Development of the

DESIGN OF AN INDUSTRIAL MATERIAL HANDLING PRODUCT FOR THE RETAIL CONTEXT

HIVE

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1. Introduction

Context

Smart Cities - Smart Living

In the past 20 years, **lifestyles have been disrupted** mainly thanks to the evolution of technology that has changed the way people communicate, work and live in general.
This era is driven by continuous change and it is estimated that two thirds of the world's population will live in cities by 2050. This will lead to a consumption of 70% of the world's energy with an **increase in the demand for services and pressure on resources**.

We speak of "**smart city**" in which networks and services are made more efficient by **digital technologies** and **telecommunications**, aiming at a **better use of resources and fewer emissions** capable of guaranteeing a high quality of life.

Sustainability

Smart Cities

Innovation

Efficiency

Context
Covid-19

At the beginning of 2020, a global pandemic was declared due to a new disease called Covid-19 that affects the respiratory system. Some countries, including Italy, have called for **quarantine**.
Precautions were taken such as **social distancing, correct hygiene behaviors and surgical masks** as well as the **closure of many activities**.

This has led to a new way of life: shopping, entertainment, relationships, school and work have switched to the **online mode**.
Lifestyles have seen a very rapid change and many of the **new habits introduced will not be possible to eliminate post-Covid**.
Users are not willing to go back, both for hygienic reasons and for fear of contagion, and for convenience.

On December 31, a **new coronavirus (SARS-CoV-2) causing the disease called COVID-19** was identified by the health authorities of the city of Wuhan (China).

On March 11, the WHO declared a global pandemic.

Focus

The focus of the project is **food shopping**. In fact, it was the common element that pushed anyone out of the house, regardless of work or health needs. This experience turned out to be different than usual, very **stressful** and often **unsatisfactory**.

The new consumer spending behaviors will be analyzed, trying to understand what their new needs are and what trends have arisen among retailers to satisfy them.

Consumers

New consumers' needs

Dealers

2. Research

New Preferences

Consumers

New needs and fears have pushed consumers to **online purchase** and to **digital payments**. The demand for online food products has **increased tenfold**, significantly increasing the pressure from e-commerce players.
As has happened in Italy, a similar phenomenon has also occurred in the rest of the world.
In the UK, 33% of consumers ordered food at home in April compared to 24% at the beginning of March.
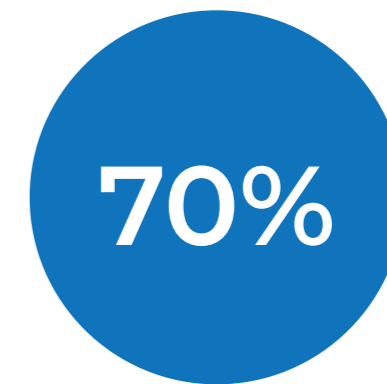In the US, demand for online shopping has grown by the expected volume over the next 2/4 years in 2/4 weeks.

Italy

+85%
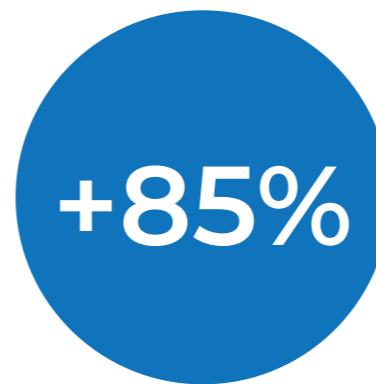
online sales of supermarket products compared to 2019
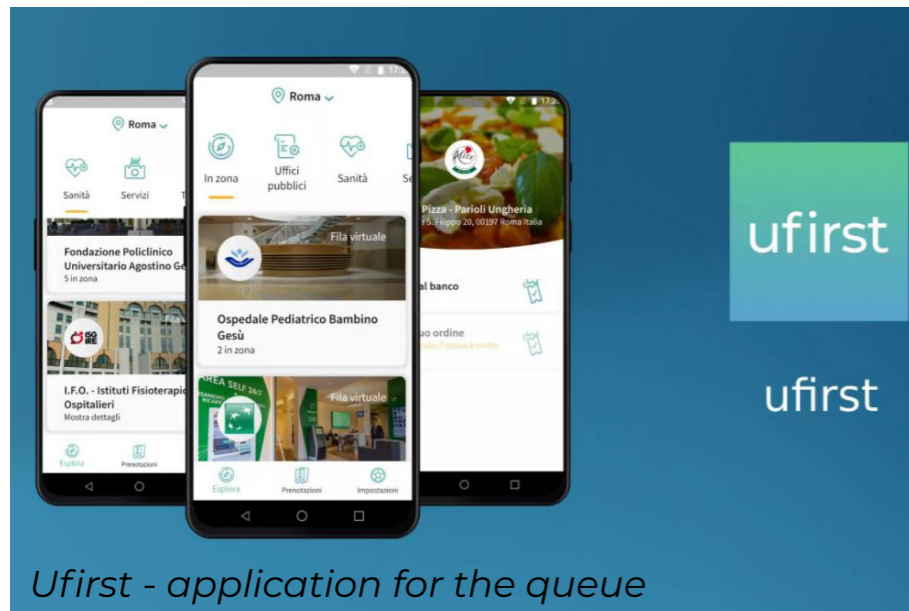
World

