



Research and design of

Mainline Freight Vehicle

Transport **Vehicle** Based on
Unmanned Logistics

◆ THESIS AUTHOR

Wang Desen

◆ THESIS SUPERVISOR

Prof.Davide Bruno



POLITECNICO DI MILANO

School of design-Integrated product design-double degree

Abstract

This article is based on the development trend of unmanned logistics, and discusses the possibility of unmanned technology development based on the logistics status of trunk freight. Taking the main transportation means of trunk freight as the carrier, we try to carry out innovation and design research on the interior, exterior, cargo box and on-board APP.

This article will first focus on the current status of the logistics model and analyze it with specific examples at home and abroad. , And at the same time make an in-depth discussion on the development background of unmanned logistics; development overview and technical principles. After studying the entire logistics model and unmanned logistics, further analysis and discussion on the heavy trucks of the main line transportation are carried out, and a certain forward-looking and feasible solution is proposed. In terms of product design, this article will combine electric vehicle drive technology and autonomous driving technology to develop a zero-pollution, high-efficiency, intelligent, electric unmanned heavy truck that is more in line with the logistics model.

This article aims to design an electric unmanned heavy truck and vehicle service system that can fully cope with the trunk freight by combining the unmanned logistics technology. And can gradually replace the existing backward trunk freight service mode, and at the same time provide a valuable case reference for the development of the logistics industry.

◆ **[Keywords]: Unmanned logistics; trunk freight; electric heavy trucks; service system**

Questo articolo si basa sul trend di sviluppo della logistica senza equipaggio e discute la possibilità di sviluppo di tecnologia senza pilota in base allo stato logistico del trasporto merci. Prendendo come vettore i principali mezzi di trasporto del trasporto merci, cerchiamo di effettuare ricerche di innovazione e design su interni, esterni, cassone di carico e APP di bordo.

Questo articolo si concentrerà innanzitutto sullo stato attuale del modello logistico e lo analizzerà con esempi specifici in patria e all'estero. , E allo stesso tempo fare una discussione approfondita sullo sfondo dello sviluppo della logistica senza pilota; panoramica dello sviluppo e principi tecnici. Dopo aver studiato l'intero modello logistico e della logistica non presidiata, vengono svolte ulteriori analisi e discussioni sugli autocarri pesanti della linea principale di trasporto e viene proposta una certa soluzione lungimirante e fattibile. In termini di design del prodotto, questo articolo combinerà la tecnologia di guida dei veicoli elettrici e la tecnologia di guida autonoma per sviluppare un camion pesante senza pilota elettrico, ad alta efficienza, intelligente ed a inquinamento zero, più in linea con il modello logistico.

Questo articolo mira a progettare un sistema di servizio per autocarri pesanti e veicoli elettrici senza pilota in grado di far fronte pienamente al trasporto di merci combinando la tecnologia logistica senza pilota. E può gradualmente sostituire l'attuale modalità di servizio di trasporto merci a ritroso e allo stesso tempo fornire un prezioso riferimento per lo sviluppo del settore logistico.

◆ **[Parole chiave]: logistica senza pilota; trasporto di tronchi; autocarri pesanti elettrici; sistema di servizio**

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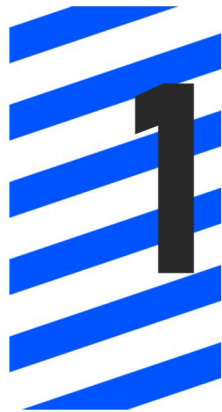
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CHAPTER

Topic selection background
and research significance

1.1 Background

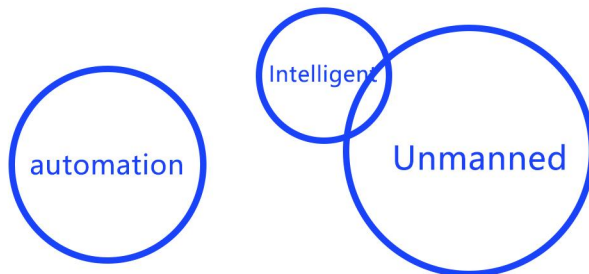
1.2 Significance

1.3 Global e-commerce overview

1.1 Background

In the past 10 years, China's e-commerce has been developing rapidly. Although the logistics industry has a long history of development and a relatively complete model in European and American countries, China's logistics industry has also developed a set of relatively The logistics model of the system, with the massive amount of parcels and the increasing material needs of the people, large-scale e-commerce platforms and logistics express companies are facing a new round of technological innovation.

More and more companies have begun to adopt a large number of automated, intelligent, unmanned logistics technology equipment and operating modes to improve logistics efficiency and reduce operating costs. With the continuous development of Internet technology, the concept of "Internet +" The concept of "unmanned storage, unmanned vehicles, drones" and other concepts in logistics has been put forward continuously, marking that the concept of unmanned logistics has been gradually implemented in enterprises and the market.

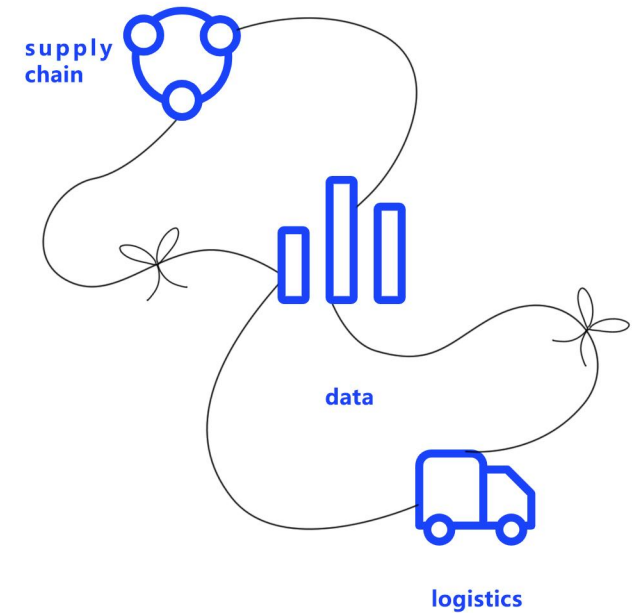


At the 2016 Yunqi Conference, Jack Ma said that from now on, the "pure e-commerce" operation model will no longer have advantages. In the future, it will be a "new retail" model combining offline, online, and logistics.

The two logistics giants Cainiao and JD.com both stated that they will open the existing supply chain, data, and logistics to the society, and become a supplier of infrastructure in the commercial retail field, and realize the comprehensive intelligence of retail and the "unmanned" logistics process, and finally become intelligent As early as 2012.

Amazon spent US\$775 million to acquire Kava System, and put KAV robots into use, which not only improved the efficiency of operations but also reduced operating costs. Since then, it has driven mobile robots in the world. Utilization rate of the warehousing link. Domestic and foreign companies are making progress one after another. In the field of unmanned driving, companies such as Baidu, Google, and Tesla are also increasing their research and development efforts. However, some experts believe that the possibility of unmanned driving was first applied to the trunk or terminal freight links. In the field of unmanned logistics, the most active explorers are undoubtedly e-commerce companies, and the research on unmanned vehicles for trunk freight is also one of the important parts of the entire unmanned logistics.

"new retail" model combining offline, online, and logistics.



This article will be based on the overall operation mode of unmanned logistics, based on unmanned driving and electric heavy-duty truck technology, to dig deep into the needs of users in the trunk freight link. Designing a trunk-line freight transportation that can adapt to future unmanned logistics has extremely high practical needs and significance.

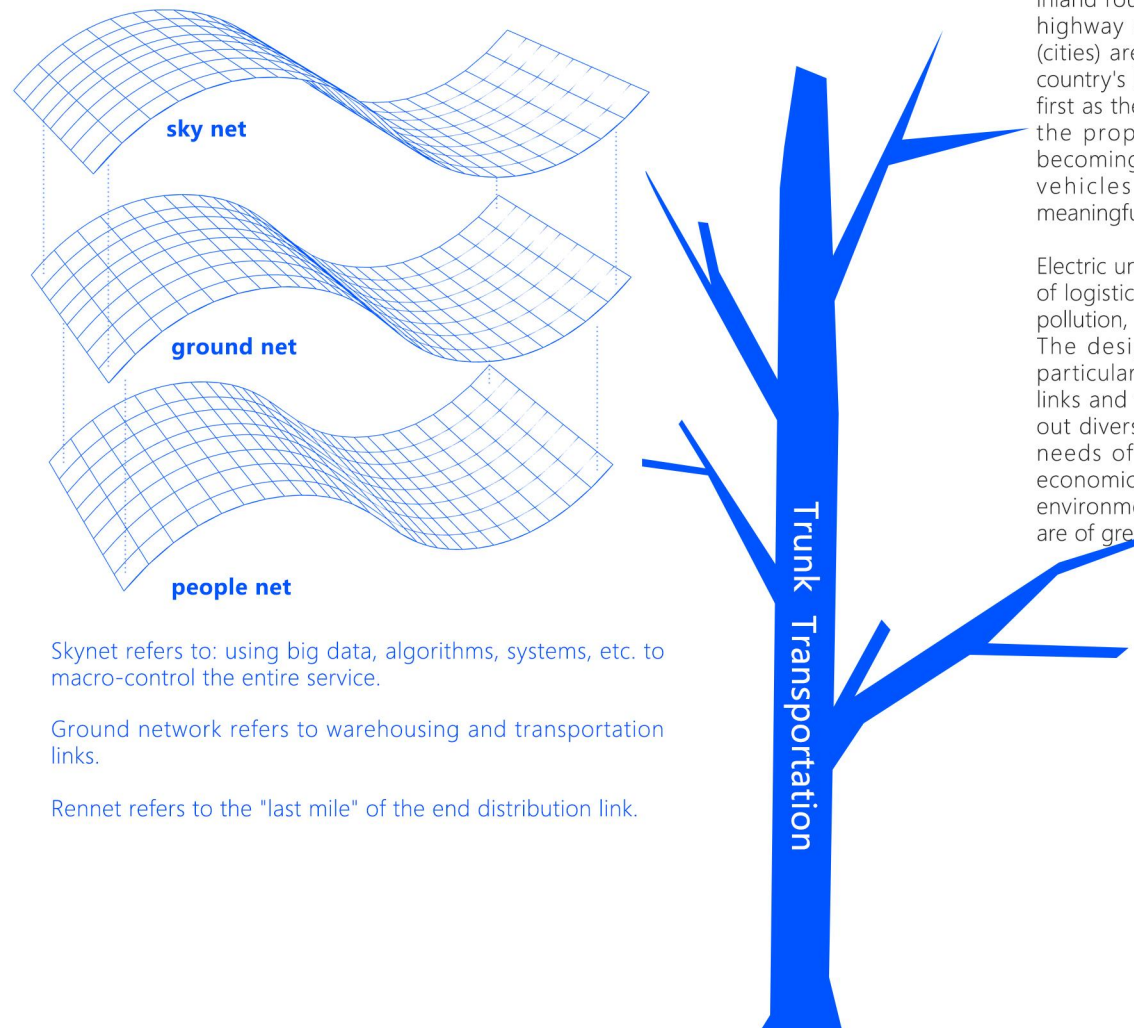
1.2 Research significance

There is no doubt that unmanned logistics is the future trend, and unmanned logistics is developed on the concept of "Internet +", so unmanned logistics must be an automatic, intelligent, interconnected and relatively A low-cost system, the basic model of e-commerce combined with logistics includes three parts: Sky net, Ground net and People net.

User data is an important part of Skynet. Through the online trading platform, the basic model of goods in various regions can be analyzed. Flow direction, so as to use big data to predict the demand for which goods in some areas, and store the goods in the nearest warehouse before the user purchases, so as to reduce the time of goods transportation and improve the user experience. For the control of logistics, logistics companies can also monitor the congestion state of various places through the monitoring of Sky net, and coordinate and dispatch the routes and methods of various logistics.

The ground net refers to the warehousing link. With the support of the modern network, the e-commerce platform will make reasonable arrangements and adjustments to the quantity and storage location of the goods according to the data of the system.

People net refers to the "last mile" of the end distribution link. Some logistics companies will establish post stations to obtain benefits through collection and delivery. This method reduces the waiting time of couriers and users, improves efficiency and improves user experience. And unmanned logistics will play an important role and innovation in these three links.



Skynet refers to: using big data, algorithms, systems, etc. to macro-control the entire service.

Ground network refers to warehousing and transportation links.

Renet refers to the "last mile" of the end distribution link.

The main application of unmanned logistics technology is in three links: warehousing, transportation, and terminal distribution. There are also different solutions for the three links: unmanned warehouses, unmanned vehicles and unmanned aerial vehicles. The main purpose of this research is to study the overall logistics model and unmanned logistics, and to propose an innovative solution for unmanned vehicles in the transportation link. The transportation links of logistics mainly include three aspects: trunk transportation, linear transportation and terminal distribution. The trunk line transportation refers to the line transportation that plays a backbone role in the entire transportation network. Generally, passenger and cargo transportation formed by transportation routes (including coastal routes, inland routes, railway routes, aviation routes, and highway routes) that cross provinces, districts (cities) are called **trunk transportation** [4]. In my country's logistics, the logistics that takes the road first as the trunk transportation occupies most of the proportion. Unmanned logistics is also becoming a trend, so the design of unmanned vehicles for road trunk transportation is meaningful.

Electric unmanned heavy-duty truck is a new type of logistics trunk transportation vehicle with zero pollution, high efficiency, high safety and low cost. The design of the vehicle will focus on the particularity of the logistics and transportation links and the different types of goods and carry out diversified designs to fully meet the various needs of the logistics industry, whether it is economic, social, technological development or environmental protection issues All of the above are of great significance.

1.3 Global e-commerce overview

Nowadays, online trading platforms are emerging one after another, and the global e-commerce transaction volume is also rising.

Due to the development of the epidemic, it has promoted the global development of online shopping, and people have gradually become accustomed to online shopping.

A large-scale online trading platform can meet most of the demand for goods, which means that consumers can purchase any desired goods or even services on the online trading platform. From the perspective of the entire world, global online trading platforms mainly include Amazon, Taobao, JD, eBay, and zalando.

Since the emergence of online trading platforms has greatly facilitated people's lives, in the past they could only buy goods around the life circle. Now the whole world has become a store. It has to be said that it has greatly changed people's lifestyles.

It also changed the world's economic structure. Riding on the heat wave of Internet development, online transactions play a very important role in our lives. At the same time, it has spawned a large number of other industries, or led the rapid development of other industries such as manufacturing and logistics.

The entire commodity transaction process is as follows: Consumers select their favorite goods on the platform, and then use the online transaction platform to make online payment after the choice is made. After receiving the order, the merchant arranges express delivery for delivery, and the goods are delivered through express delivery. In the hands of the consumer, the merchant will receive the transaction fee only after the consumer confirms that the product is in good condition, and the platform will charge a certain handling fee and advertising fee from it.

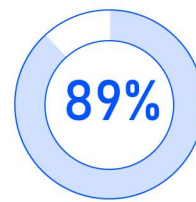
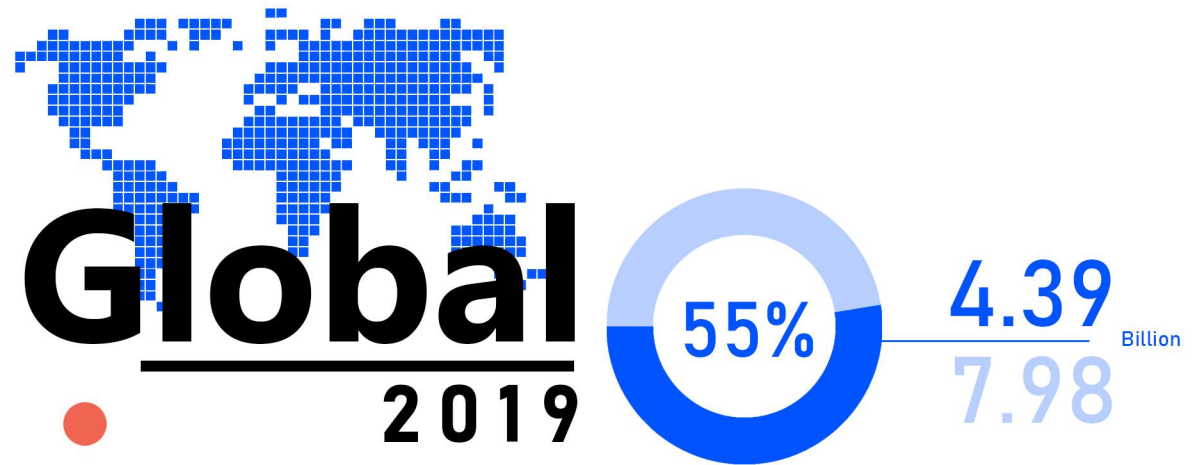


The latest number of global Internet users

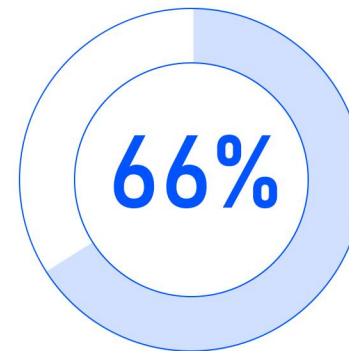
We Are Social and Hootsuite jointly released the 2019 digital report. The report shows that the global population is 7.676 billion people, of which 5.11 billion are mobile phone users, 4.39 billion are Internet users, and 3.48 billion are active on social media. In terms of the growth of netizens, India ranked first, with an increase of 97.89 million people in the past year, an increase of 21%, and China ranked second, with an increase of 50.67 million people in the past year, an increase of 6.7%.

Among them, the use of social networks accounted for 89%, online shopping accounted for 66%, and video viewing accounted for 65%.

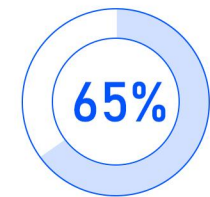
The report also shows that Internet users around the world spend an average of 6 hours and 42 minutes online every day, which means that people spend a quarter of their lives online. This figure is slightly lower than last year's 6 hours and 49 minutes. Interestingly, an interesting trend is that Internet users who spend the longest time online are mainly from developing countries and middle-income countries.



Social Contact



online Shopping



Watch Video

resource comes from:<https://tech.huanqiu.com/article/9CaKrnKhCF4>

Comparison of the number of Internet users in China and Europe.

As of the end of 2020, China's population is about 1.4 billion, of which about 904 million are Internet residents, accounting for 65%. About 78% of these Internet residents will shop online, which means that the number of consumers is extremely large. For Europe.

China / 2020



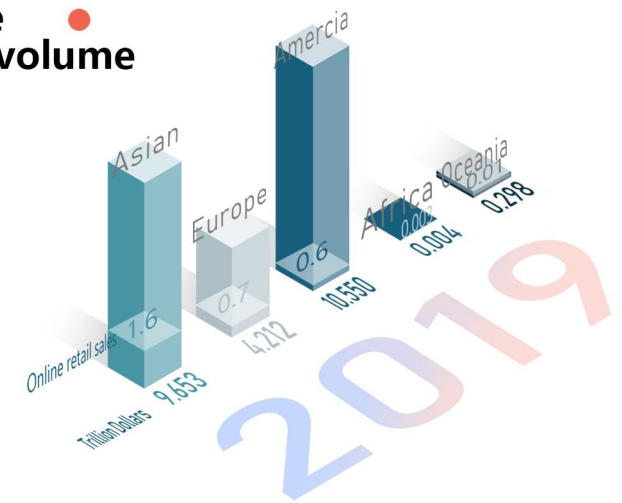
Europe / 2015



In 2015, the total population of Europe was approximately 820 million people, of which 530 million were Internet residents, accounting for 65%, but the proportion of people shopping online was 49%, which means that there are still more people in Europe. A huge potential market is waiting to be developed.

E-commerce transaction volume

The report shows that in 2018, seven countries in the Asian region include: China, India, Thailand, Turkey, Japan, Singapore, South Korea, e-commerce transactions totaled 965.3



billion US dollars, online retail transactions totaled 1633.42 billion US dollars;

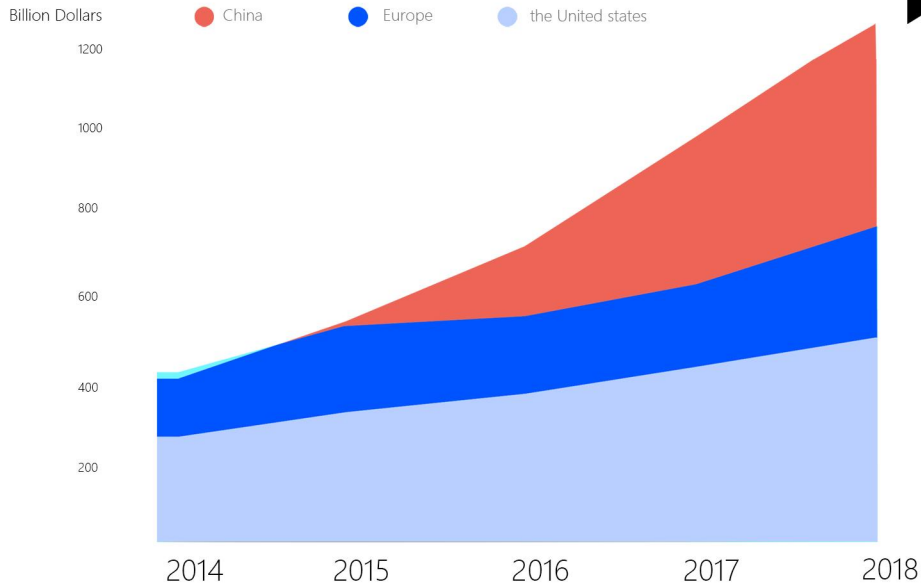
15 countries in the European region include: France, Germany, Russia, Spain, Italy, Sweden, the United Kingdom, the Netherlands, Belgium, Ireland, Luxembourg, Denmark, Austria, Ukraine, e-commerce transactions totaled 4211.82 billion US dollars, online retail transactions totaled 698.16 billion US dollars;

In the Americas, the United States, Canada, Mexico, and Brazil have total e-commerce transactions of US \$ 10,549.83 billion, and online retail transactions of US \$ 628.03 billion.

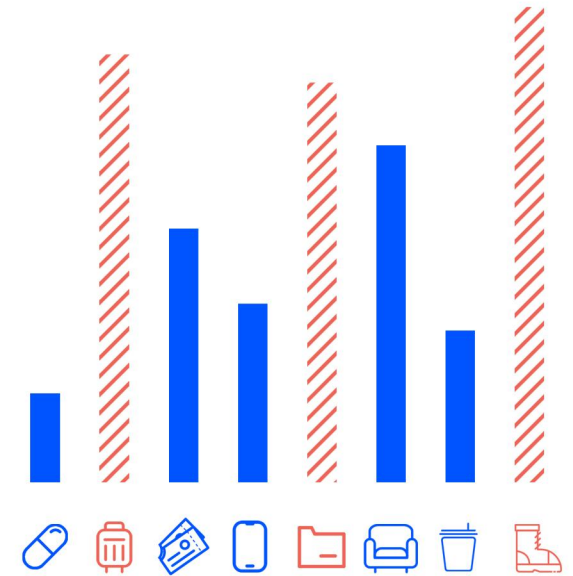
South Africa's e-commerce transactions in Africa are US \$ 4.076 billion and online retail transactions are US \$ 3.25 billion

Australian e-commerce transactions in Oceania are US \$ 298 billion, and online retail transactions are US \$ 11.6 billion

Online retail transaction value(B2C)



From the table we can see that the popularity of different products in European online shopping can be roughly divided into the following categories: medicine, Travel and holiday accomodation, tickets and events, electronic equipmnet, media & computer software, household goods, clothe and sports goods.



- Student
 - 16-24 years old
 - Highly educated people
- 2016**

From the above figure, we can see that the rise of e-commerce first began in the United States and Europe, but the growth rate from 2014 to 2018 was not very fast. Due to China' s huge demographic dividend, starting in 2014, The development of e-commerce is particularly rapid. In 2015, the transaction volume of e-commerce surpassed the country and Europe, becoming the world's number one. From a global perspective, e-commerce transactions in 2018 accounted for 30% of global GDP, of which B2C transactions accounted for 17% of global GDP, which is equivalent to the total GDP of 2.2 Italy. It is also equivalent to the combined GDP of the 93 Republic of Congo.

Among them, travel and holiday accomodation, media & computer software and clothes and sports goods are the most purchased. Medicines are the least purchased, which is easy to understand, because people often need medicines. It is needed at this moment, so offline purchases are a more convenient and effective way. At the same time, we found that young students are the main force in online purchases, and people with high degrees of education make online purchases more frequently.

Resource comes from:European Ecommerce Report 2017



SUMMARY

- ◆ In the future, e-commerce will be composed of supply chain, big data, and logistics, namely Sky net, ground net, and People net.
- ◆ The scale of global online shopping will continue to expand.
- ◆ The majority of online shoppers are young people, high-quality people, and spread to other groups.



CHAPTER

Theoretical Research
Framework

**2.1 Research Status of
Contemporary Logistics
Operation Mode**

**2.2 Express Logistics
Research**

**2.3 Research status of
unmanned logistics**

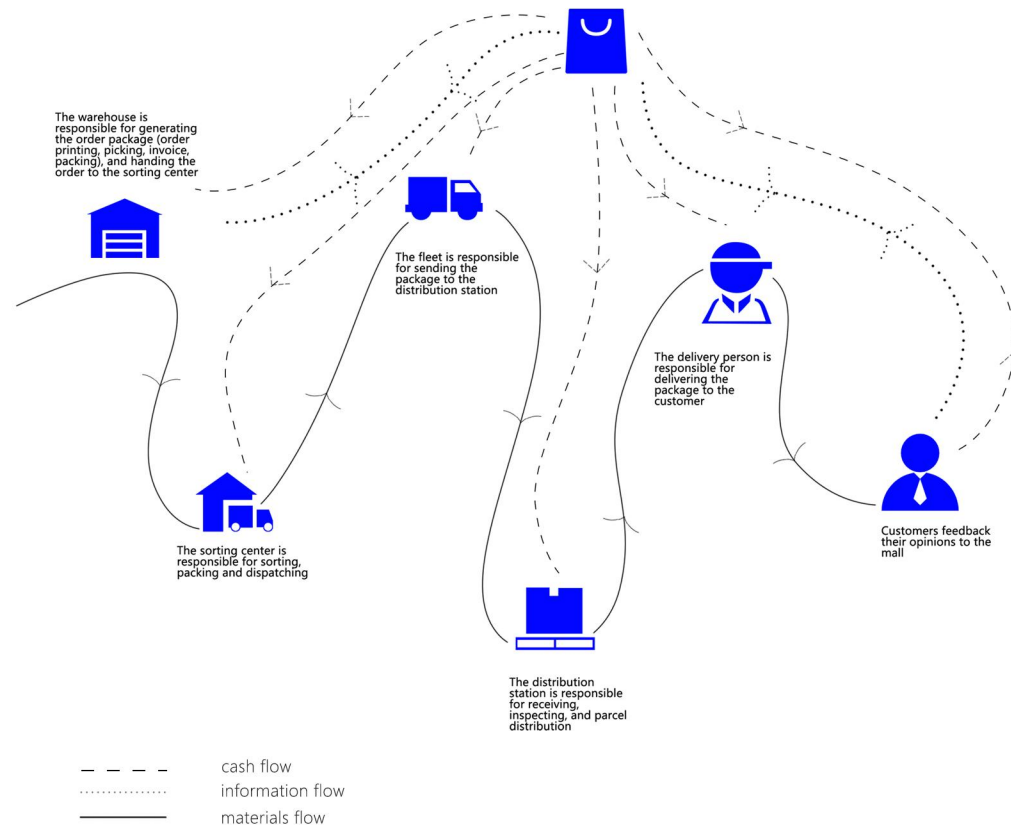
**2.4 Heavy truck analysis
for trunk freight**

**2.5 Electric
unmanned heavy
truck**

Analysis of JD Logistics Model

JD.com was established in 1998 and has so far developed into my country's largest self-operated e-commerce company. Its main products are 3C products (computer; communication; consumer electronics), home appliances, consumer goods {electronic department stores}, and apparel and furniture . And for many years, we have been doing our best to create first-class logistics services. When we mentioned JD Logistics, our first impression was "fast", "arrival next day" and other words. Online products driven by high-standard logistics services are better sold, so an efficient logistics model is of great significance to e-commerce platforms.

Behind JD's high-quality service is actually a very powerful and complex logistics system, which was later adjusted, improved and perfected in the course of time. JD.com named this system "Qinglong Logistics Distribution System". In the entire logistics distribution process, efficient operation of capital flow, information flow and material flow is realized. It is this system that supports the entire logistics ecology of JD. Jingdong pursues informatization. The economic benefits of, specialization, platformization and scale have also led and reshaped industry standards [1].



JD's logistics services include self-built warehousing centers, transportation fleets, distribution networks and distribution teams, etc., and every logistics link is included. At the same time, each logistics link is strictly controlled and managed. If there is any accident Can directly mobilize resources for management and crisis handling. The JD team's unified management methods, unified work clothes, and unified delivery vehicles all declare to the outside world that I am a formal professional team and only provide professional and efficient services. The figure below shows the distribution network of JD Logistics (Figure 1)

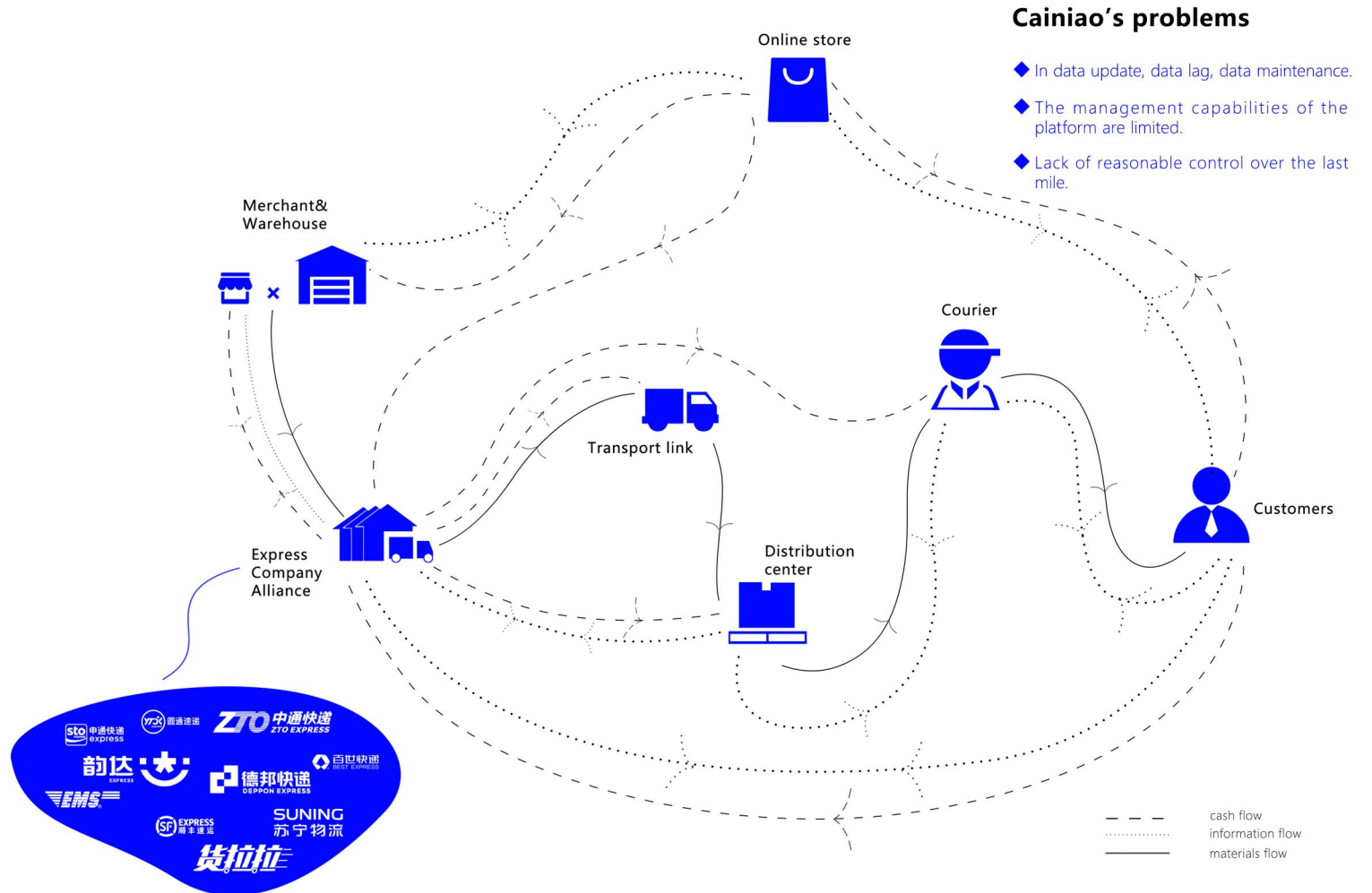
JD's problems

- ◆ Jingdong's distribution model is relatively simple, and the cost of distribution is high. Because there are a lot of short-selling behaviors in the distribution process, the utilization of its logistics resources is almost 50%-60%. For other logistics, the rate is 80%.
- ◆ The distribution pressure of logistics is huge. With the continuous expansion of JD.com, people's purchasing power continues to increase, which will cause JD to lose touch in the distribution link.
- ◆ Control is not effective in time.3. Untimely delivery, delay, even loss, wrong delivery, and mismatch of delivery information will affect the shopping experience of the entire JD.com customers.



Cainiao's platform-based management model deeply integrates big data resources, which can reduce the logistics costs of various logistics companies, and can effectively improve stability and accuracy in the process. At the same time, it can learn from big data that the most time-saving and labor-saving transportation routes and methods of the company save time while reducing costs, thereby bringing consumers a better shopping experience.

Cainiao is an Internet technology company focusing on logistics network platform services. It means it is not an express company, it is an internet company which work with different express companies to promote the digital and intelligent upgrade of the express logistics industry, enhance the logistics experience for global consumers, provide smart supply chain solutions for global businesses, and help reduce logistics costs for the entire society.

