for the vehicle, the other secondary dimensions were not specifically discussed. These components’ size were only approximately determined, which included the size of motor, framework, batteries etc. The final concept would contain the dimensions for these components.

7.1.3 The initial package for the concept vehicle

The early study merged the specific dimensions to the transportation design. For a rational transportation design development, an initial package and limitation could clarify the limitation for the later form development and design. Therefore, a digital mock- up was established according to the initial concept of sketching ideation and the dimension selection in early study.

The following picture depicted the digital mock-up in the Rhino V. The mock-up initiated from the package design on side view. Some major dimensions were illustrated in the following picture. The overall vehicle size referred some mainstream small vehicles currently, so its height was 1480mm, and the wheel base was 2100mm. Moreover, the H-point was confirmed with 700mm. This side view dimension was decided to let the vehicle enables two occupants from the side view. Other dimensions like chassis height and the seat height were also confirmed according to the basic size of the vehicle and the posture of occupants.

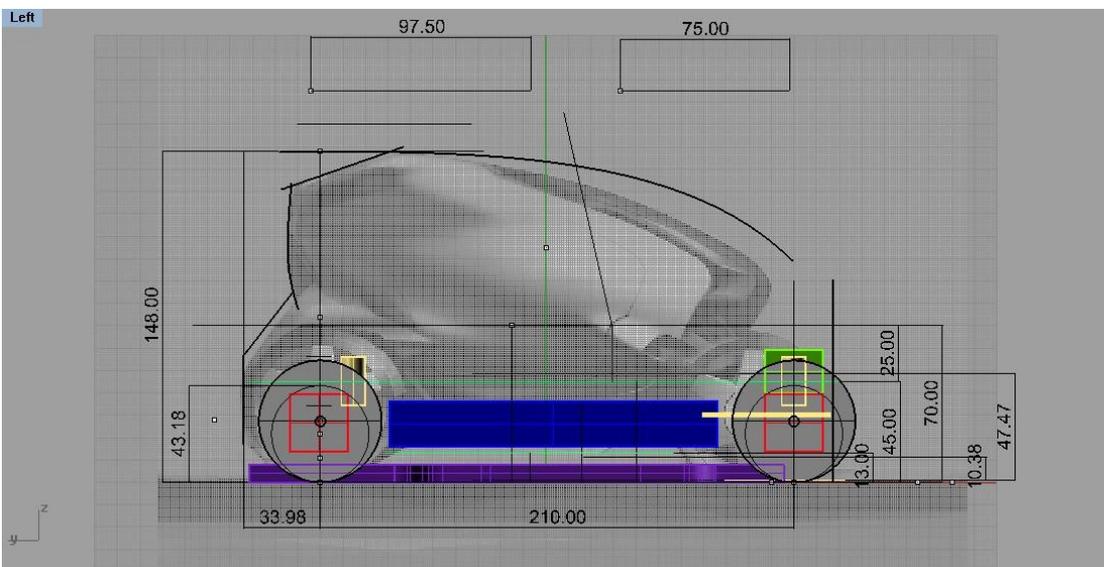


Figure 7.D The digital mock-up with rough dimensions

Based on the size in the side view. The dimensions from other perspective had been complete. The overall width was 1550 with the front wheel track as 1340. In this case, the mock-up constructed a brief model for the future design. Moreover, the basic components like motors, batteries and suspension were added in the mock-up in order to limit and facilitate the later design development.

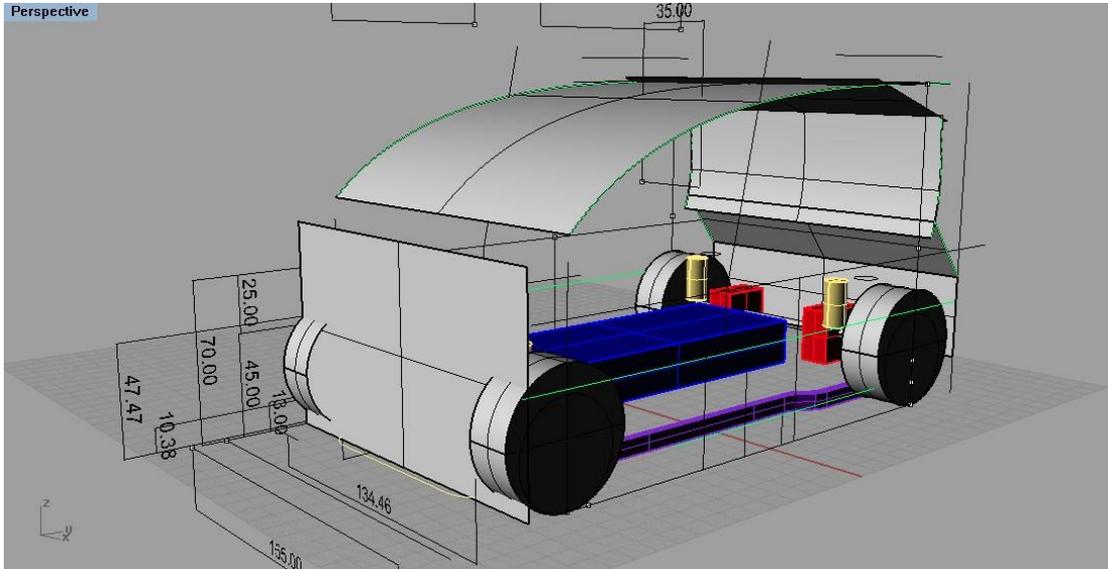


Figure 7.E The perspective of view for digital mock-up

The mock-up gave adequate reference for package design. Based on this mock-up, brief package was elaborated. The following pictures implied the package.

7.2 Concept elaboration

7.2.1 The second round sketching.

The exterior design continued to develop the idea from sketching ideation with the limitation from the former package design. A plenty of sketches were implemented again to elaborate the specific appearance and details for the electric vehicle.

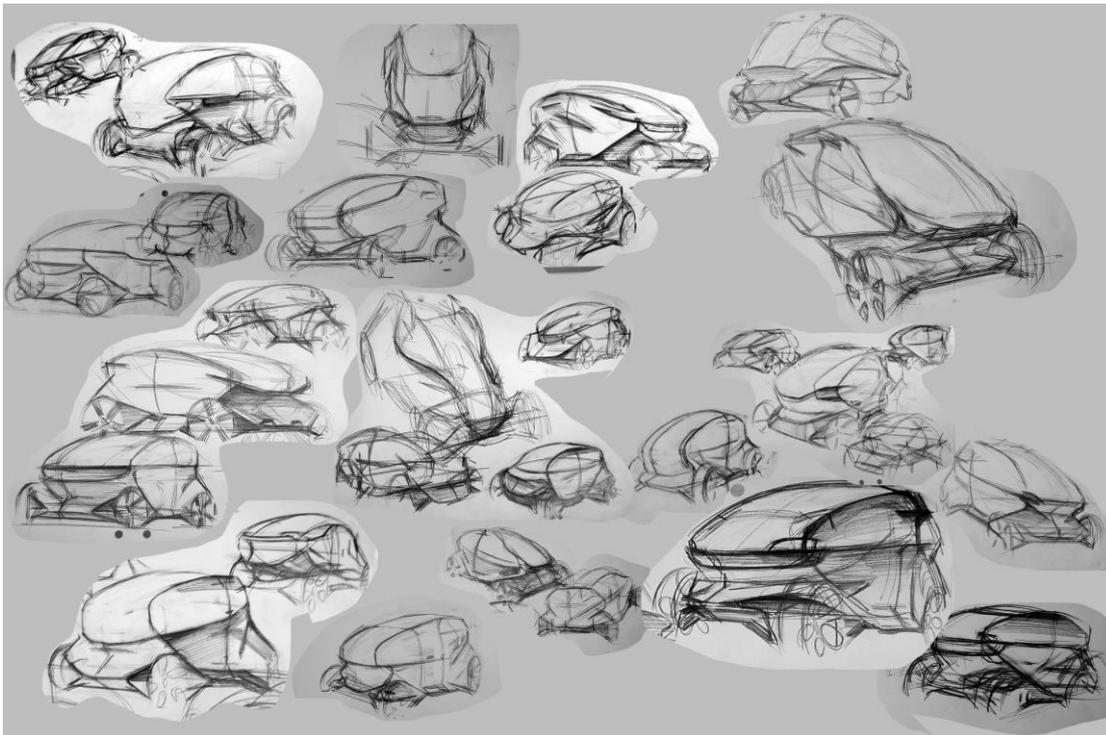


Figure 7.F The second round sketches.

This round of sketch development followed the package limitation, and moreover, these forms started to add more variation inspired from the design language dedicated for electric vehicle.

From the beginning, a vast number of sketching was implemented to discuss the basic gesture for the side view of conceptual vehicle. The concept depicted in the key sketching contained a stylish front structure like streamline, which aimed to enhance the feeling of being an urban transport car and reduce the air resistance slightly. The rear part had a comparatively cubic volume due to the functional limitation of taking two occupants in the rear space. The overall volume or exterior appearance rigidly coincided with the requirements from the package and the aesthetics.

The final concept remained the design language from the smart, concise and effective characteristics, which were expressed by the smooth surfaces with hard edges. This final exterior design had expressed the core value of efficient and effective from an elegant but stable visualization.

9.2.2 Interior design

The interior design contained a simple and intensive structure that dedicated for three occupants. The development for the interior design only interpreted the basic seats positions for the occupants. In other words, compared to the development of exterior design, less stylish components were focused on. In this case, sketching for interior design were implemented in this section, and these sketches were mainly profiled the interior arrangement from the perspective of top view.

After a vast number of sketching and discussions on the concrete arrangement for the layout, eventually, a dense, intensive and effective compartment was selected as a proper interior space for three passengers with one occupant in front position and two occupants in the rear. This was because that the layout could extremely minimize the spatial resource, and at the same time, it enhanced the accessibility through extending the entrance of car door.

However, the operation system and the details of the interior space were not included in this project. The details with stylish components would be refined later in the final concept.

7.3 Service Design

This concrete smart transportation would be implemented into a corresponded service, which regulated the cooperation between numerous transportations as units were highly integrated. The service was refined according to the insights of users and the specific environment in the focused area.

Some participants in the previous research implied the considerable requirement for extending the service coverage for passengers, and its needs from users could be regarded as the appealing for enhancing the accessibility of public transport service. In that case, the previous transportation design on extending the car door had physically improved fluentness of entrance. However, other functionalities to abbreviate the using process would be served as the indirect way to enhance the accessibility of this renting service.

In order to cover the users from different regions, this renting service promotes its function and regulated traveling line to serve for commuters who lived in remote area or individually. In this case, on one hand, those living in the commuters cluster could form their temporary group in advance, and this group were allowed to pick up the vehicle parked in a dedicated station on the next day for commuting; on the other hand, people who lived in remote area could asked for being picked up in certain place and join the team.

In addition, the relationship and other components that could be probably utilized into this service network were discussed, and their corresponded functionalities were assumed as a further direction of the development for this conceptual service. For instance, Internet information service or mobile application could enhance the cooperation with online commerce and other emerging industries in China currently.

Ultimately, the service would be depicted with a map that clarified how the commuters use this service from forming the group of people sharing the vehicle with to arriving in their destination. Generally speaking, the map indicated the interaction process between the users and the service.

7.4 Conclusion

The result of concept development phase converts the concept from an ambiguous idea to a comparative holistic transportation with a service system that contains considerable possibility to operate with. The section was preceded with the product specification and guidelines closely. More consideration in terms of the dimensions, functions and the service would be interpreted later in the next chapter.

8/ Final Concept

This final conceptual product will be introduced and explained in this chapter.