70%

consumers who plan to continue shopping online during and after the pandemic

New Preferences

Dealers

Mass Market Retailer (MMR)

Ufirst - application for the queue

hyperstore, supercenter, superstore, megastore, or big-box store

- **Digital services** to improve the shopping experience
- **Contactless payments** implementation

Local Dealer

City of Turin - LaSpesaServita

convenience store, small shop not belonging to a chain of stores

- New ways of distributing products with **digital initiatives**
- Opportunity to **expand** beyond the city limits

Solidarity Buying Groups

L'Alveare che dice Sì

associations of consumer groups with ethical and savings purposes

- Meeting with **technology**
- **Increased participation requests** has strengthened the GAS

New normal

At the end of the pandemic there will be a "**New Normal**". This new everyday will be determined by a massive transfer of operations to **digital mode** but **without leaving physical stores**.

- **Shopping 2.0** with multi-channel experiences
- **Automation** is a fundamental part of the retailer's strategy
- **Omnichannel** sales model
- **Proximity Commerce and Click&Collect** will be the new purchasing models
- Sales trend will be **glocal**

Consumers

Trend

Health & Safety

Safe and contactless operations

Proximity of urban spaces

More effective and closer services in an easily livable context

Sustainability

Both economic and environmental, linked to the concept of "smart energy" with high use of technology

Smart attitude

openness to innovation

Home consumption

More time and budget spent at home

Consumers
Consumption preferences

ITALIAN 49%

Interest in local products with Italian and traditional raw materials, Km0

SUSTAINABLE 42%

preference for sustainable nutrition

HEALTHY 38%

Preference for fresh food with lower sugar and few calories

HOMEMADE 35%

Homemade food to save money and to feel safe

SAFE 34%

Hygienically safe packaging and products

DIGITAL 23%

The service is more in the channel than in the product

2 out of 3 users willing to change supermarket for eco-friendly shops

9 out of 10 users choose sales channels with the lowest prices, offers and promotions

Preferences

Fruit

Vegetable

Packed products

Retail trend

Retail has seen an acceleration of the trends that were already emerging:
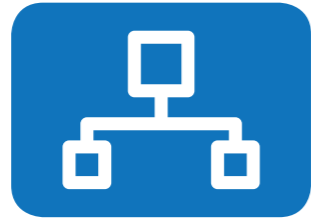
Business model evolution

Through **multi-channel sales** and the rethinking of **added value**

Purpose driven

Supporting customers and employees brings greater **brand loyalty**

New approaches to costs

Investing in **new technologies** for better management of operations and to create value

Customer preferences

By providing **safer and more efficient purchases**: loyalty programs, customer data and enabling technologies

M&S - delivery with Deliveroo

M&S - order fulfillment with Ocado

Retail trend

Automation

- Increased production, safety and quality

- Development of new products and services and entering new areas outside the core business

- New work activities with complementary roles to machines and focus on activities that use human innate abilities

Digitalization

- Rethink services by offering more streamlined interaction processes

- Ensure assisted channels with a human touch

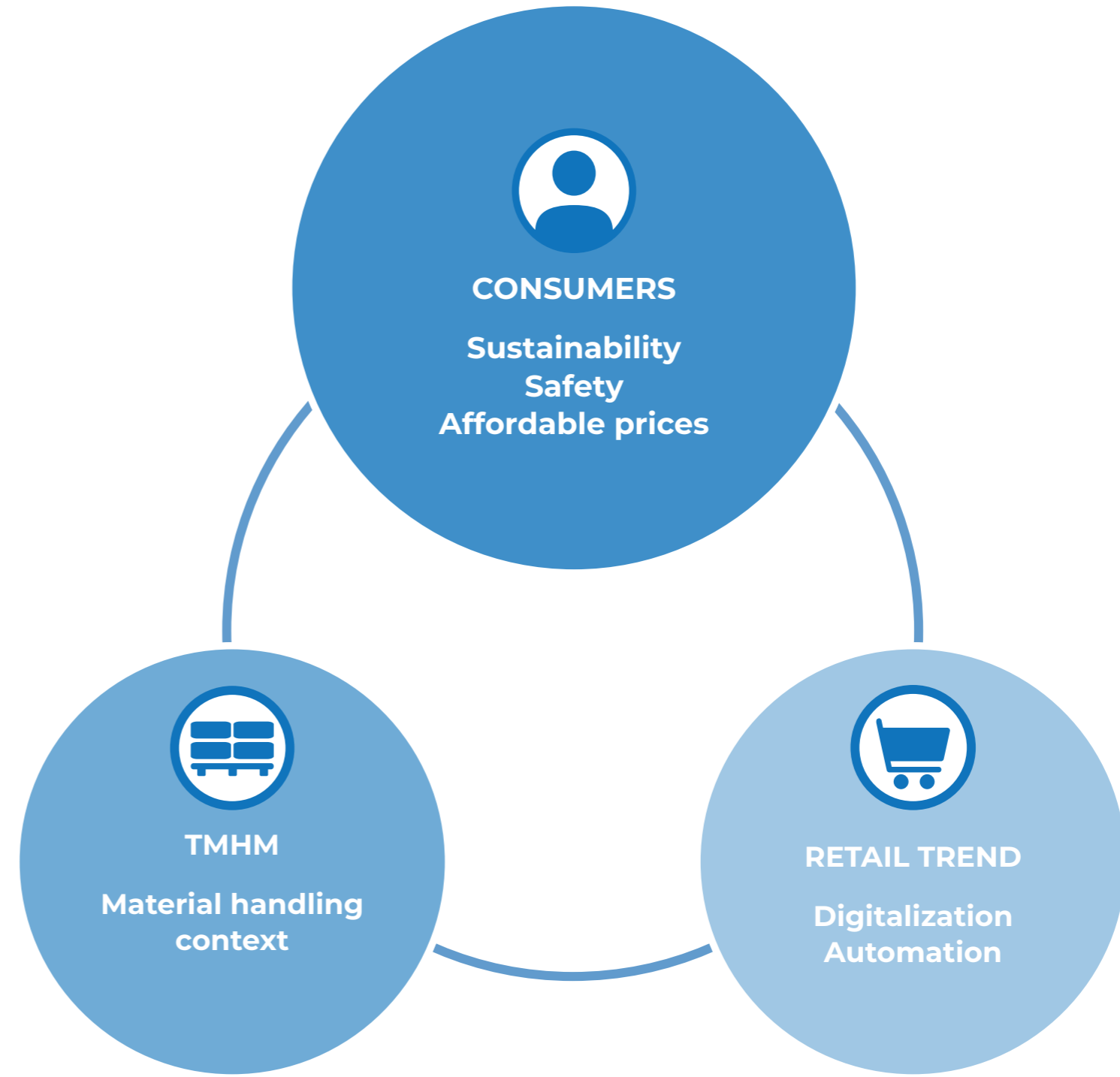- Cybersecurity culture to increase users' confidence in digital purchases