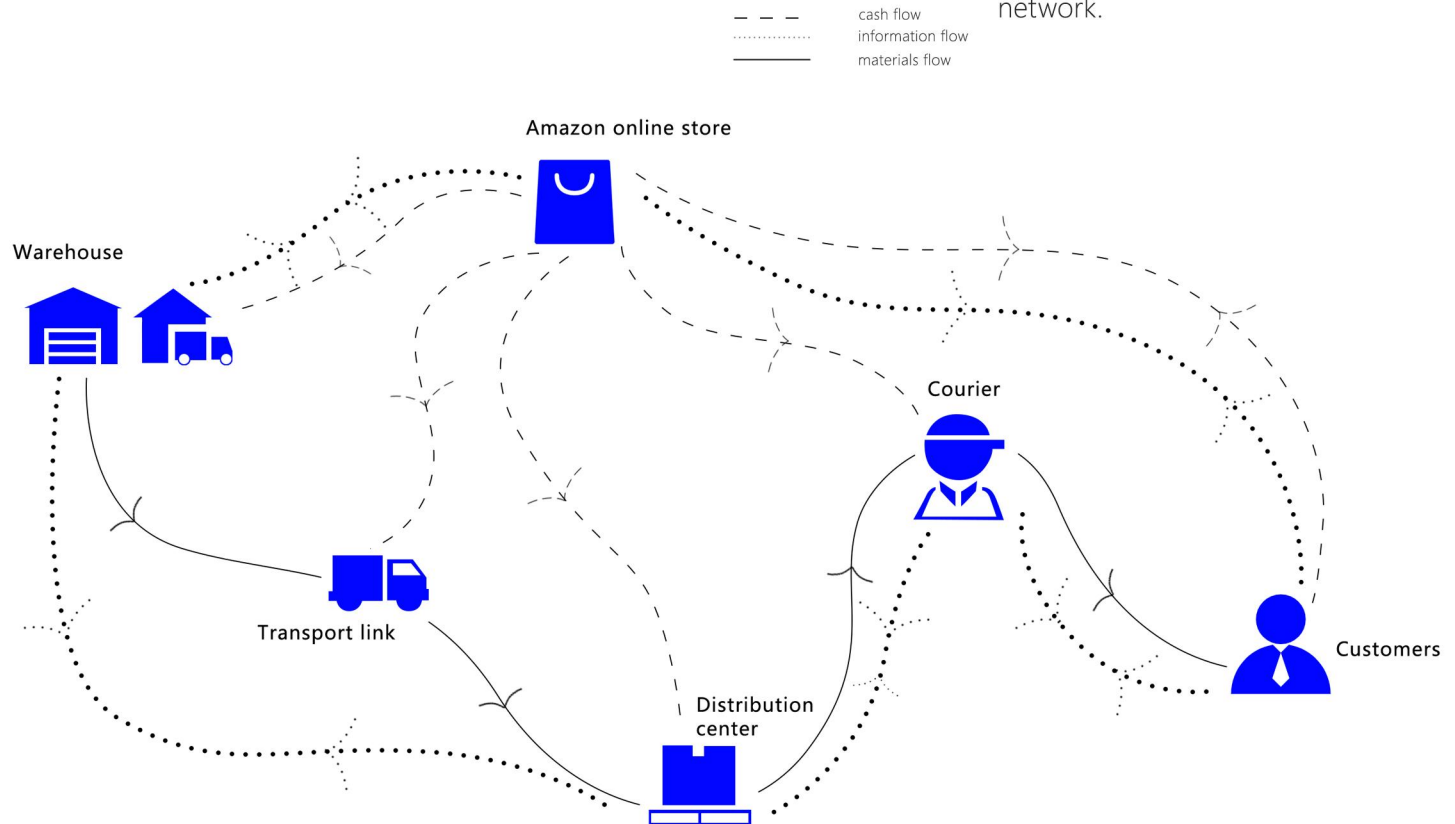


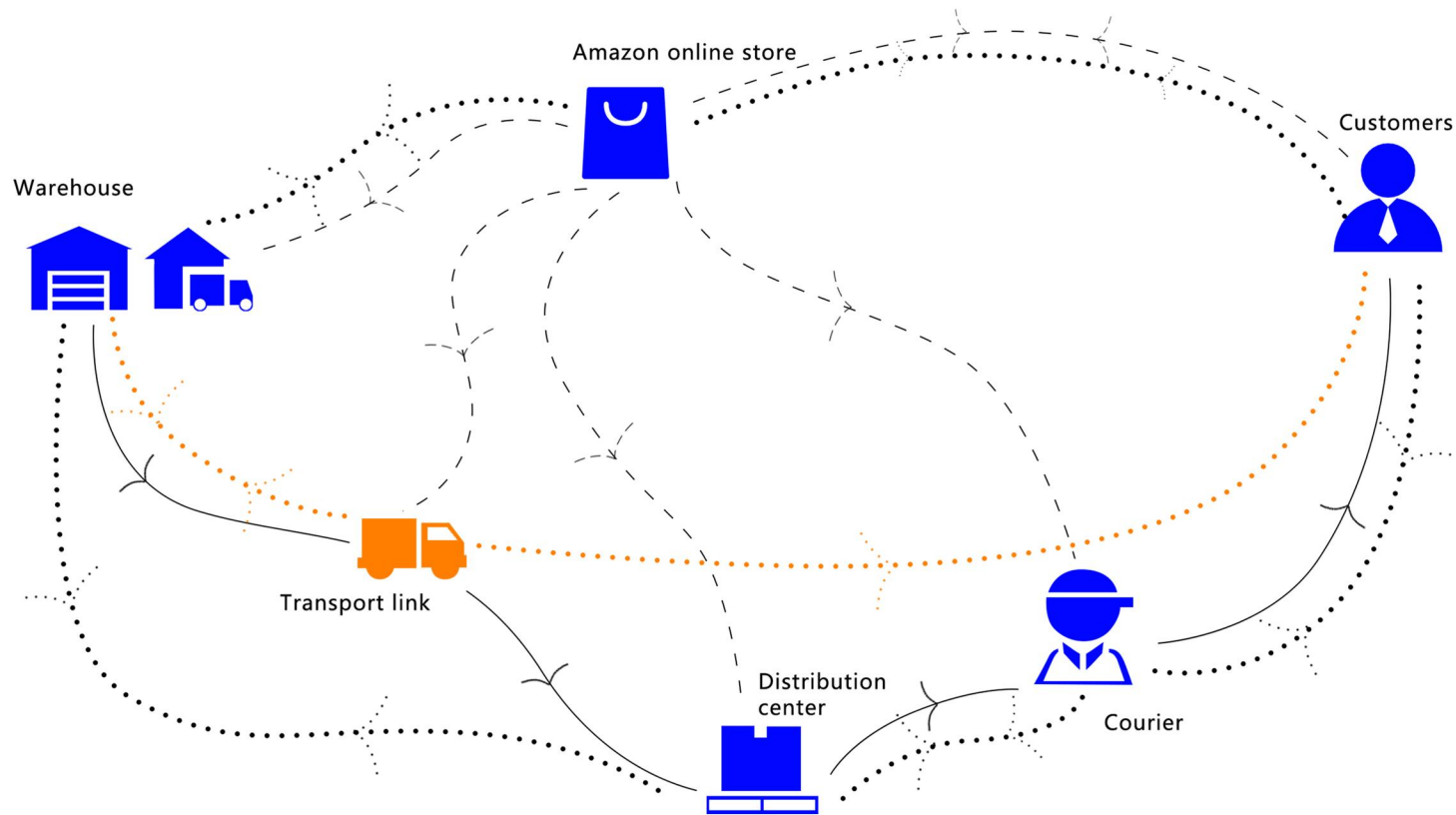
Analysis of Cainiao Network Logistics Mode



For the logistics process, Amazon will open up all systems such as packaging and shipping, trunk transportation, branch transportation and last-mile delivery, and can monitor the movement and status of each package. So in summary, the Amazon logistics network has two advantages: network If the scale is large enough, the network system on a global scale will cover all the areas that can be covered. It also means that the user information and data obtained from the first-hand shop are obtained. This is very necessary for the update of the information network. In the information age, whoever masters the ability to obtain information will master the market. For overseas warehousing, they are self-built and self-operated, so the efficiency and cost of operation and logistics are guaranteed.

As the world's largest e-commerce company, Amazon has a strong online sales platform and logistics network in nine countries including the United States, Canada, China, the United Kingdom, France, Germany, Italy, Japan, and Spain. It has a total of 200 million active users worldwide. Data shows that 44% of the U.S. population lives within 20 miles of the Amazon logistics center, while the proportion of the U.S. population living within 20 miles of the Amazon logistics center rose from 5% to 44% between 2005 and 2016. Said that Amazon is gradually building its logistics network.





New system map

In the new system diagram I proposed, the main innovation is to increase the two-way information exchange from the warehouse to the transportation node, and also increase the information flow between customers and the transportation node, because we know that the digital upgrade of the express industry involves the entire express delivery process.

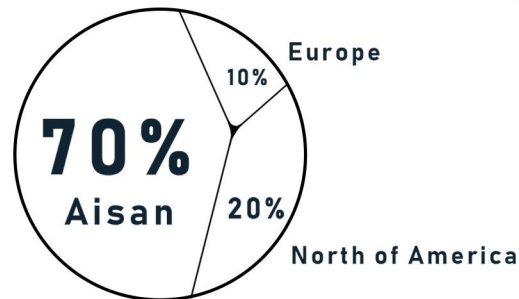
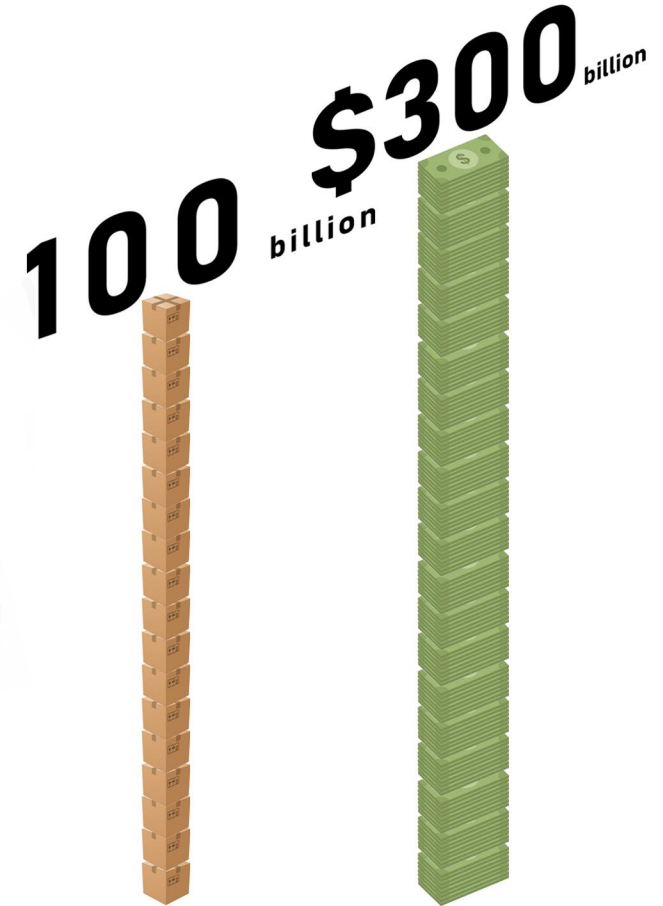
From smart warehousing to express station to smart delivery drones, there are objective progress, but there are not many upgrades in the field of trunk transportation, or there are few practical examples in this field, so there is an urgent need in this field. Digital upgrades are needed, so that the entire logistics chain can be upgraded. Therefore, increasing the information flow of trunk transportation and other links can make the entire trunk transportation link reliable, traceable, and transparent. At the same time, it can also monitor the status of express cargo in real time to ensure its safety, increase the full load rate, and increase transportation efficiency.

1. How to build the **system** and improve the operation mode to cope with the increasing logistics pressure.
2. How to improve the **information update** in the context of big data more efficiently.
3. How can we better **reduce manpower and time costs.**



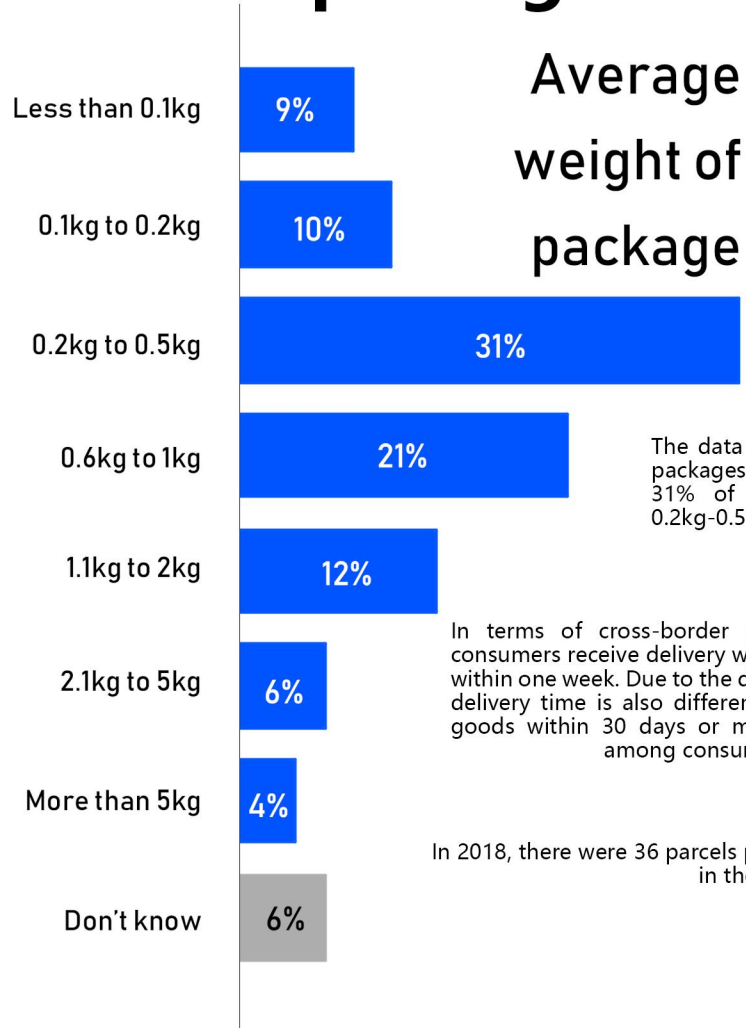
Global | 2018 express delivery volume

From the picture on the right, we can see that the global express delivery volume in 2018 was 100 billion pieces and The transaction volume reaches 300 billion dollars. Among them, Asia accounted for 70%, and Europe accounted for at least 10%. There is a relatively complete supply chain and manufacturing industry, coupled with a large population, which leads to its huge size. At the same time, we can also see that Europe and the Americas also have huge market potential. With the upgrade of logistics digitalization, the more More and more business opportunities will be revealed.



Resource come from:Global e-commerce data report

Data of packages



Average weight of package

The data shows that 72% of cross-border packages are lighter than 1kg, of which 31% of the packages weigh between 0.2kg-0.5kg and 21% of the packages weigh between 0.6kg-1kg.

In terms of cross-border parcel delivery speed, 18% of consumers receive delivery within three days, and 48% receive within one week. Due to the difference in logistics distance, the delivery time is also different. 9% of consumers receive the goods within 30 days or more, and this is most common among consumers in Brazil, Russia and Mexico.

In 2018, there were 36 parcels per capita in China, 53 per capita in the UK, and 14.4 per capita in Italy.

Number of express delivery per capita in 2018



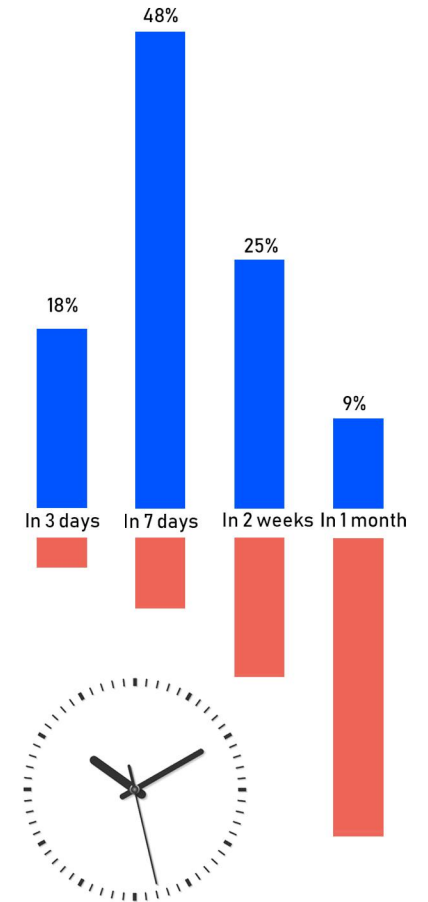
China



UK



Italy

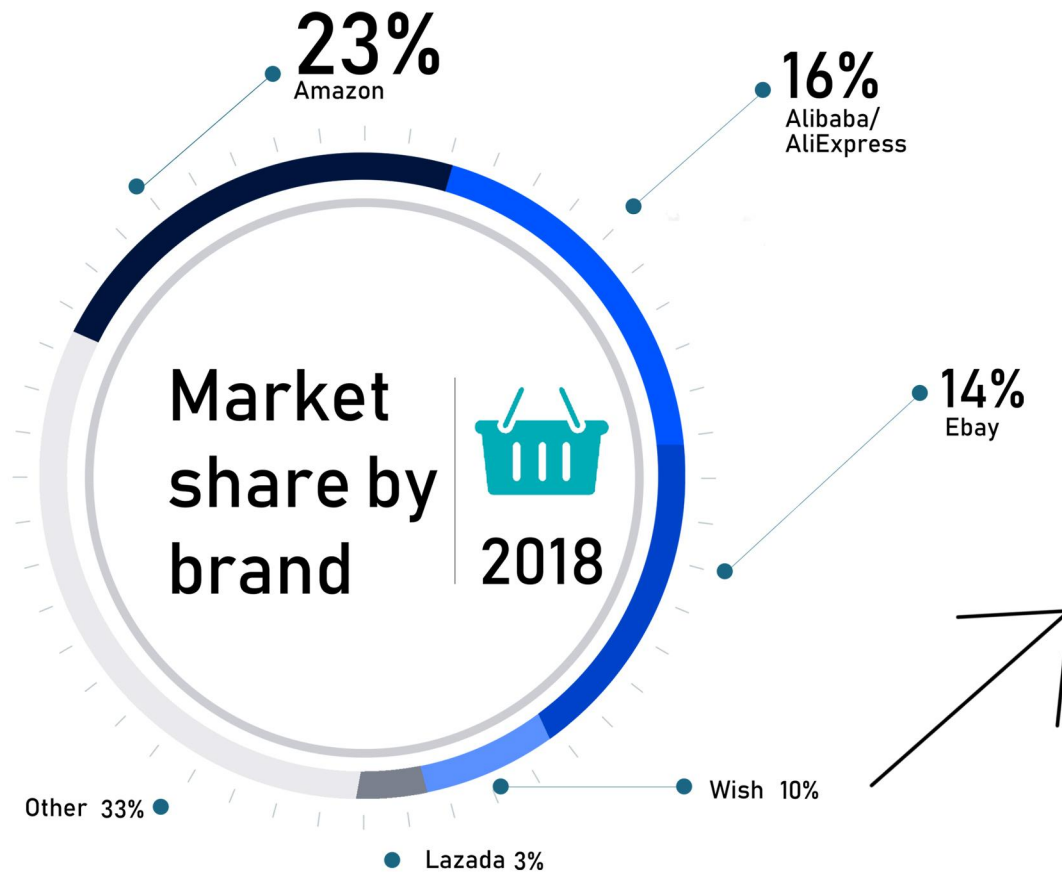


Average delivery time

Resource comes from: European e-commerce market report ,International Post Corporation

Amazon has become the most popular platform, clothing and electronic products are the most popular consumer products

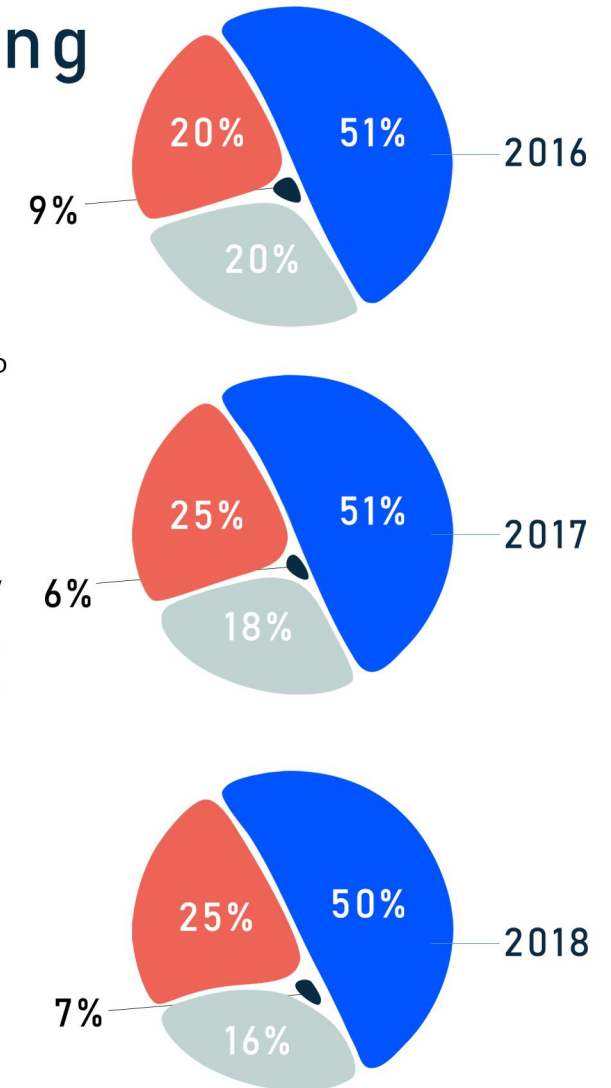
At the same time, respondents' preferred shopping platform is Amazon (23%), followed by Alibaba\AliExpress (16%), eBay (14%) and Wish (10%).



Parcel data tracking

The data shows that in 2018, consumers pay more attention to the tracking of package information at any time. 27% of respondents usually follow up, 50% said they would keep track most of the time, and 16% and 7%

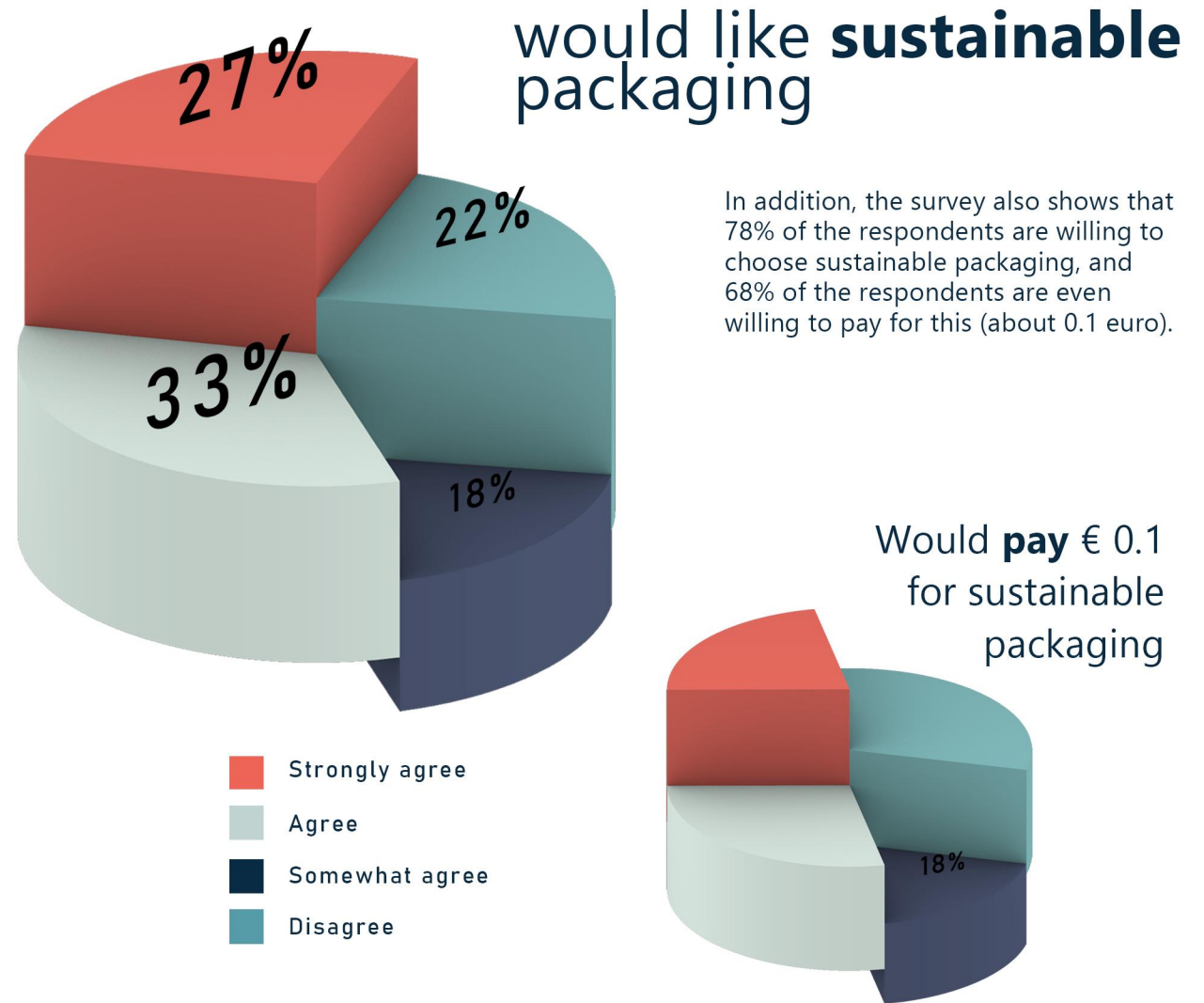
- Always
- Most of time
- Sometimes
- Less often



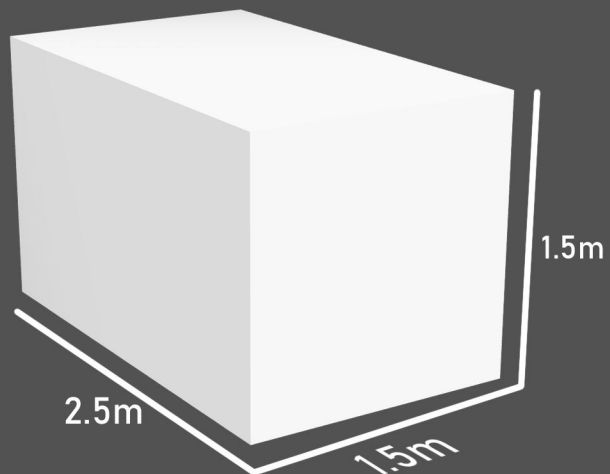
Resource comes from: European e-commerce market report

In addition, the survey also shows that 78% of the respondents are willing to choose sustainable packaging, 68% of the respondents are even willing to pay for this (about 0.1 euros).

At the same time, carbon-balanced parcel delivery is increasingly recognized, with 66% of the respondents holding a positive attitude and 61% of the respondents willing to pay for it (0.1 Euro).



In general:



MAXIMUM SIZE: 2.5M*1.5M*1.5M

MAXIMUM WEIGHT: 50KG



BAG



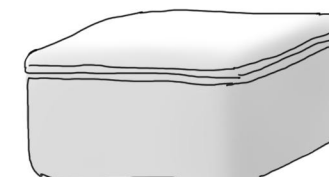
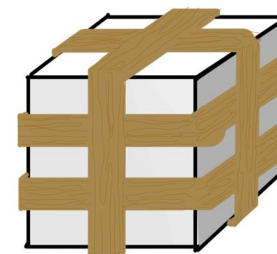
BOX



PAPER BAG



BOX+BAG



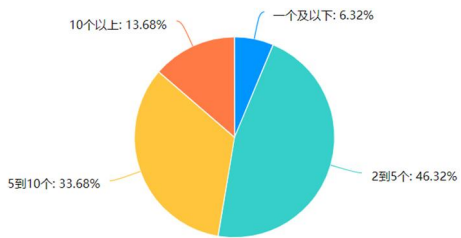
There is a maximum size limit for express delivery. Generally speaking, the billable weight of a single piece does not exceed 50KG or the three sides (length, width, and height) do not exceed 2.5 meters, 1.5 meters, and 1.5 meters respectively. At the same time, the main packaging is divided into the following categories: carton, file bag, packaging plastic bag, packaging tape + carton, wooden box and foam box, of which carton, file bag, packaging plastic bag and packaging plastic bag + carton are the most common.

due to the lack of uniformity. The user's awareness and quality are not high, and the size of express packaging is messy. In the future, green packaging and unified standards will replace the current packaging. SF Express and JD Express have invested huge research and development on this. Standardization of express packaging is just around the corner.

Chapter 2/2.2 Express Logistics Research/2.2.2 Customer attitude

选项	小计	比例
全日制学生	47	49.47%
生产人员	0	0%
销售人员	3	3.16%
市场/公关人员	0	0%
客服人员	2	2.11%
行政/后勤人员	4	4.21%
人力资源	1	1.05%
财务/审计人员	0	0%
文职/办事人员	0	0%
技术研发人员	7	7.37%
管理人员	3	3.16%
教师	8	8.42%
顾问/咨询	0	0%
专业人士(如会计师、律师、建筑师、医护人员、记者等)	9	9.47%
其他	11	11.58%

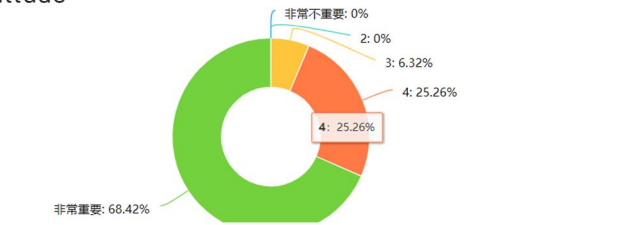
选项	小计	比例
一个及以下	6	6.32%
2到5个	44	46.32%
5到10个	32	33.68%
10个以上	13	13.68%
本题有效填写人次	95	



第8题: 实时物流信息对您来说的重要指数 (量表题)

本题平均分: 4.62

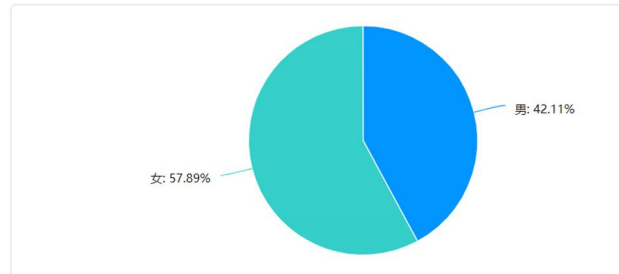
表格 饼状图 圆环图 柱状图 条形图 隐藏零数据



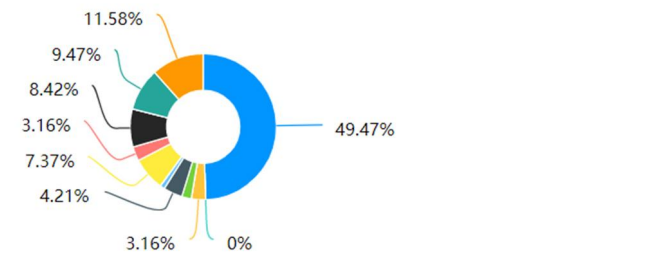
第2题: 您的性别: [单选题]

选项	小计	比例
男	40	42.11%
女	55	57.89%
本题有效填写人次	95	

表格 饼状图 圆环图 柱状图



表格 饼状图 圆环图 柱状图 条形图 隐藏零数据



■ 全日制学生 ■ 生产人员 ■ 销售人员 ■ 市场/公关人员 ■ 客服人员 ■ 行政/后勤人员 ■ 人力资源
■ 财务/审计人员 ■ 文职/办事人员 ■ 技术/研发人员 ■ 管理人员 ■ 教师 ■ 顾问/咨询
■ 专业人士(如会计师、律师、建筑师、医护人员、记者等) ■ 其他

数值 小计排序 配色

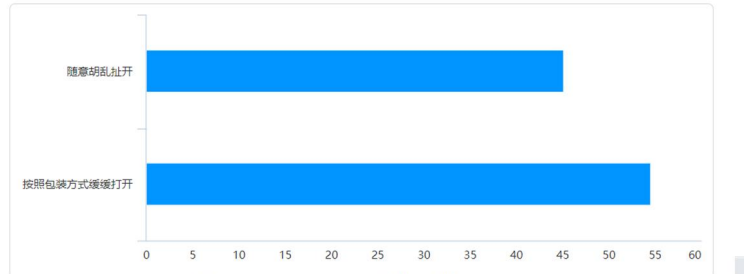
第16题: 您认为导致快递包装中最浪费的部分是? [单选题]

选项	小计	比例
塑料袋	17	17.89%
纸箱, 纸袋	37	38.95%
填充物	28	29.47%
胶带	10	10.53%
其他 [详细]	3	3.16%
本题有效填写人次	95	

表格 饼状图 圆环图 柱状图 条形图

第7题: 您会怎么拆快递? [单选题]

表格 饼状图 圆环图 柱状图 条形图



选项	小计	比例
快递公司官网	19	20%
线上平台(如淘宝、京东、支付宝、菜鸟裹裹等)	91	95.79%

第17题: 您认为快递包装过度的原因是什么? [多选题]

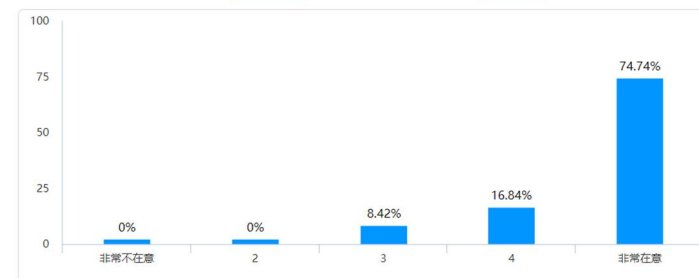
选项	小计	比例
为保证物品安全, 防止运输过程中受损而多次包装	77	81.05%
快递包装材料差, 所以需要多次包装	21	22.11%
没有一定的行业包装标准, 所以导致乱象丛生	52	54.74%
包装人员缺乏相关培训和经验, 导致包装不合理	18	18.95%
本题有效填写人次	95	

查看多选题百分比计算方法

表格 饼状图 圆环图 柱状图 条形图

选项	小计	比例
4	16	16.84%
非常在意	71	74.74%
本题有效填写人次	95	

表格 饼状图 圆环图 柱状图 条形图 隐藏零数据



Customer Attitude

Everyone has different opinions on the current express service, and the involvement of express service needs to understand the customer's thoughts and improve the user experience from the user's point of view. The number of questionnaires is 101, of which 95 are valid questionnaires.