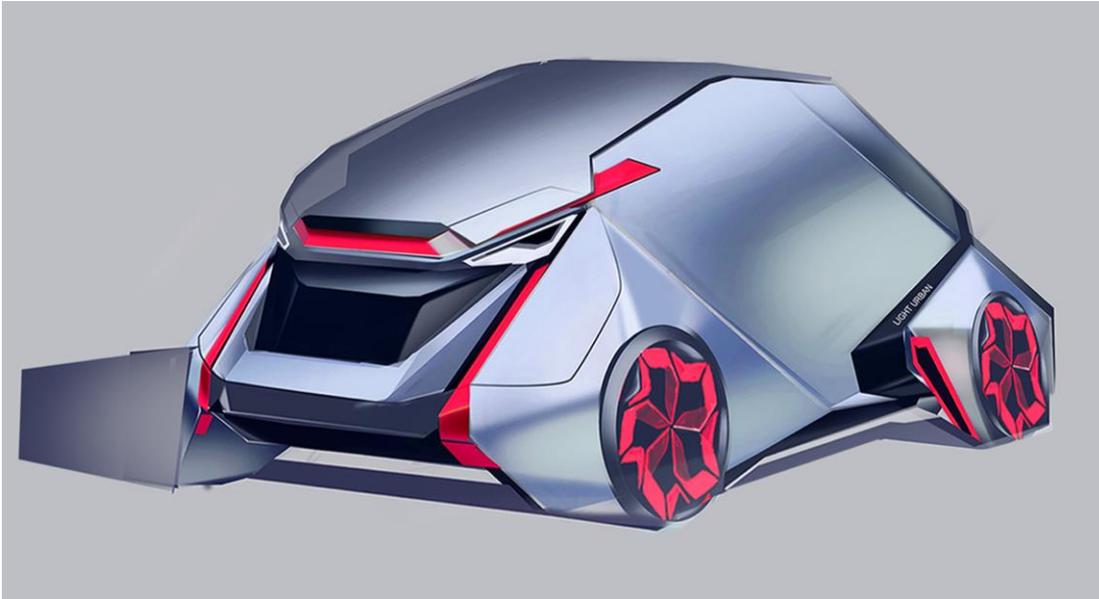


Figure 7.G The visualization for final concept from front perspective of view

8.1 The transportation

The transportation was an intense and tiny vehicle with the feeling of flexible and stable, which would be able to facilitate the daily traveling for the residents in suburbs of Shanghai. Through the dense and intensive layout for this vehicle, it extremely minimized the dimension of the vehicle and found out a balance point for the conflict between the occupants' comfort and the volume of the vehicle. This small vehicle mainly aimed to abbreviate the distance between commuters' living place to the major traffic hubs where they had to pass or arrive every day. This vehicle furthermore enhanced the comfort for each occupant, because their seats and respective space were guaranteed.

This vehicle is designed for the commuters that living in remote area but working in downtown, which was working as an effective alternatives to residents. In other words, it would not compete with current mainstream public transport service like bus or taxi, and instead, it would work as a proper assistance for existing public traffic network.

The exterior design was elaborated according to the insights from the users and some particular aesthetic language for urban electric vehicles. As a vehicles would work in the urban, its elegant, simple and tiny out looking was in line with the impression of a modernized city, moreover, the obvious lines and the metal color could represent the identity of the intended users who were voted as the most hopeful and passionate generation in current China. The stylish out looking of polygonal surfaces were utilized to enhance the feeling of efficiency and reliability. In this case, the overall design style was constructed by these polygonal components and units.

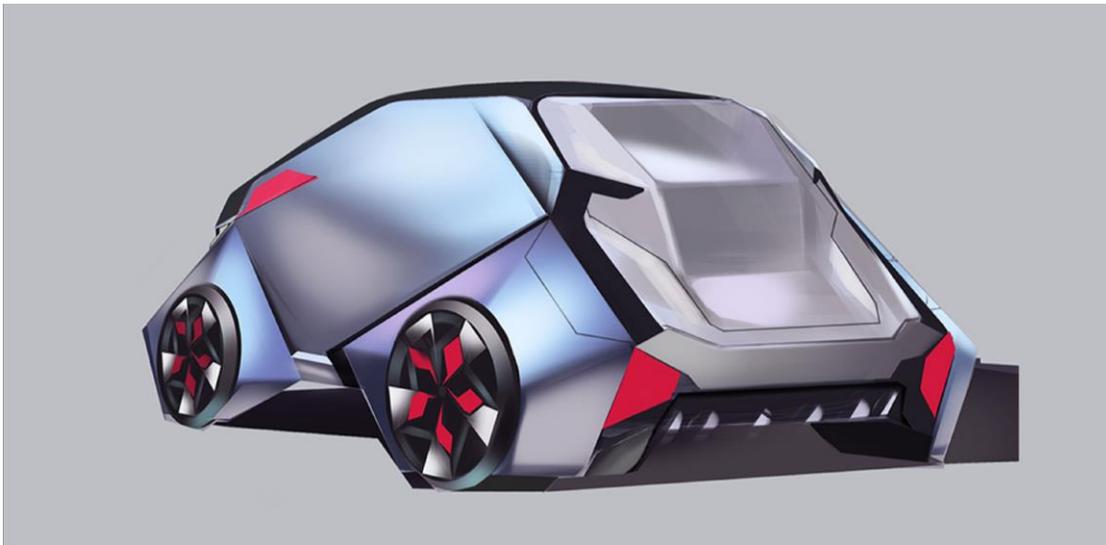


Figure 7.H The visualization for final concept from rear perspective of view.

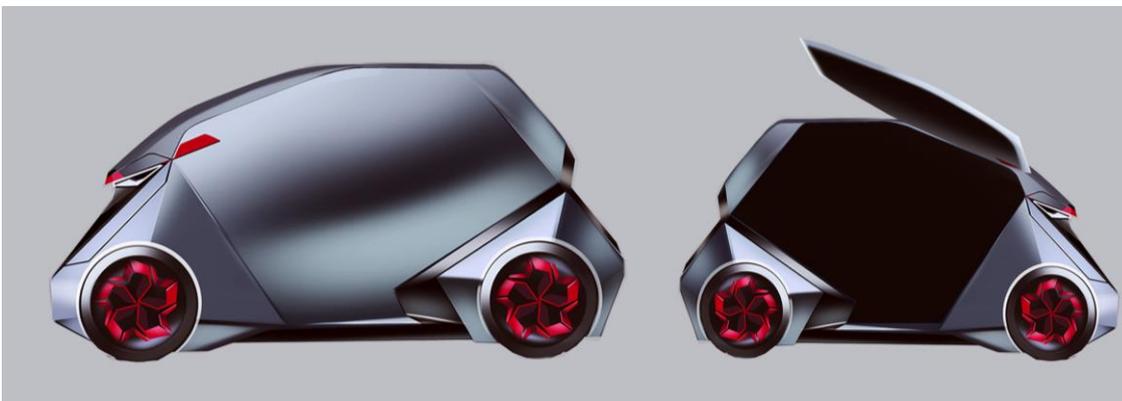


Figure 7.I The visualization for final concept from side view.

As it depicted in the picture, occupants would be able to enter the vehicle from the gull-wing doors, which provided adequate space for occupants and reduce the barriers for entrance. The following picture indicated the layout of interior space from the top perspective of view. As what Chinese drivers usually did, the position of driver was arranged in a common position, which was because that it would help the drivers to accustom themselves to the operation for new vehicle. In the drivers' left position, there was vacant space as the luggage storage, and it also eliminated the obstacles for entrance. Two occupants could sit in the rear position intensively with the safety belts behind them.

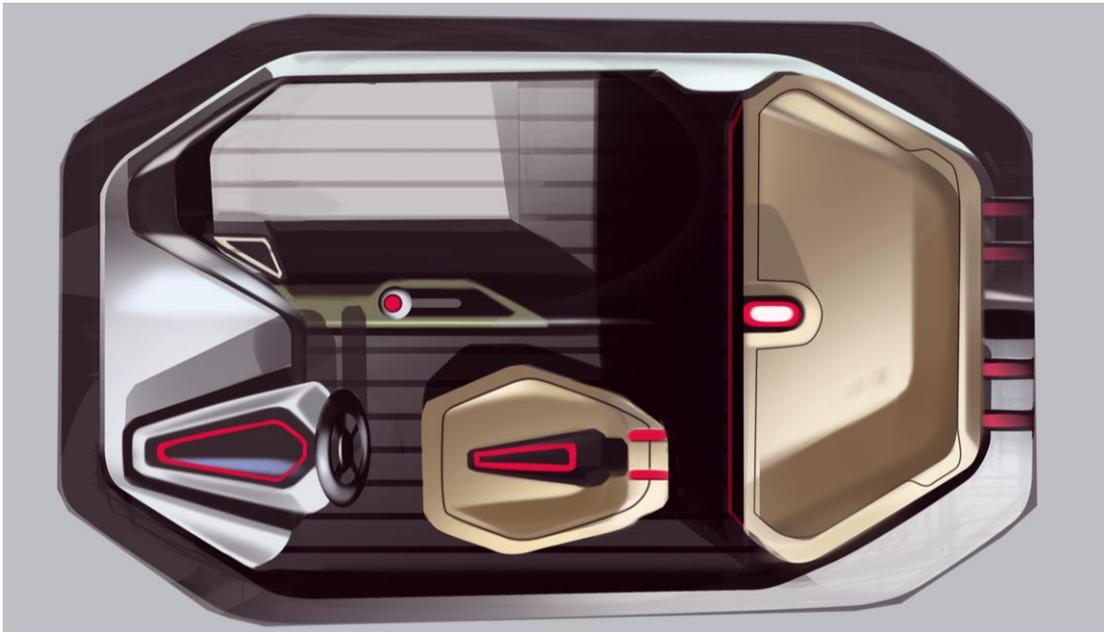


Figure 7.J Visualization for interior design from top view

This vehicle was driven by electric power with a group of batteries in the bottom of the chassis. Compared to traditional passenger vehicles with engine powertrain, the transportations with electric power would be able to save more interior space for occupants. The front suspension was working with a dependent system, since normally the dependent system would make it easier to drive and provide more stable operation, which could reduce the pressure of drivers and improve their driving experience. On the contrary, the rear suspension was working in an independent system, and the MacPherson independent suspension system was implemented as a proper option in this concept, and it was because the rear suspension always determined the comfort and stability for the occupants in the rear compartment.

In addition, the major motor was located in the front part in the vehicles' framework, which was because that the charging machine was arranged closed to the front motor. Two motors near the rear suspension were working as a secondary dynamics and the four wheel drive system would provide a stable and comfortable experience for occupants.

8.2 The dimensions and package design

The basic package design was in line with the result of digital mock-up in last chapter, the dimension of final concept was determined after a short study on the anthropometric size for Chinese people. However, the official data of Chinese authority in 1980s could not be utilized in this project, because after 30 years development, people's physical dimension had changed dramatically, especially the variation on male. In this case, the project still referred to the database in SAE J833 from Society of Automotive Engineers in American (1983), and the physical dimension for male in 1980s American could be treated as a substitution for Chinese male nowadays.

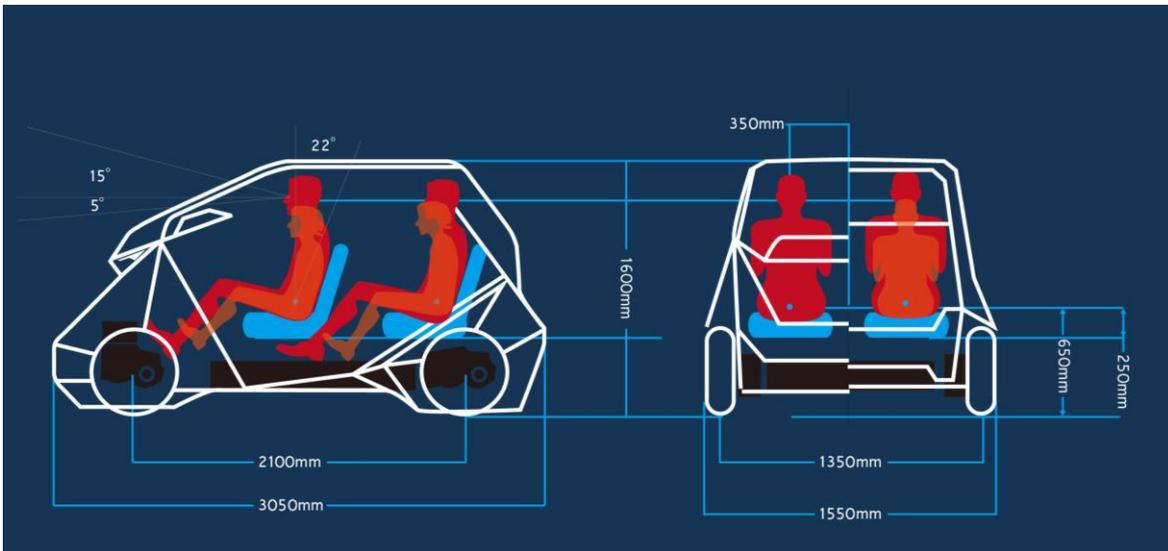


Figure 7.K The basic dimension and package design.