Retail trend

Fabric- Fulfillment Center

Home   Book a test drive   Model 3 accessories   Model S accessories

盛大开业 「特」别驾临

预约试驾，看直播
享特斯拉精美礼品
4月21日-4月28日

TESLA

Tesla - shop on Tmall

15

3. Analysis

Brief

Creation of a material handling product that allows to satisfy the new spending preferences of users and similar to the new sales trends

CONSUMERS

Sustainability
Safety
Affordable prices

TMHM

Material handling context

RETAIL TREND

Digitalization
Automation

Case studies

Food sales services

Click&Collect (supermarket)

Carrefour Drive

Click&Collect (locker)

Locker Esselunga

Automated delivery

Robot Starship Technologies

Casherless shops

AiFi Oasis

online shopping

on-site shopping

Delivery services

Delivery boxes

Boxillion

Drones

Drone UPS

Robots

Robot FedEx

Locker

Amazon

In-Car delivery

Smart
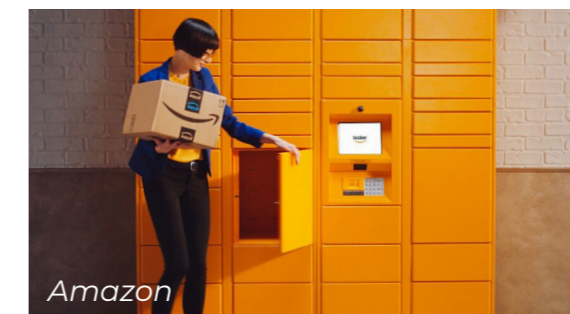
point to point

collection point

Case studies

Results

Locker

Spacing
and hygiene

Preliminary investigation to encourage the use of lockers by the Autorità per le Garanzie nelle Comunicazioni, because it is *"the most suitable for a scenario of physical distancing over time"*

Casherless shops

Autonomous choice of products

Evaluation parameters

· Contactless payment
· Binding delivery time
· Automation
· Probability of failed delivery
· Sustainability
· Limited number of products
· Controlled temperatures

Competitors

Robomart

ROBOMART	
Payment	contactless
Products tracking	RFID tags and cameras
Products temperature	controlled
Inventory check	automatic
Products	prepackaged
Assistance	mobile application
Autonomous driving	level 5 with human control
Autonomy	128 km (80 mi)
Internal volume	2 m³ (70 ft³)
Service	payment call
Use of the service	mobile application
Business	vehicle and platform license to dealers

Weaknesses

- Excessive use of packaging
- Call payment
- Binding to possession of the application

Enabling technologies

Autonomous driving

Type of autonomous driving: Automated Driving System that allows **driving without a driver** (level 5)

Product tracking

Complete automation for **contactless shopping**: need to scan products via computer vision (HAR sector - Human Activity Recognition)

Contactless payment

Decreased physical contacts to reduce the chance of contagion. Purchases enabled by **approaching** the payment method with RFID technology (cards) or NFC (devices)

Target users

The definition of the user target to which the product is aimed was identified by analyzing the trends of consumer preferences.

It was decided to address those users who care about sustainability and the ethics of the product with a short supply chain to allow prices to be reduced.
This is typical of consumers adhering to Solidarity Buying Groups, but considering the new general propensity of citizens in technology.