The questionnaire was designed mainly from the basic questions of the number of times the express parcel was received, the views on the express packaging materials, how to deal with the opened express box, and the attitude of express information tracking and green express.

Generally speaking, the median number of express parcels received by people in a month is roughly between 5-7. The timeliness and safety of express delivery are the most important, and they are very positive about the progress of express delivery without carbonization, and they are also willing to spend. A small fee supports green express delivery. However, some current courier service problems have also been found in this.



Available from: <https://www.wjx.cn/login.aspx>

95/101

Valid response

56%

of 95

feel that timeliness is the most important attribute in express delivery services, and it is also the most important link in express delivery.

68%


of 95

Think that real-time logistics information is very important to them.



: If the express delivery is faster, I don't want to **wait** at all. It's best to place an order today and arrive tomorrow 



: Once the express package was **completely broken**, and I found out when I received the express. The courier also shirked the responsibility and said that it was not his fault, and the experience was really bad. 



: Will my personal information be **leaked** if the electronic form is not cleaned up? What if the bad guy finds out? 



: There are so many **courier boxes**, I don't know what to do. 



Summary of pain point



1. The cargo loading is too **messy**, and both loading and unloading **waste time**.
2. When the goods arrive at the intermediate transfer center, all the goods need to be unloaded, then scanned and distributed, which **consumes** a lot of time. Although the entire process is completed by machines, it also requires human maintenance. If the volume of freight suddenly increases, the transfer center will be unable to normal work. **Delay** the delivery time of the goods.
3. In the process of trunk transportation, users cannot understand the **safety and instant information** of express delivery.
4. Due to the uneven quality of the couriers during the transfer process, **violent express delivery** will often be seen, resulting in **damage** to the goods or packaging and reducing the user experience.
5. After arriving at the distribution center, unloading takes a long time and consumes a lot of manpower. The main line transport vehicles and the branch line transport vehicles are not well **connected**.



The research background of unmanned logistics



IVECO Z truck

At present, almost all e-commerce platforms and logistics platforms are promoting the process of unmanned logistics, in order to improve the efficiency of logistics links and thus enhance the shopping experience of consumers. The entire unmanned logistics is driven by digitalization as the core. Use automated, intelligent infrastructure equipment to replace manpower, but now it is subject to policy, capital, technology, and environmental constraints. The process of unmannedness is not as fast as we thought, but it is true that every company and institution is researching Direction, because this is a trend in the future, this trend will integrate the most advanced intelligent technology and equipment under the control of a certain cost to minimize human resources, time resources and material resources, so as to achieve high efficiency and low cost, Highly environmentally friendly logistics and distribution methods, consumer experience will also get better and better.

JD 2002



Suning AGV



Courier cabinet



DHL drones



Tesla semi truck

In terms of unmanned logistics innovation, it is undoubtedly the first to develop the largest logistics company-Amazon. The success of Amazon is inseparable from the advanced logistics system that it has been studying. In 2012, Amazon took the lead in acquiring KIVA. SYSTEM, Amazon uses older kiva robots in the picking and delivery process of the warehousing link, which greatly saves labor costs and increases efficiency.



Volvo vera



Renault EZ pro concept

Later, JD.com, Cainiao and Suning.com also followed Amazon's operating model and began to carry out research on unmanned logistics. There are probably four reasons for the research and development of unmanned logistics in China: market demand, technological development, and labor costs. The continuous increase in logistics, the introduction of a number of government policies and the assistance of capital have jointly promoted the development of unmanned logistics in China. In the express delivery industry and e-commerce industry, unmanned logistics is their main player. We can see from the process of unmanned logistics by JD Cainiao and Amazon. Next, we will study their respective development priorities and directions.

Key technology of unmanned logistics

◆ Unmanned warehouse

Unmanned warehouse technology is a core of the development of unmanned logistics. As the name implies, unmanned warehouses use automated equipment and instruments to replace manual power to complete all logistics tasks in the warehousing process. The main technologies include three-dimensional warehouse architecture and **3D vision. Identification system, automatic packaging technology, AI, IOT**, etc.



Three-dimensional storage structure



3D visual recognition system



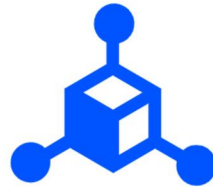
Automatic packaging technology



AI

◆ Unmanned vehicle

The field of unmanned vehicles is currently being studied by mainstream auto companies and the Internet industry. The logistics industry has the greatest possibility of unmanned driving technology in its application due to the particularity of its operating conditions. The main equipment involved in unmanned vehicles includes **GPS, laser, radar sensors, ultrasonic sensors, and multi-angle high-definition. camera.**



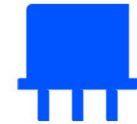
IOT



GPS



Laser and radar sensors



Ultrasonic sensor



HD camera



Flight control system



Automatic obstacle avoidance



Automatic route planning

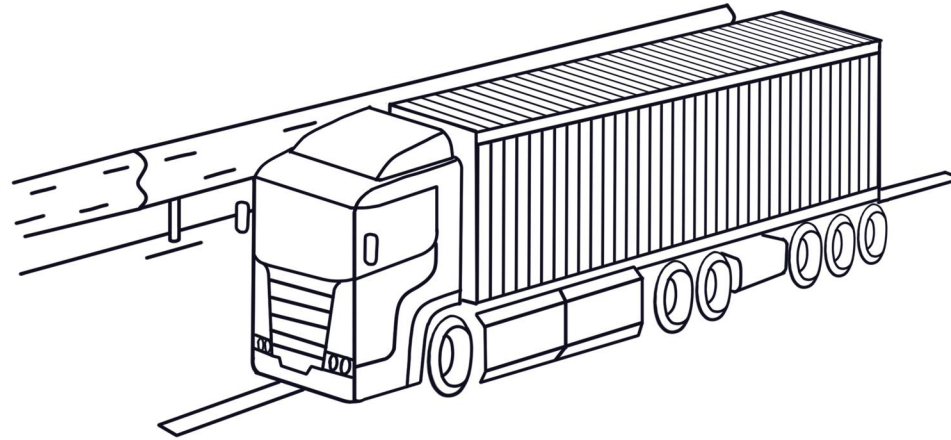
◆ Drone

In the three-level intelligent logistics system consisting of trunk level, branch level and terminal level, drones have gradually become an important development direction of the system. Among them, terminal-level logistics drones have the fastest development speed. **Flight control systems, navigation systems, Power system, communication technology system**, etc. But the most difficult technical barriers are **automatic route planning and automatic obstacle avoidance.**

Comparison between transport system on tires and iron

Advantages of road transportation

- Road transportation has **comprehensive** coverage, and the road transportation network is dozens of times larger than the density of the railway network and the density of the water way network.
- Compared with the railway system, the biggest advantage of the road transportation system during operation is its higher **flexibility**.
- The road transport procedures are simple and the service attitude is significantly higher than that of the railway. Goods with low packaging requirements, fragile and difficult to load and unload, are suitable for road transportation. Goods with large volume but small weight, large number of pieces and frequent batches are very **suitable** for road transportation.

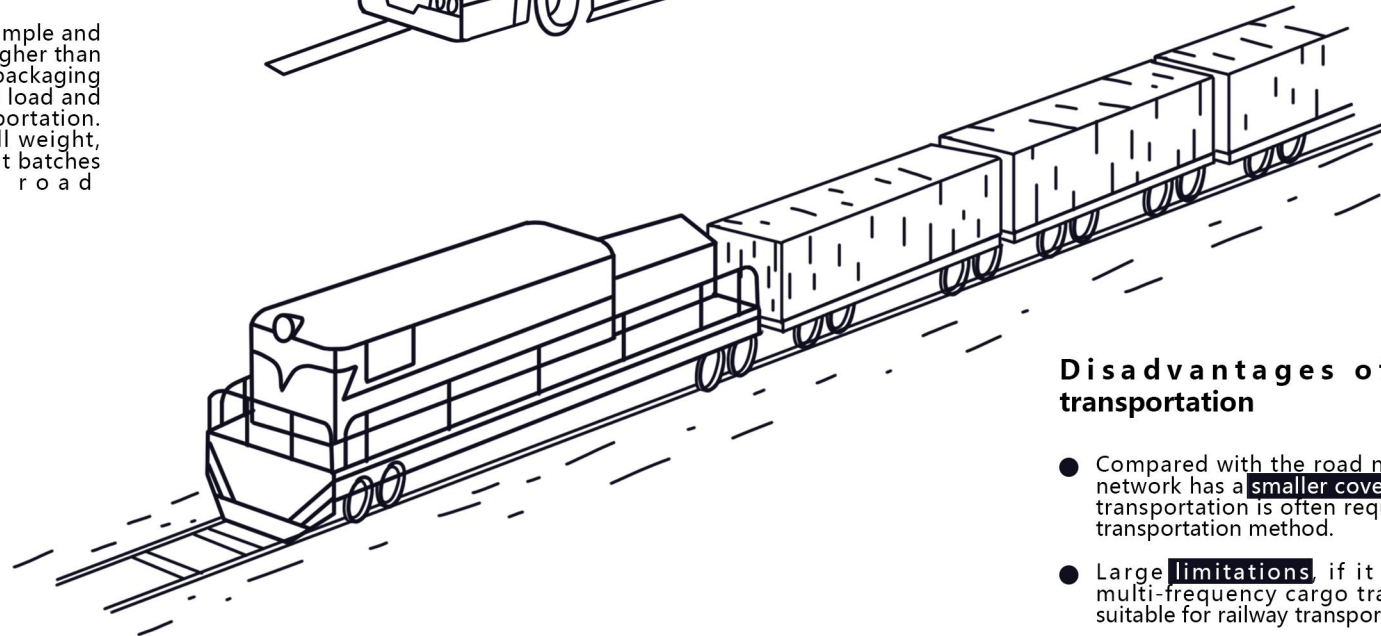


Disadvantages of road transportation

- The maintenance of the transportation system, these **costs** are more frequent.
- The personnel cost control of road transportation is inherently **uncertain**, and it is difficult to implement precise control.
- From a global perspective, although the quality of highways in developed countries is better, there are still some **areas with low coverage and uneven regional distribution**.

Advantages of rail transportation

- The railway transportation has a **strong carrying capacity** and is suitable for the centralized transportation of bulk materials.
- Railway transportation has economies of scale and **low** unit transportation costs.
- Regardless of the factors of restructuring on the way, the railway is **safe and fast** rain or shine.



Disadvantages of rail transportation

- Compared with the **road network**, the railway network has a **smaller coverage area** and road transportation is often required as an auxiliary transportation method.
- Large **limitations**, if it is a small batch, multi-frequency cargo transportation is not suitable for railway transportation.
- The possibility of **damage** to goods transported by rail is very high, and rough handling is common. There are certain requirements for the packaging and protection of stock disaster goods.

Summarize

For long distances, especially when the distance is more than 1,000 kilometers, when transporting large amounts of goods, railway transportation has great advantages. It can control the cost and transport the goods to the destination efficiently and safely.

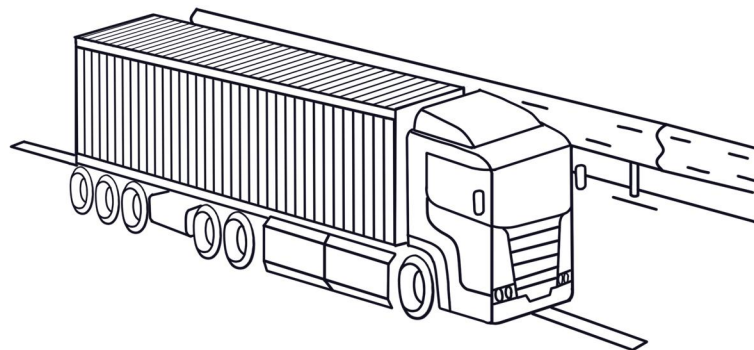
But for Express goods with distinctive characteristics and attributes may be more suitable for road transportation. Because express express has the characteristics of flexibility, large volume, light weight, and large number of pieces, it is more suitable for road transportation that is flexible and covers a wider area.

However, I think that the express delivery methods in the future may be more diversified, and more suitable transportation methods can be arranged according to the different characteristics of the goods.

For cross-country, cross-continental, or heavy express delivery, you can choose rail transportation, and for general cargo with a small span, you can choose road transportation.



European Railway Network



It can be seen from the map of Europe that the highway coverage area in Europe is wider than the railway coverage area.

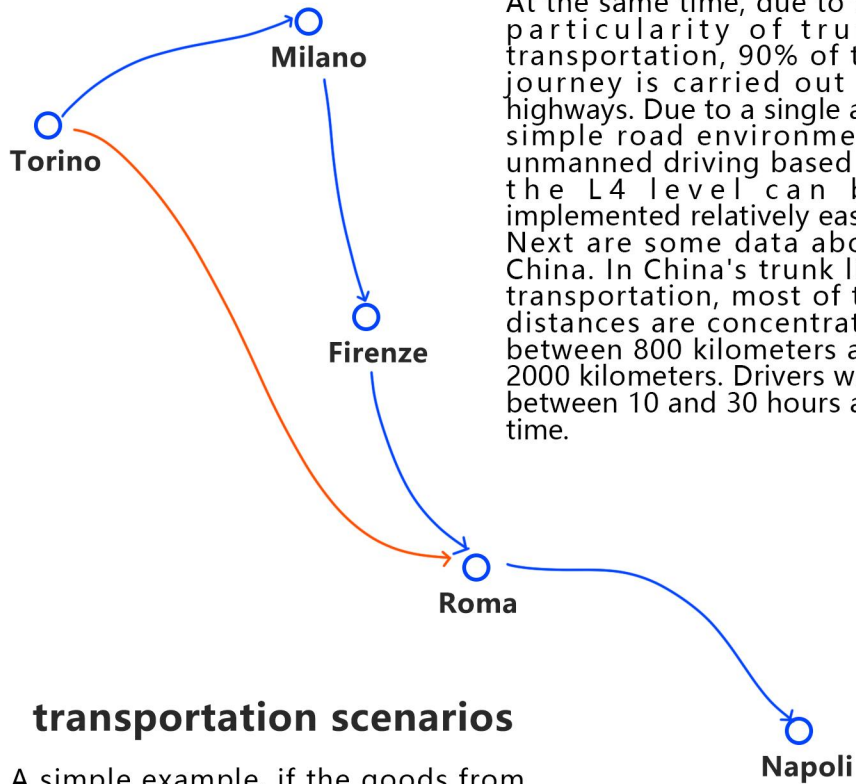
And the coverage area is larger, but it does not mean that the transportation capacity of road transportation is stronger than railway transportation.

It can only be said that the express transportation is special. Under the attribute, the capacity and scope of road transportation is larger than that of railway transportation.

Therefore, under the current circumstances, express delivery mainly relies on road transportation.

European Road Network

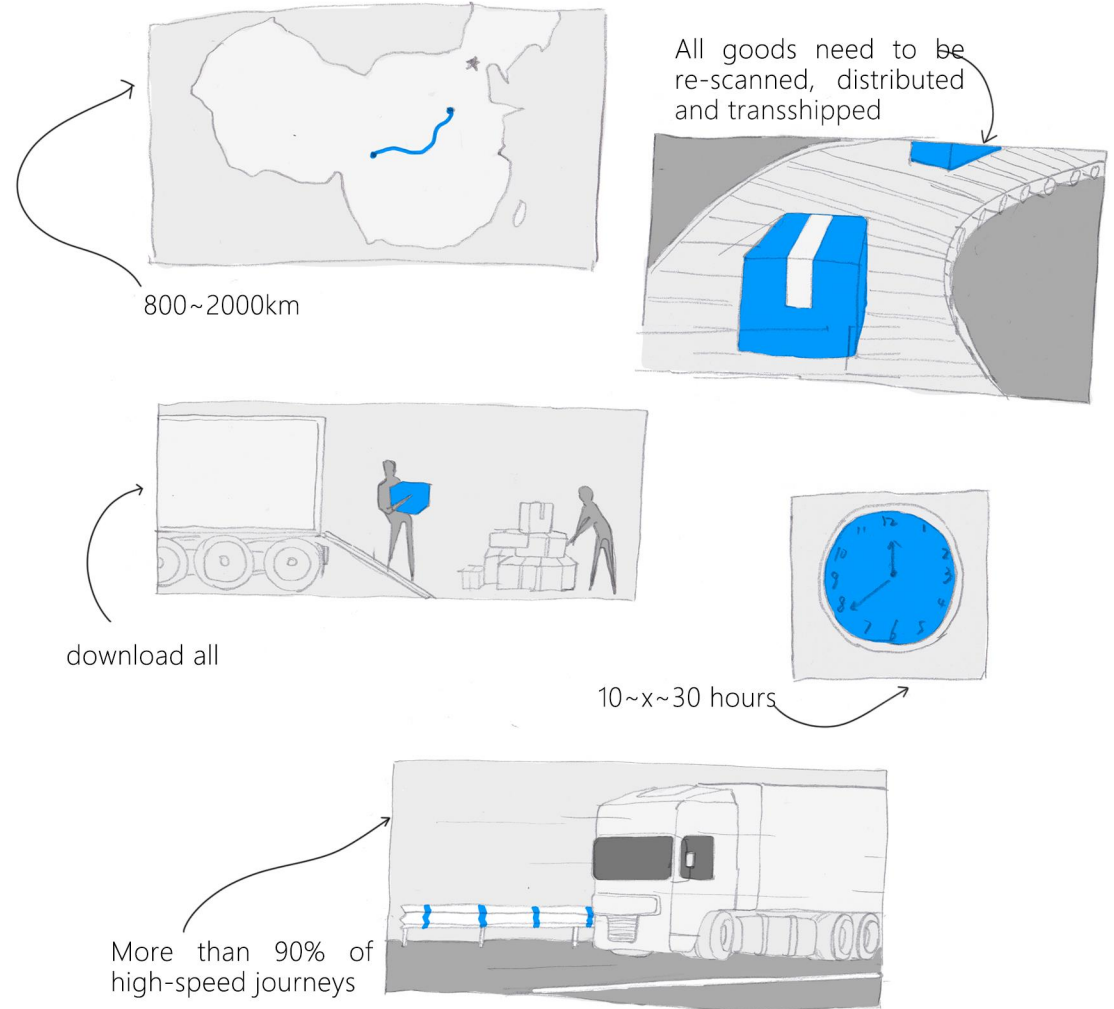




At the same time, due to the particularity of trunk transportation, 90% of the journey is carried out on highways. Due to a single and simple road environment, unmanned driving based on the L4 level can be implemented relatively easily. Next are some data about China. In China's trunk line transportation, most of the distances are concentrated between 800 kilometers and 2000 kilometers. Drivers work between 10 and 30 hours at a time.

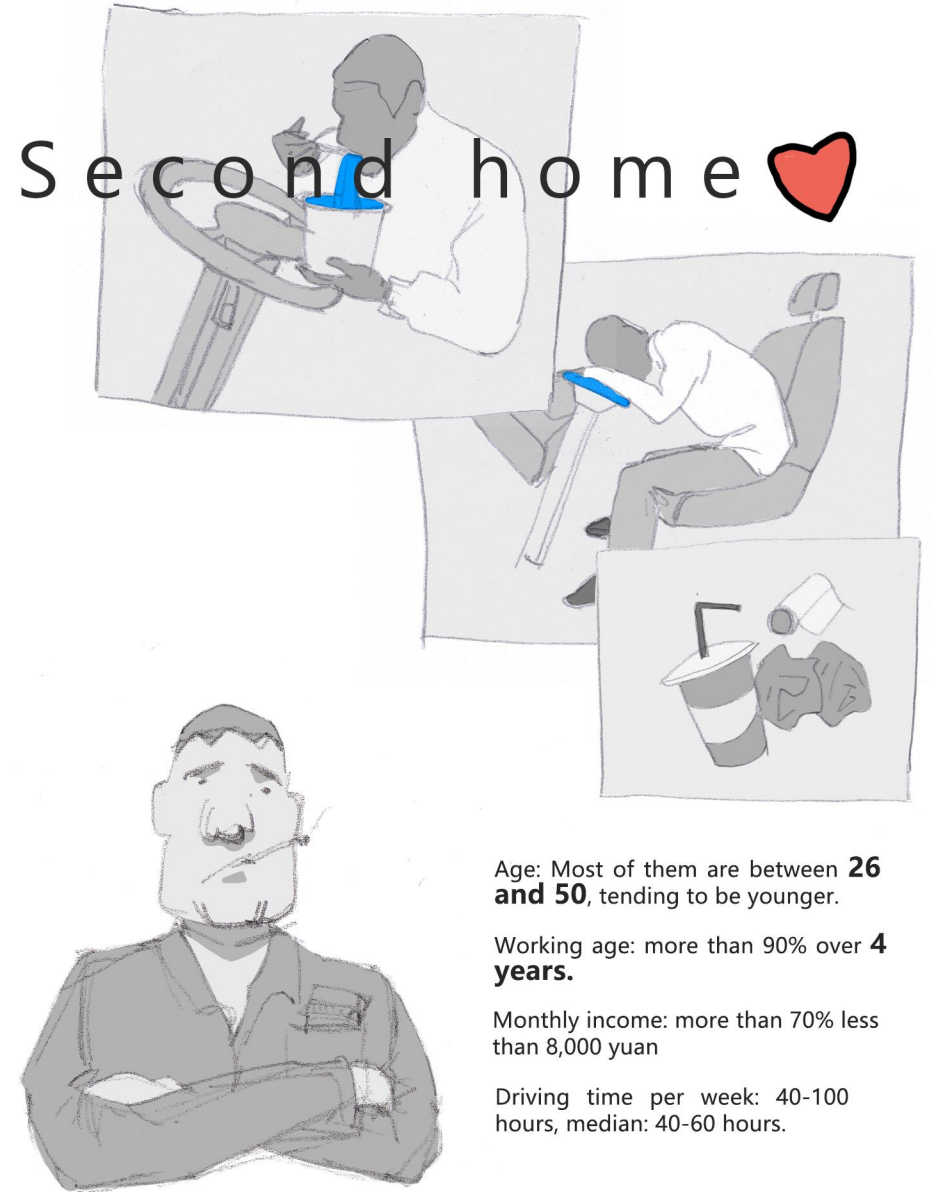
transportation scenarios

A simple example, if the goods from Turin are to be shipped to Rome, if the quantity of goods is large enough, then the direct way is often adopted. If the quantity of goods is not enough, you need to transit to Milan and unload the goods destined for Milan. , And then distributed by Milan, packed and shipped to Rome. In this process, all the goods need to be unloaded and then scanned and distributed. It will consume a lot of manpower and material resources, and there may be more efficient ways to optimize this process.





Second home



Age: Most of them are between **26 and 50**, tending to be younger.

Working age: more than 90% over **4 years**.

Monthly income: more than 70% less than 8,000 yuan

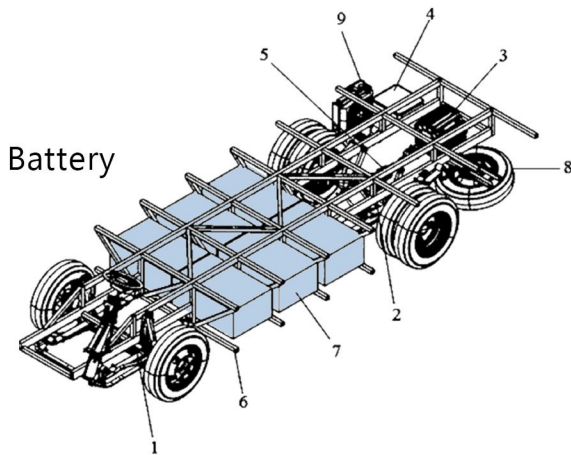
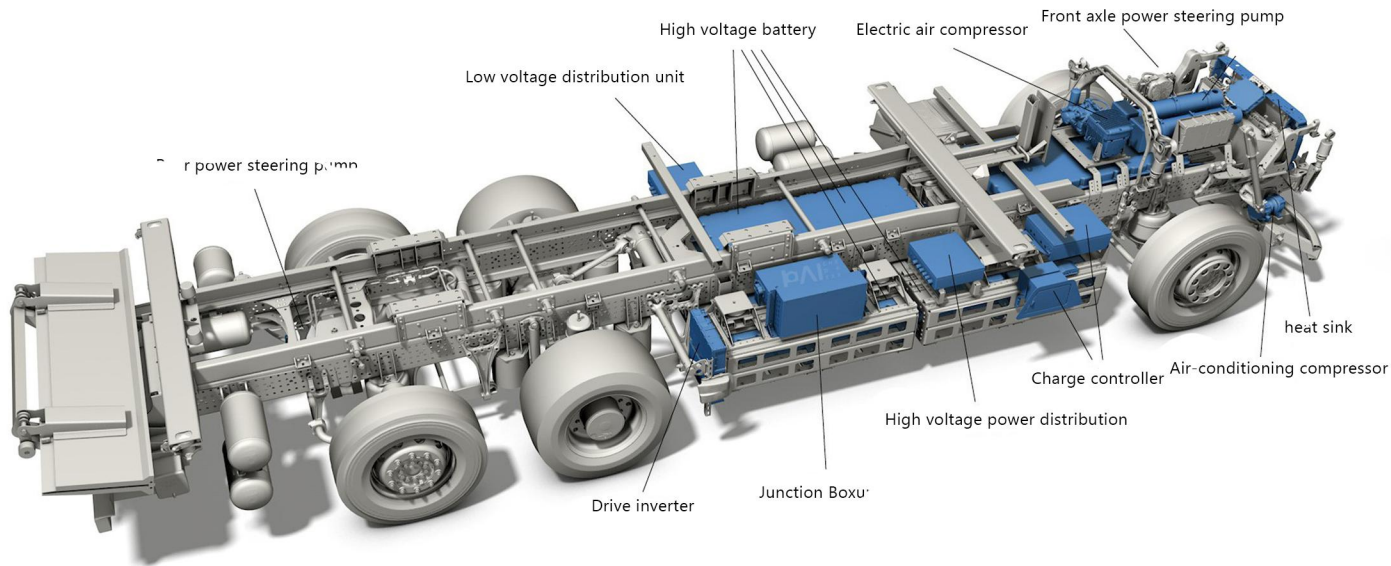
Driving time per week: 40-100 hours, median: 40-60 hours.

Resources come from: <https://www.yunshuren.com/article-11443.html>

EUROPEAN



chassis of electric truck



Battery

Recharge mileage: 482~800 km

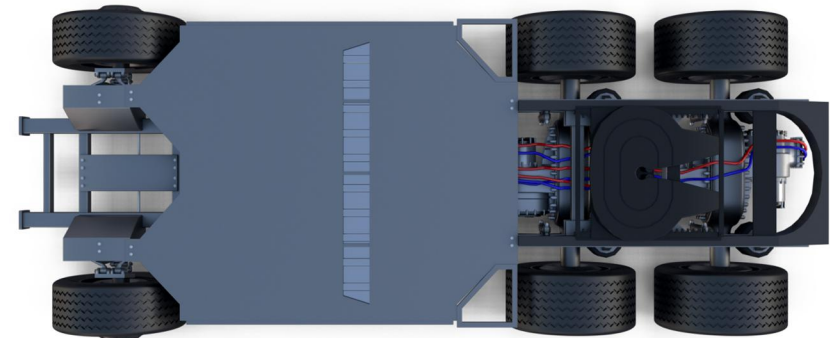
Battery capacity: 500 kWh

Battery size: 3m*0.5m*2.2m

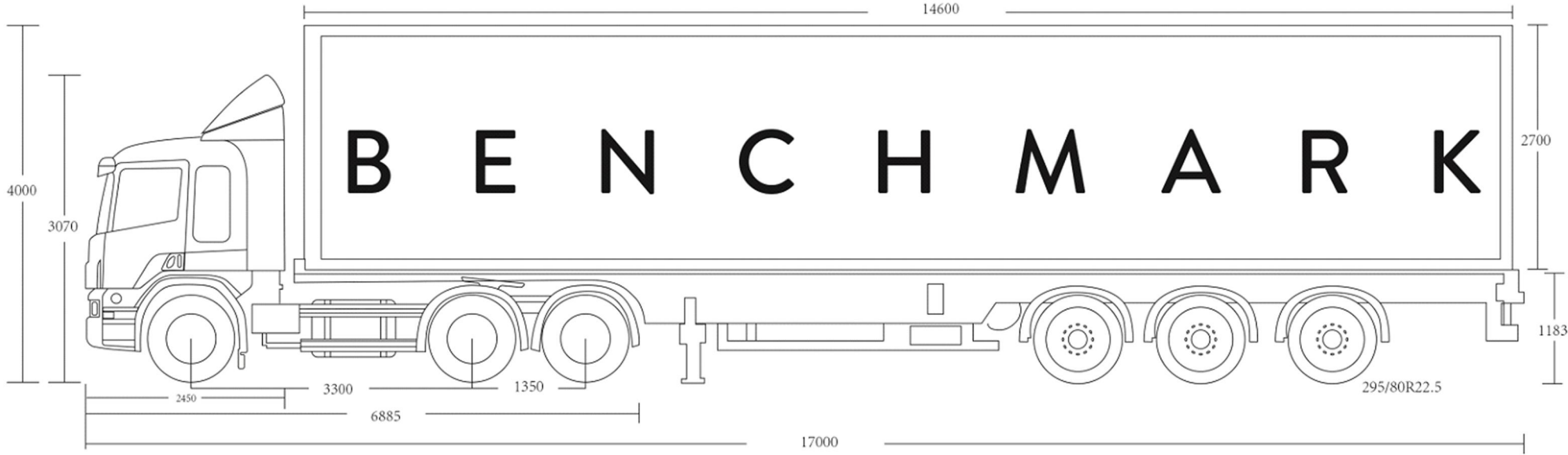
Front axle steering wheel

Battery system

Electric motor&Middle, rear axle



Chapter2/2.5 Product overview/2.5.1 Determine the size parameters.



SCANIA × P410



CHAPTER

Practical research framework

3.1 Modeling intention map

3.2 Exterior design

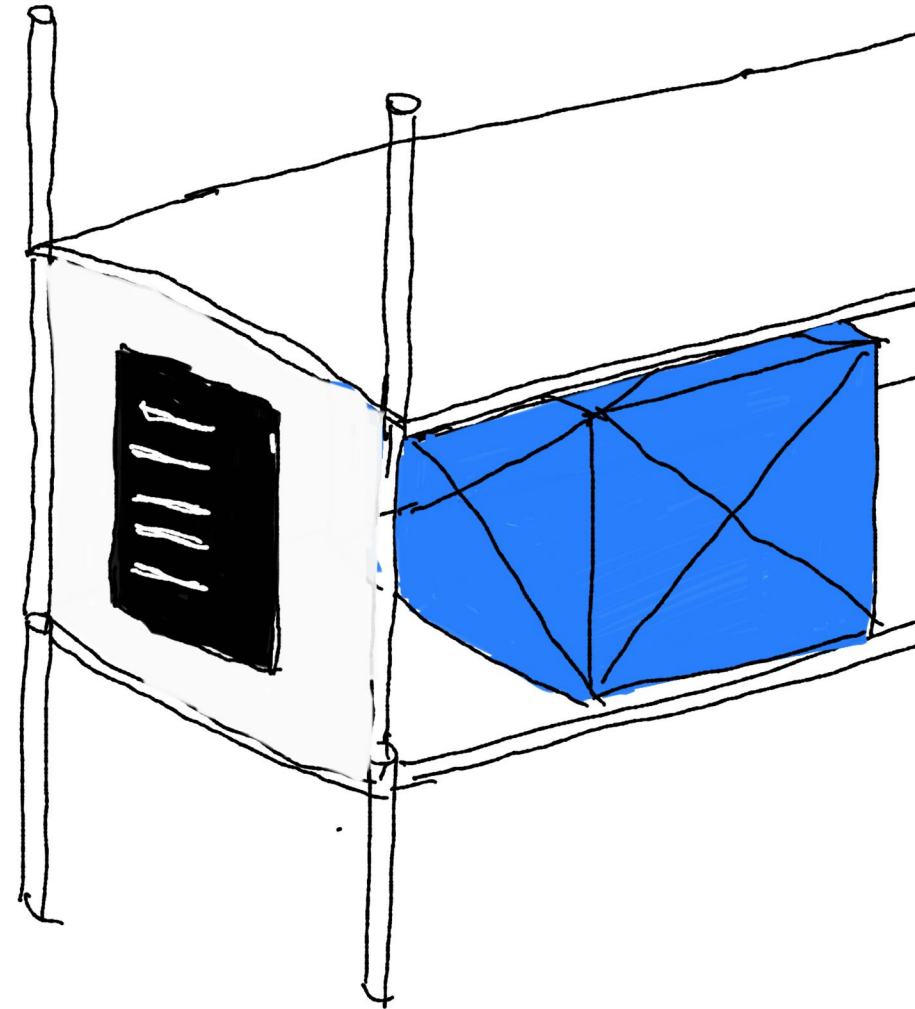
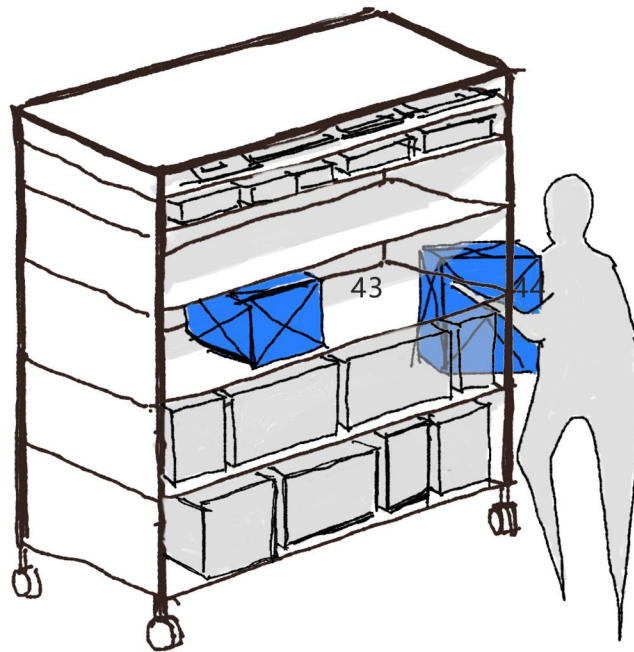
3.3 Interior design

Express transfer cabinet

At present, the method of loading is to fill the cargo box as much as possible in a disorderly manner. Although it is helpful to increase the full load rate, it takes a lot of manpower, material resources and time in the unloading and loading process.