The overall length of the car was 3050 with a 2100 wheelbase, and the width was 1550 mm with 1600 high. The height from hip-point to ground was 250mm which was lower compared to some mainstream urban electric car. However, since the cargo space was eliminated due to the consideration for package, this layout was the most smart and intense arrangement in this design context.

As it depicted in the picture, the package and dimension of this vehicle was designed for the people with physical dimension form 5% of the bottom to the 95% to the top. This intense space could basically satisfy the requirement of most users, and it minimized the potential barriers caused by improper physical dimensions.

Moreover, some basic dimension for driving had been clarified as well, the vision angles was proper enough for driving safely, and the back angles was similar to what it had in normal electric vehicles.

8.3 The service system

The conceptual vehicle was not working as an isolated units, instead, it was working with other facilities and vehicles in a particular system. The following system map visualized the process and procedure of how these vehicles work for commuters and how commuters interact with the product.

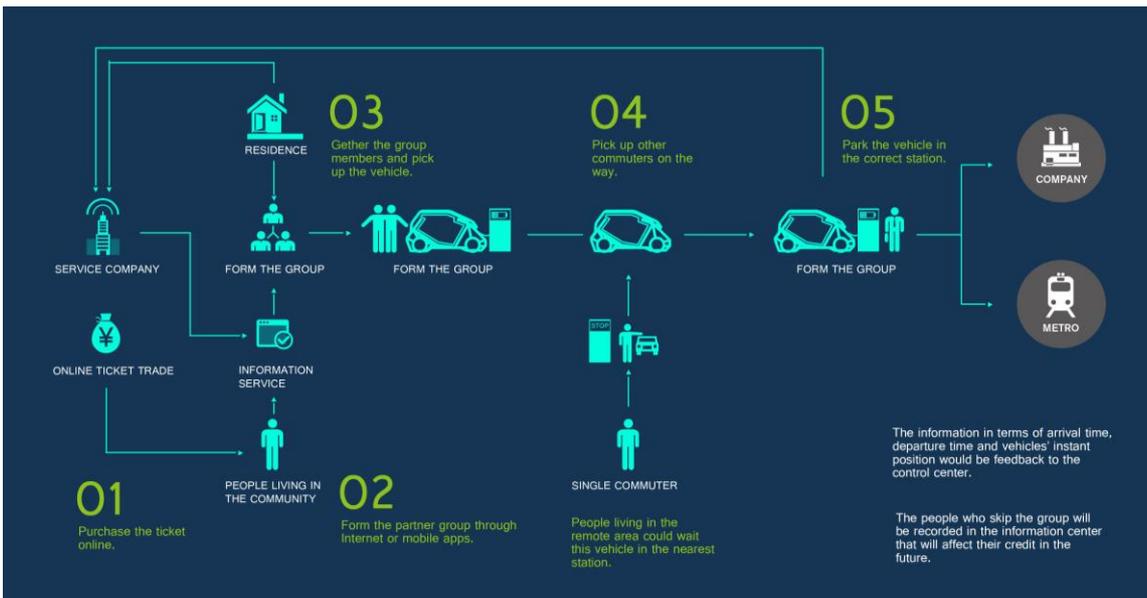


Figure 7.L System map of the conceptual renting vehicle service.

This system map above illustrated the components in this service and their relationships. From a user's perspective, the commuters living in the community or residential clusters could book a vehicle in advance, however, the prerequisite for booking was forming a group with suitable people who had common working place or destination. In this case, the first step was purchase the ticket online, forming the group with proper partners and books vehicles for the group of three. However, in this three people group, there must be a people with drive license included.

On the next day, the people in certain group had to appear in the right parking place or charging station, then they could drive the vehicle they booked formerly to their common destination, for instance the traffic hubs or technology park where their working place were. The vehicle must be parked at the particular charging station. During the after work hours, the same group could take the vehicle back or cancel the vehicle to other peoples.

Moreover, the driving lines or orbits could be decided by the group members themselves, it might avoid the crowed routes and lines and distribute the vehicles into different area.

For the people living in remote area, they could also book the vehicle and pointed the places to be picked up. All the instant information's in terms of vehicle's position, the amount of occupants and their credit records etc. would be collected and analyzed in the information center. The data could be shared on the online platform or mobile applications with the specific information about departure time, arrival time and users credit records etc. For instance, for those who always skipped the booking, their account would show the times they skipped, in this case, other people could refer to the previous record of each users to avoid the extravagance of vehicle resource.

8.4 The user needs

This diagram demonstrated how the specific design functionalities alleviate the issues extracted from previous study.

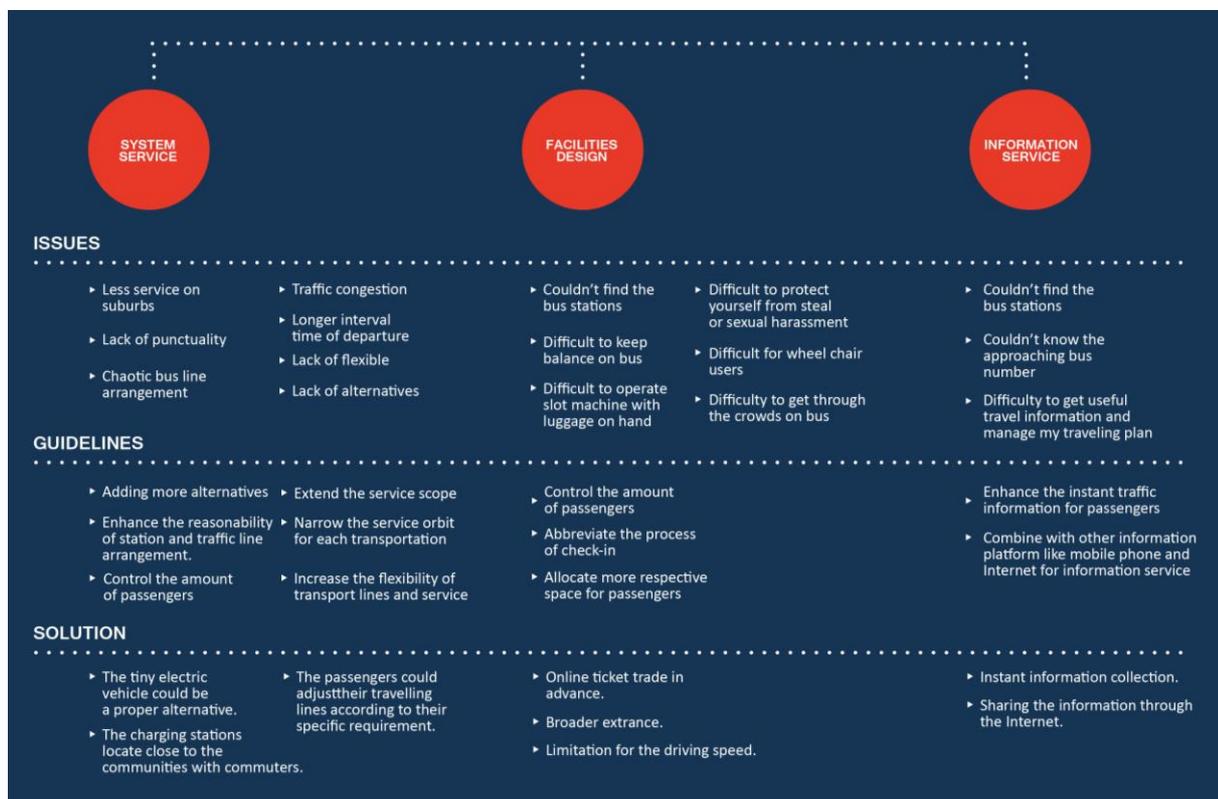


Figure 8.A The evolution from issues to solutions in three different categories.

The user's need from the research mainly distribute in a basic state that mainly concerned about the functionalities as a simple transportation. In this case, the final concept was focused on how to improve the basic function for public transport.

In the systematical level, a highly flexible service was provided dedicated for the commuters living in the communities where clustered many intended users. This particular service had narrowed its service scope compared to traditional public bus service, in that sense, it was an optimization of traffic resource. Moreover, it abbreviate the waiting time for the users, and it guaranteed the punctuality that caused by uncertainty of arrival or departure time, which enabled the users to arrange their time schedule more accurately and safely.

In addition, the renting service contained more advantages like private cars, and it would decrease the extravagance of unsustainable driving singly. Moreover, people were allowed to adjust their driving line according to their different requirements, which might be beneficial to the traffic condition for certain area.

When it came to specific transportation design, the intense dimension with dedicated seats ensured that each occupant could receive a position personally. Moreover, it had eliminated and simplified the process of check-in, which accelerate the efficiency for transport at the beginning.

At last, the information service could be provided through Internet and applications on mobile phones. Actually, this service utilized some merit from the Internet and mobile phones, its inherent attributes made it easy to be integrated with emerging Internet technologies.

8.5 Conclusion

In fact, the service could work under an idealized condition, in order to make it really work, more effort should be down in the future. Indeed, some factors were not comprehensively considered such as the amount of investment, the locations for charging station, the amount of vehicles etc. However, making a service holistic and realizable are always difficult, but this conceptual traffic service as a part of public transport in urban city had implied some valuable points for the development in the future solution.

9/ Discussion

9.1 The Project Result

The overall project was ended up with an outcome of the possibility for future traffic solution. The original idea for this project stemmed from other two projects named as PUNCH and MISTRA. PUNCH was a project proceeded by Department of Applied Mechanics of Chalmers University of Technology, and the MISTRA Urban Future was a cooperated project aimed to establish the future urban structure for some metropolises around the world, which included Shanghai. In this case, this thesis project jointed the proposals of those two respective projects and extracted the intersection as the basis for this thesis project.

The final outcome in this thesis project contained two major results, a holistic transportation design with corresponding service and the distribution of passengers' needs in Jordan's user need hierarchy. In this case, this section would focus on these two results, it would discuss how the final concept evaluated from the ideations to the anticipation with matching the insights from the user research. Moreover, the discussion on the user need distribution for public transport design would be performed to explore some significant guidelines that utilized for public transportation design in the future.

9.1.1 The distribution of user needs.

Traditionally, an idealized and holistic product design development should cover the user's needs from the different levels in line with functionality, usability and pleasure. In fact, this comprehensive situation would hardly happen in the real product design development process due to the limitation in terms of financial resource and precondition. In other words, the touch points for certain product design might be matched with the inherent attributes of the products. For instance, the design for luxury cars often concentrated on exploring and generating interest for users' social or psychological pleasure than physical benefits, because the essential attributes of those products determined the anticipation from its intended users. Hence, at the beginning of the product design development process, it would be better to clarify the properties of the products and users' anticipation.

Actually, it was our understanding that those three levels of user needs in Jordan's user need hierarchy did not have a progressive relationship on their significance. In other words, as a product, the functionality and usability might not be the priority in its design process. For instance, some product with extremely considerable social pleasure or meaning could work with normal performance on basic functionality. In other words, the proportion of those three types of user needs was different in different products, which is determined by their inherent features. Hence, it would make sense to discuss the distribution of user needs in this thesis project.