Smart attitude

Low prices

Sustainability

Local products
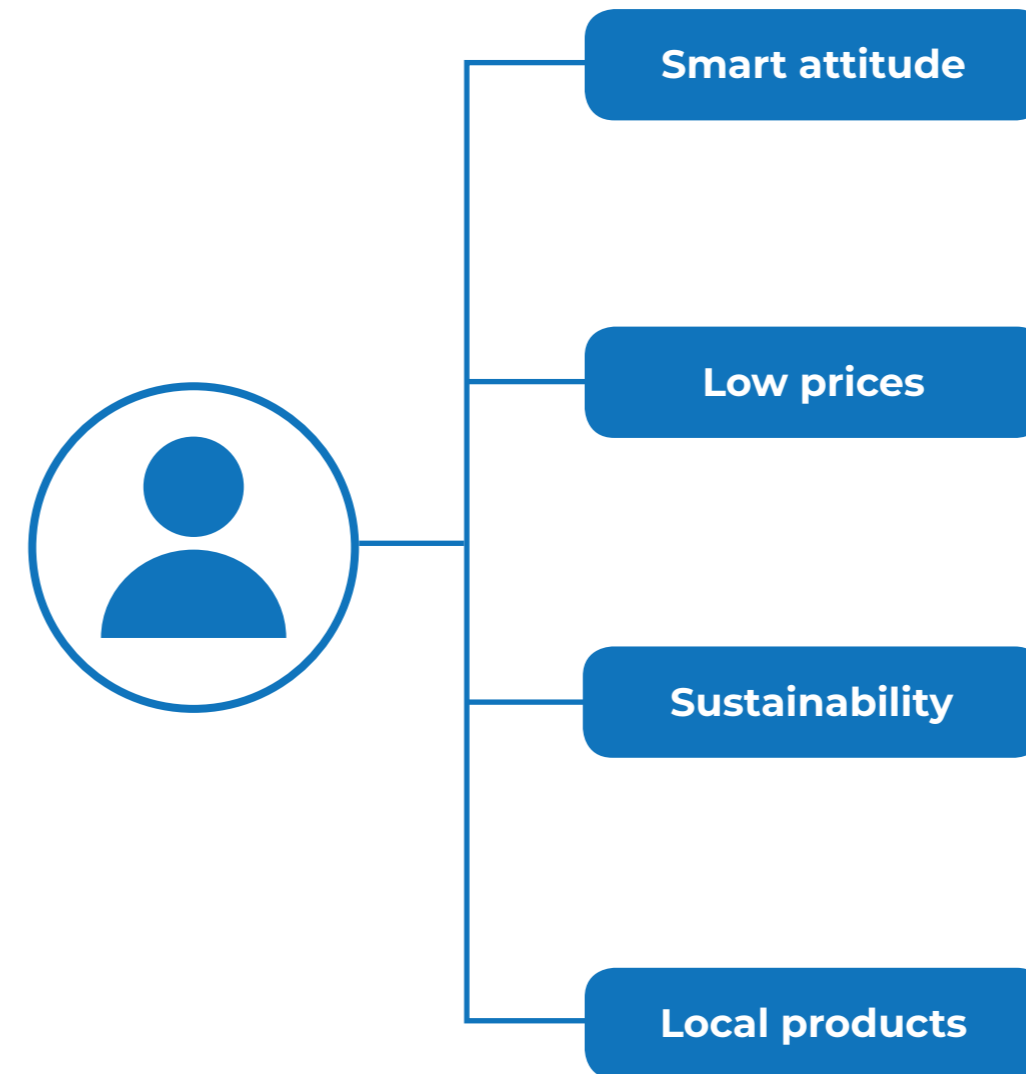
4. Project

Concept

Design of an autonomous electric vehicle for the sale of sustainable food, coming directly from the producers and purchased in a safe and contactless way.

Product
Design limits

The technology to be taken into consideration for sizing must allow to **preserve** food, **power** the vehicle, allow **autonomous driving**, **track products**.