This is for the logistics industry that pursues efficiency. There is no benefit, so I proposed such an express transfer cabinet, which is connected from the beginning of express transportation. The design and size of the express transfer cabinet are based on the current self-lifting cabinets on the market, and I have learned the current distance between each layer of the cabinet.

At the same time, each courier cabinet has a simple tablet computer to record all the courier information of the courier cabinet, so that the couriers of the same destination are put together, and it is more convenient to transfer them, even if a certain item needs another item. Redistribute, you can easily find it through the information on the tablet

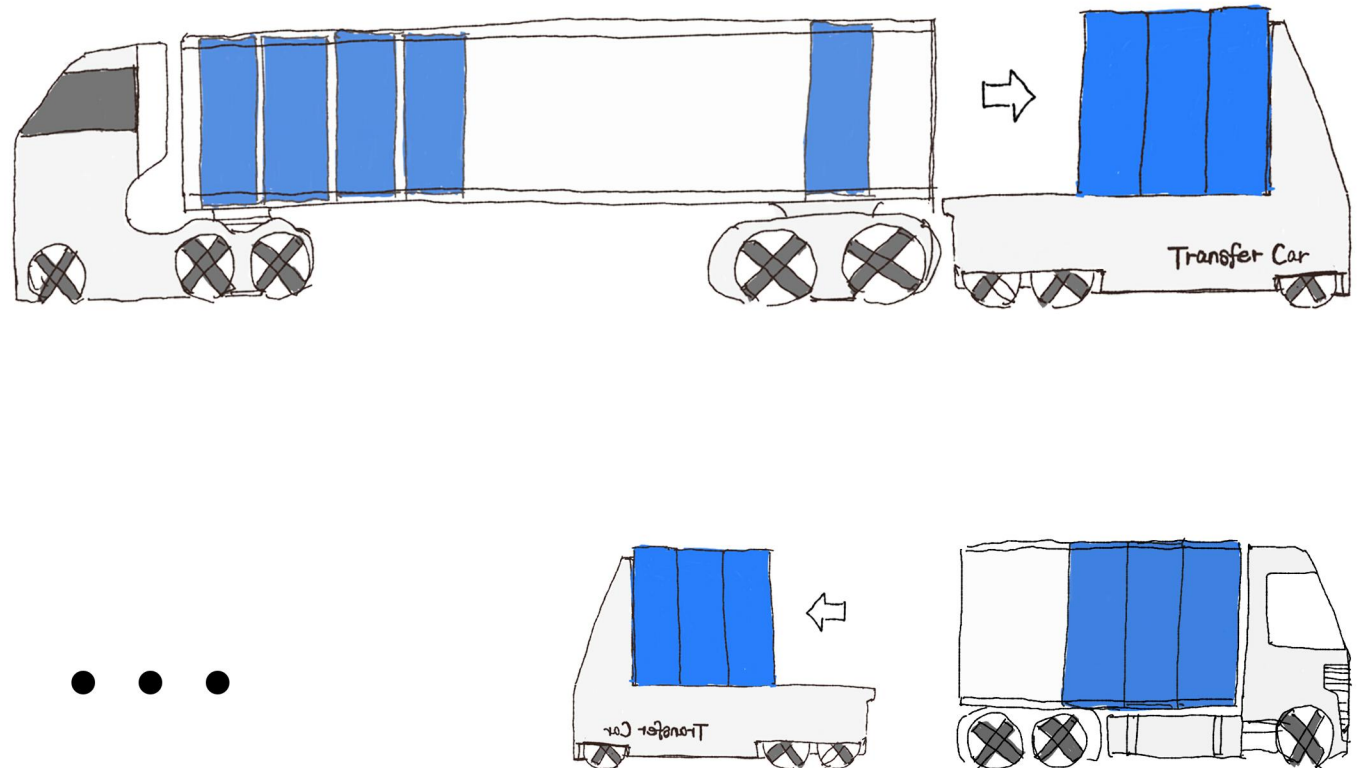


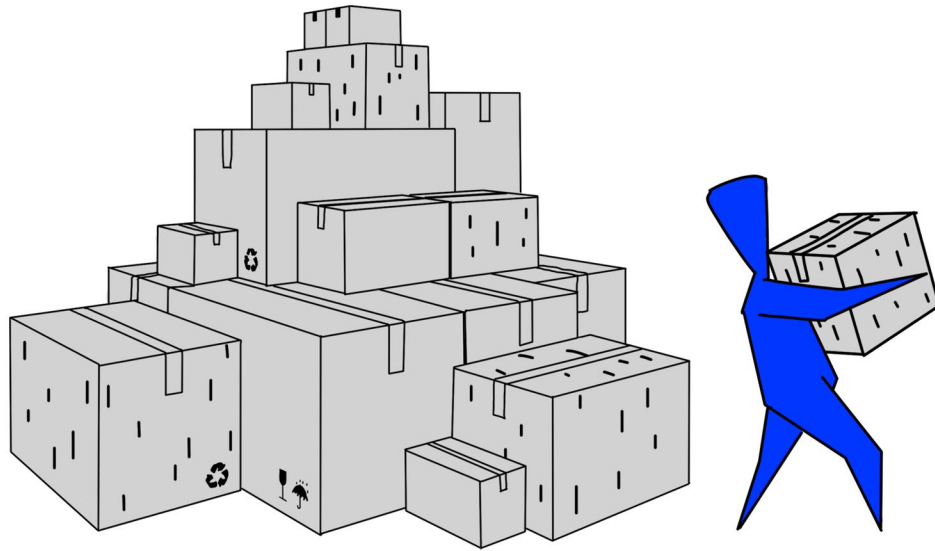
Modular cabinet

Modular transfer cabinet has great advantages. It can open up two major links of main line transportation and branch line transportation.

Modular transfer cabinet can be adapted to the cargo box of trucks and the cargo box of minivans. The size of the transfer cabinet is 240cm high, 240cm wide, and 50cm long.

Generally speaking, the length of the carriage of a large semi-trailer is about 14 meters, the height is 270cm, and the width is 250cm, which can accommodate 27-28 transfer cabinets. The data of minivans commonly used in the express industry is: 8.6 meters in length, 250 cm in width, and 250 cm in height. Can hold 16-17 transfer cabinets. In this way, the main line transportation and the branch line transportation are effectively connected, and the transportation efficiency can be improved.

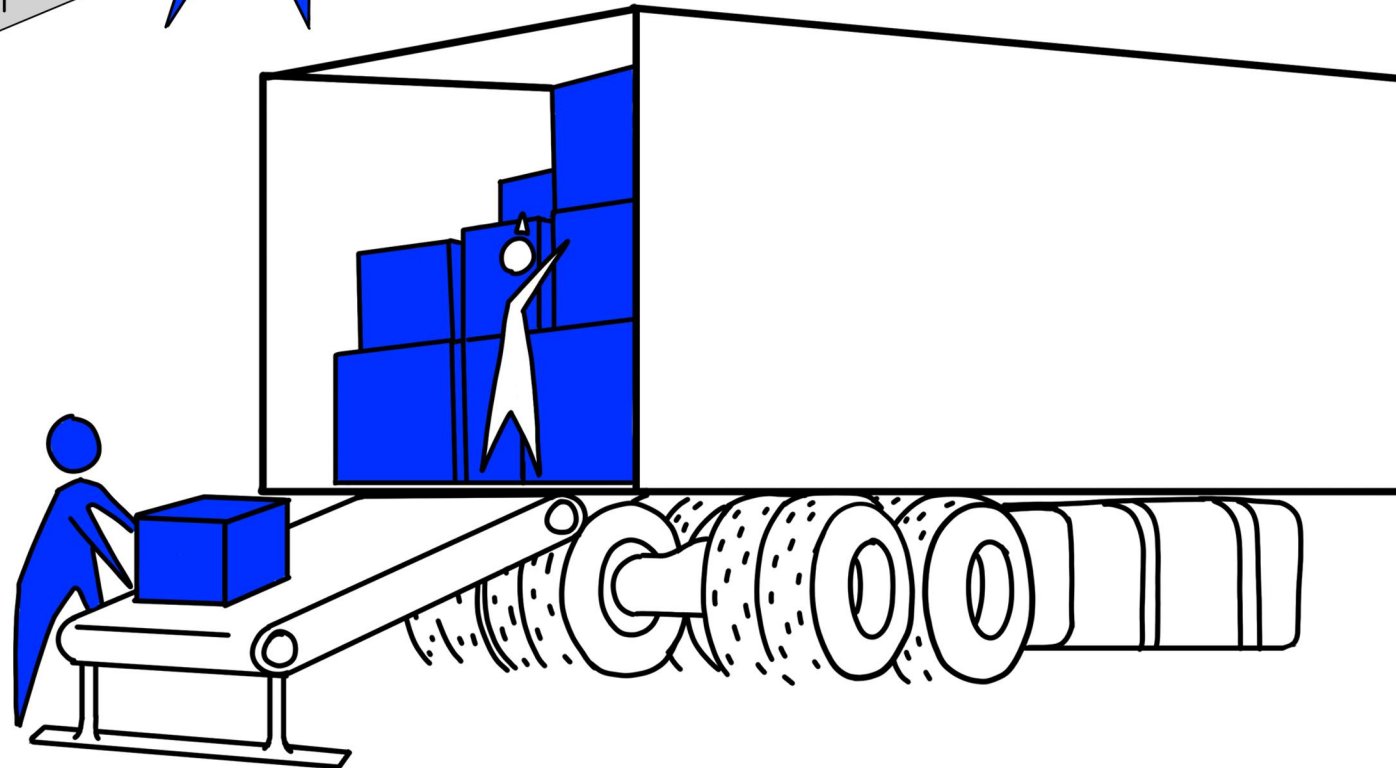


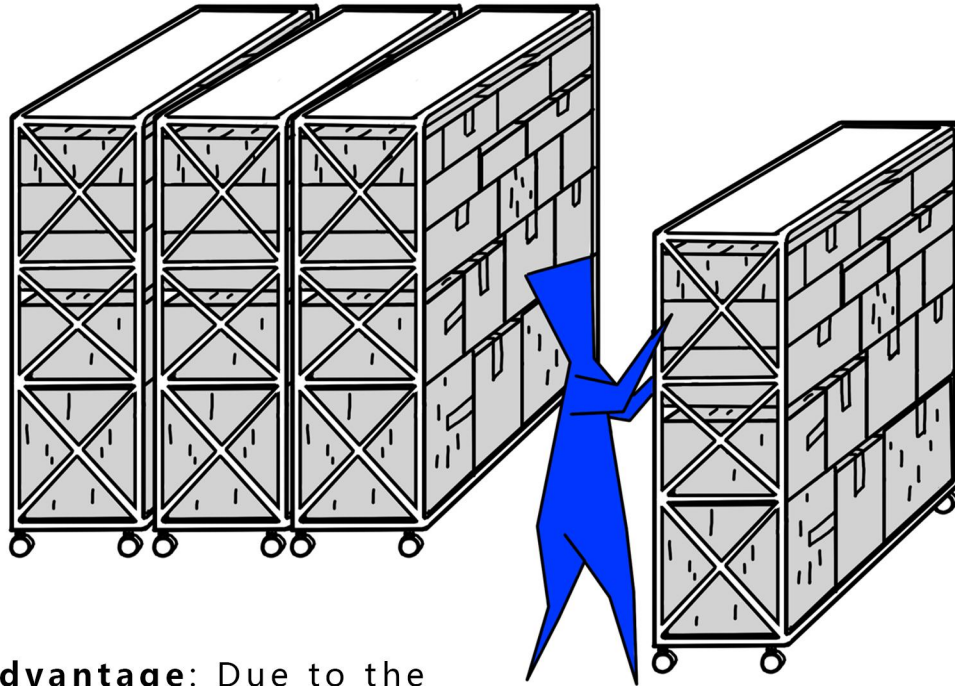


Advantages: This method uses its own packaging as a support to complete the loading of goods, which can save a lot of unnecessary weight, thereby **reducing the overall weight of the truck, reducing energy consumption** and increasing cruising range under the same mileage.

Why I insist on using a transfer cabinet

Disadvantages: This method is more troublesome in the process of transshipment, **wastes time, wastes manpower**, and the process is **cumbersome** and the **efficiency is relatively low**.

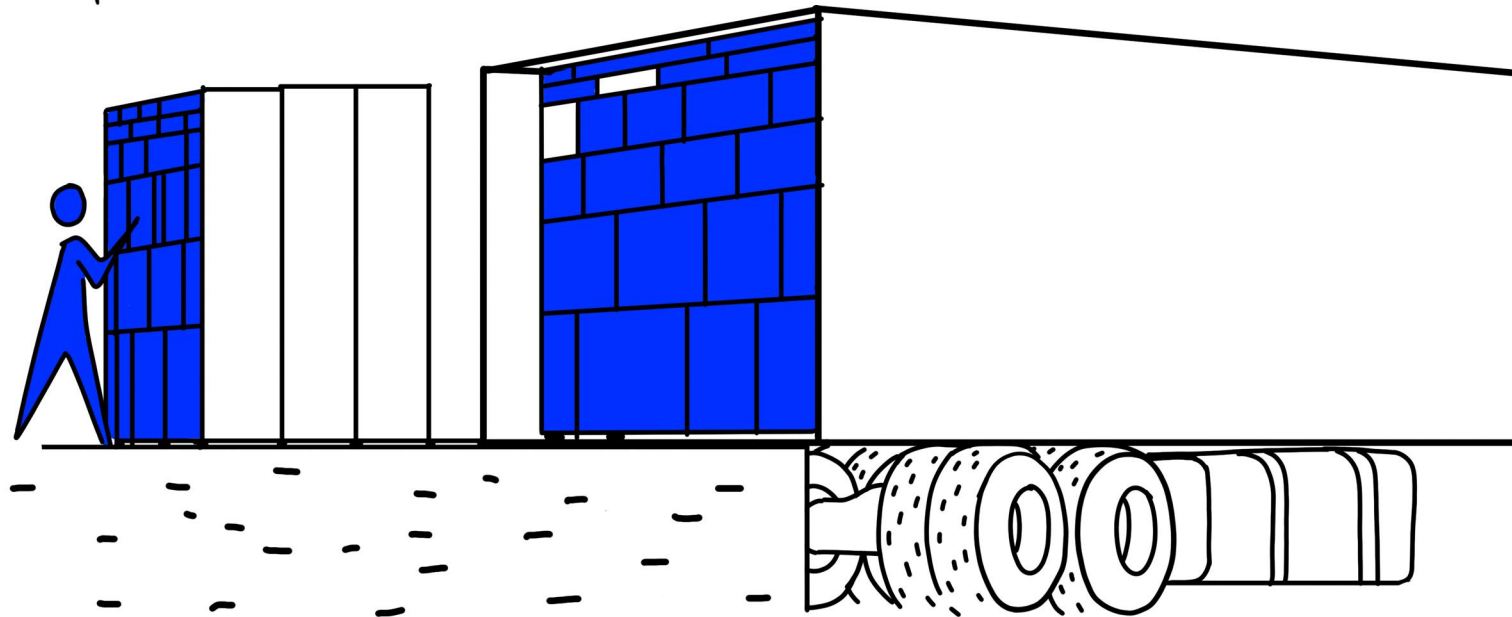




Why I insist on using a transfer cabinet

Advantages: The transfer process is relatively **simple, saving time and labor costs**. Each transfer cabinet is a small unit, and all the goods in this unit are sent to the same destination. Such an integrated design And the way of transshipment has greatly improved the efficiency. **Easier to control.**

Disadvantage: Due to the necessity of the transfer cabinet, the **weight** of the whole vehicle will be **increased**. This will **reduce the cruising range and consume more energy**, but due to the special properties of express packages, as mentioned before, express has the characteristics of light weight and large volume, so even with the weight of the transfer cabinet It will not exceed the full load weight of the truck. Therefore, the total length of the journey will also be less than the cruising range of the truck. For the express delivery industry, the most important thing is timeliness. In order to improve timeliness, it is feasible to consume a little more energy.

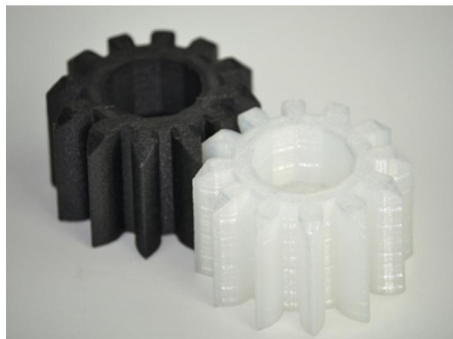


Materials



ABS

- Shock proof
- Easy to produce and manufacture
- Materials of choice for 3D printing



PA

- high strength
- High temperature resistance



PVC

- brittle material
- good rigidity
- high strength



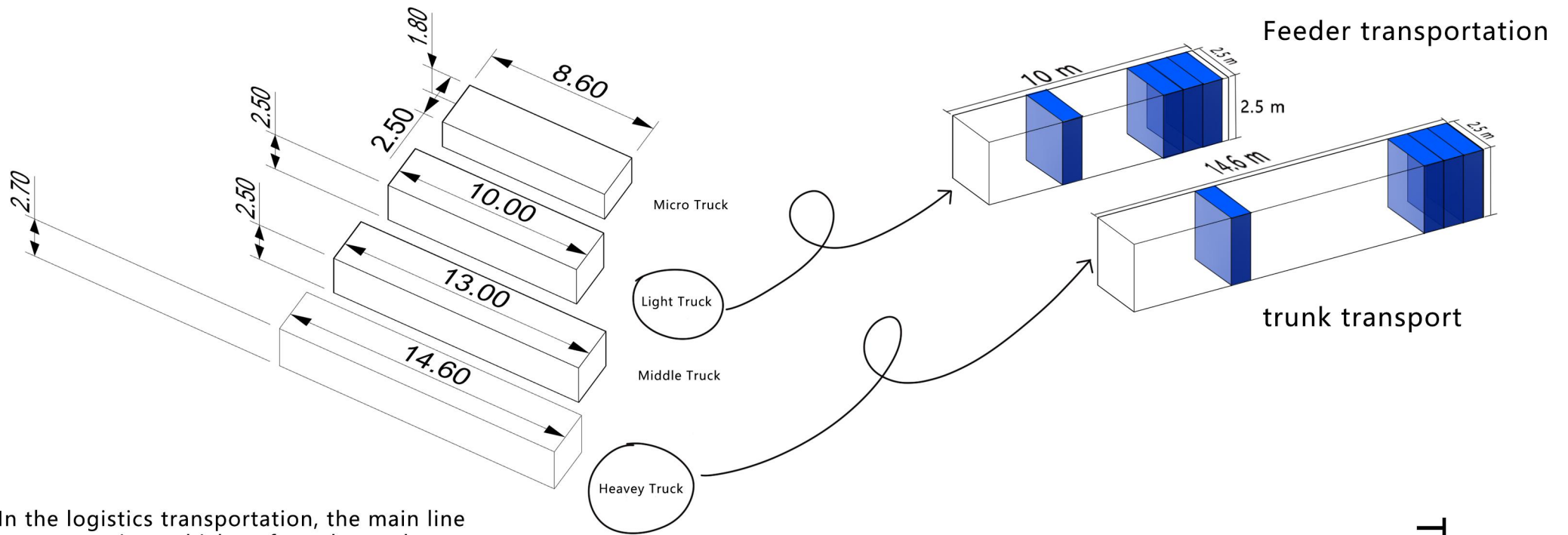
Steel

- Low price
- excellent mechanical properties
- good processing performance



Aluminum alloy

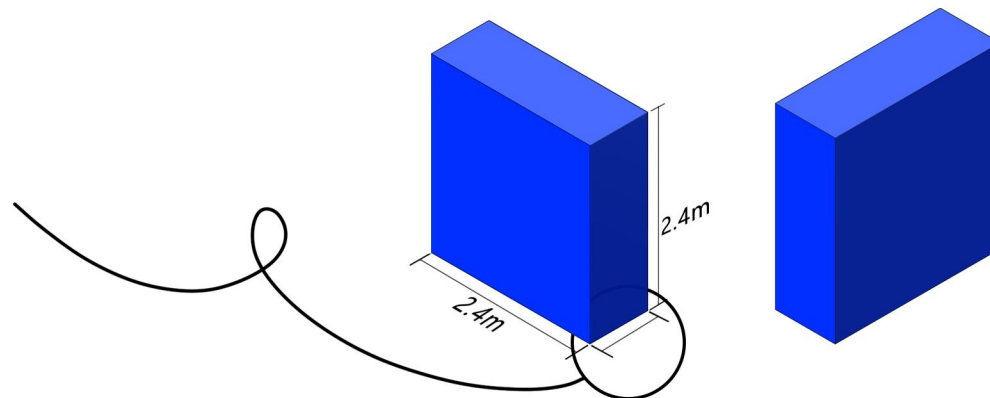
- Low price
- excellent mechanical properties
- good processing performance



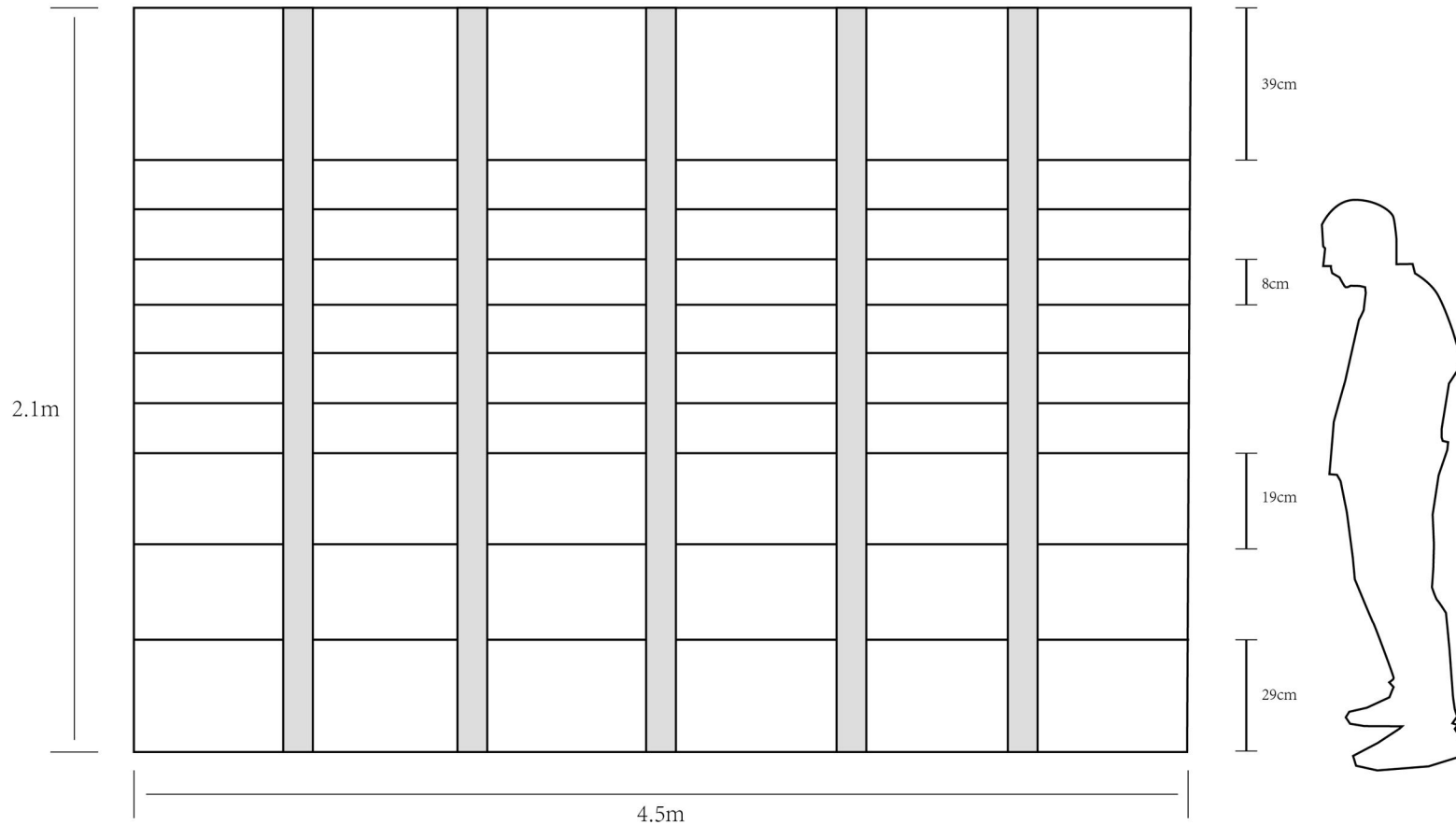
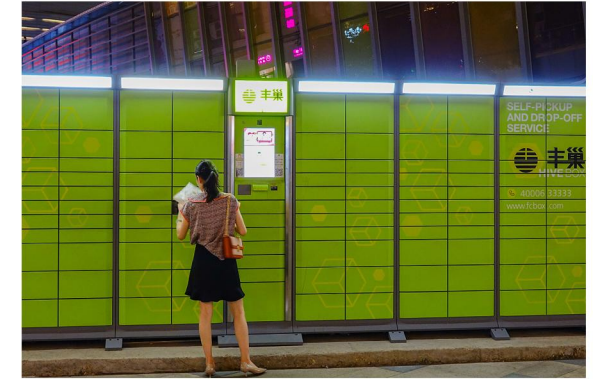
In the logistics transportation, the main line transportation vehicles often choose heavy trucks, that is, tractors with semi-trailers, and the branch line transportation vehicles often choose light trucks. As shown in the figure, the data of the cargo box is probably like this, so The modular express transfer cabinet attached to the cargo box needs to be designed with reference to the data of the cargo box. Thus, the height of the transfer cabinet is 2.4 meters and the width is 2.4 meters.

?

But the thickness is not determined. Because the thickness design not only needs to refer to the length of the cargo box, but also to the size of the courier.

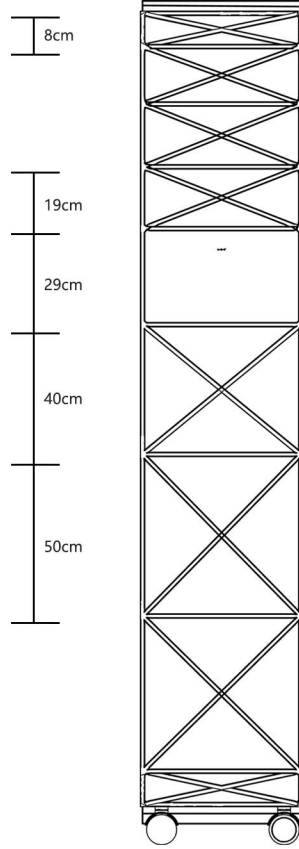
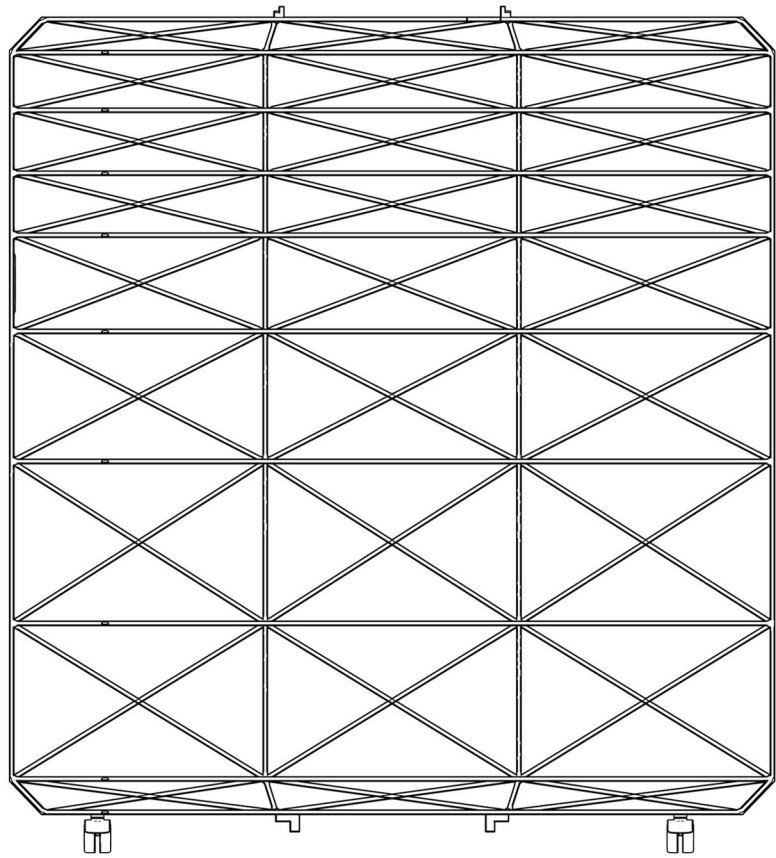


Transfer cabinet



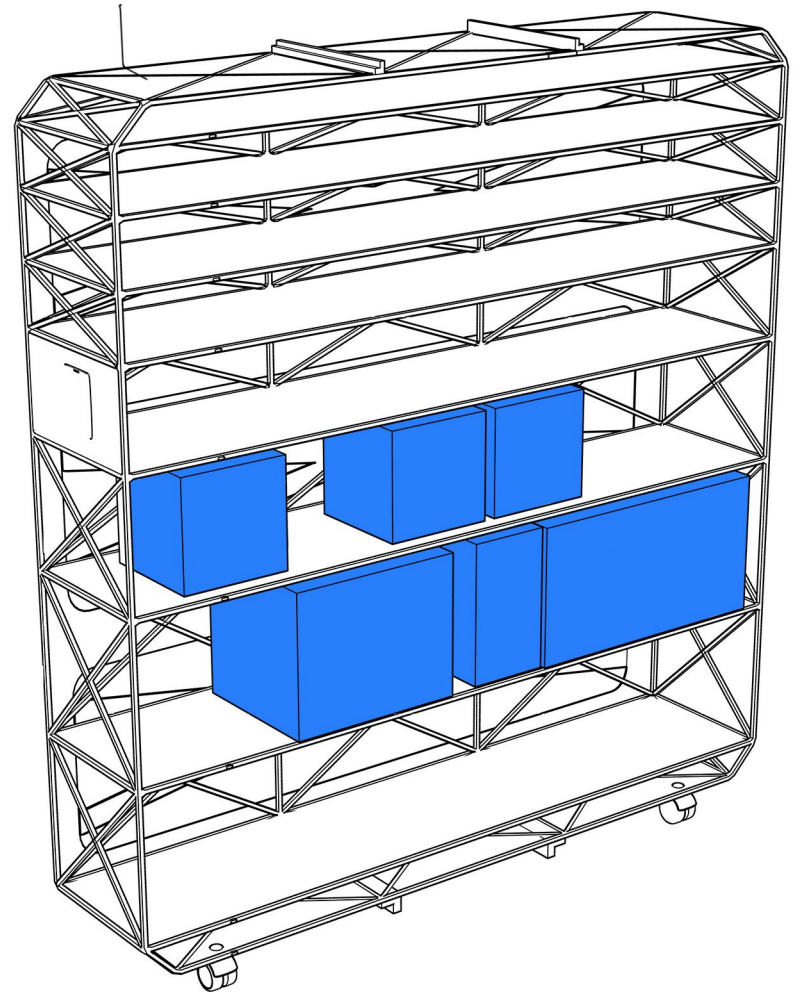
Express cabinet dimension

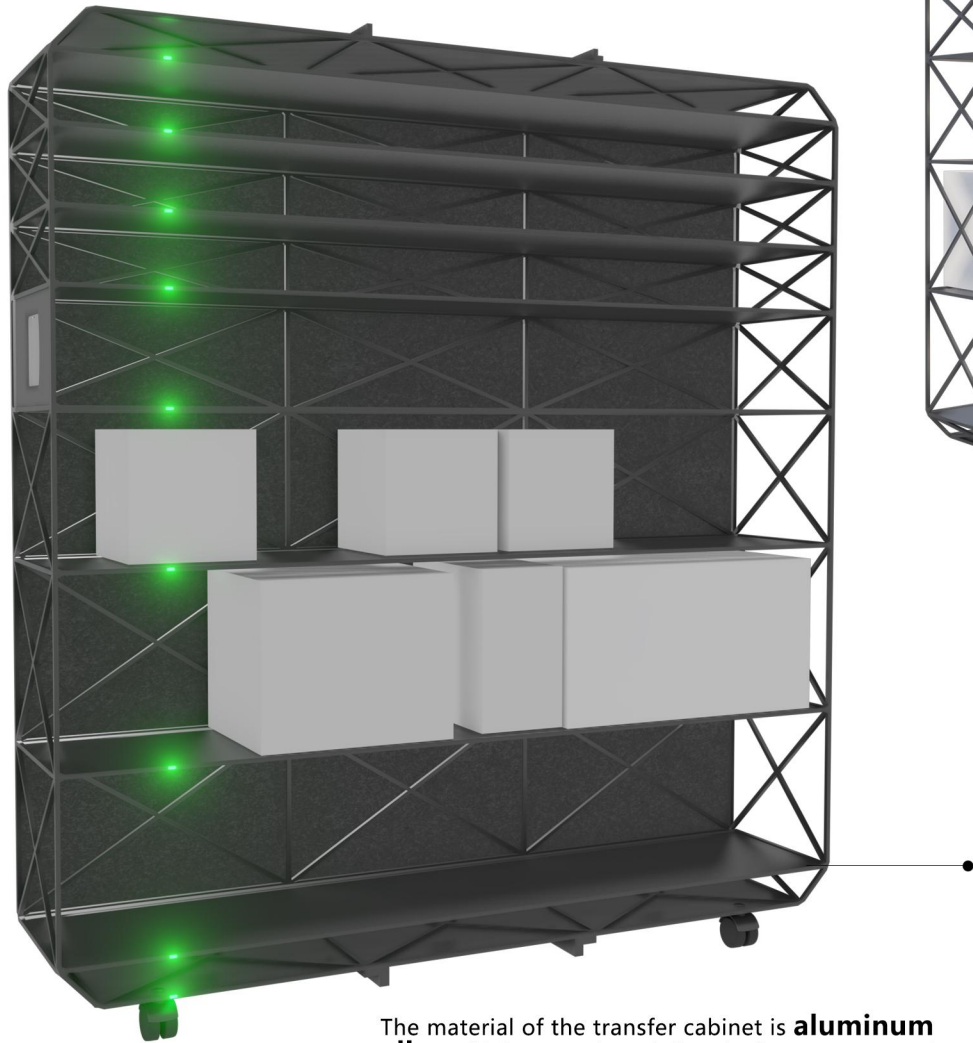
The picture on the left is some specific data of the express cabinet. The height of the grid is 39cm, 29cm, 19cm, 8cm. The depth is 45cm, and the width is 37cm. This space size can meet most of the express needs. I drew inspiration from the design of such express cabinets and designed my express transfer cabinets.