About user needs hierarchy

In this thesis project, the result of the user research indicated the distribution of user needs, which could be regarded as a qualitative users' anticipation. The data eventually depicted that a vast number of passengers were unsatisfied with the performance stem from the basic functionalities in this service, like punctualities, accessibility and reliability. Obviously, the result reflected a fact that the passengers' concentration on fundamental requirements was much higher than the requirements on psychological level. Moreover, the bad performance concerned with basic functionalities had deeply impacted the passengers rather than other affecting factors, and it had produced numerous negative experiences for passengers as well.

In this case, fitting the needs that most passengers were caring for would be the priority at the beginning of product design development process. One method should be reducing the affecting factors that generated negative experience for users. Likewise, since these negative influencing factors were mainly distributed in the level of functionality and usability. In this case, the concentration of public transportation design should emphasized the improvement on the factors belong to those two level. Hence, improving the performance of basic functionalities was the prerequisite for the further product development.

About the user experience

The official data demonstrated that the public traffic service was losing its attractions constantly during these years. In addition, according to a previous study on people's attitude of current public traffic service in Shanghai, the result implied that a negative common notion on public transport service had been established among the residents in Shanghai. A vast number of residents regarded public transport service as an

ineffective, unreliable and inefficient traffic tools for daily traveling. It seemed to point out the user experience were playing an important role that could influence the passengers selections, however, this negative experience mostly related to the physical feeling rather than other types of reaction.

As it mentioned before, the user experience contained three aspects like aesthetic experience, emotional experience and product meaning. However, the interviewees in this project did not have much anticipation regarding these aspects. As a result, the concentration on user experience was a secondary point in public transportation design compared to the concentration on basic functionalities.

The reasons for the distribution

Nowadays, enhancing the user experience would be an effective strategy to improve the attraction for certain product. However, this mainstream notion had not been proved according to the result in this project. It was our understanding that the latent causes for this distribution stemmed from two aspects from the internal perspective and external perspective.

On one hand, as a sharing product, passengers could not cultivate emotional interaction with the product like what they dealt with private product, which meant people could hardly discover personality in this product that was able to reflect their own personality or to represent their identity. Therefore, people would be satisfied as long as the product or service fitted their basic needs. This reason could be regarded as an internal cause for the distribution that can be probed in this project.

On the other hand, it was our assumption that people this public transport service was cheap, and compared to other traffic options, the public seemed like an alternative that often be chosen by people who were living frugally. Moreover, in Shanghai, the exterior design of public transportation had not been unified and embellished; as a result, the capacity of producing aesthetic experience in public transportation was limited.

However, in this context, the investigation on user needs and user experience could be continued in the future, and the work concerned with this area was limited in this thesis project. Once the basic functionalities could be easily performed, people might start to pursue the pleasure emotionally and psychologically, so how to promote the experience in that context should be investigated in depth. Moreover, the generalized profile for intended users could not comprehensively represent the characteristics of other residents in Shanghai, especially the marginalized people who had physical or mental deficiencies. After all, public transportation should ultimately be a product that designed for all, which must include more people as much as possible. This thesis had restricted the scope of intended users due to the limitation of time and capacity.

9.1.2 The final concept.

The details of final concept was introduced in the last chapter, obviously, the final concept would be implemented in a more idealized context compared to the real circumstance in the suburbs of Shanghai. In fact, the concept should continue to develop, here are some points that should be elaborate and continued in the future study.

The potential influence for the traffic environment of suburbs in Shanghai

It would be an extravagance for urban spatial resource if the amount of the vehicles were not limited. However, this conceptual service could increase the amount of motorized vehicles in a short period, which might be a big change for the traffic environment in suburbs of Shanghai.

However, the conceptual provided the probability of point-to-point traveling for residents, which was different from the functions like traditional public traffic. This could be regarded as a combination between large volume transport and small volume transport, for the commuters who were living frugally, it might decrease the possibility of purchasing private cars. In that sense, it would indirectly enhance the influence and modify the identity of public transport system.

In addition, the conceptual in this context were utilized as a bridge that linked the remote area to the traffic hubs, which meant their orbits would be limited in the suburban areas. In this case, the emerging vehicles could not affect the traffic condition in the city center immediately, and at the same time, this service provide a potential opportunity to abbreviate the distance between commuters' residence and working place.

Another potential affecting factors was the location of charging stations and the orbit of the smart vehicles. These two factors were the critical components in the conceptual service. In fact, the specific electric

charging strategy had not been deeply discussed and evaluated, which meant that the ways of charging vehicles could be more flexible or have more substitutes rather than energizing in the charging station, which might occupied a lot of space in suburbs. This conflict might be fixed by the development of technology regarding the size of battery or how to energize them.

The orbits of the vehicles were not limited in this project, and actually how to arrange the orbits of the small vehicles had not been deeply discussed because of the limited time and personal capacity. Hopefully, these details could be elaborated in the future study.

The product inclusiveness in this service

In this thesis, the project did not take adequate effort to investigate how to improve the product inclusiveness for our products, even if normally people thought public transportation design should contain considerable inclusiveness as a basic design principle. Since the purpose in this purpose did not concentrate on caring for the handicapped or improving the inclusiveness for the current public transport service.

However, a short study on anthropometric data for Chinese people. Unfortunately, the only one proper database was established in 1980s, and those anthropometric data could not be utilized in this design project. At last, the package design referred to the physical dimensions from the SAE J833 of SAE International, which contained a database established by anthropometric dimension of American people in 1989. Moreover, the physical dimension of American people in 1980s could work as a reference in this design for people in China currently. In this case, the sample of 95% of male in SAE J833 might be proper and even correct, however, according to our experience, the 5% of female might have some tolerance, since the physical size for Asian female still could not reach the same standard that American female had twenty years ago.

At last, the package and dimension of the vehicle design had covered the needs of people from 5% female to 95% male in China. This dimension could extremely minimize the obstacles that people might encounter. For the people who excluded in this interval, some particular product or equipment could be devised to be assistance for them.

The maintenance for this service

The last discussion would focus on the maintenance for this service, it was because operating such a complex service system required a majority of effort. Allocating more spatial and financial resource to maintain this service needs a diverse and holistic consideration and horizontal, but in this project, this part had not been holistically investigated. However, the later description would give some ideas on how to keep the financial balance for the local government.

Commercials would be a proper and effective way to absorb some interest for the maintenance. In fact, some valuable commercials related to the live of intended users might be effective, and people might be glad to receive some useful information on their way back home. Indeed, this idea could be regarded as strategy merged in the specific design. More ideas could be generated from a larger perspective of view.

In fact, the charging stations must have a vast number people who were waiting for their group mate, which could be treated as a latent consumers, and that area enclosed charging station could be upgraded into a small shopping center that provided breakfast or other commodities regarding people's daily life. At the same time, the local government could elevate the rent for that area and get more tax from the tenants, which might be a proper way to balance the budget for local government.

Actually the significance of the final concept was pointing out a potential path for the development of public transportation service in the future. Compared to the conventional public transport service, this conceptual service enhanced the flexibility and provided more point-to-point traveling modality for people lived in suburbs. However, in this context, these smart vehicles were only utilized as a supporting transportation for short distance traveling, but it had generated a new thread for the future traffic solution.

9.2 The Implemented theories and methods

This section depicted the main methods that were implemented in this project and their corresponding performance. This section would discuss how these theories and methods were working in this overall procedure in this project.

The system theory in public transport service design

The overall project was initiated from an analysis in a systematical perspective of view. The studies on the referenced products implied that most issues stem from the chaotic or unreasonable arrangement regarding its service system.

However, the solution in this project cannot change the inherent affecting factors in the environment, but it implied the causes hidden in this complexity, which reminded and guided the designers to think of certain issues from a more holistic perspective in the future.

However, the layout of the urban structure could not be modified immediately, and the environment will change in the future that no one could predict what will happen. Hence, the systematical thinking will be increasingly important, and the designers should consider the inclusiveness and usability from the beginning of the system design rather than making sloppy decision.

The value proposition of public transport service

In the last part of this thesis, the outcome briefly implied idealized value proposition for public transport service in the future. Actually, the product value proposition canvas played a crucial role in this project, which guided the user research at the beginning. Moreover, most of the questions in were extracted from the framework of product value proposition canvas. However, this was a typical business model but this project utilized it as a user research method, which aimed to reestablish the identity and probe the core value for the idealized public transport service in Shanghai.

Only if the current public transport service reform its identity will it attract more resident in the future. However, after the interview and online survey, it was clear that people were more or less disappointed with the prevailing public traffic service and did not regarded it as a platform that was able to generate emotional or psychological pleasure by novel technologies. Indeed, the decreasing attraction of public transportation led the urban traffic condition into a vicious circle that must be fixed in the future.

In this case, enhancing the diversity and adding more alternatives in the overall public transport service was the main suggestion in this thesis, and a highly integrated service system was the guarantee for the fluently working of these diverse traffic modalities.

The specific methods utilized in this project

Many design methods and tools were introduced and implemented in this project to comprehend the background, to explore the insights, to find out the touch point and generate the ideas etc. Actually some of the methods were utilized properly, and the other ones did not totally function.

The literature study was used as an initiation to collect the macro information of the traffic condition in suburbs of Shanghai, and this project selected Pudong area as representative suburbs to investigate. However, it was difficult to eliminate the subjective bias on the traffic experience in this area, since the author used to work and live in this area for few months. This negative experience led the author to focus on the negative point and to analyze the resource according to his opinion mostly. In other words, the single person could not make his analysis as objective and comprehensive as what they did in a design team. Moreover, the temporal and spatial limitation constrained the research activities for student who was studying in Gothenburg.

The interview and online survey were used for exploring some insights from users. Unfortunately, the preparation for interview or online questionnaires were not adequate, that was because before the interview started, some interviewees were not totally comprehend the background of this project, and during the process of interview, some questions were vague to them and difficult to understand. For instance, when it came to the emotional and social functionalities, people did not know which the proper answer to fit the questions was. This made some result was not totally fit the questions, but subsequently, the study refined their answers and eliminate the confused information, but it might miss some crucial or inspired ideas or insights.

In this ideation and concept development sections, sketching and digital mock-up became the major tools in this project. Obviously, the design tools used in this crucial section seemed not so diverse. Indeed, a real mock-up and ergonomic test would be better to be utilized in order to simulate how it would work in real space or if it was comfortable or not, but with the environmental restriction, the digital mock-up was the most proper option. The last section was the visualization of the concept, a real and elegant digital rendering in computer programmer was performed. Moreover, the holistic service was depicted by a system map.

9.3 The development in the future

In order to approach the purpose of this project, some work or effort should be performed in the future. The following description indicated the points that should be continued to be investigated in the future.

- One crucial point was how to join the conceptual service with the current service need to be further developed. The connection or transportation transferring had deeply affected passengers traveling experience, and most interviewees mentioned that the bad traffic connection elevated the probability for them to confront more obstacles when they had to transfer among different traffic tools. As it mentioned before, the overall public traffic system in the future should be highly integrated, in this case, more studies or ideas need to be explored in the future.
- The utilization of the product needs to be promoted, since in this concept, the small vehicles were working dedicated for the commuters in rush hour. Therefore, using those products only for daily commuting seemed like an extravagance. In that sense, digging out more functionalities would maximize the utilization for this vehicle and make it more reasonable.
- As a public transportation, more inclusive design for marginalized users, because public transport service would be a sample to show the care for all and regarded all kinds of people like the same.
- The design for the parking space and parking station need to be discussed in the future, and it required comprehensive studies on the traffic environment in suburbs of Shanghai, and a holistic analysis on current urban structure.
- It would be useful to make a real physical mock-up, at least it needs a computer test in Jack, which was a computer program that enabled people to simulate the real context to test if the product was physically proper for users.

9.4 Recommendations

The outcome of the whole project was not only a product design, some recommendations for the modification or establishment for future traffic solution were also generalized at the end of the project. In fact, a conceptual design could not be totally realized in the real life, but the significance of the conceptual design was providing the probabilities for the realization of idealized traffic solution in the future. The following text implied some refined recommendations according to the overall process and outcome of this project.