EPAL - European standard pallet

1200

800

4200-4500

1700-1900

~1600

1400-1500

~1500 (5° percentile)
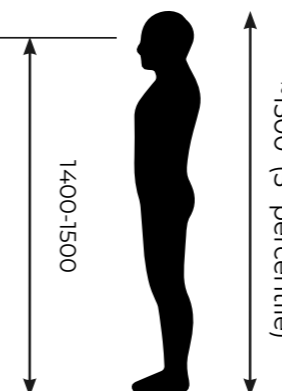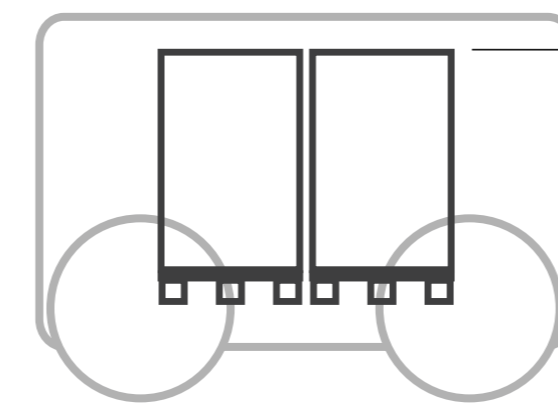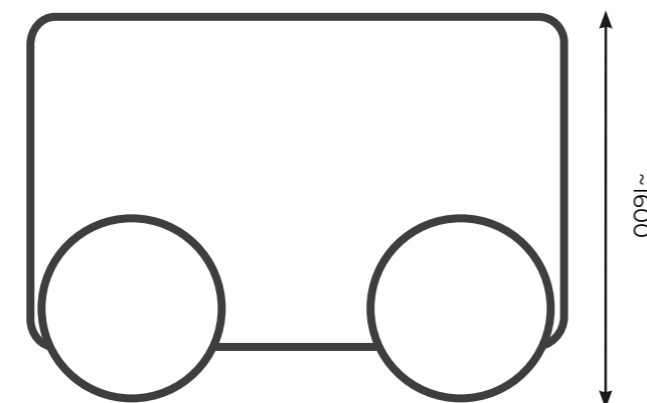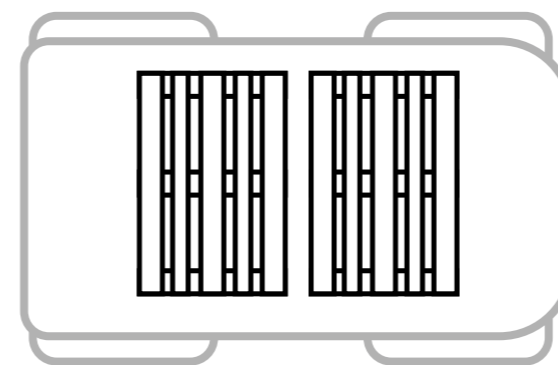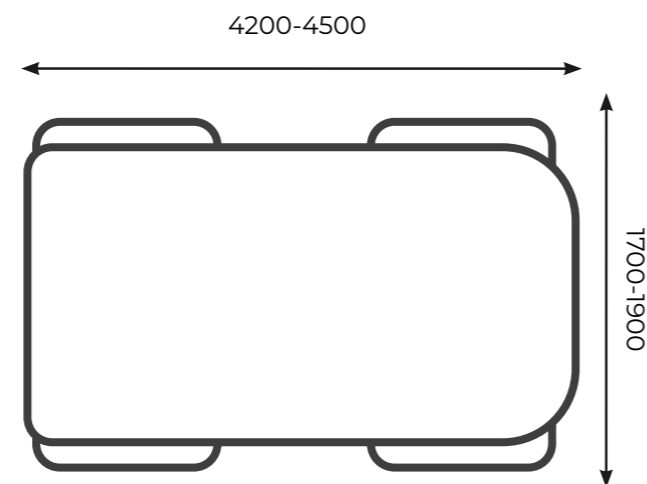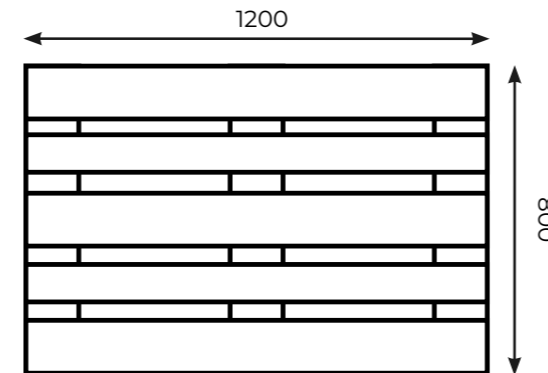
- Dimensions suitable for **road travel**
- **Europallet** dimensions as a starting element for agility of **loading-unloading operations**
- Spaces for the insertion of **technology**
- Maximum height that allows **viewing of the products**

Product

Formal research

Electric and autonomous vehicles trend
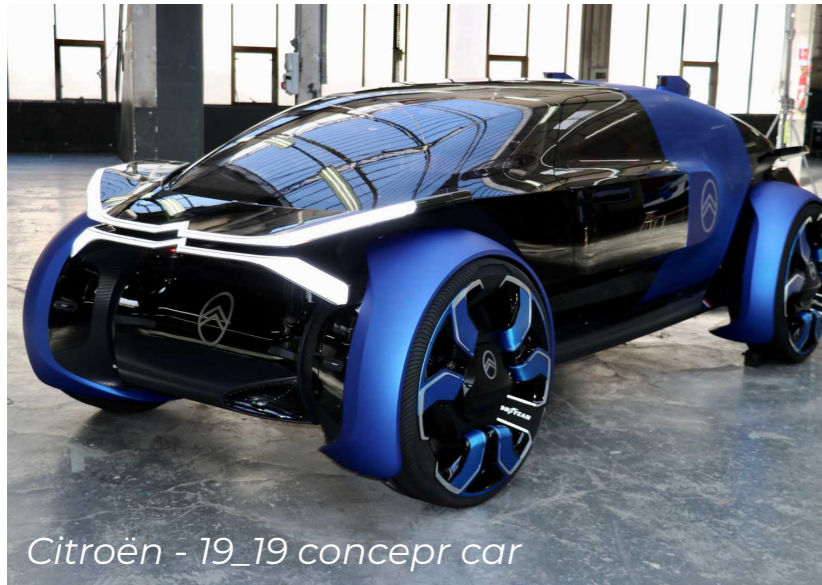
Urban transport trend:

Last mile trend:

Material handling trend:

Citroën - 19_19 concepr car

Bosh - IoT shuttle

Renault - EZ-Pro

STILL - cubeXX

Renault - EZ-Go

Amazon - Zoox robotaxi

Mercedes - Vision Van concept

Doosan - Forklift concept
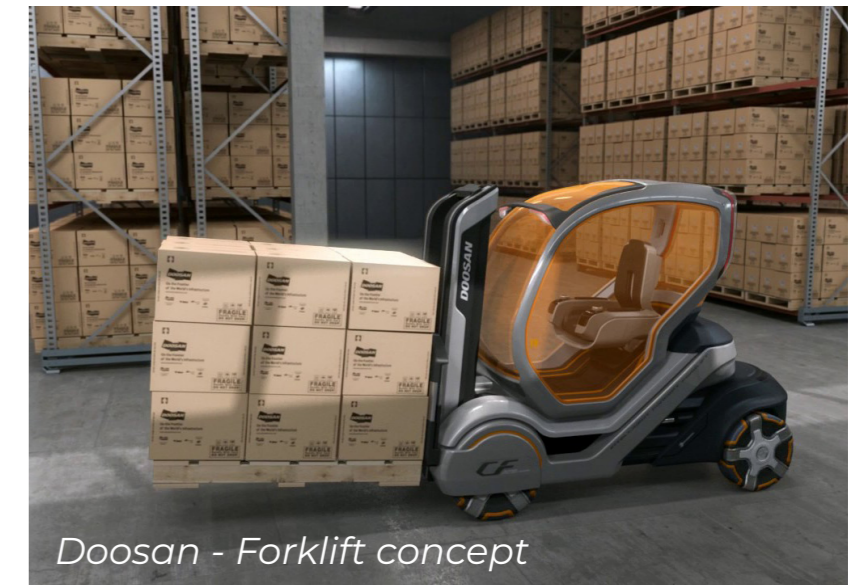
Product

Formal research - Toyota Material Handling

Electric counterbalanced trucks:

Toyota Traigo 48, 4 wheels 2.0t

AI Team Logistics - warehouse of the future:

Toyota Pallet Drone
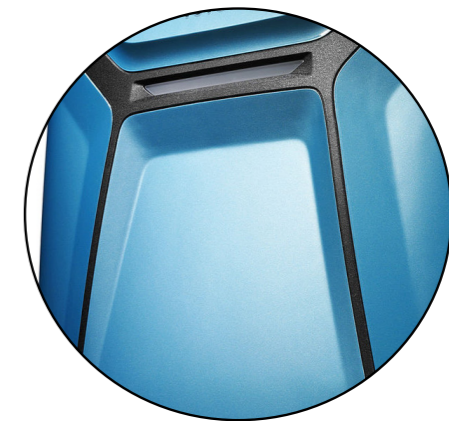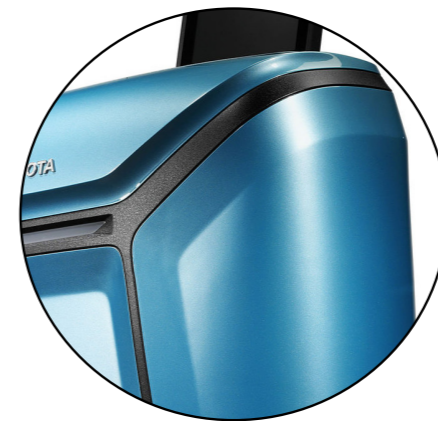
Product