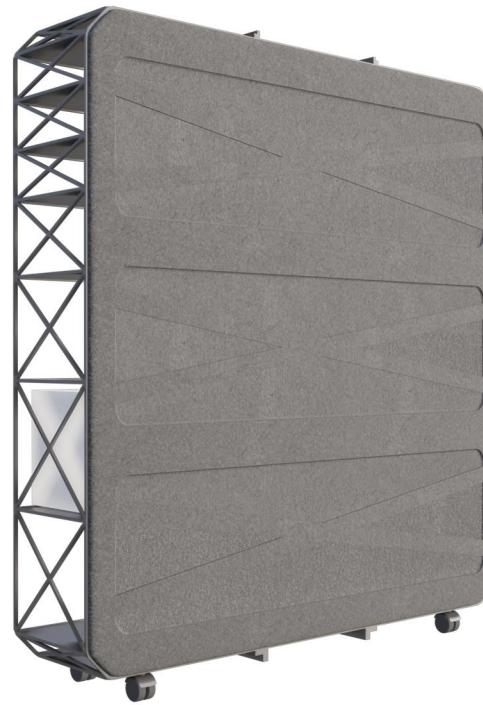
8cm
19cm
29cm
40cm
50cm

2.4m



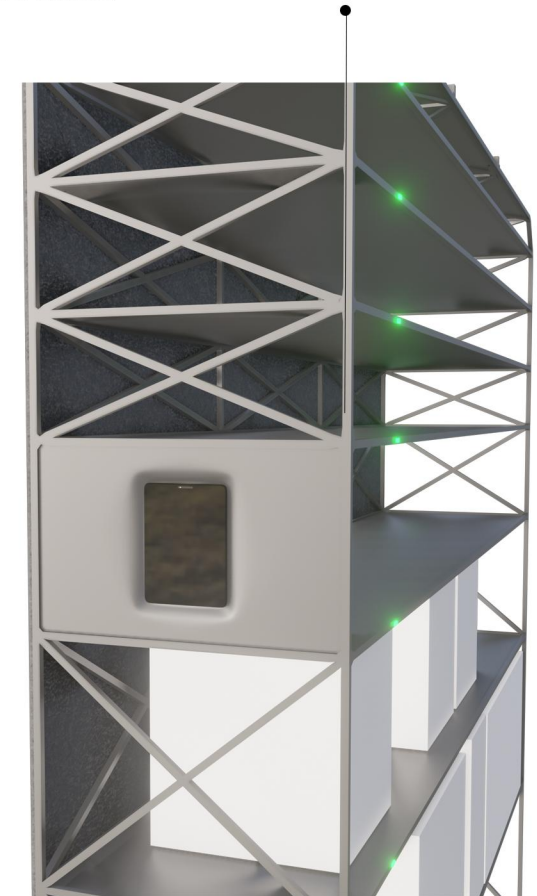
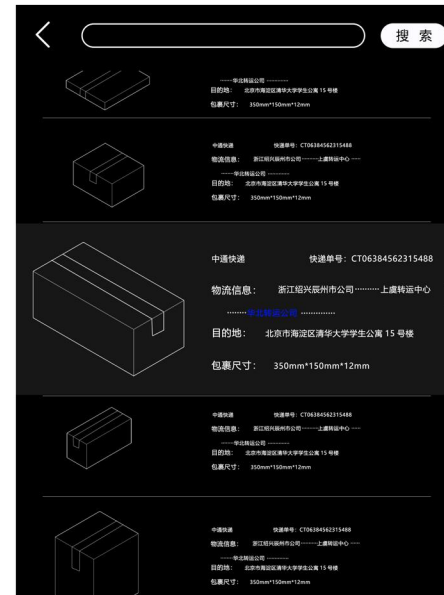


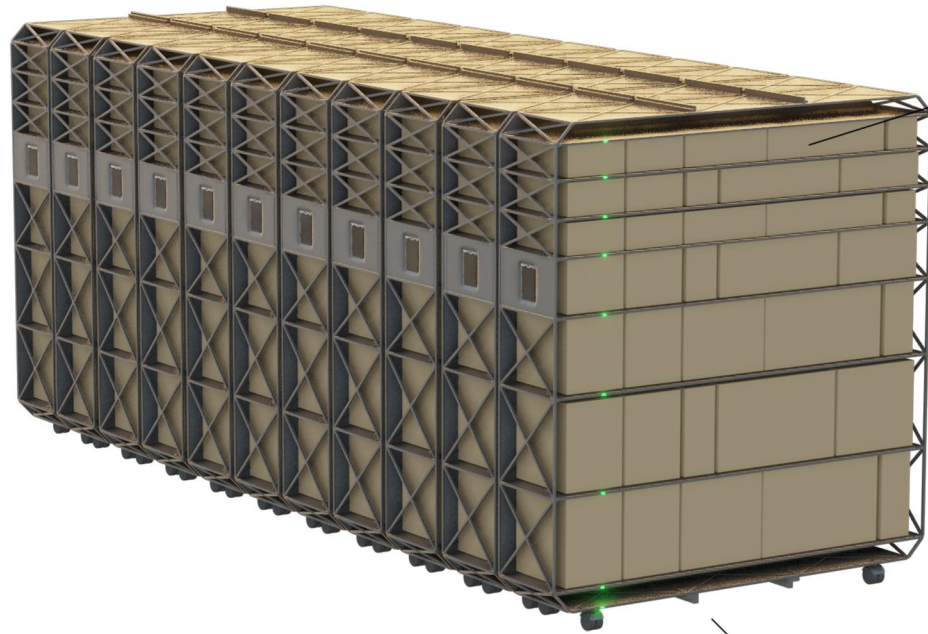
The material of the transfer cabinet is **aluminum alloy**, which not only satisfies the better structural strength, but also has a lighter weight. The hollow structure can further reduce the weight. The design of the pulley allows the express cabinet to be easily moved, and at the same time, the use of T The glyph structure connects the transfer cabinet with the truck trolley. There will be an LED light on each floor so that it can flash when the courier is looking for a specific item to remind the courier where the item is.



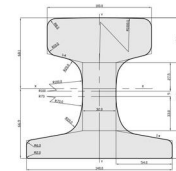
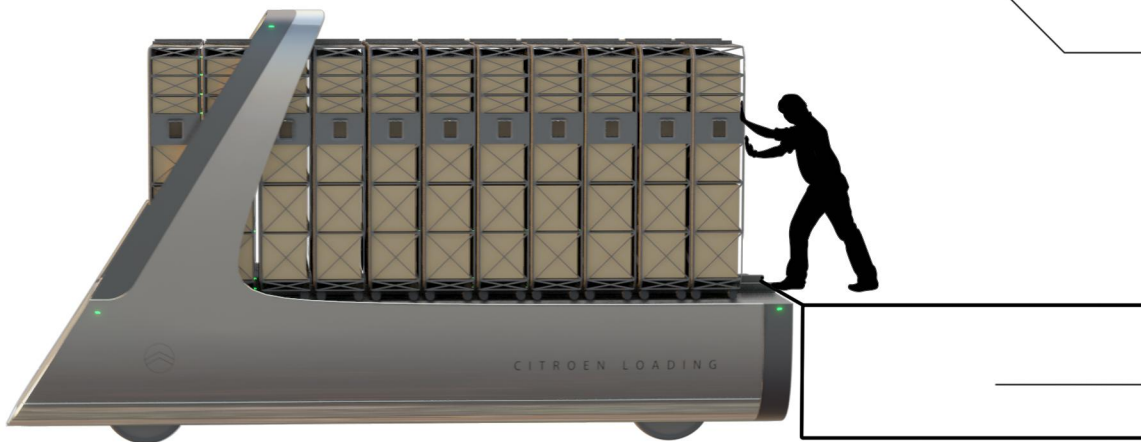
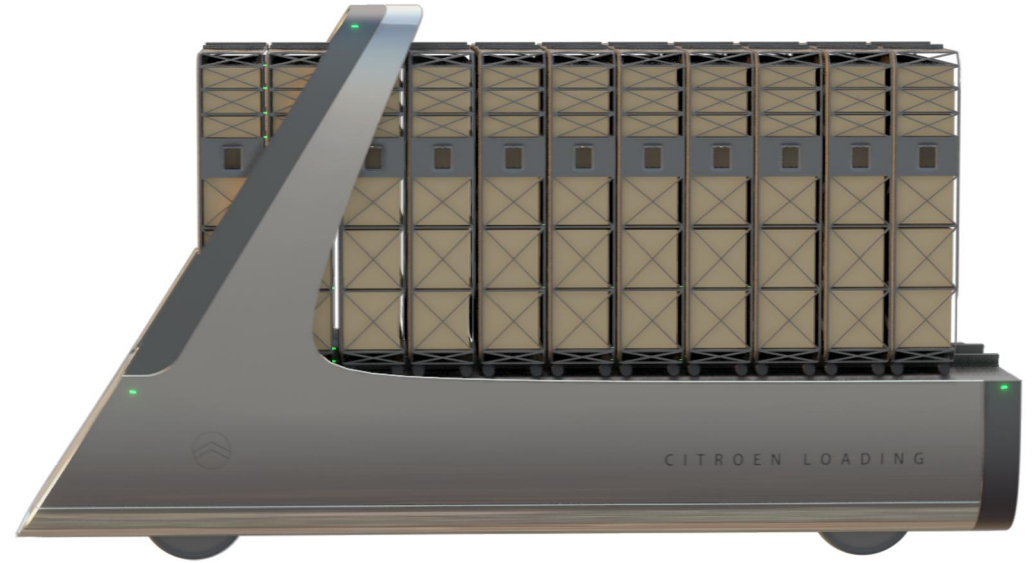
- The **foam board** of the transfer cabinet, this design can reduce the pressure caused by the mutual extrusion of the goods, and effectively prevent the damage of the goods.

The **pad** will record and display all the cargo information on the transfer cabinet, such as (origin, destination, package size, weight, etc.), so that the courier can quickly find the cargo, and it is also convenient for the delivery of the cargo when the cargo is transferred.





● 模块化的组合方式能够有效的利用装载空间，且可以在运输车到达之前预先将货物在转运柜上装好，车辆到达的时候将转运柜推入货箱即可，大大缩短由于装货所等待的时间，同理卸货也是同样原理。

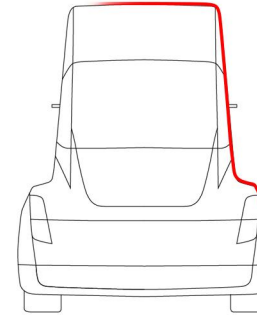
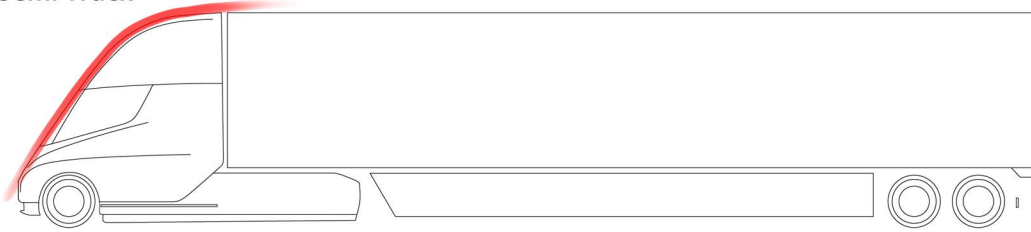


● 利用铁轨的 T 型原理，让货柜和车辆更加紧密的结合，防止转运柜之间的碰撞。

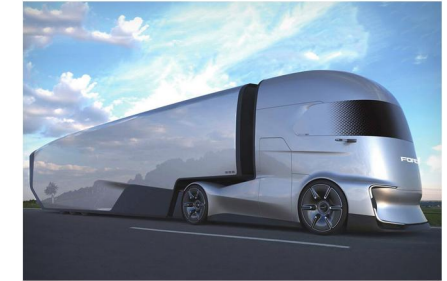
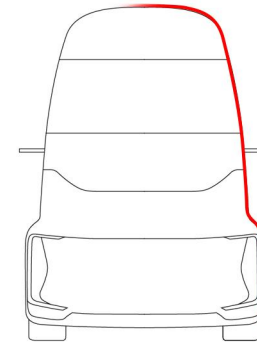
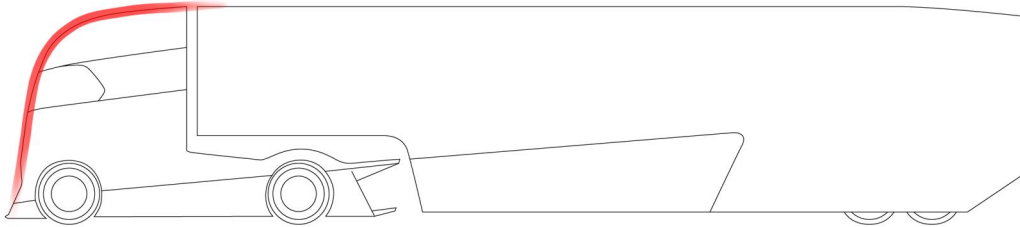
● 利用水泥高台将转运柜从分拨中心室内运送至转运车上，滚轮式设计有助于工作人员的运输。

Keywords: **Simplicity, purity, overall sense**

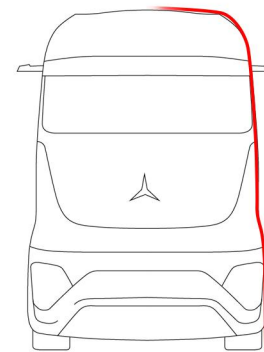
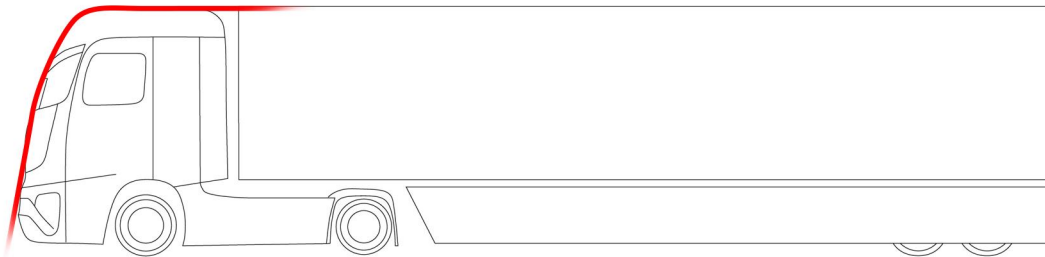
Tesla Semi Truck



Ford F-Vision Truck

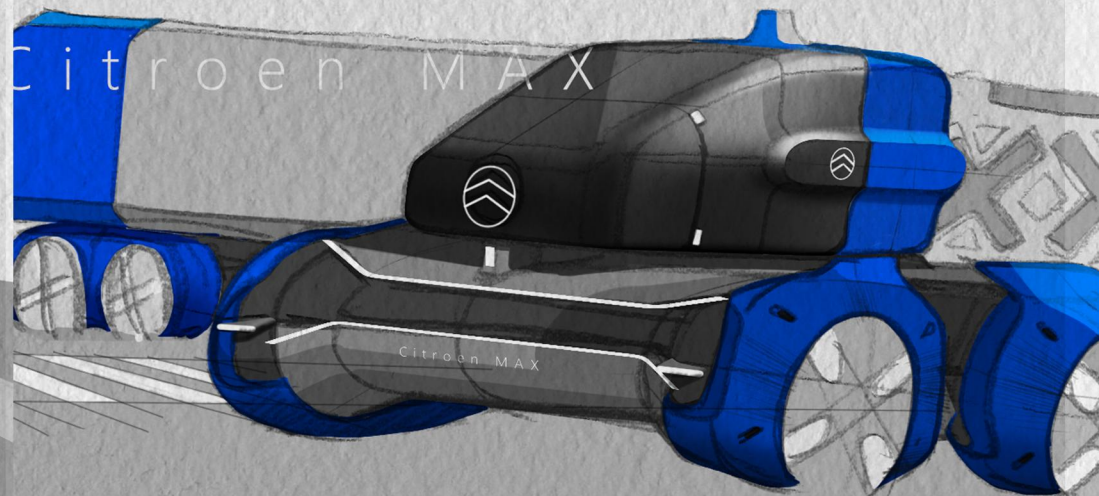
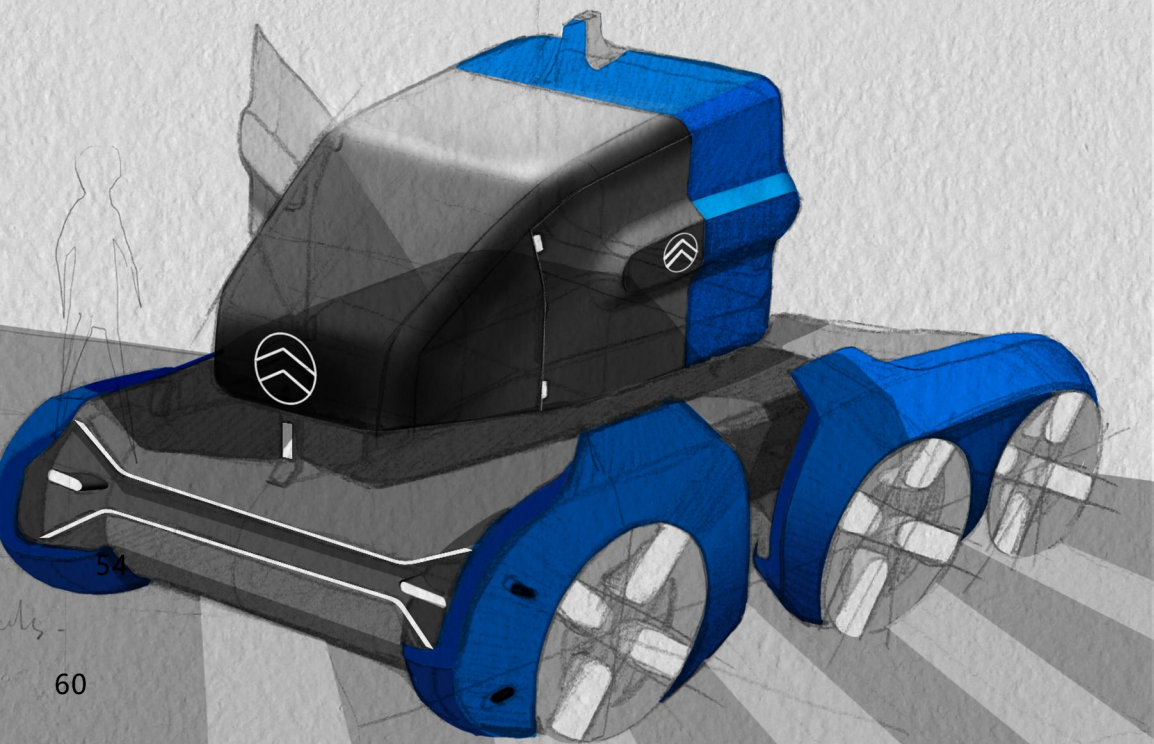
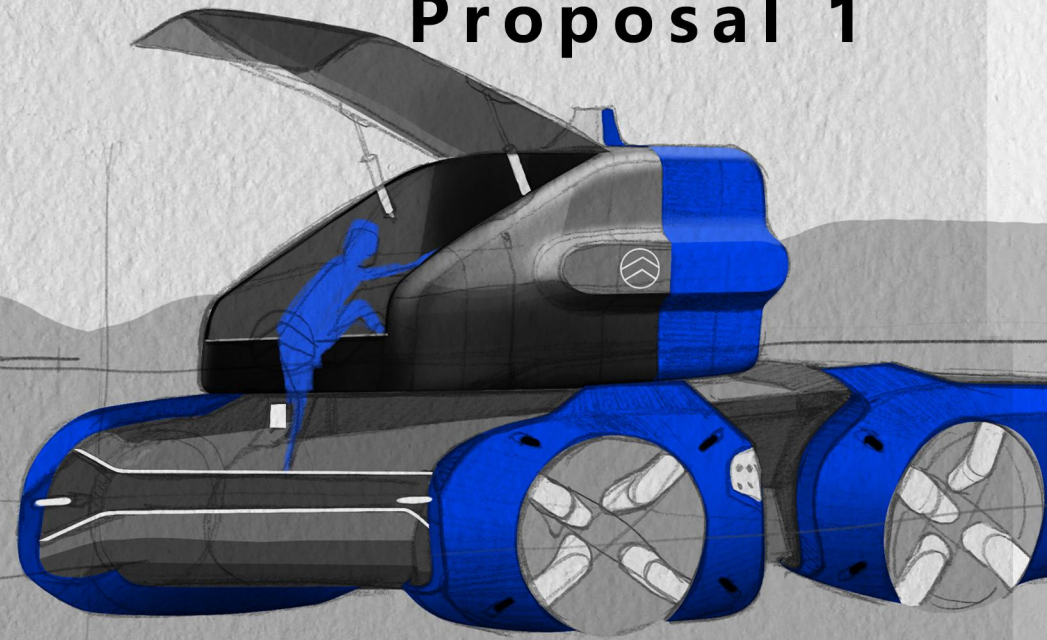
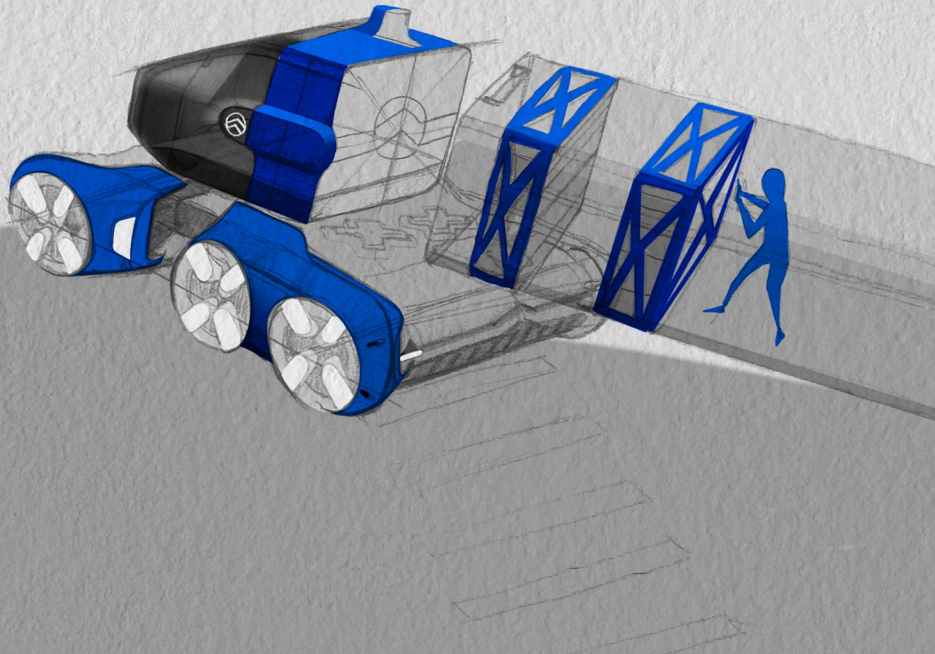


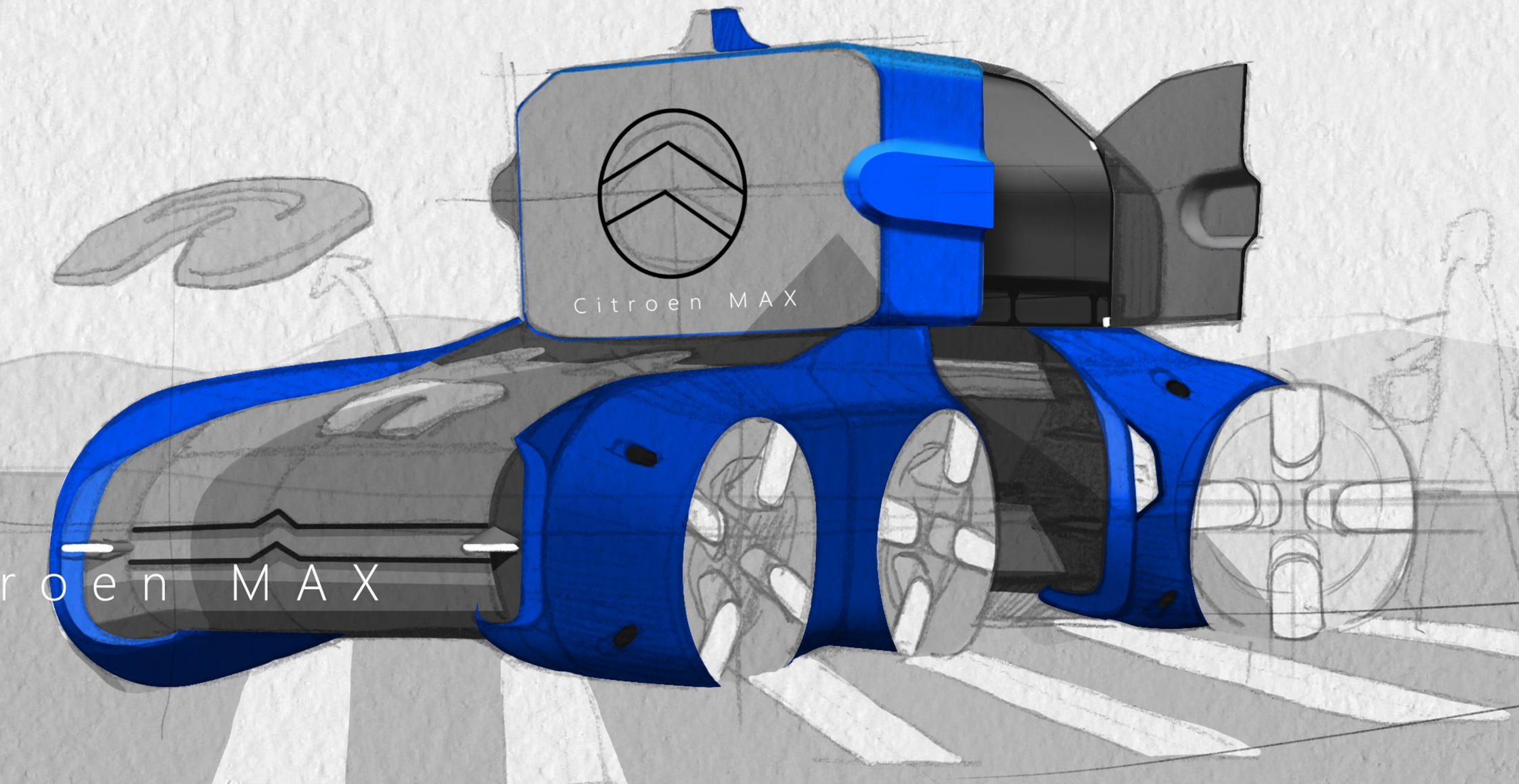
Mercedes-Benz Future Truck 2025





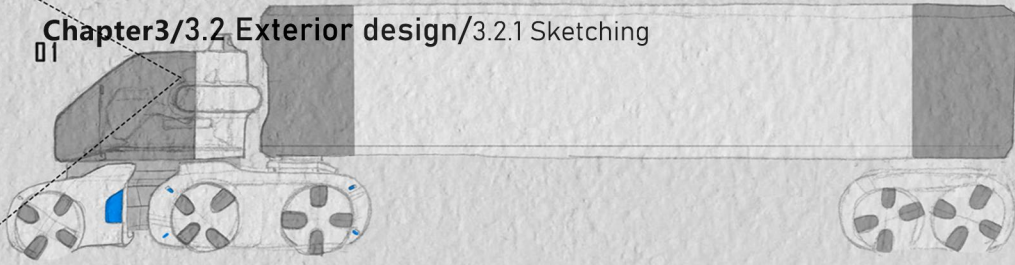
Proposal 1





Chapter 3/3.2 Exterior design/3.2.1 Sketching

01

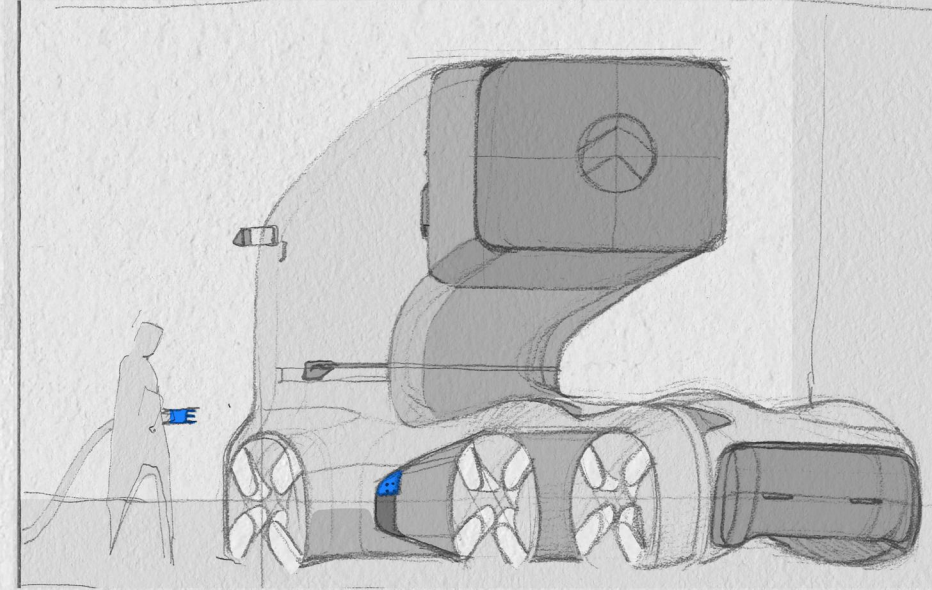


02

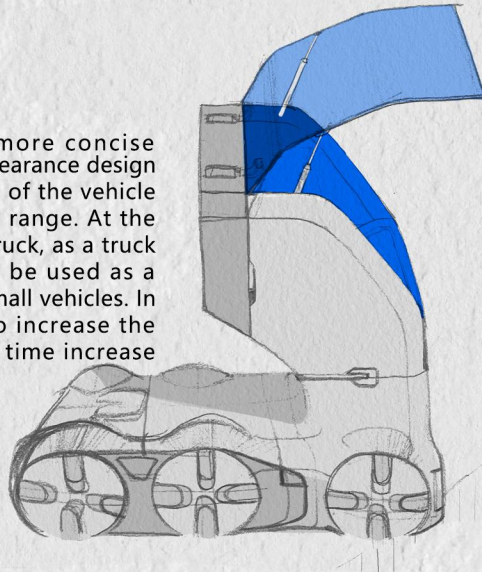
02




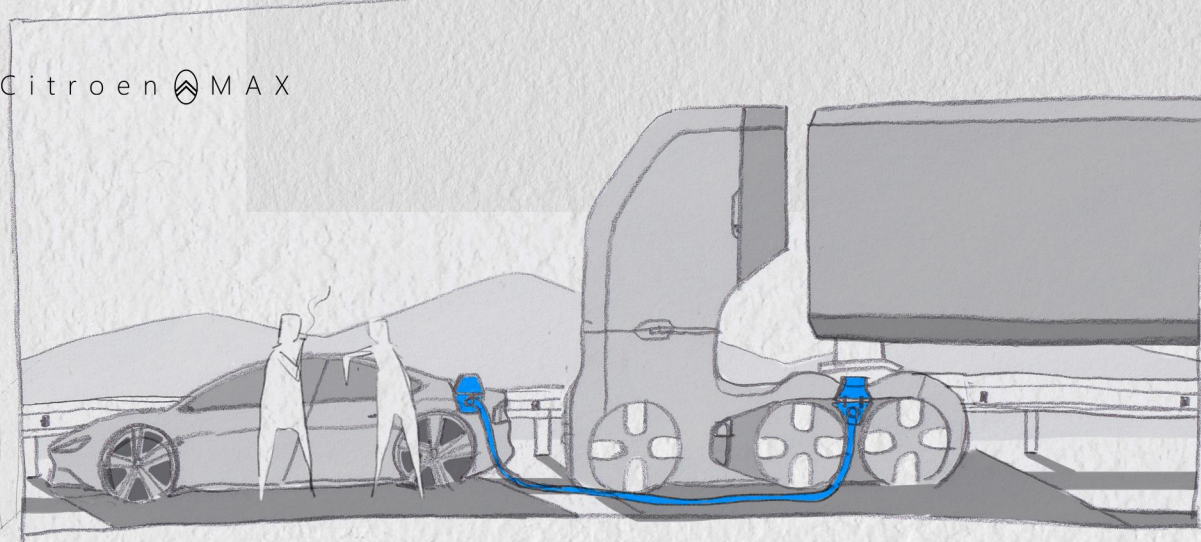
Proposal 2

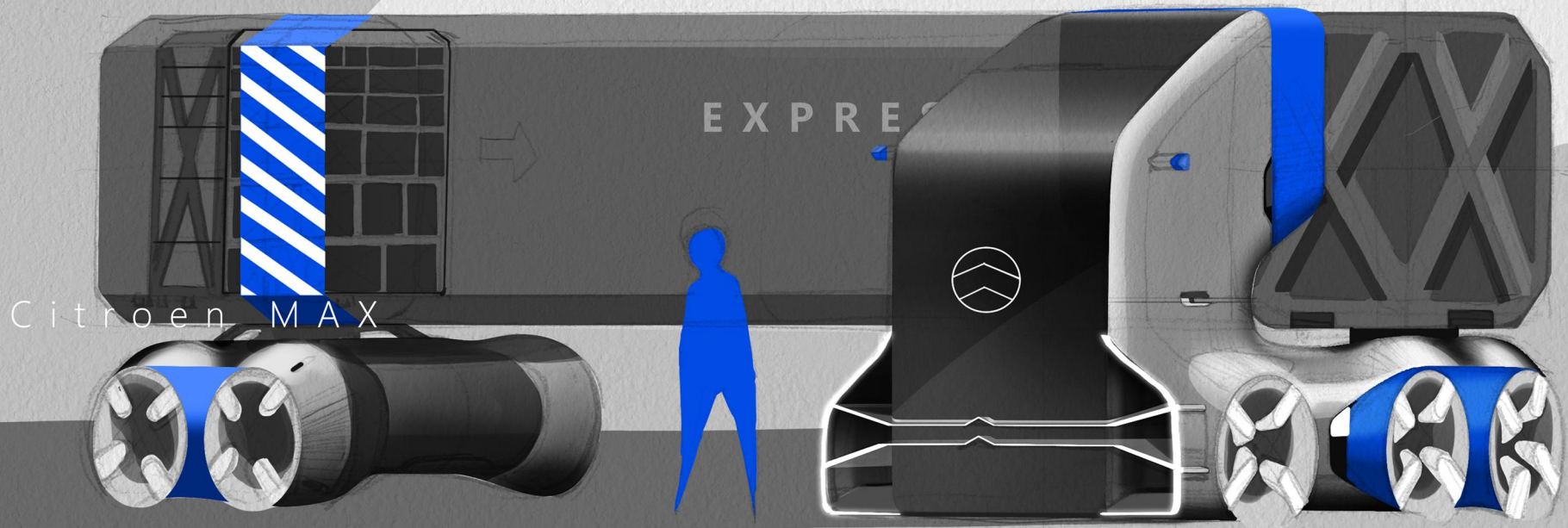
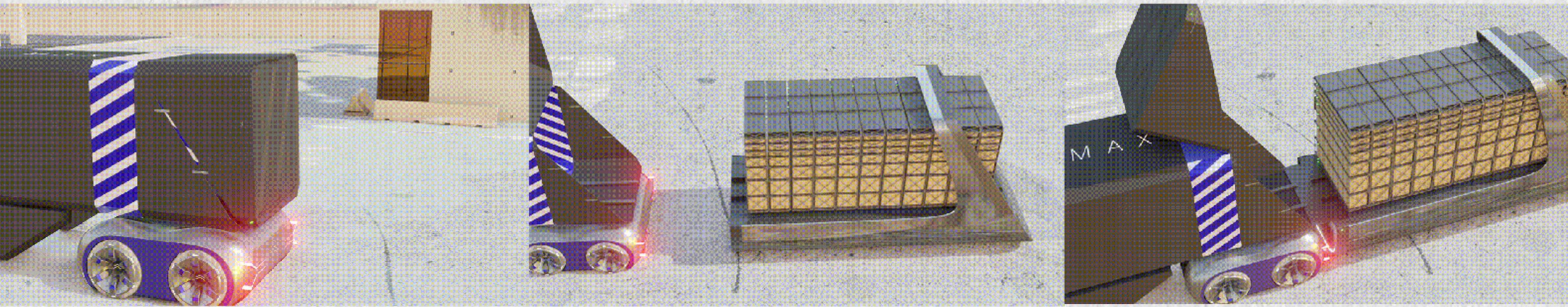