- Enhancing the diversity and the cooperation of different traffic modes will be a potential method to increase the efficiency of public transport service. Moreover, the cooperation needs to be highly integrated.
- The information service will become increasingly significant in the future. Utilizing the Internet and improving the accuracy of traffic information service will dramatically facilitate passengers' experience.
- The service should be devised and planned according to the concrete conditions in terms of the urban structure, environment and the users' needs. Some necessary adjustment should be performed instantly in order to optimize the efficiency of public traffic resource.
- Upgrade the usability and product inclusiveness for concrete facility design, which will probably eliminate the potential barriers for special users.

10/ Conclusion

The user research in this project indicated that improving the performance regarding basic functionalities as transportation was extremely crucial to change people's negative impression on public transport service. The analysis also implied the significance of system thinking in the beginning of the design, since any mistakes or neglecting on the initial systematical station will deeply affect the performance of subsequent design, even if it had been elaborated well.

The other critical factor in the public transport was the transparency of traffic information. The bus company should constantly be sensitive to the information in terms of resident distribution, users' requirement and the different traffic solution.

The suburban area of Shanghai contains considerable power of development. In this case, an efficient, sustainable and inclusive public transport service should be generated in the future to fit the needs of the residents in this city.

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12/ Appendix

APPENDIX I PROJECT PLANNING

APPENDIX II PRODUCT VALUE PROPOSITION CANVAS

APPENDIX III THE USER RESEARCH INTERVIEW

APPENDIX IV THE ONLINE SURVEY

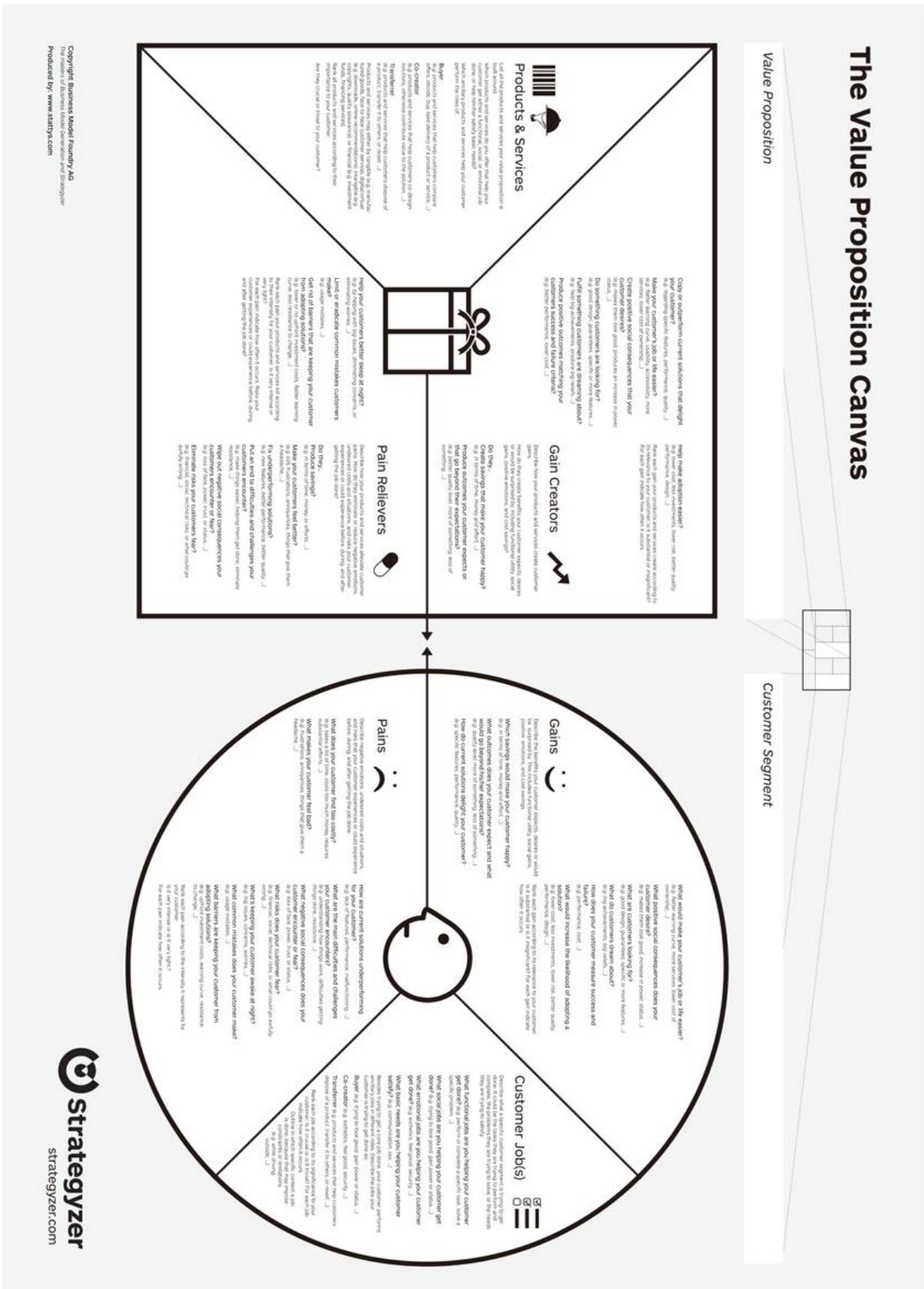
APPENDIX V BENCHMARK OF CAR DIMENSIONS

APPENDIX VI THE ANTHROPOMETRIC DATA

APPENDIX VII THE MOOD BOARD AND SKETCHES

APPENDIX II PRODUCT VALUE PROPOSITION CANVAS

The content in this canvas was the guideline for the initial user research. For more clear information, please visit the official website, which could be found in the reference part in this thesis. I



APPENDIX III THE USER RESEARCH INTERVIEW

The questions of the interview were designed with referring to the canvas of product value proposition. The following questions had established framework of the conversation in each interview. In this interview, the interviewees were asked to answer the questions from a customers' perspective but they should be critical enough.

The Questions

CUSTOMER JOBS

1. What functional tasks is current service helping passengers perform?
2. What social jobs is current service helping your customer get done?
3. What emotional jobs are you helping your customer get done?
4. What basic needs you helping your customer satisfy?

PAINS

5. What does your customer recognize too costly?
6. What makes your customers feel bad?
7. How are prevailing solutions underperforming for your customers?
8. What are the main difficulties and challenges?
9. What negative social consequences does your customer encounter or fear?
10. What risks do your customers fear?
11. What is the big issue or concerns that makes your customers awake at night?
12. What common mistakes does your customer make?
13. What barriers are keeping your customer from adopting solutions?

GAINS

14. Which savings would make your customer happy?
15. Which outcomes does your customer expect and what would go beyond their anticipation?
16. How do current solutions delight your customer?
17. What would make your customer's job or life easier?
18. What positive social consequences does your customer desire?
19. What are customer looking for?
20. What does customer dream about?

21. How does your customer measure success and failure?

22. What would increase the likelihood of adopting a solution?

The result

The following result in the diagrams is the original data from three most representative interviewees, which was used in the presentation for this project. The result keeps the original content of Chinese conversation, and these interviews were implemented by Skype.

Interviewee: Qian Zhou

Age: 23

Questions	Answers
<p>What functional tasks is current service helping passengers perform?</p> <p>现有的公交服务系统能够帮助用户完成那些功能?</p>	<ul style="list-style-type: none">● A way of transportation, especially for the short distance.● A useful and reachable channel to do the advertisement.● This kind of transportation way will not be waste too much energy, and can be kind of Low carbon life.● Achieve the way of healthy living.
<p>What social jobs is current service helping your customer get done?</p> <p>这个服务能够提供哪些社交功能? 例如拓展交际面, 社会地位的提升之类。</p>	<ul style="list-style-type: none">● Share the places they have been there before.● Find some topics that can discuss with others.
<p>What emotional jobs are you helping your customer get done?</p> <p>能满足什么样的情感功能? 例如放松心情之类。</p>	<ul style="list-style-type: none">● Good sight out of the window will comfort the customers.● Talk with others or help the elder people.

<p>What basic needs you helping your customer satisfy?</p> <p>现有的公交服务能够满足他们什么基本需求呢？例如沟通，吃饭，性的需求等基础层次的需求？</p>	<ul style="list-style-type: none"> ● Basic needs of transportation. ● Get some news from the TV-set of the bus or metro. ● Saving money.
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Pains

Questions	Answers
<p>What does your customer recognize too costly?</p> <p>现有的公交服务中，那些环节用户会感觉耗费高？例如时间，经历，注意力等属性的耗费。</p>	<ul style="list-style-type: none"> ● The waiting time is the most costly thing. ● If there is a lot of noise made by others will disturb me. ● If there are many people in the bus, it will cost my attention to protect myself of falling down.
<p>What makes your customers feel bad?</p> <p>哪些点会让他们感觉不好？</p>	<ul style="list-style-type: none"> ● Too much noise and too many people. ● No enough seats for them. ● Lovers' intimate behavior. ● Too hot or cold in the bus. ● Traffic jam. ● Cannot hear the station' s name easily.
<p>How are prevailing solutions underperforming for your customers?</p> <p>有哪些地方做的不够好？</p>	<ul style="list-style-type: none"> ● Waiting too much time. ● Cannot easy find enough charge. ● Drive too fast and not smooth. ● Too much boiling ads around the bus. ● Always cannot get to somewhere on time. ● Never control the number of person in the bus.

<p>What are the main difficulties and challenges?</p> <p>用户使用起来有哪些困难呢？结合自身和经验观察来回答。</p>	<ul style="list-style-type: none"> ● Difficult to find the right information at the bus station. ● The grab rails, sometimes, are too high for the girls to catch. ● For the people in wheelchair, it is not easy to get on the bus. ● Sometimes, if there are a lot people in the bus, it is not easy to get on at the front door and get off at the back door.
<p>What negative social consequences does your customer encounter or fear?</p> <p>使用这种服务能够造成哪些负面的社交影响，例如社会地位的下降，丢脸等...</p>	<ul style="list-style-type: none"> ● The driver speak very rudely ● The bus driver don' t willing to wait a little bit time at one station, even he saw somebody running to get on. ● Have no enough time to get off the bus.
<p>What risks do your customers fear?</p> <p>用户担心那些风险呢？例如安全，时间，等其他。</p>	<ul style="list-style-type: none"> ● Traffic jam ● Fear of the thief on the bus. ● The bus stop too early at night.
<p>What are the big issues or concerns that make your customers awake at night?</p> <p>有哪些巨大的问题，让用户寝食难安？</p>	<ul style="list-style-type: none"> ● Extremely bad weather.
<p>What common mistakes does your customer make?</p> <p>在用户使用或者操作的过程中，容易犯的一些错误？</p>	<ul style="list-style-type: none"> ● Mistake the direction of the bus. ● Miss the station, if the driver does not remind them. ● Forget to carry the luggage with them.
<p>What barriers are keeping your customer from adopting solutions?</p> <p>有哪些因素会阻碍用户接受新的解决方案？</p>	<ul style="list-style-type: none"> ● The government does not support the new solutions. ● Weak promotion method. ● Bad habits they used to.