Ideation

Sketch phases
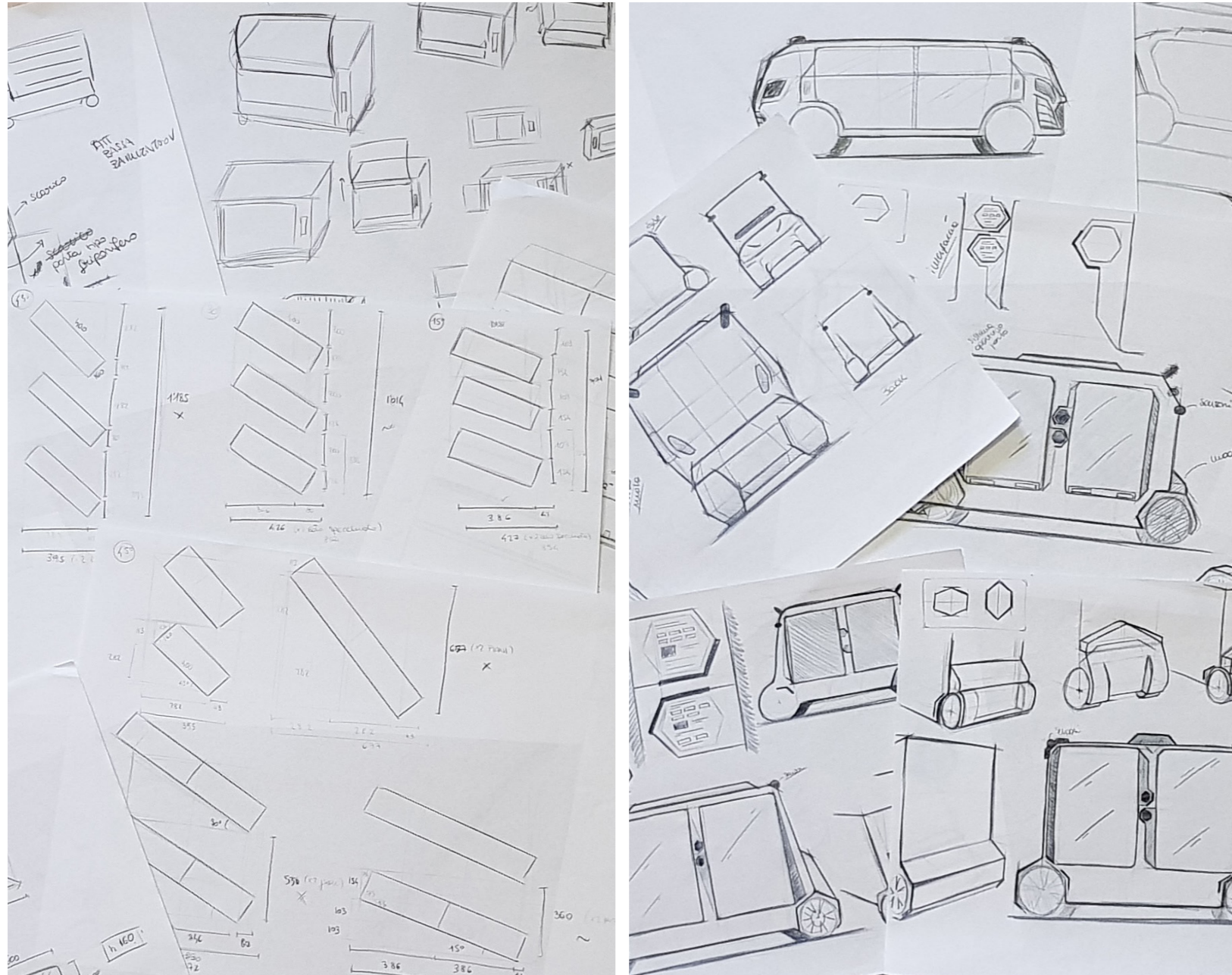
Dimensional and formal analysis
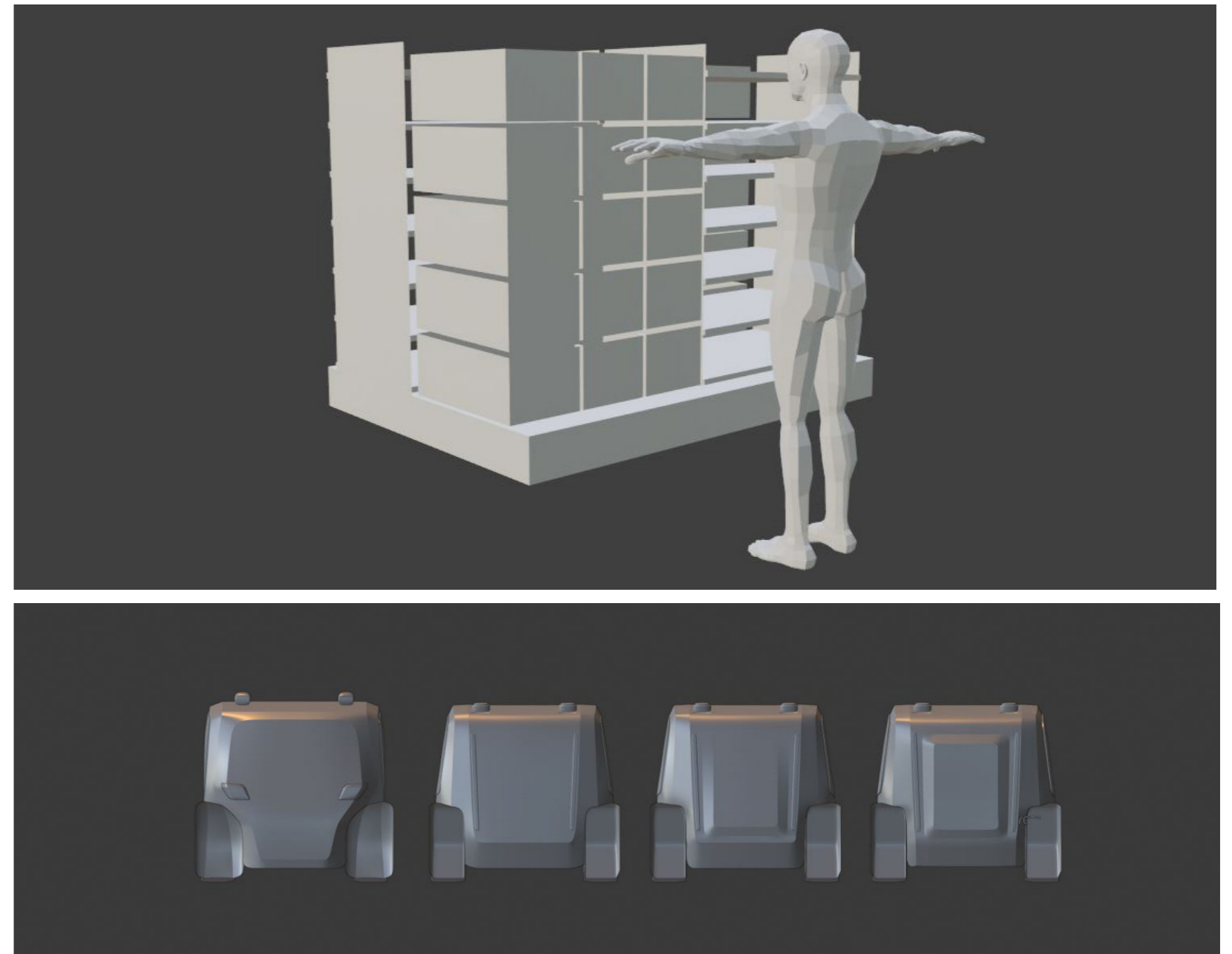
Product