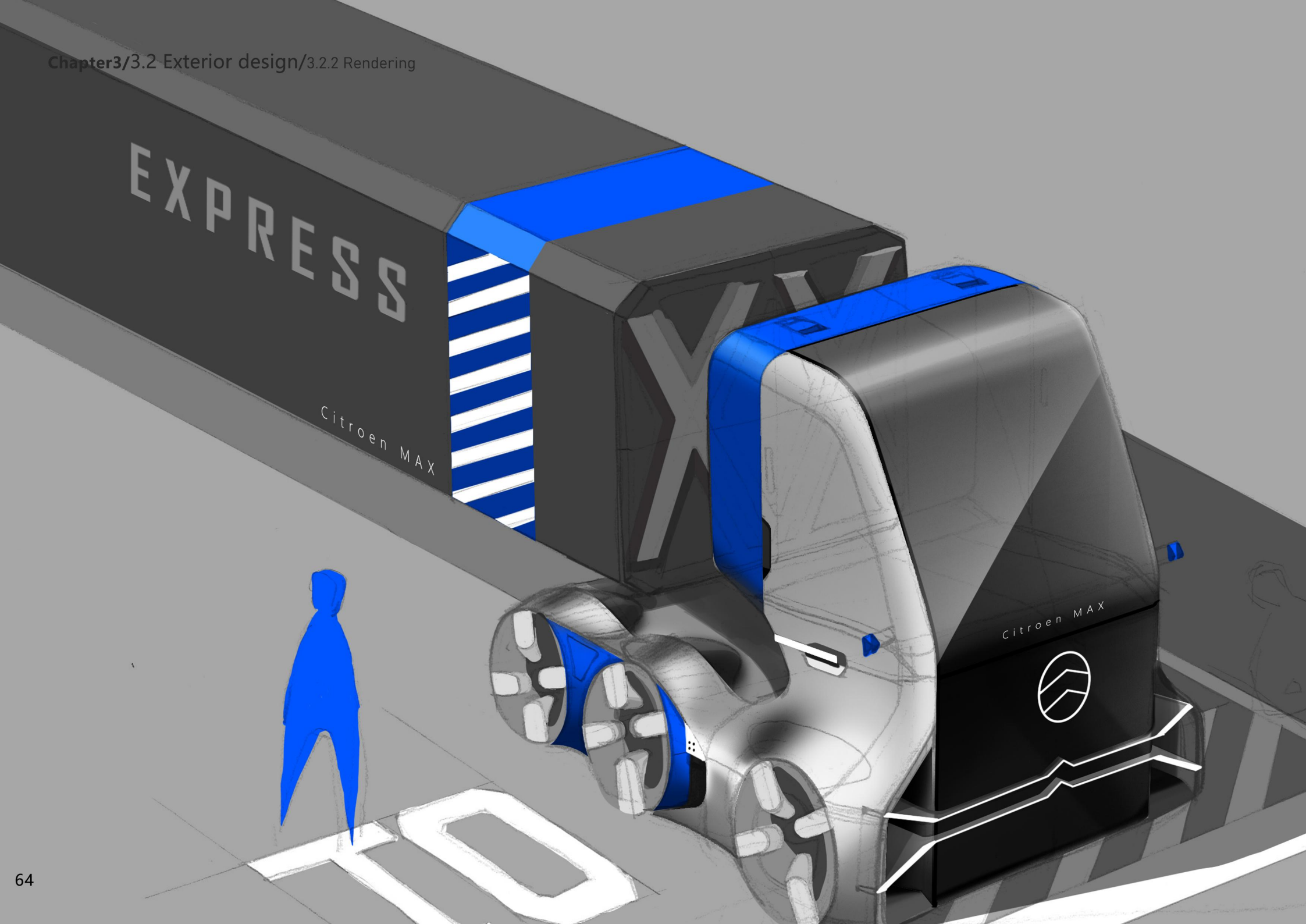
The **second solution** tried a more concise modeling language, and used this appearance design to further reduce the wind resistance of the vehicle and effectively increase the cruising range. At the same time, it is considered that the truck, as a truck with huge power storage, can also be used as a mobile power source. Charge other small vehicles. In this way, the caring design can also increase the influence of the brand. At the same time increase people's recognition of the brand.



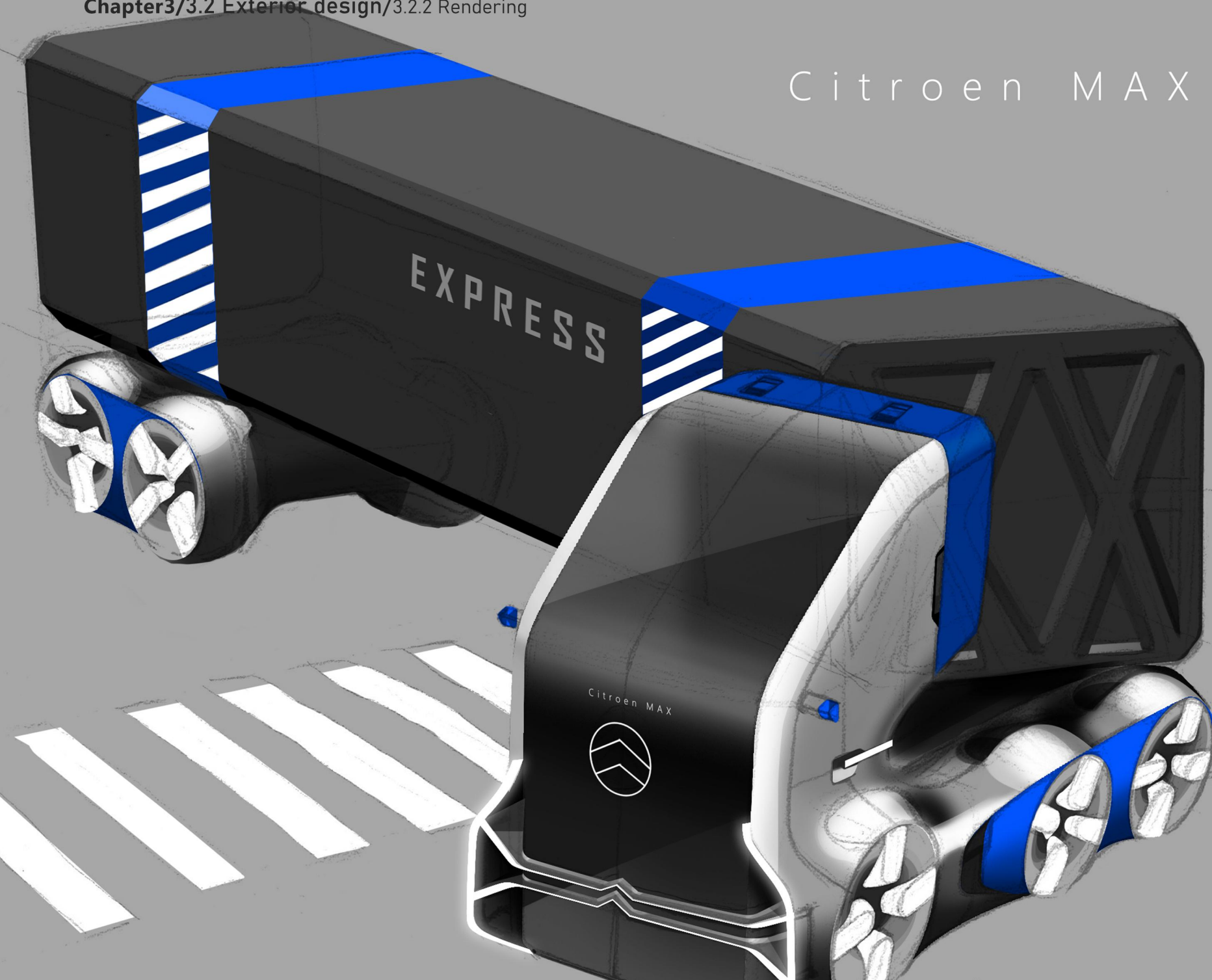
Citroen  MAX







Citroen MAX

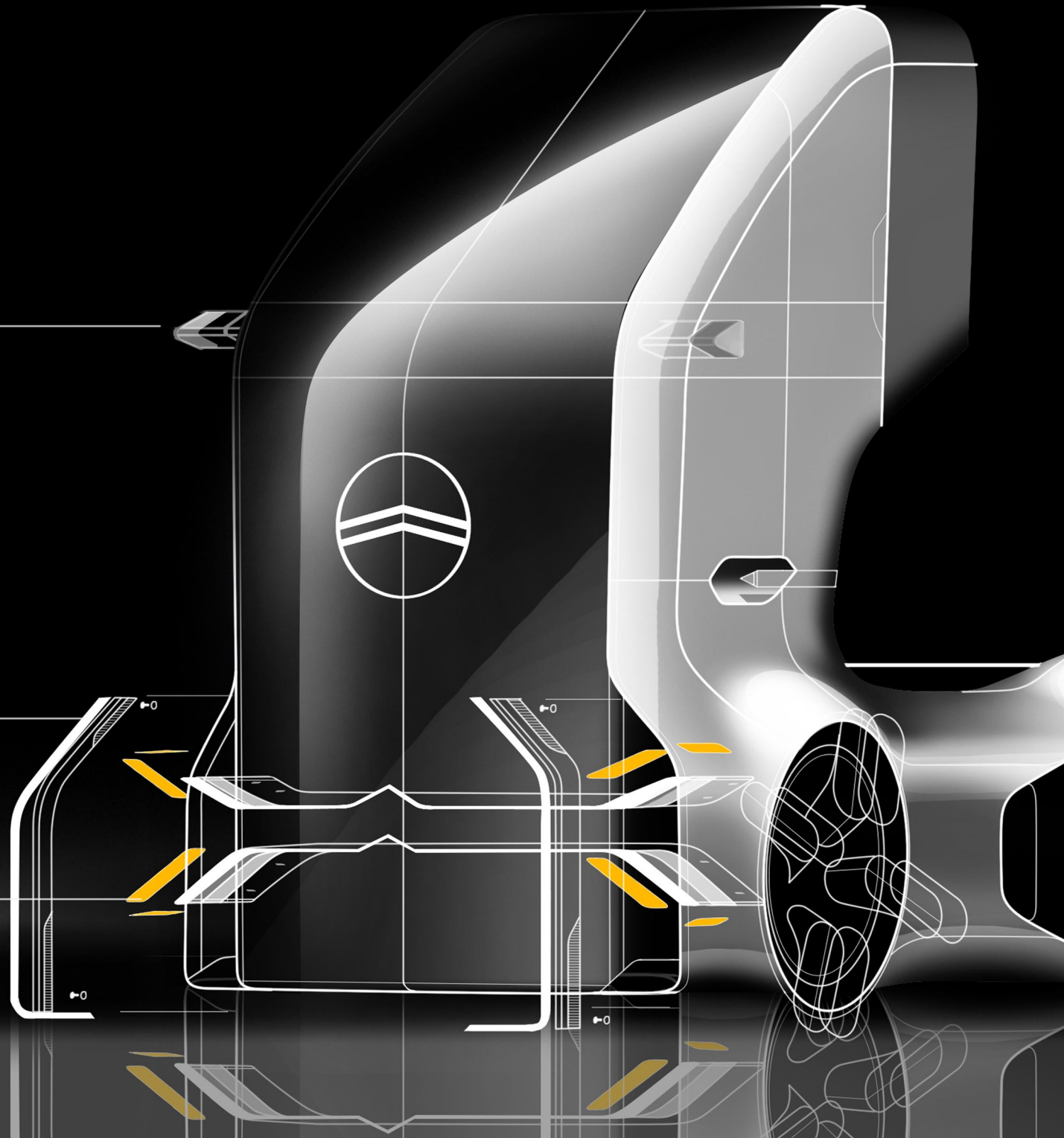


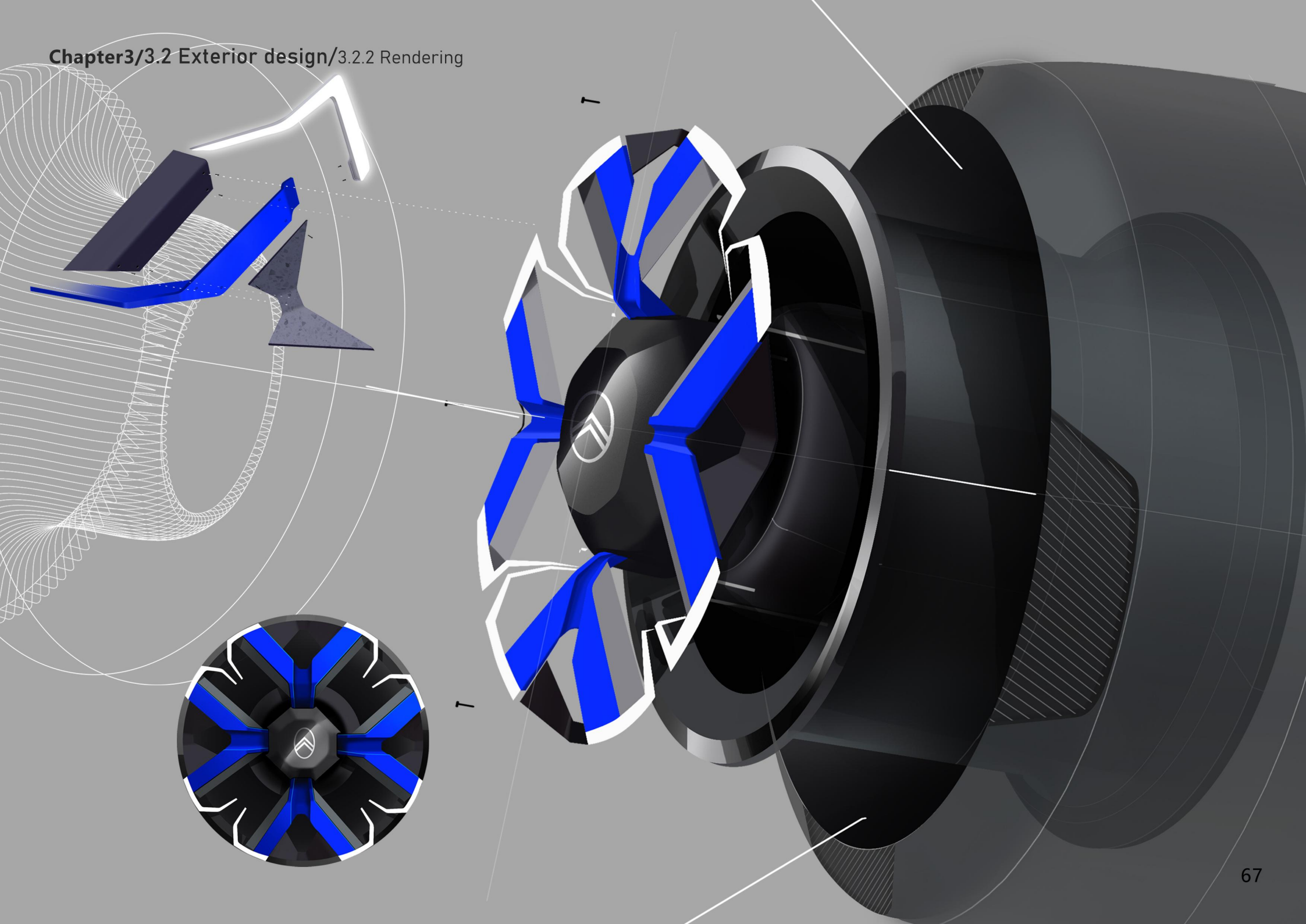
Chapter3/3.2 Exterior design/3.2.2 Rendering

Review mirror Camera

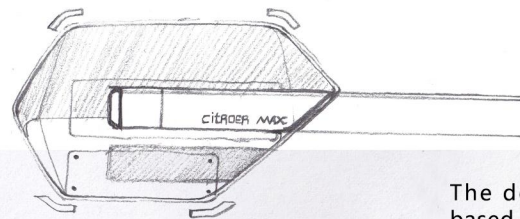
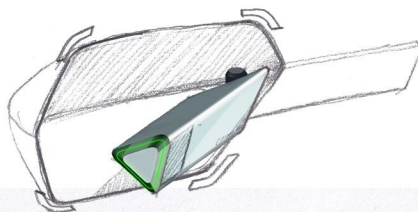
LED lights High beam

Turn signal

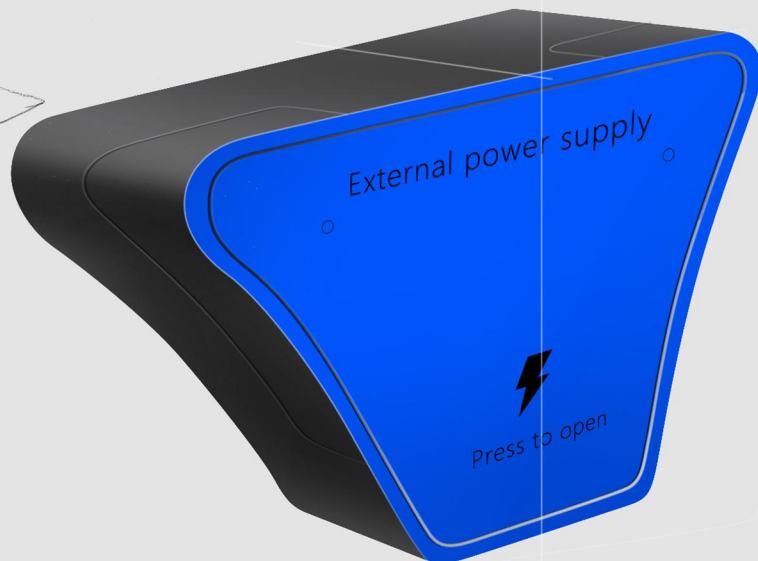
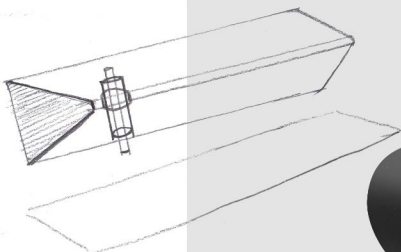
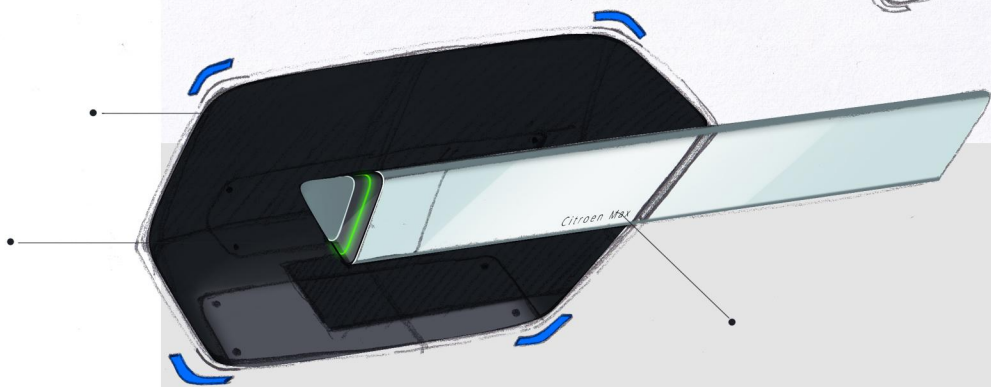




Handle



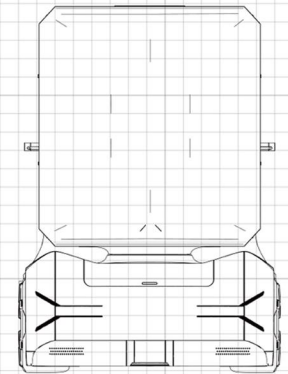
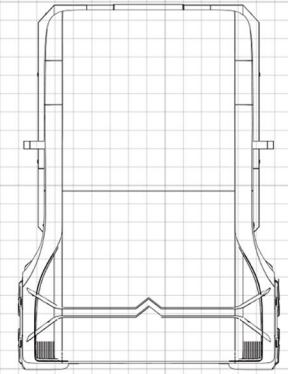
The design of the details is also based on the whole, and the plug of the external power supply is also internationally guaranteed.



External Power

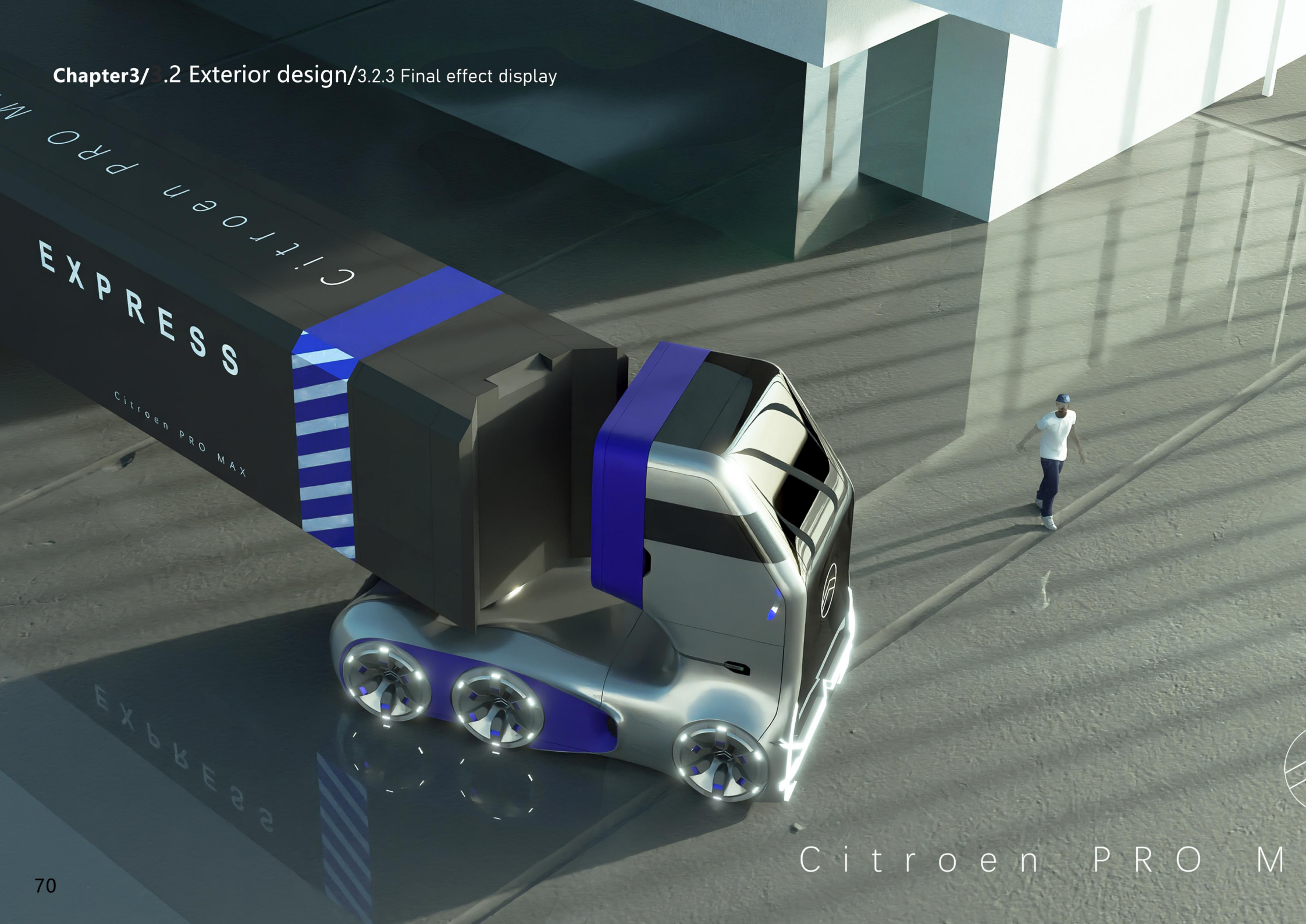


LAYOUT

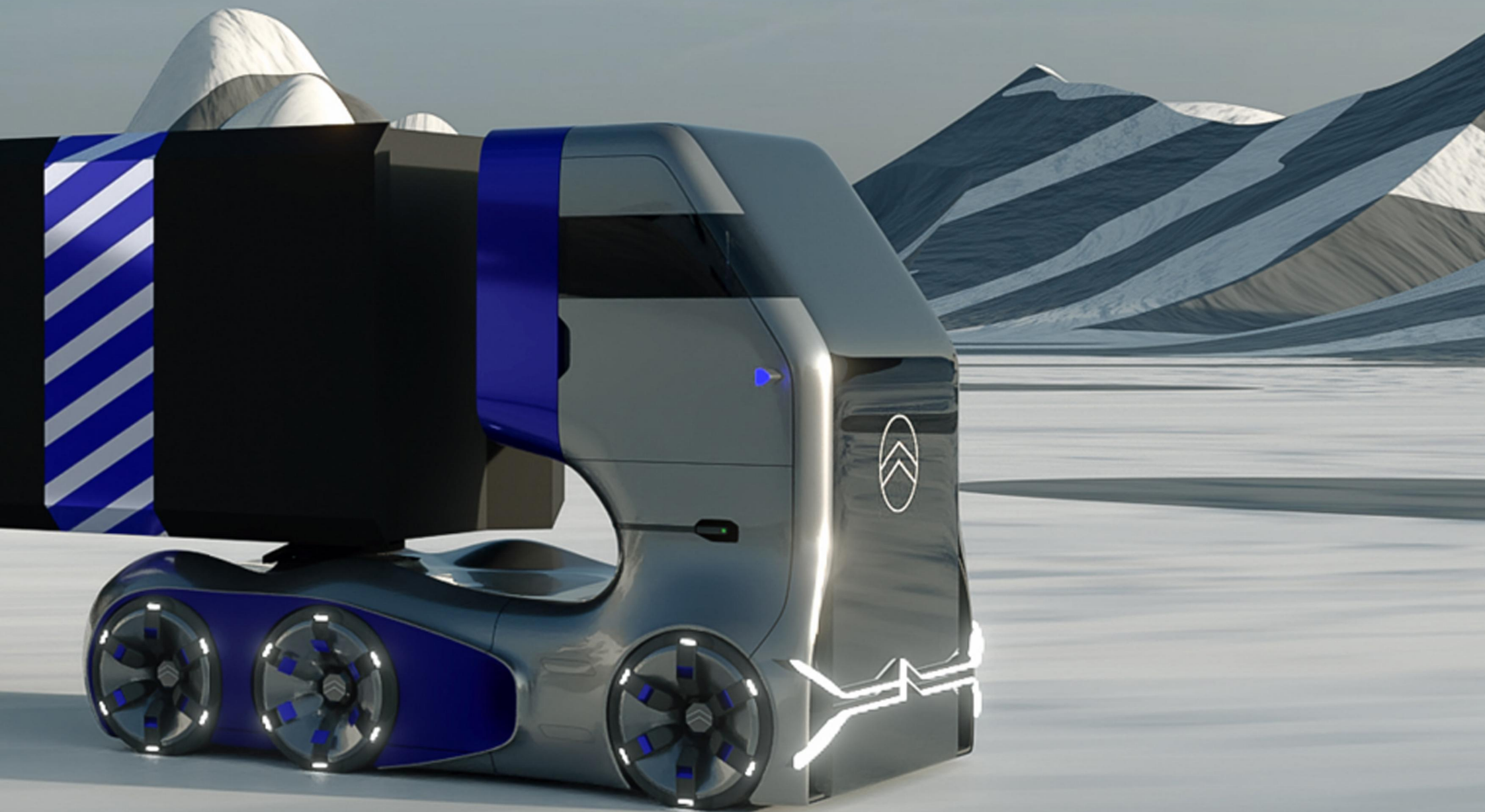


Seat Height 43cm
Back Angle 22

Length 1760 cm
Width 255 cm
Height 400 cm

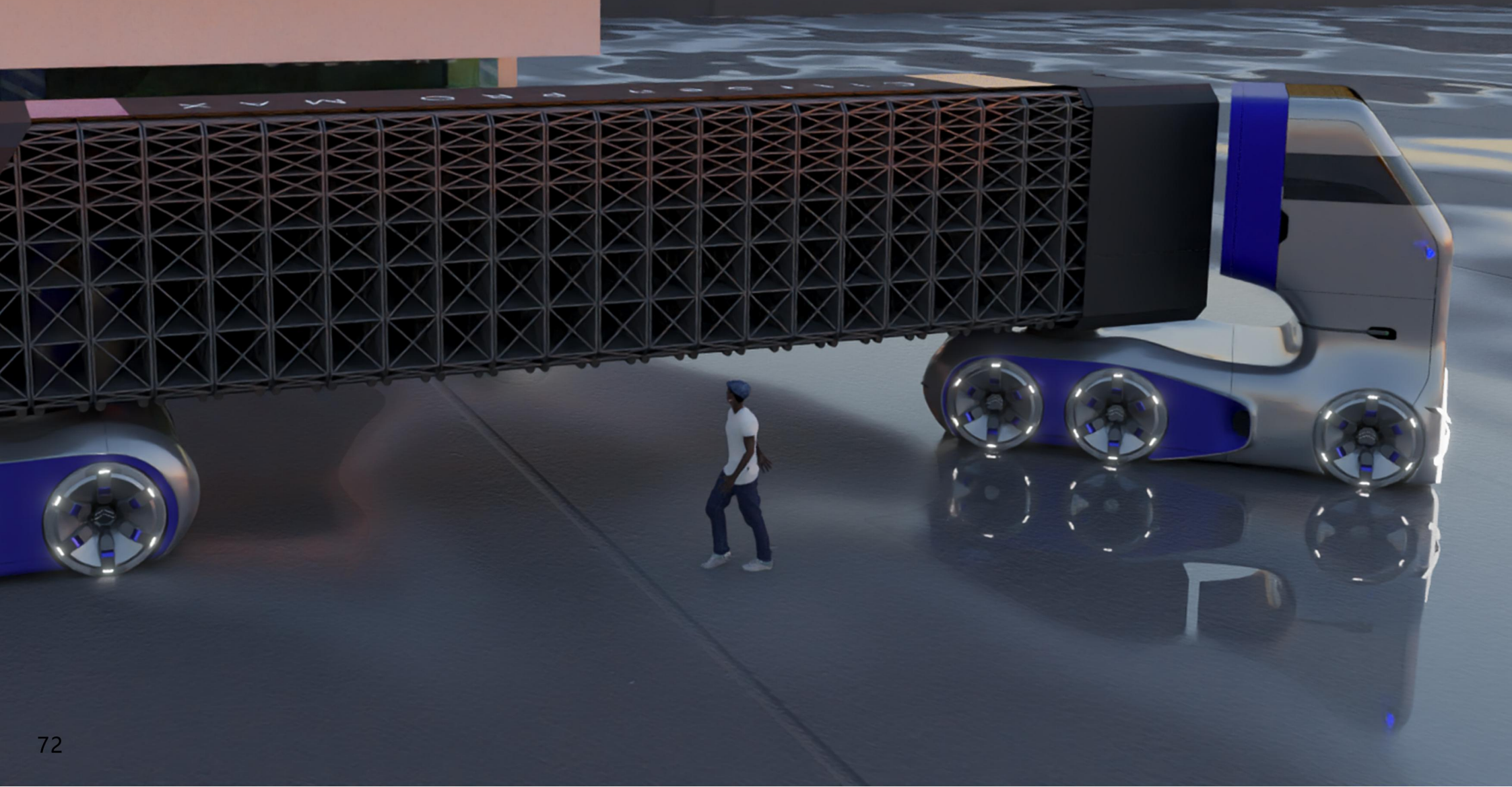


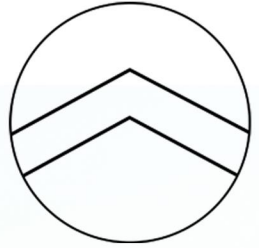
C i t r o e n P R O M





O M A X





C i t r o e n P R O M A X

What about interior?