Gains

Questions	Answers
<p>Which savings would make your customer happy?</p> <p>该服务帮助用户解决了什么？从而让用户产生满足感。</p>	<ul style="list-style-type: none"> ● Saving their money and time. ● Easy to learn.
<p>Which outcomes does your customer expect and what would go beyond their anticipation?</p> <p>有哪些设计或产出是用户所期待甚至超出他们期待的？</p>	<ul style="list-style-type: none"> ● Free to take the bus. ● Enough space for everyone. ● Interesting entertainment during the trip. ● Get to their destination very fast.
<p>How do current solutions delight your customer?</p> <p>现有的服务是如何让用户满意的？</p>	<ul style="list-style-type: none"> ● We can use the bus card instead of preparing the small change every time
<p>What would make your customer' s job or life easier?</p> <p>哪些环节为用户的工作生活带来便利？</p>	<ul style="list-style-type: none"> ● The bus stop close to their home or workplace. ● Special lane only for the bus.
<p>What positive social consequences does your customer desire?</p> <p>哪些环节为用户带来了正面的社交影响？</p>	<ul style="list-style-type: none"> ● Get some useful information about current fairs during the trip.
<p>What are customer looking for?</p> <p>短期内，用户对于现有产品有哪些具体的期待呢？</p>	<ul style="list-style-type: none"> ● Prepare more buses if there are a lot people in the morning. ● Shorten the waiting time.
<p>What does customer dream about?</p> <p>用户对于产品有哪些长远的，宏观的期待或改进？</p>	<ul style="list-style-type: none"> ● An efficient system of all kinds of transportation. ● Good service given by working staff.
<p>How does your customer measure success and failure?</p> <p>你是如何来判断一个公交系统成功与否，或者一个成功的公交系统需要具备哪些必要条件？</p>	<ul style="list-style-type: none"> ● Including everyone in this society, no matter disabled people , elder people or children can use this system very convenient. ● Automatic operation.

<p>What would increase the likelihood of adopting a solution?</p> <p>如何提高用户接受新方案的可能性?</p>	<ul style="list-style-type: none">● Consider the needs of different kinds of people before they come up with a new solution.● Good communication will people when they try to promote the new solution.● Do some change according some feedbacks.
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Interviewee: Lihao Dui

Age: 26

Customer Jobs:

Questions	Answers
<p>What functional tasks is current service helping passengers perform?</p>	<p>1. Converting one person from one place to another, and saving their time and energy.</p> <p>2. Sometimes, it is a way for sightseeing, sitting in the fast-moving vehicle, enjoying the breeze, relaxing and experiences the rhythm of the environment, could more or less be another function.</p> <p>1. Traveling, take a person from one place to another.</p> <p>2. Transportation for sightseeing and relaxing.</p> <p>把朋友从一个地方转移到另一个地方，到一个目的地，节约时间，保存体力。</p> <p>有时候也作为一种观赏方式，坐在一个快速移动的车里，吹风，放松，体验城市，体验环境的另外一种途径，另外一种感受。</p>
<p>What social jobs is current service helping your customer get done?</p>	<p>1. Saving money and the time, your life could be more pragmatic. As a student, a person without fixed income, taking bicycle is a representation of the pragmatic characteristic as a student. Not like many parvenu, constantly showing off their luxury cars or taking taxis, I would say taking bus would enhance your self-identity.</p> <p>2. You can taking bus with your friends, and chat with them, however, taxi cannot provide a platform enables us talking openly. In that sense, the enhancement of communication could be thought of as social job.</p> <p>3. The behavior of offering seats to elder people makes contribution to your identity and reputation.</p> <p>1. Contribution to your self-identity.</p> <p>2. Contribution to your regulation.</p> <p>1. 节省了节约钱，让人感觉你很务实，没有固定收入，出行自行车公交车，体现出学生求真务实的态度，不是那种没文化的土豪，非要搭车买车，求真务实，背书包坐公交车对于自己的身份有认同感。低调奢华有内涵。</p>

	<p>2.很多人一起做，可以和同学们在车上谈论，出租车不适合交流，体育政治问题，出租车司机搭讪。</p> <p>3.如果有老奶奶，让座显得自己有素质。</p>
What emotional jobs are you helping your customer get done?	<p>1. Feeling good, since sitting on a higher position.</p> <p>2. The crowd and shaking decrease your experience on comfort.</p> <p>1. Feeling good</p> <p>3. 比较大比较高，往窗外开，视野比较开阔。感觉好。</p> <p>4. 拥挤不稳定，晃动。如果没有人，公交车乘坐的舒适度高。</p>
What basic needs you helping your customer satisfy?	<p>Time saving, expense saving, needs of traveling</p> <p>节约时间，节约金钱，满足出行。</p>

Pains

Questions	Answers
What does your customer recognize too costly?	<p>The cost in terms of attention, since the constant movement, you need to protect yourself from the thief. Moreover, when you occupied a position, you need to care the elder people around, and keeping your behavior out of disrupting others.</p> <p>1. Overloaded attention on behaviors.</p> <p>2. Preventing thieves.</p> <p>花费注意力，不停移动，防止有小偷。有座位了会看是否有人需要让座。拥挤，破坏形象。</p>
What makes your customers feel bad?	<p>You need to be exactly careful. Sometime, you will worry about that the crowd block the entrance. When you were stuck in the crowd, you have to keep your behavior instead of being aggressive. Moreover, you position should not block others' locomotion.</p> <p>The uncertain of punctuality makes you frustrated. The information of bus service was not as</p>

	<p>transparent as metro was. In this case, you are not able to know the exact time of bus arriving, or even know if the company has changed the bus line.</p> <p>1. Concern with losing buses due to the crowded passengers.</p> <p>2. Concern with the temporal arrangement.</p> <p>很小心。最怕人多，挤不上去车，也不能太凶悍，需要注意自己的举止。站在那里很拥挤，不要挡在别人路。</p> <p>1. 公车什么时候来，什么时候到了，不如地铁信息准确透明，很没有安全感，不知道花多少时间等待，花多少事前去，甚至不知道车是否改道了。</p>
<p>How are prevailing solutions underperforming for your customers?</p>	<p>1. The station needs a display to indicate the time schedule for every bus. For instance, show when the bus came to station, where it was, and the information was not clear.</p> <p>2. Normally, passengers often encounter lots of barriers at the entrance/exit due to the narrow passage and stages. Particularly, the people with huge luggage and elder people were not able to pass these barriers conveniently. So far, handicapped people merely take public transportation as the circumstances could not serve fluent system to disabled passengers in China.</p> <p>3. Coin operator often embarrasses the people with luggage on both hands, and it would be difficult for them to allocate an additional hand. In German, they eliminated the height gap between platform and the sidewalk, which enables wheelchair user to get through without barriers. Moreover, buses in German contain more interior space, so I can arrange my luggage freely.</p> <p>4. The station name often misleads passengers, because the name of the station is not the correct. For the non-resident, people need to check online information in advance, the information on stop board does not match the real positions. For the new-comer, it is suffering if</p>

	<p>they were traveling with luggage.</p> <ol style="list-style-type: none"> 1. Lack of information reminding to tell us when the bus would arrive in. 2. The inconvenience regarding the narrow interior space. 3. The confusing information. <p>缺少一个等车的提示，告诉车大概多久能过来。车的位置，还有几站到目的地，信息不够明确。</p> <p>5.上下车不方便，对于老年人和拉杆箱行李的客人，不够方便，国内的残疾人基本不做公交车，实现不了残疾人做公交车，如何投钱，如何缴费。德国公交站台很高，车很平稳，路面和车地面是平行的，站台和车地面是平的。残疾人自己可以推着车进去了。内部空间更大。有些地方可以设置栏杆靠着就可以，比坐着舒服，还能放东西，一旦有东西出行就最大。</p> <p>6.公交站牌的，起名字的方式，陌生人必须要查，最近的路不是显示的路，信息匹配不是最佳信息，找的地方很难找到，带着行李简直就是灾难。</p>
<p>What are the main difficulties and challenges?</p>	<ol style="list-style-type: none"> 1. If I did not have change, I would not be able to pay for the bus. 2. Normally, on the other side of the road, you can find the corresponding station to opposite direction, but sometimes you cannot find it. The positions of bus station should be rearranged to be more reasonable. Particularly, when changing the transportations, people often spend enormous time on looking for the right stations. 3. It is boiling to watch the commercial on bus TV, which is a negative factor for my experience. They replay the same commercial consistently, which could be more diverse to amuse our passengers. 4. The banisters are too high, passengers prefer to set their arms down. More banisters would be good. <ol style="list-style-type: none"> 1. The rigid payment denomination. 2. The vague location of bus stations.

	<p>3. The boring commercial and bus TV/radio.</p> <p>4. High banister position.</p> <p>1.没有一块钱，收一块钱两块钱，也可能没有零钱怎么换。</p> <p>2.同一站的公交车两个方向，有些时候斜对面可以看到，但是有时候找不到那个站，找不到。换乘时候反方向换乘，所以会比较不方便。高架桥不能穿行，你需要走，公交站位置不合理，过马路不方便，天桥残疾人和带行李乘客比较困难。</p> <p>3.公交车电视节目，很多时候很无聊，很多广告，车里的车载广告，比较影响体验。换多一点广告，调侃精神，娱乐大众，太墨守成规了。需要在路程中有些娱乐的项目，给一些关怀的感觉。像打气筒来打广告，没有人文关怀。</p> <p>4.很多时候希望把手放下来，多设置一些栏杆。</p>
<p>What negative social consequences does your customer encounter or fear?</p>	<p>1. Not really, the student's private car is always given their parents. Similarly, taking taxi frequently is a symbol of dissipation. In my case, bus taking is corresponding to my identity.</p> <p>1.学生，和比较成功的人都比自己年龄太多的，20多岁有汽车是家里人买的。做公交车没有压力，如果搭车浪费，反而会得到谴责，别人的认同证明自己就应该节约点，符合职业身份认同。</p> <p>2.拉着拉杆箱，在车上，一个美女在身边走过，视觉上交流，目光交流，就希望自己不要在这个狼狈的场合里。不过这是特殊时刻。</p>
<p>What risks do your customers fear?</p>	<p>1. The malfunctions might cause the fire, or ceased the bus on the road. These malfunctions cannot grantee the punctuality for me, in this case, I will be late. A perfect service should include the respect to the users.</p> <p>2. If standing in the crowd, you have to keep your eyes on your bag because of thief.</p> <p>3. Sometimes, after long-time waiting, the bus may not come. Moreover, you do not know where the closest stop to your destination is.</p> <p>1. The probability of malfunctions.</p> <p>2. Thief.</p>

	<p>3.The lack of punctuality.</p> <p>1.公交车冒烟，突然故障，会出现迟到，无形中对于时间造成了影响，花钱少，所以安全性差，保证不了自己的时间收到尊重。</p> <p>2.人很多的时候，小偷，吵架，老奶奶，让座。</p> <p>3.可能等不到公交车，没有地铁那么准时，然后公交车线路比较偏，在上海，被地铁淘汰的线路，下来是工地，下车的环境很恶劣。</p>
<p>What are the big issues or concerns that make your customers awake at night?</p>	<p>1. If I merged one bus, which I have never ever take before, to my traveling planning. The uncertainty makes me worried. Because, you do not know if you can catch the bus or not on the next day.</p> <p>1.Risk of taking new bus.</p> <p>2.Risking of being excluded by overloaded buses.</p> <p>1. 如果要把公交车纳入出行计划，时间风险，没有做过的公交车列入出行计划，车是否有，车挤得上挤不上，要走多远，如果做陌生公交车，所以会担心。</p>
<p>What common mistakes does your customer make?</p>	<p>Take the bus to incorrect direction.</p> <p>Miss the intended stops.</p> <p>Left your luggage on the bus/station.</p> <p>1.Taking the incorrect direction.</p> <p>2.Overriding the destination.</p> <p>3.Losing luggage in the buses/stations.</p> <p>1.做反方向。</p> <p>2.坐过站。</p> <p>3.带的东西，上车的时候把东西忘在站台上，东西忘在了公交车上。</p>
<p>What barriers are keeping your customer from adopting solutions?</p>	<p>Habit, and the old mental model.</p> <p>1. The stereotype thinking to resisting new solutions.</p> <p>习惯，惯性，这些东西有吸引力，试过一次就觉得好。操作技巧，熟悉操作，操作逻辑。当它和原本的逻辑不匹</p>

	配。
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Gains

Questions	Answers
Which savings would make your customer happy?	<p>In terms of money, energy and time.</p> <ol style="list-style-type: none"> 1. Savings in terms of time. 2. Saving in terms of money. 3. Saving in terms of energy. <p>1.金钱的节约。 2.力量的节约。 3.时间的节约。</p>
Which outcomes does your customer expect and what would go beyond their anticipation?	<p>Lower ticket price, the more vacant seats and more space.</p> <p>The more interesting commercial, the novel exterior design, and the relaxing atmosphere.</p> <ol style="list-style-type: none"> 1.Lower ticket price. 2.More vacant space. 3.More interesting TV/radio. 4.The innovative exterior design. <p>1.车票便宜点。 2.车厢空位多一点，空间充裕点，很惊奇。 3.电视节目有所改观 4.新的车外形设计 5.让人感觉很休闲，不是挤得很不开心。</p>
How do current solutions delight your customer?	<p>Nothing to do with the happiness, it is only an assistant equipment for traveling, I never considered the emotional reactions in my mind.</p>

	<p>没有开心，就是一个出行，省钱，没有考虑过难受。</p>
<p>What would make your customer's job or life easier?</p>	<p>The bus lines that facilitate your locomotion, and it save your money.</p> <p>更加快捷的出行，省钱。</p>
<p>What positive social consequences does your customer desire?</p>	<p>Nothing.</p> <p>1. 没有啥的。</p>
<p>What are customer looking for?</p>	<p>The accuracy of information.</p> <p>High efficiency, speed and productivity.</p> <p>1.信息准确性</p> <p>2.更加快捷高效，速度更快。更快更高更强。</p>
<p>What does customer dream about?</p>	<p>Free of charge, release your mind out of check-in, losing money and behavior. The idealized situation is like stepping into the building without any additional action of us.</p> <p>If the product started to care about the emotional pleasure, then it would be the one I dream about.</p> <p>1. Elimination of check-in/out system.</p> <p>1. 免费，不用考虑安检，给钱，让座，很方便，直接走直接离开，百分之90理想的状态。移除所有的 barrier，当产品开始放在如何取悦顾客，将会是最理想的状态。</p>
<p>How does your customer measure success and failure?</p>	<p>The punctuality.</p> <p>1. The accurate punctuality.</p> <p>1. 是否准时到达，大家不会要求很高，只花1块钱，只希望准时准点，不出意外，大众对于他的期待，也是我对于他的期待。</p>
<p>What would increase the likelihood of adopting a solution?</p>	<p>Current bus service should extend its coverage, and the position of stations should be more reasonable.</p> <p>1. More service coverage.</p> <p>1. 它的延伸可以更多一点，到达的地方更加合理更加多一点，能够预测大家要去哪里，稍微只能一点，不要到了一个莫名其妙的地方，然后把大家放下了，前面高架后面工</p>

厂。网络的触手再延伸多一点。

Interviewee: Jing Wu

Age: 25

Customer Jobs:

Questions	Answers
What functional tasks is current service helping passengers perform?	<p>1. Converting one person from one place to another, and saving their time and energy.</p> <p>2. Sometimes, it is a way for sightseeing, sitting in the fast-moving vehicle, enjoying the breeze, relaxing and experiences the rhythm of the environment, could more or less be another function.</p> <p>1. Traveling, take a person from one place to another.</p>

	<p>2. Transportation for sightseeing and relaxing.</p> <p>把朋友从一个地方转移到另一个地方，到一个目的地，节约时间，保存体力。</p> <p>有时候也作为一种观赏方式，坐在一个快速移动的车里，吹风，放松，体验城市，体验环境的另外一种途径，另外一种感受。</p>
<p>What social jobs is current service helping your customer get done?</p>	<p>1. Saving money and the time, your life could be more pragmatic. As a student, a person without fixed income, taking bicycle is a representation of the pragmatic characteristic as a student. Not like many parvenu, constantly showing off their luxury cars or taking taxis, I would say taking bus would enhance your self-identity.</p> <p>2. You can taking bus with your friends, and chat with them, however, taxi cannot provide a platform enables us talking openly. In that sense, the enhancement of communication could be thought of as social job.</p> <p>3. The behavior of offering seats to elder people makes contribution to your identity and reputation.</p> <p>1. Contribution to your self-identity.</p> <p>2. Contribution to your regulation.</p> <p>1. 节省了节约钱，让人感觉你很务实，没有固定收入，出行自行车公交车，体现出学生求真务实的态度，不是那种没文化的土豪，非要搭车买车，求真务实，背书包坐公交车对于自己的身份有认同感。低调奢华有内涵。</p> <p>2. 很多人一起做，可以和同学们在车上谈论，出租车不适合交流，体育政治问题，出租车司机搭讪。</p> <p>3. 如果有老奶奶，让座显得自己有素质。</p>
<p>What emotional jobs are you helping your customer get done?</p>	<p>1. Feeling good, since sitting on a higher position.</p> <p>2. The crowd and shaking decrease your experience on comfort.</p> <p>1. Feeling good</p> <p>3. 比较大比较高，往窗外开，视野比较开阔。感觉好。</p> <p>4. 拥挤不稳定，晃动。如果没有人，公交车乘坐的舒适度</p>

	高。
What basic needs you helping your customer satisfy?	Time saving, expense saving, needs of traveling 节约时间，节约金钱，满足出行。

Pains

Questions	Answers
What does your customer recognize too costly?	<p>The cost in terms of attention, since the constant movement, you need to protect yourself from the thief. Moreover, when you occupied a position, you need to care the elder people around, and keeping your behavior out of disrupting others.</p> <p>1. Overloaded attention on behaviors.</p> <p>2. Preventing thieves.</p> <p>花费注意力，不停移动，防止有小偷。有座位了会看是否有人需要让座。拥挤，破坏形象。</p>
What makes your customers feel bad?	<p>You need to be exactly careful. Sometime, you will worry about that the crowd block the entrance. When you were stuck in the crowd, you have to keep your behavior instead of being aggressive. Moreover, you position should not block others' locomotion.</p> <p>The uncertain of punctuality makes you frustrated. The information of bus service was not as transparent as metro was. In this case, you are not able to know the exact time of bus arriving, or even know if the company has changed the bus line.</p> <p>1. Concern with losing buses due to the crowded passengers.</p> <p>2. Concern with the temporal arrangement.</p> <p>很小心。最怕人多，挤不上去车，也不能太凶悍，需要注意自己的举止。站在那里很拥挤，不要挡在别人路。</p> <p>1. 公车什么时候来，什么时候到了，不如地铁信息准确透明，很没有安全感，不知道花多少时间等待，花多少事前</p>

	<p>去，甚至不知道车是否改道了。</p>
<p>How are prevailing solutions underperforming for your customers?</p>	<p>1. The station needs a display to indicate the time schedule for every bus. For instance, show when the bus came to station, where it was, and the information was not clear.</p> <p>2. Normally, passengers often encounter lots of barriers at the entrance/exit due to the narrow passage and stages. Particularly, the people with huge luggage and elder people were not able to pass these barriers conveniently. So far, handicapped people merely take public transportation as the circumstances could not serve fluent system to disabled passengers in China.</p> <p>3. Coin operator often embarrasses the people with luggage on both hands, and it would be difficult for them to allocate an additional hand. In German, they eliminated the height gap between platform and the sidewalk, which enables wheelchair user to get through without barriers. Moreover, buses in German contain more interior space, so I can arrange my luggage freely.</p> <p>4. The station name often misleads passengers, because the name of the station is not the correct. For the non-resident, people need to check online information in advance, the information on stop board does not match the real positions. For the new-comer, it is suffering if they were traveling with luggage.</p> <p>1. Lack of information reminding to tell us when the bus would arrive in.</p> <p>2. The inconvenience regarding the narrow interior space.</p> <p>3. The confusing information.</p> <p>缺少一个等车的提示，告诉车大概多久能过来。车的位置，还有几站到目的地，信息不够明确。</p> <p>5.上下车不方便，对于老年人和拉杆箱行李的客人，不够方便，国内的残疾人基本不做公交车，实现不了残疾人做公交车，如何投钱，如何缴费。德国公交站台很高，车很</p>

	<p>平稳，路面和车地面是平行的，站台和车地面是平的。残疾人自己可以推着车进去了。内部空间更大。有些地方可以设置栏杆靠着就可以，比坐着舒服，还能放东西，一旦有东西出行就最大。</p> <p>6.公交站牌的，起名字的方式，陌生人必须要查，最近的路不是显示的路，信息匹配不是最佳信息，找的地方很难找到，带着行李简直就是灾难。</p>
<p>What are the main difficulties and challenges?</p>	<ol style="list-style-type: none"> 1. If I did not have change, I would not be able to pay for the bus. 2. Normally, on the other side of the road, you can find the corresponding station to opposite direction, but sometimes you cannot find it. The positions of bus station should be rearranged to be more reasonable. Particularly, when changing the transportations, people often spend enormous time on looking for the right stations. 3. It is boiling to watch the commercial on bus TV, which is a negative factor for my experience. They replay the same commercial consistently, which could be more diverse to amuse our passengers. 4. The banisters are too high, passengers prefer to set their arms down. More banisters would be good. <ol style="list-style-type: none"> 1. The rigid payment denomination. 2. The vague location of bus stations. 3. The boring commercial and bus TV/radio. 4. High banister position. <p>1.没有一块钱，收一块钱两块钱，也可能没有零钱怎么换。</p> <p>2.同一站的公交车两个方向，有些时候斜对面可以看到，但是有时候找不到那个站，找不到。换乘时候反方向换乘，所以会比较不方便。高架桥不能穿行，你需要走，公交站位置不合理，过马路不方便，天桥残疾人和带行李乘客比较困难。</p> <p>3.公交车电视节目，很多时候很无聊，很多广告，车里的车载广告，比较影响体验。换多一点广告，调侃精神，娱乐大众，太墨守成规了。需要在路程中有些娱乐的项目，</p>

	<p>给一些关怀的感觉。像打气筒来打广告，没有人文关怀。</p> <p>4.很多时候希望把手放下来，多设置一些栏杆。</p>
<p>What negative social consequences does your customer encounter or fear?</p>	<p>1. Not really, the student's private car is always given their parents. Similarly, taking taxi frequently is a symbol of dissipation. In my case, bus taking is corresponding to my identity.</p> <p>1.学生，和比较成功的人都比自己年龄太多的，20多岁有汽车是家里人买的。做公交车没有压力，如果搭车浪费，反而会得到谴责，别人的认同证明自己就应该节约点，符合职业身份认同。</p> <p>2.拉着拉杆箱，在车上，一个美女在身边走过，视觉上交流，目光交流，就希望自己不要在这个狼狈的场合里。不过这是特殊时刻。</p>
<p>What risks do your customers fear?</p>	<p>1. The malfunctions might cause the fire, or ceased the bus on the road. These malfunctions cannot grantee the punctuality for me, in this case, I will be late. A perfect service should include the respect to the users.</p> <p>2. If standing in the crowd, you have to keep your eyes on your bag because of thief.</p> <p>3. Sometimes, after long-time waiting, the bus may not come. Moreover, you do not know where the closest stop to your destination is.</p> <p>1. The probability of malfunctions.</p> <p>2. Thief.</p> <p>3. The lack of punctuality.</p> <p>1.公交车冒烟，突然故障，会出现迟到，无形中对于时间造成了影响，花钱少，所以安全性差，保证不了自己的时间收到尊重。</p> <p>2.人很多的时候，小偷，吵架，老奶奶，让座。</p> <p>3.可能等不到公交车，没有地铁那么准时，然后公交车线路比较偏，在上海，被地铁淘汰的线路，下来是工地，下车的环境很恶劣。</p>
<p>What are the big issues or concerns that make your customers awake at night?</p>	<p>1. If I merged one bus, which I have never ever take before, to my traveling planning. The uncertainty makes me worried. Because, you do not know if you can catch the bus or not on the next</p>

	<p>day.</p> <ol style="list-style-type: none"> 1. Risk of taking new bus. 2. Risking of being excluded by overloaded buses. <p>1. 如果要把公交车纳入出行计划，时间风险，没有做过的公交车列入出行计划，车是否有，车挤得上挤不上，要走多远，如果做陌生公交车，所以会担心。</p>
What common mistakes does your customer make?	<p>Take the bus to incorrect direction.</p> <p>Miss the intended stops.</p> <p>Left your luggage on the bus/station.</p> <ol style="list-style-type: none"> 1. Taking the incorrect direction. 2. Overriding the destination. 3. Losing luggage in the buses/stations. <p>1. 做反方向。</p> <p>2. 坐过站。</p> <p>3. 带的东西，上车的时候把东西忘在站台上，东西忘在了公交车上。</p>
What barriers are keeping your customer from adopting solutions?	<p>Habit, and the old mental model.</p> <ol style="list-style-type: none"> 1. The stereotype thinking to resisting new solutions. <p>习惯，惯性，这些东西有吸引力，试过一次就觉得好。操作技巧，熟悉操作，操作逻辑。当它和原本的逻辑不匹配。</p>

Gains

Questions	Answers
Which savings would make your customer happy?	<p>In terms of money, energy and time.</p> <ol style="list-style-type: none"> 1. Savings in terms of time. 2. Saving in terms of money.