Interior Ideas

The most basic idea about the interior is to make the driver more comfortable and give the driver more freedom.

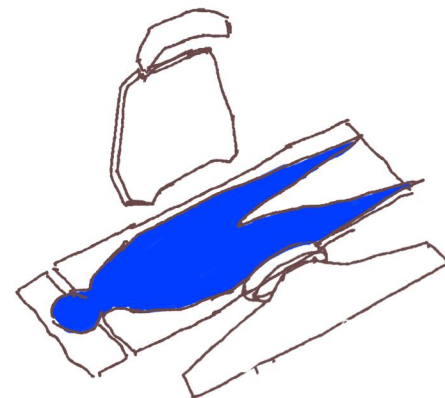
When the driver is required to drive, the control will be given to the driver. When the truck is driving automatically, the driver can sleep or work. Therefore, the space design must not only meet the basic needs of the driver, but also have a reasonable layout. From the picture on the right, we can see different usage scenarios.

Therefore, this design can allow the driver to have a good working environment, while also being able to meet his normal rest time, thereby reducing the occurrence of danger.

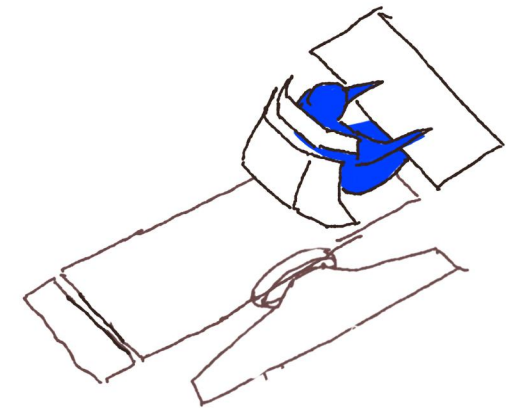
Because of the automatic driving function, there is no need for two drivers to perform shifts. It reduces labor for the company and saves costs at the same time. Taking into account more humanistic care, the car is equipped with a hidden trash can, microwave oven, hot water, and various charging ports.



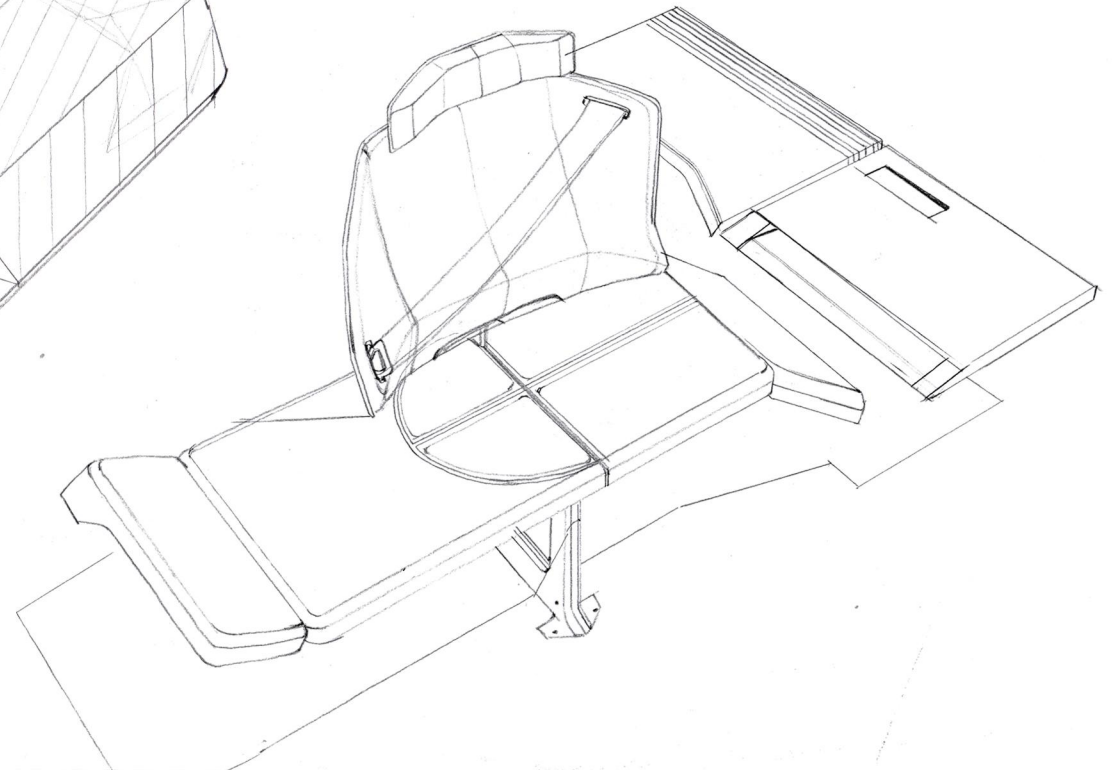
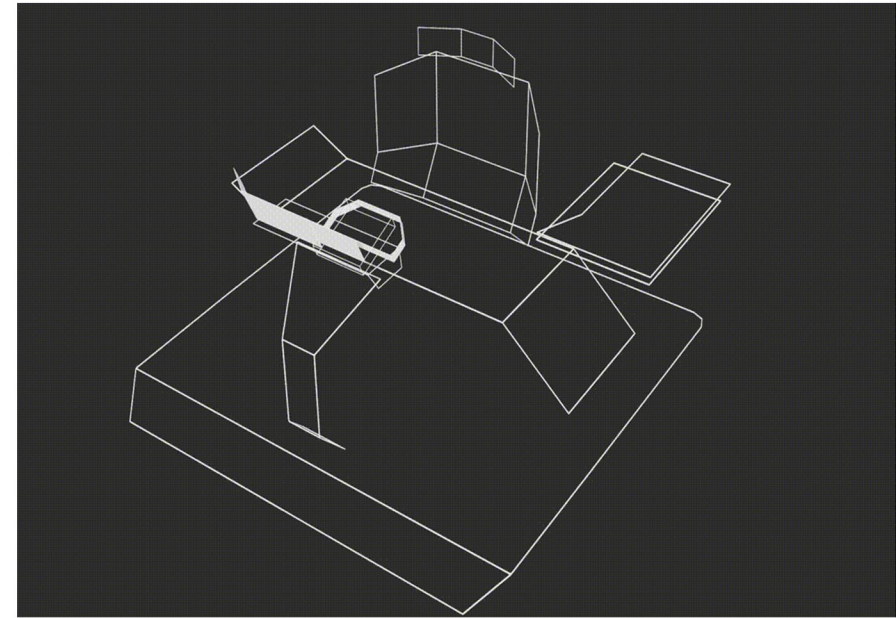
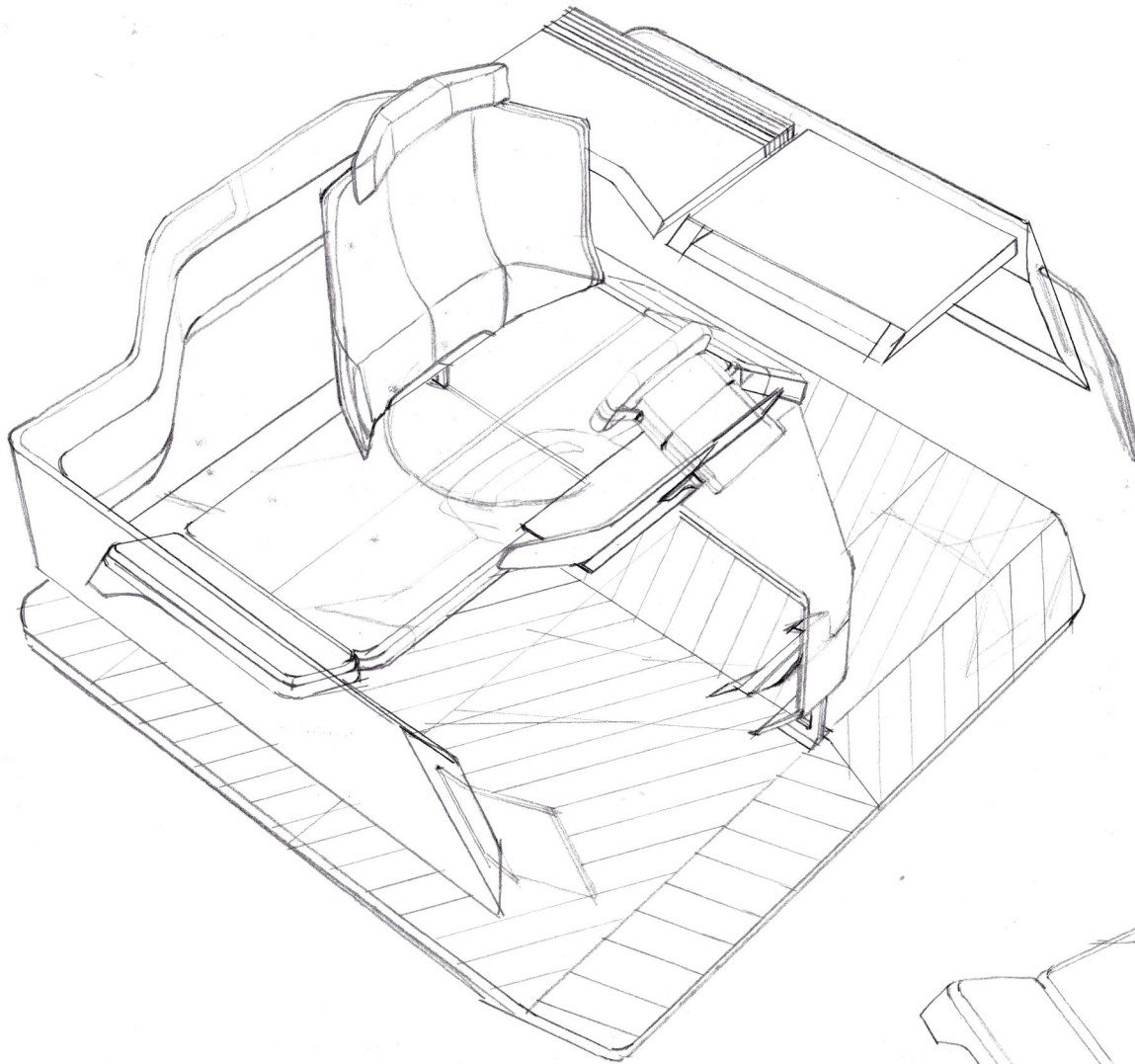
Driving model



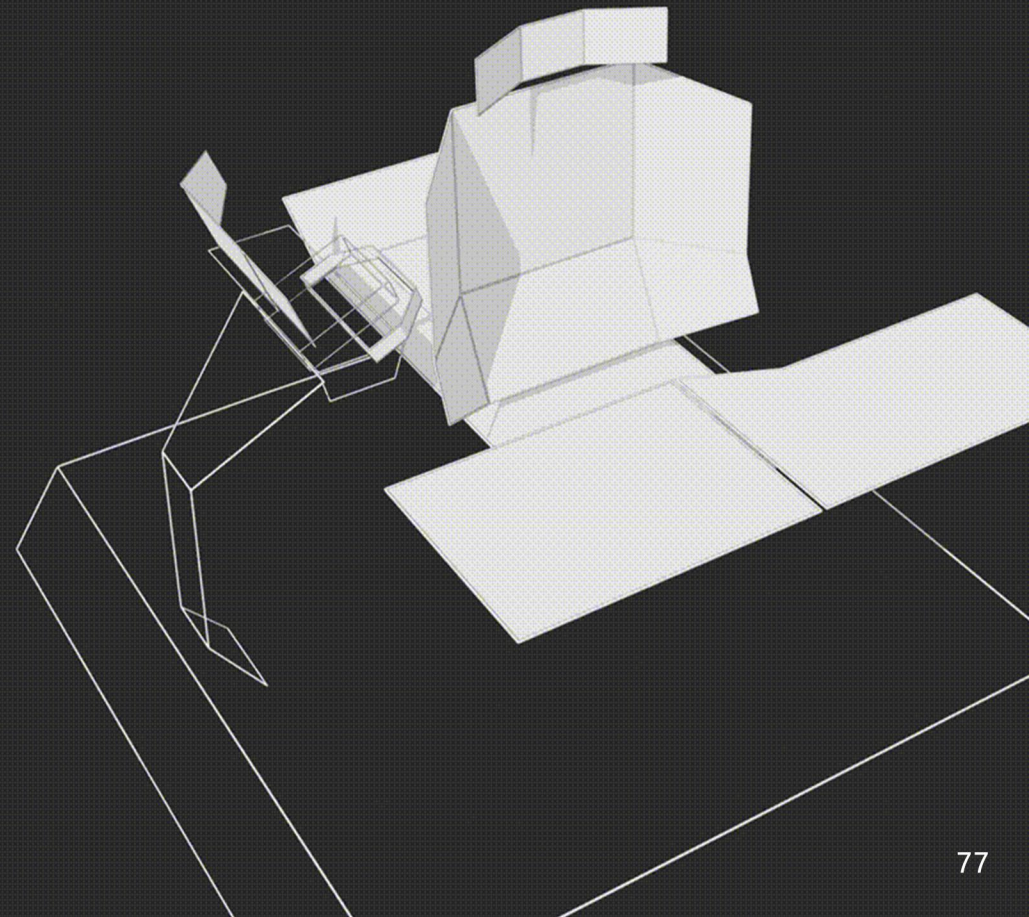
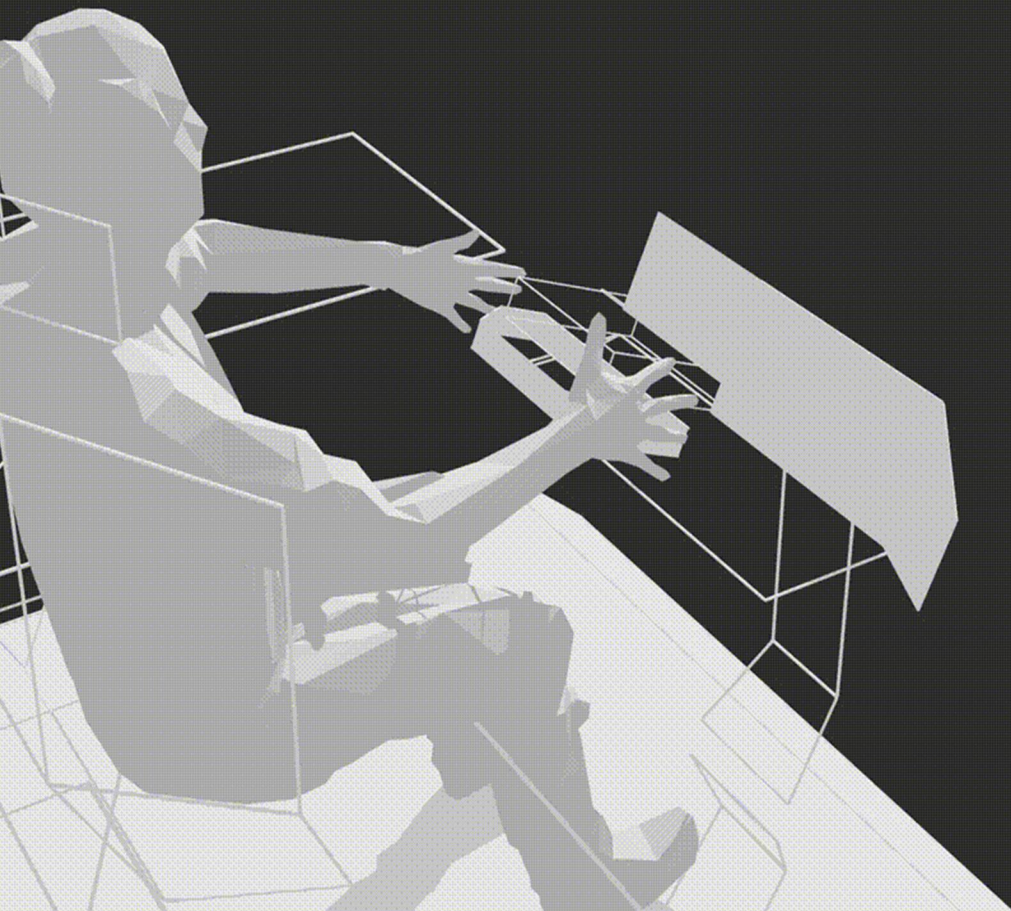
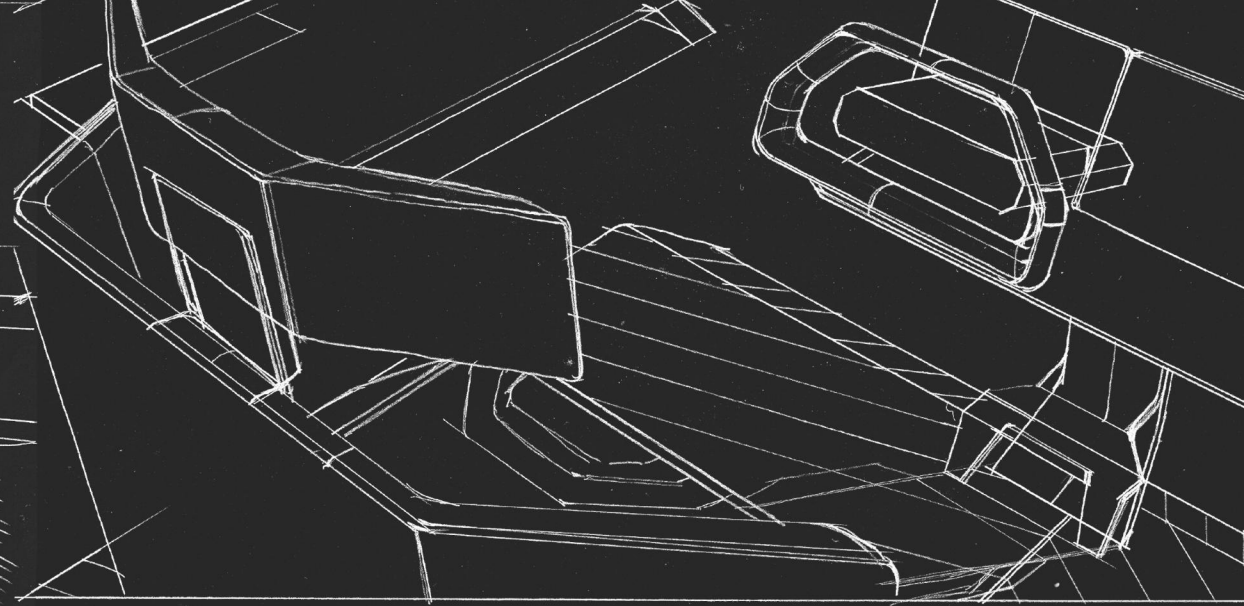
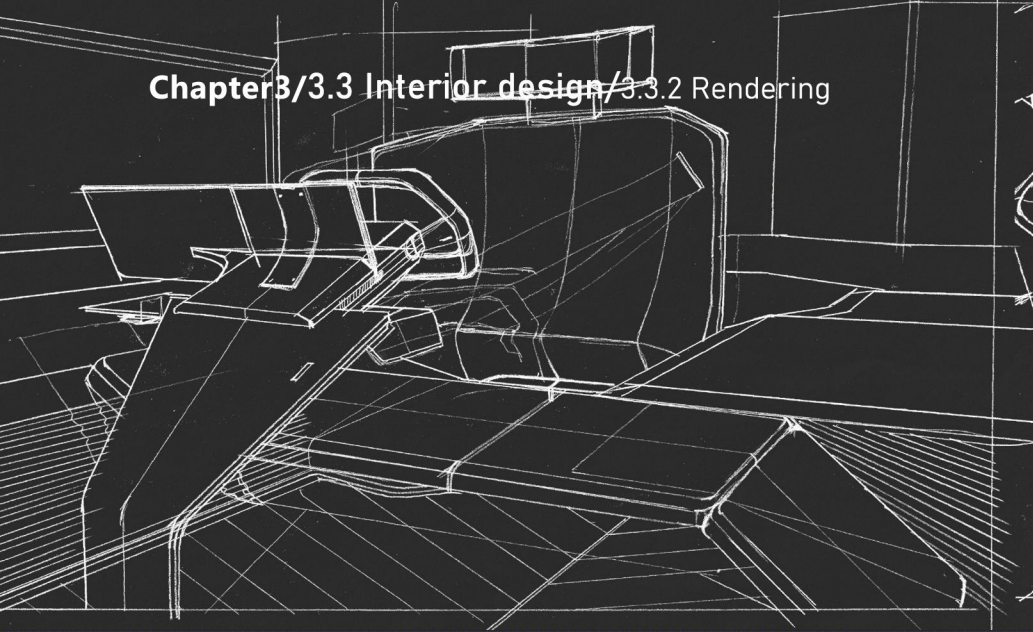
Sleeping model

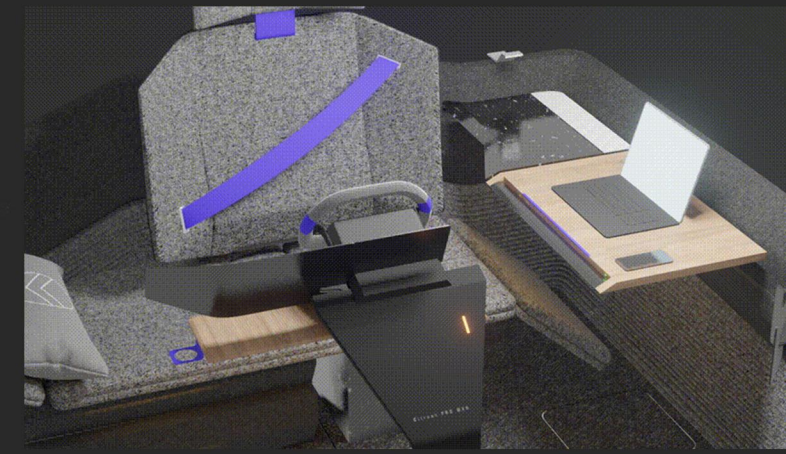
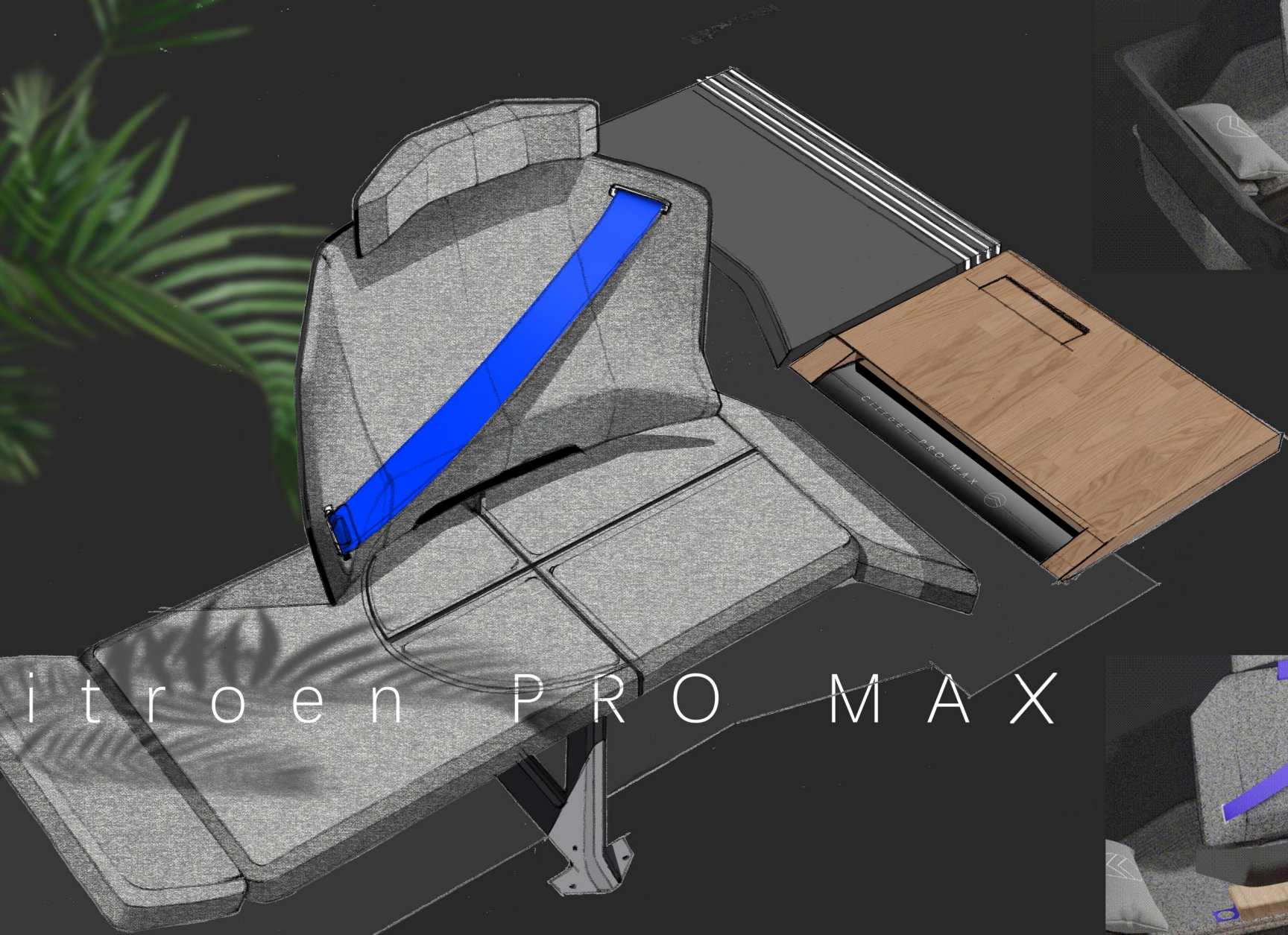


Working model

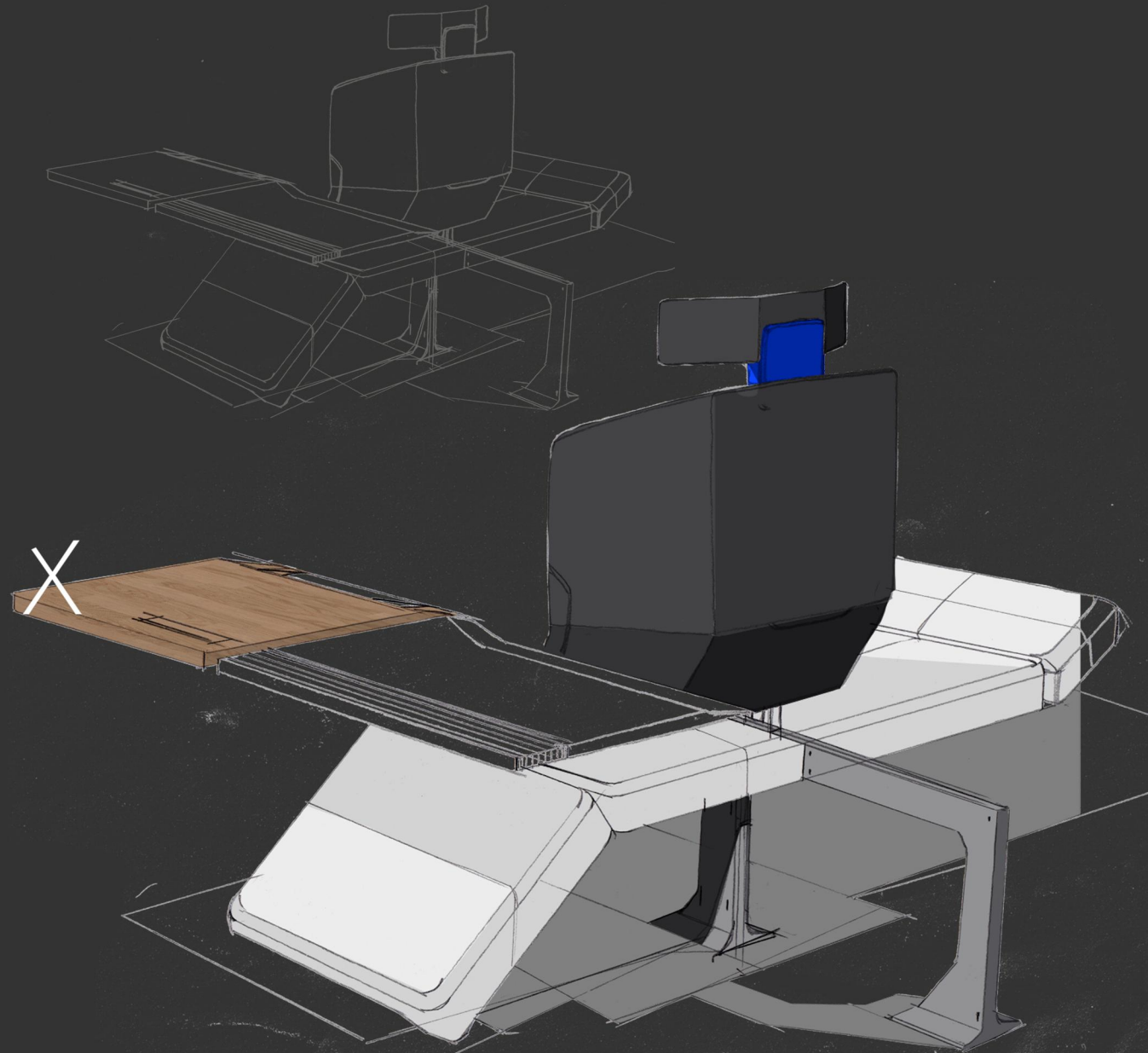
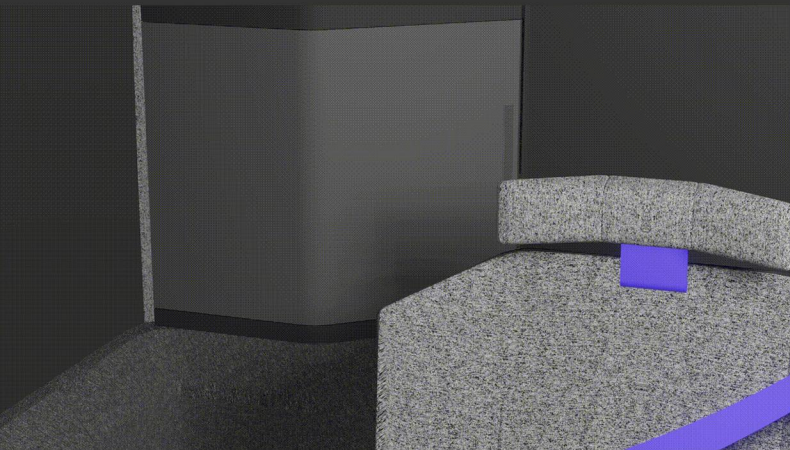
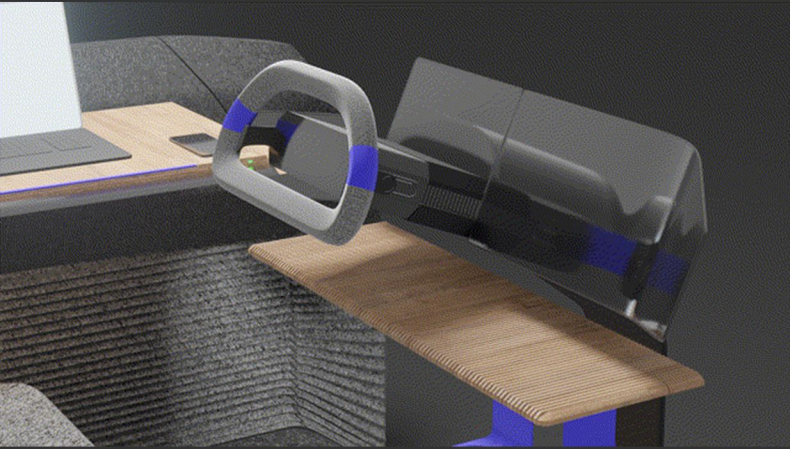