	<p>3. Saving in terms of energy.</p> <p>1.金钱的节约。</p> <p>2.力量的节约。</p> <p>3.时间的节约。</p>
<p>Which outcomes does your customer expect and what would go beyond their anticipation?</p>	<p>Lower ticket price, the more vacant seats and more space.</p> <p>The more interesting commercial, the novel exterior design, and the relaxing atmosphere.</p> <p>1.Lower ticket price.</p> <p>2.More vacant space.</p> <p>3.More interesting TV/radio.</p> <p>4.The innovative exterior design.</p> <p>1.车票便宜点。</p> <p>2.车厢空位多一点，空间充裕点，很惊奇。</p> <p>3.电视节目有所改观</p> <p>4.新的车外形设计</p> <p>5.让人感觉很休闲，不是挤得很不开心。</p>
<p>How do current solutions delight your customer?</p>	<p>Nothing to do with the__14 happiness, it is only an assistant equipment for traveling, I never considered the emotional reactions in my mind.</p> <p>没有开心，就是一个出行，省钱，没有考虑过难受。</p>
<p>What would make your customer' s job or life easier?</p>	<p>The bus lines that facilitate your locomotion, and it save your money.</p> <p>更加快捷的出行，省钱。</p>
<p>What positive social consequences does your customer desire?</p>	<p>Nothing.</p> <p>1. 没有啥的。</p>
<p>What are customer looking for?</p>	<p>The accuracy of information.</p> <p>High efficiency, speed and productivity.</p>

	<p>1.信息准确性</p> <p>2.更加快捷高效，速度更快。更快更高更强。</p>
<p>What does customer dream about?</p>	<p>Free of charge, release your mind out of check-in, losing money and behavior. The idealized situation is like stepping into the building without any additional action of us.</p> <p>If the product started to care about the emotional pleasure, then it would be the one I dream about.</p> <p>1.Elimination of check-in/out system.</p> <p>1. 免费，不用考虑安检，给钱，让座，很方便，直接走直接离开，百分之90理想的状态。移除所有的 barrier，当产品开始放在如何取悦顾客，将会是最理想的状态。</p>
<p>How does your customer measure success and failure?</p>	<p>The punctuality.</p> <p>1. The accurate punctuality.</p> <p>1. 是否准时到达，大家不会要求很高，只花1块钱，只希望准时准点，不出意外，大众对于他的期待，也是我对于他的期待。</p>
<p>What would increase the likelihood of adopting a solution?</p>	<p>Current bus service should extend its coverage, and the position of stations should be more reasonable.</p> <p>1. More service coverage.</p> <p>1. 它的延伸可以更多一点，到达的地方更加合理更加多一点，能够预测大家要去哪里，稍微只能一点，不要到了一个莫名其妙的地方，然后把大家放下了，前面高架后面工厂。网络的触手再延伸多一点。</p>

APPENDIX IV THE ONLINE SURVEY

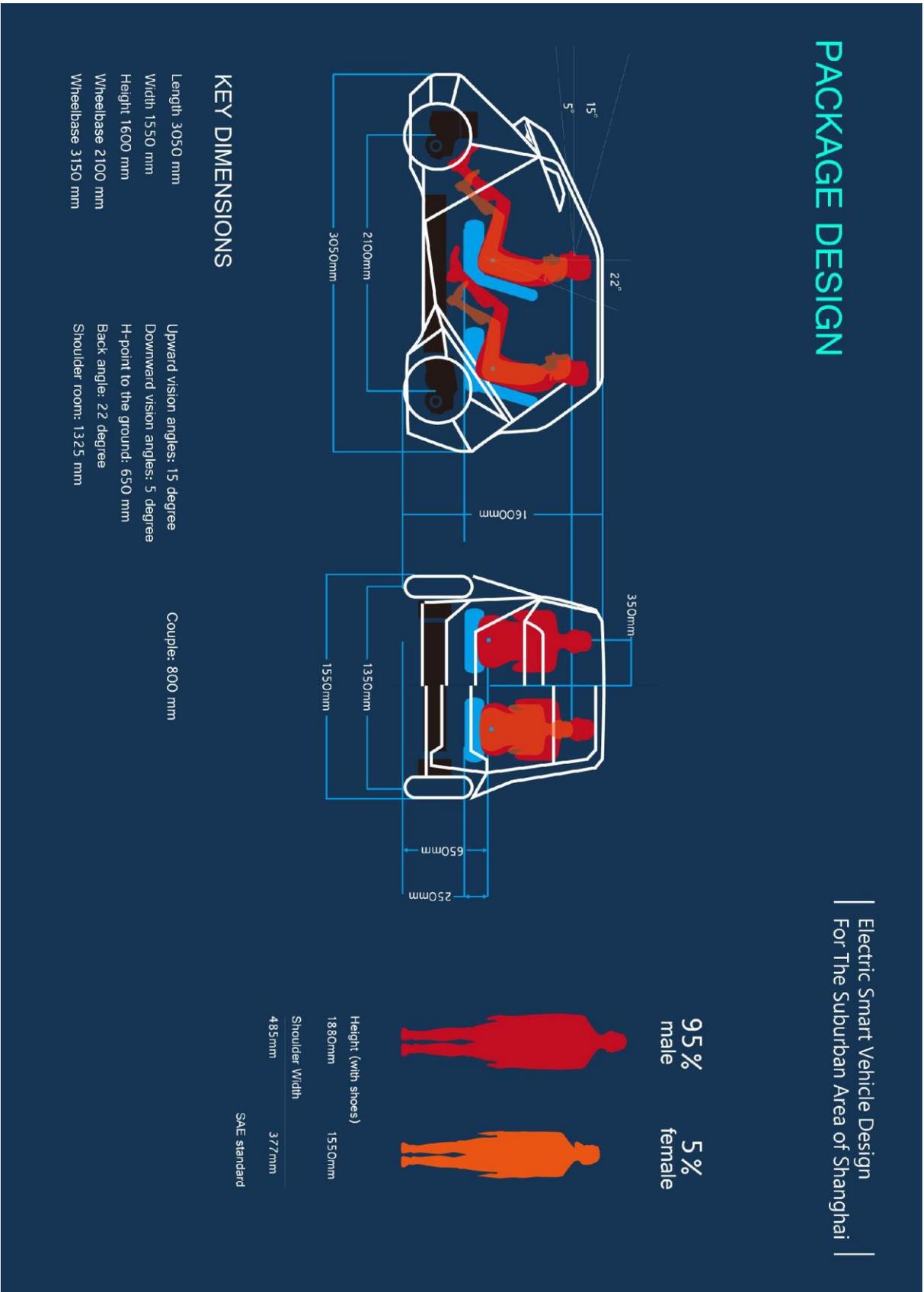
The online survey was performed in an online survey platform of China called Wenjuanxing (<http://www.sojump.com/>). The questions for online survey was redesigned, it eliminated the confused part and made the survey easier to be understood. The specific data for this online survey was <<http://www.sojump.com/jq/3254435.aspx>>. This section only translated the questions from Chinese version to English version, since the specific options have been discussed already in the report.

1. Name
2. Gender
3. Do you have driving license?
4. Where do you live in Shanghai
5. Age
6. What is your job?
7. Your frequency of taking public bus?
8. How long will it takes from your residence to working place?
9. How long will it takes from your residence to nearest bus station by feet?
10. How do you think about the basic functionality for a qualified ground public transportation? Please rank each function based on their significance to you.
11. The following options are the common cost for taking existing public bus. Please rank each options based on their extent.
12. The following options are potential factors that might cause negative experience for users, please rank them based on their significance to you.
13. What do you think is the most crucial defect for current public traffic service? Please choose the right options and rank them according to their importance to you.
14. What kind of difficulties you may encounter?
15. What kind of mistakes you may confront?
16. If there were some new solutions emerging, what do you think might be a barrier for people to accept new traffic solutions or alternatives?
17. What is the most remarkable merit or saving from current public bus service?
18. The following options are the potential modifications for current bus service, which one is you expecting for? Please rank them based on your preference.
19. Do you have any other requirements in terms of the functionalities for the future solution.
20. What do you usually do in the compartment?

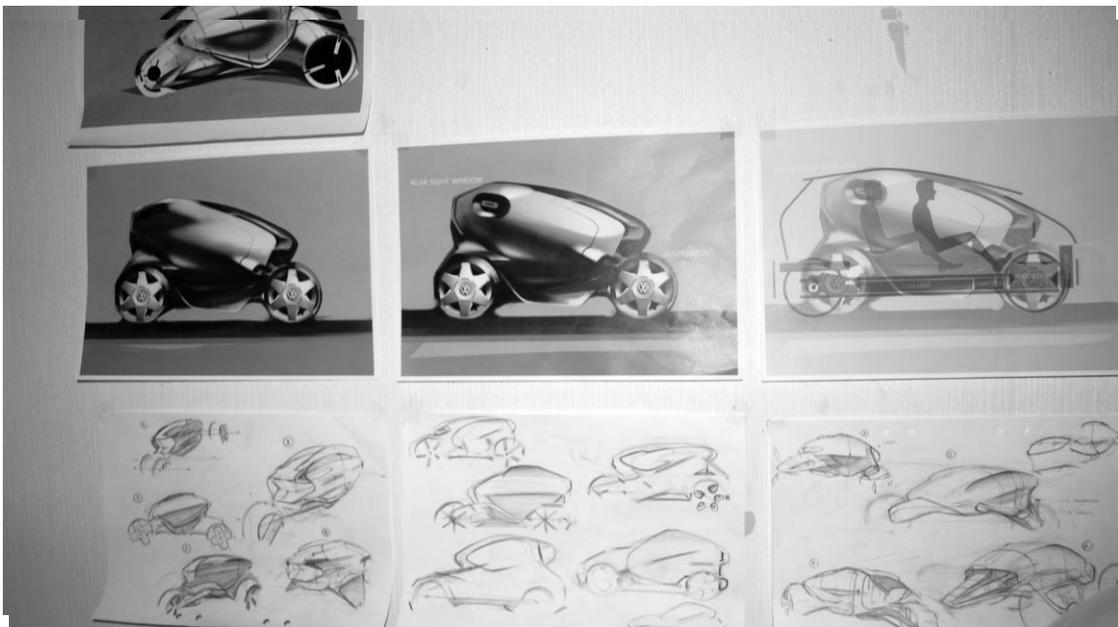
21. What do you think will be the most proper alternative for public transport service?
22. The product/ artifact is nice to see?(Visual impression)
23. The product/artifact is nice to touch? (Haptic impression)
24. The product/ artifact is nice to hear?(Auditory impression)
25. The product/artifact is nice to smell?(Olfactory impression)
26. How do you feel when you are taking or using the public bus service?
27. Do you think the existing service is easy to use?
28. Does the service generate some social influence on you?
29. Does the existing product/service fit your needs?
30. Do you think the design for existing product/service is reasonable?

APPENDIX VI THE ANTRIPOMITRICAL DATA

The package design and vehicle dimensions referred to the anthropometric from 5% female to 95% male.



The initial concept sketches



After the selection among the different concepts, the final concept was what was showed off in the report and presentation.