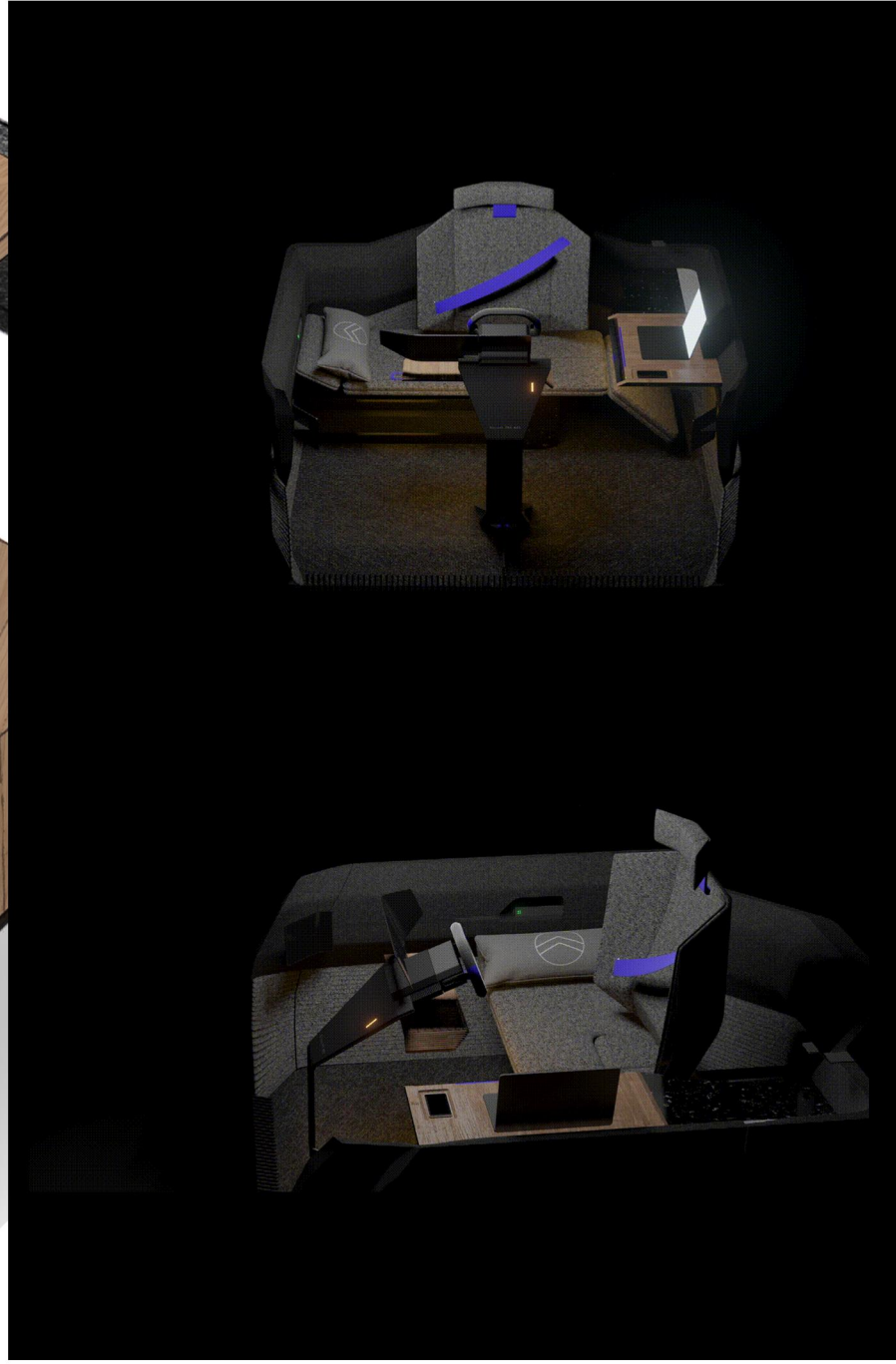
Sketches

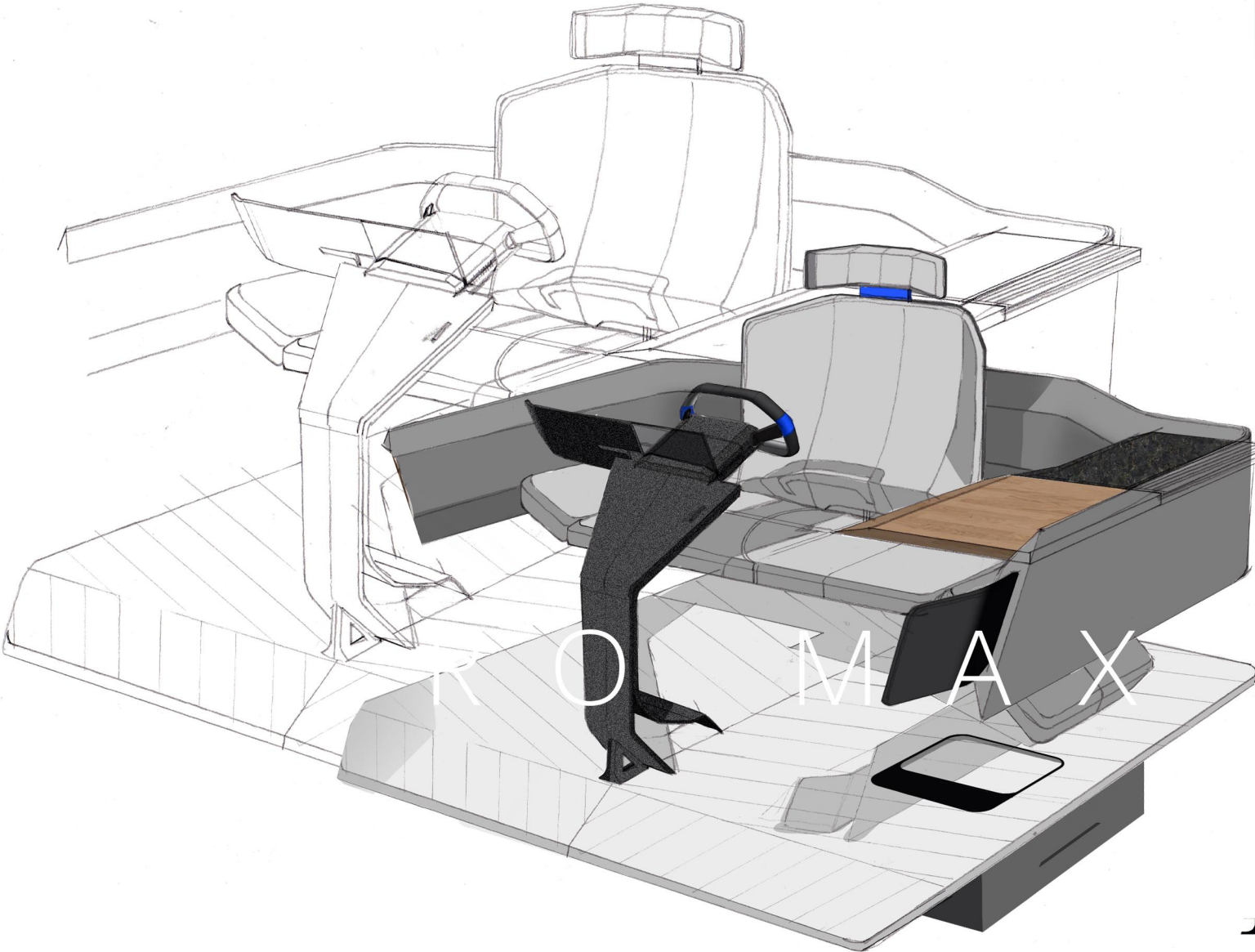
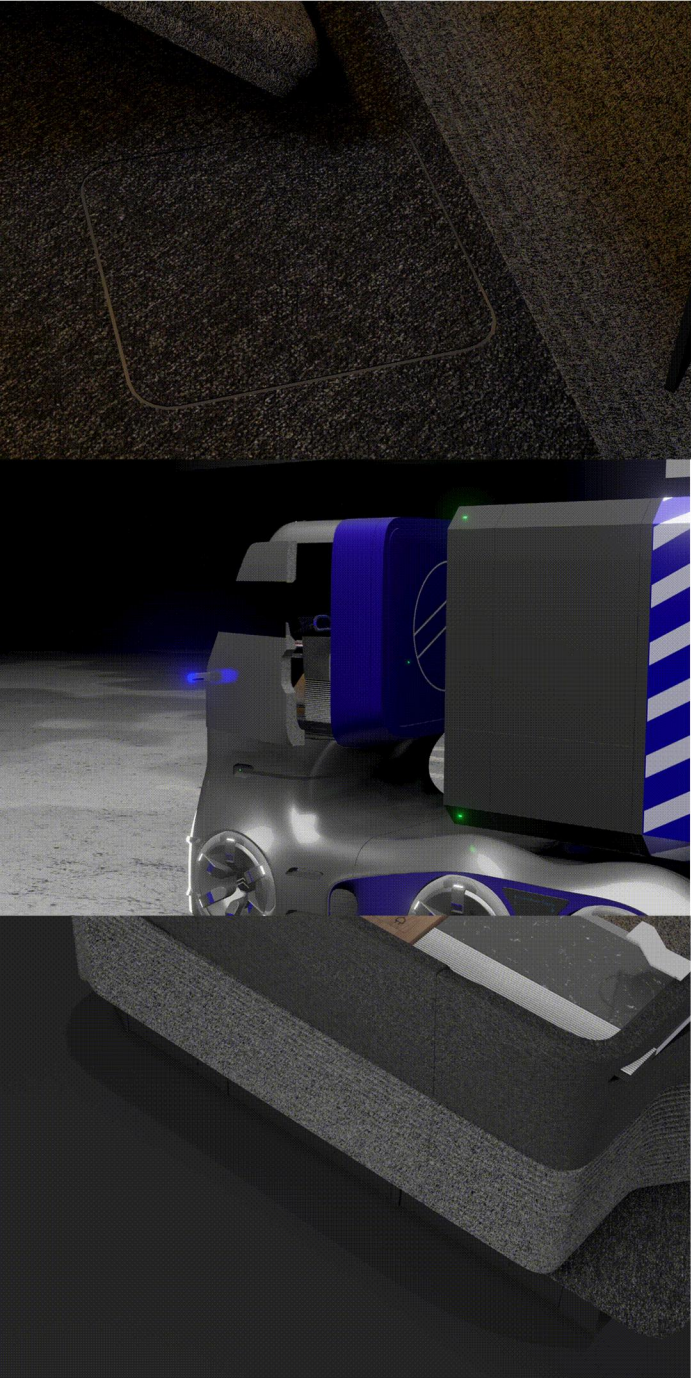




i t r o e n P R O M A X









Steering wheel & IP

方向盘设计为可折叠的，因为它可以在自动驾驶过程中为驾驶员留出更多的空间。

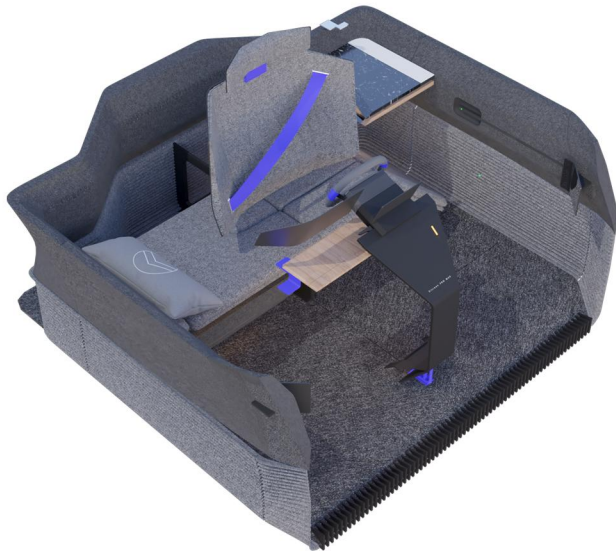
同时，在自动驾驶期间折叠方向盘可以有效地提醒驾驶员该驾驶员当前处于自动驾驶模式。

整个 IP 的设计非常简单。目的是最大程度地减少对驾驶员视线的阻碍和干扰。在 IP 下有一个非常方便存放水杯的地方。这种设计还节省了大量的存储空间。

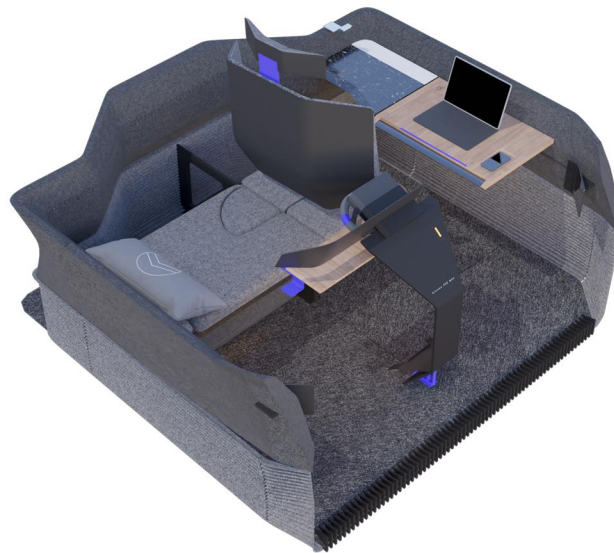
屏幕分为两个部分，其中一个为 12.9 英寸的 Ipad，可以将其取出，以便在移交货物时更加方便，另一个宽屏用于显示车辆信息和娱乐。宽屏可让驾驶员获得更好的体验。



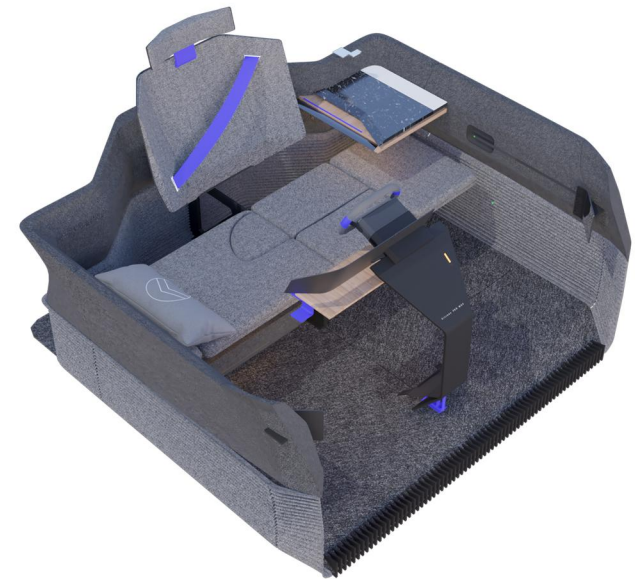
● Driving Mode

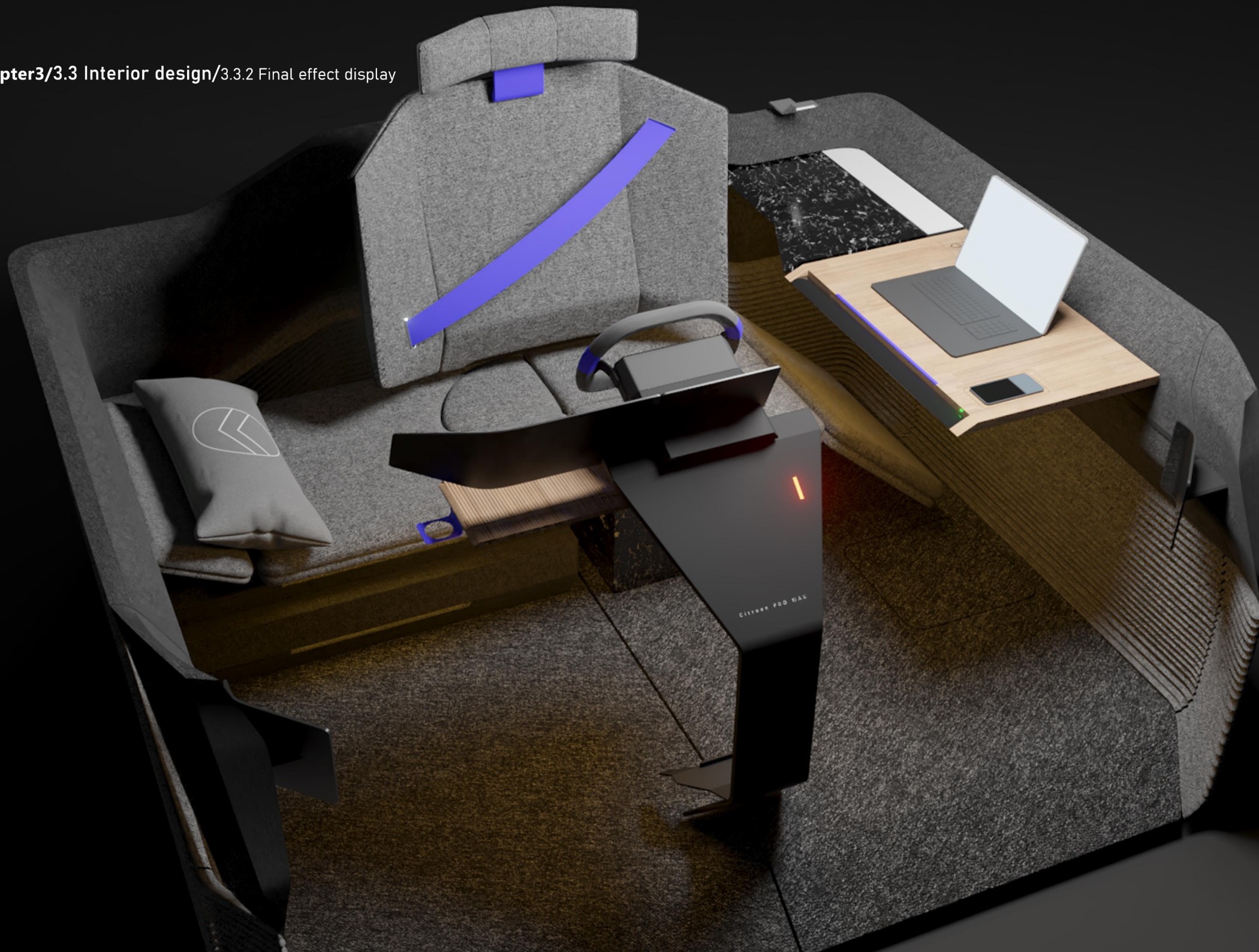


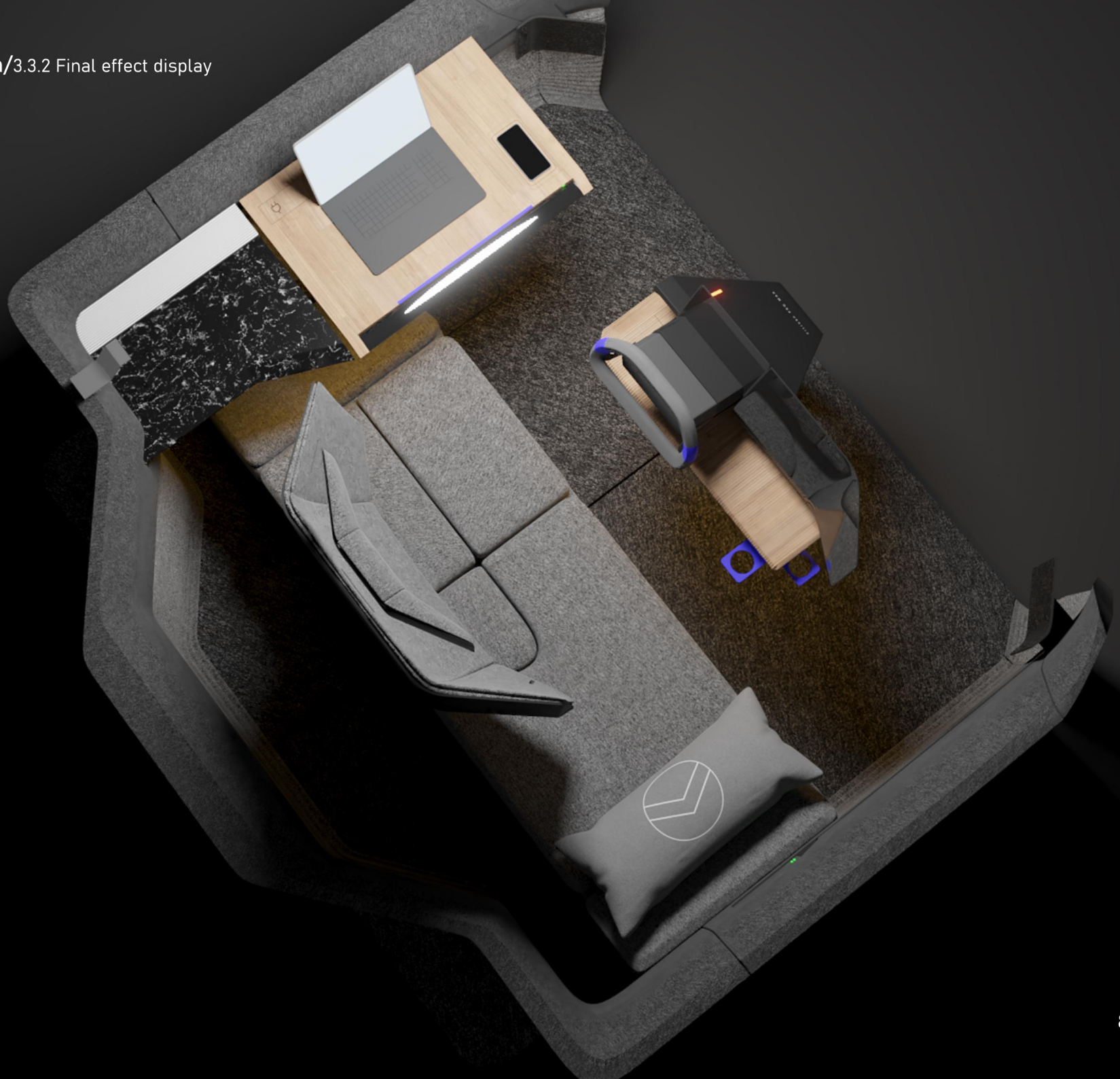
● Working Mode

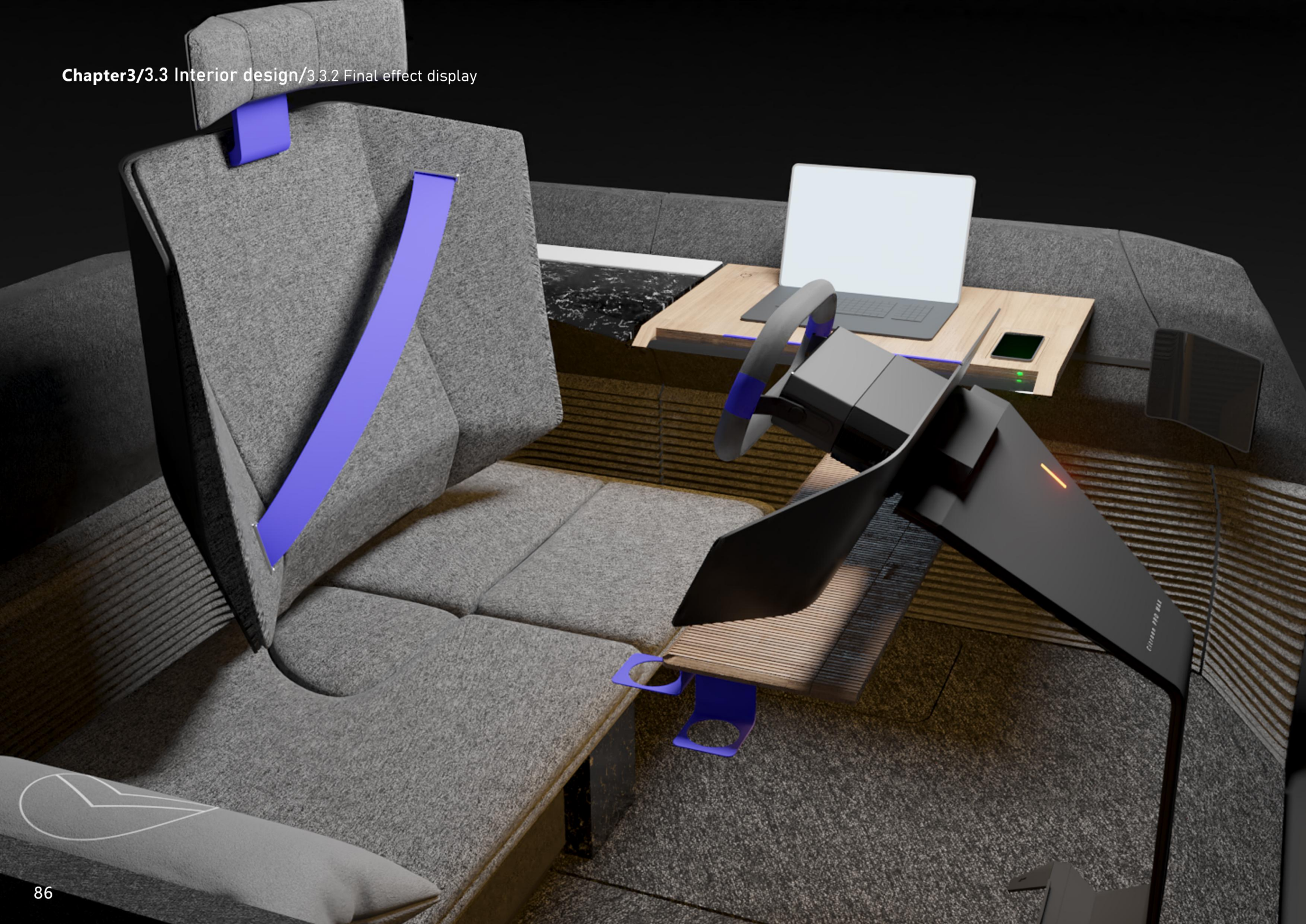


● Sleeping Mode

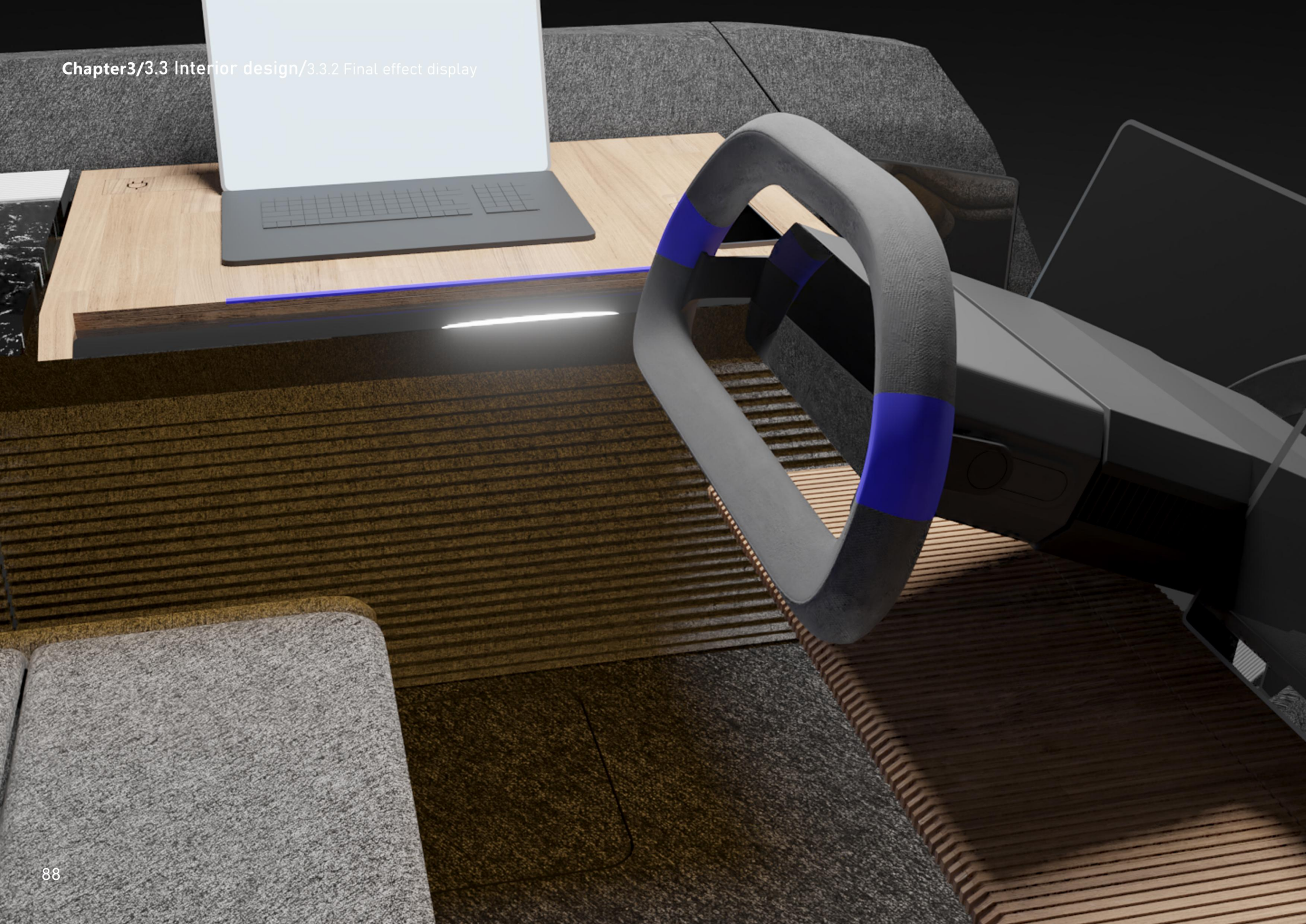




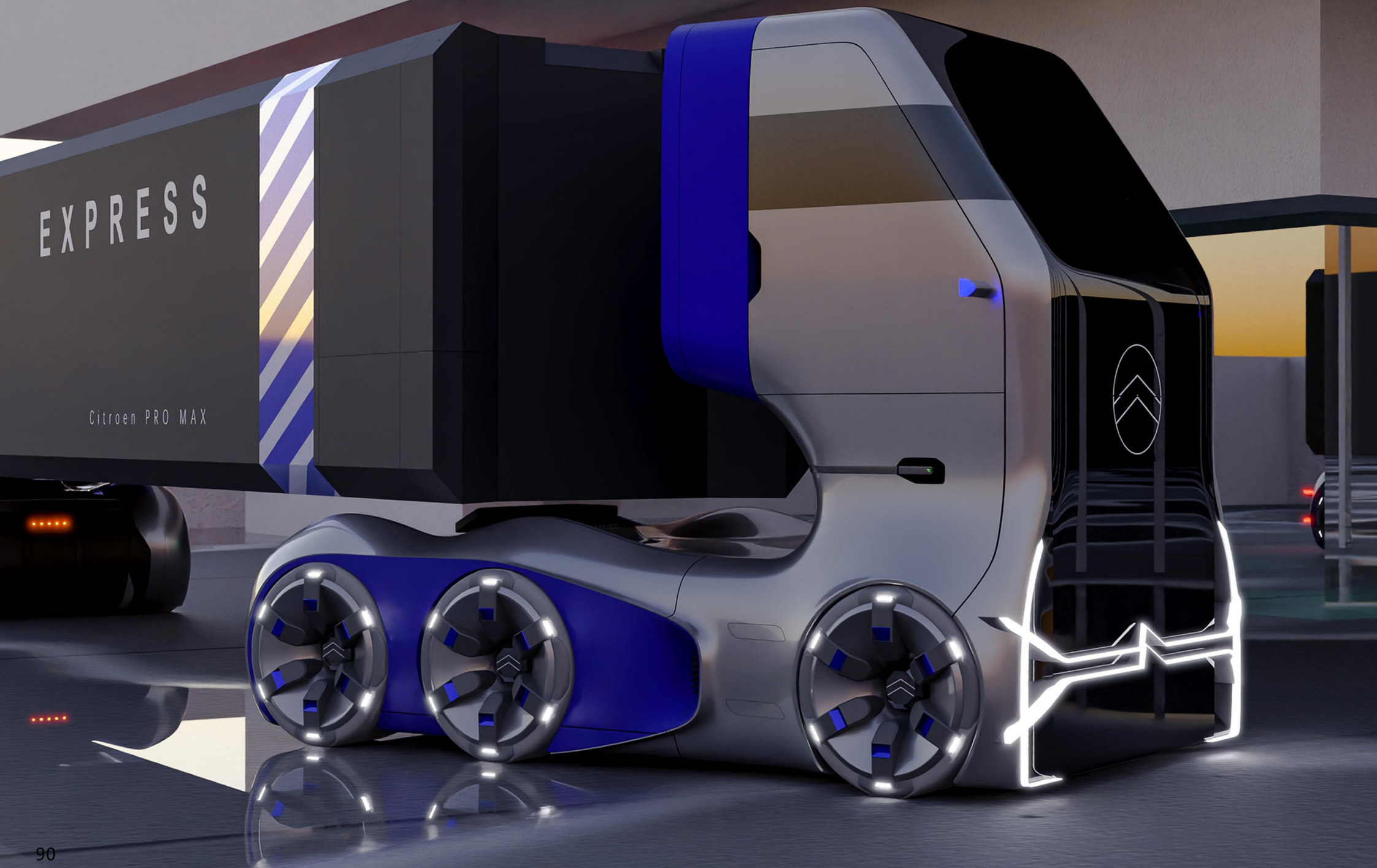














CHAPTER

4.1 Research methods

4.2 Conclusion and Outlook

4.3 Acknowledgement

4.4 Bibliography

Conclusion and Outlook

In summary, under the background of unmanned logistics, unmanned logistics trucks are bound to be an important milestone in the development of unmanned logistics in the future.

This project fully understands the relationship between today's online sales platform and the logistics industry. After reviewing the business logic, it fully analyzed the logistics model and status quo of various logistics companies, focusing on the special and huge type of express delivery, and created a mainline freight electric heavy truck that is more suitable for future logistics scenarios.

In the process, we investigated data on global e-commerce, express parcel data, logistics and freight data, etc., in order to provide reliable support for the next design process. Form your own logical closed loop. Most of the data comes from valid papers, journals and websites.

Electric unmanned heavy trucks will be an important presence in the future logistics links, because it will connect the two most important transportation links of trunk line transportation and branch line transportation. It is related to the overall efficiency of the logistics link. At the same time, it can better meet the needs of the logistics industry in the digital upgrade process. Improve the company's earnings and improve people's quality of life.

The design of the express transshipment cabinet can effectively improve the transshipment efficiency, and significantly improves the efficiency in the express unloading, scanning, distribution, and loading links. And can effectively ensure the safety of express delivery. Prevent incidents such as violent express delivery.

I encountered a lot of problems during the process, and need to spend time to solve them patiently, such as data search and sorting, creative conception and expression, but I will learn a lot of new knowledge and skills throughout the process, I hope this project It can provide an effective reference for the innovation and upgrade of trunk transportation in the logistics industry.

Acknowledgement

Without the help and support from **professor Massimo Bianchin, professor Davide Maria Bruno & Professor Llu Zhihuo**, this graduation project would be more difficult. I would not only thank them for their guidance and careful guidance, but also for their support in the process. My encouragement and resources.

In addition, I would also like to thank the teachers and classmates of Politecnico di Milano and Tsinghua University. In such an environment with strong academic division and innovative atmosphere, they can always give me new inspiration and Motivation, thanks to all the teachers and students of this exchange program.

Secondly, I want to thank my roommates during the exchange at the Politecnico di Milano: **Zhang Yi, Wang Haoyang, Chen Zhengxin, Wang Yuting, Song Hanmo**. It is their daily life and company that makes me feel at home in a foreign country.

I thank my roommate **Yan Zeteng** at Tsinghua University for giving me a lot of encouragement and inspiration. In addition, I would like to thank my father **Wang Faqiang** and mother **Liu Jing** for their nurturing grace, allowing me to complete my 7 years of study and growth in Tsinghua and Politecnico di Milano.

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Design in



Academy of Arts & Design, Tsinghua University



POLITECNICO
MILANO 1863

CONTACT

Telephone

+8618813120733

Email:

297151300@qq.com

Portfolio:

<https://www.behance.net/dededede1>