Final shape and dimensions

The formal solution chosen deliberately differs from the appearance of a car, in order to make the different purpose clear.
It looks like a **massive and symmetrical** vehicle with **simple surfaces** to which **movement is given through creases** that determine the changes of direction.
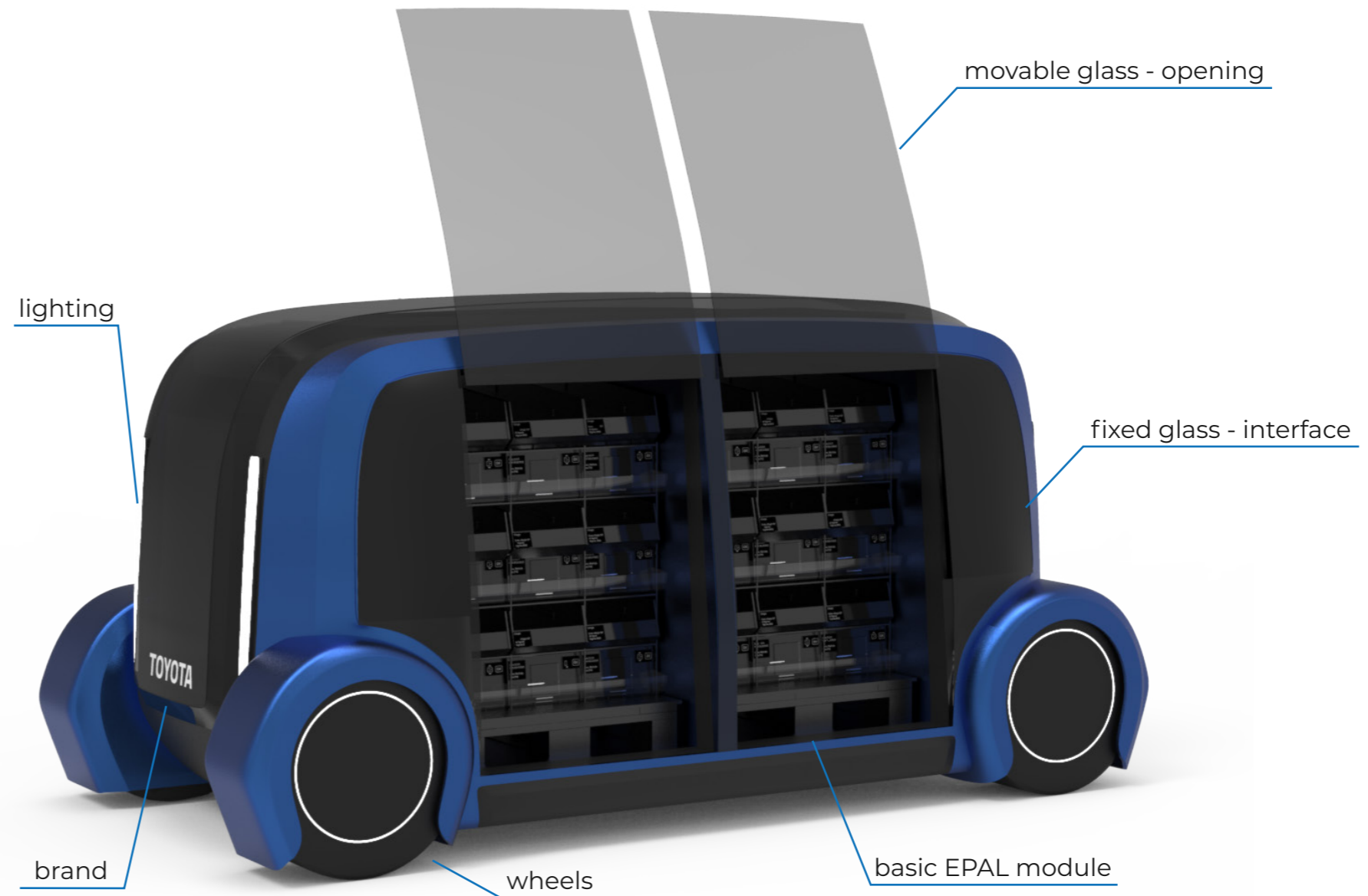

Side

Front

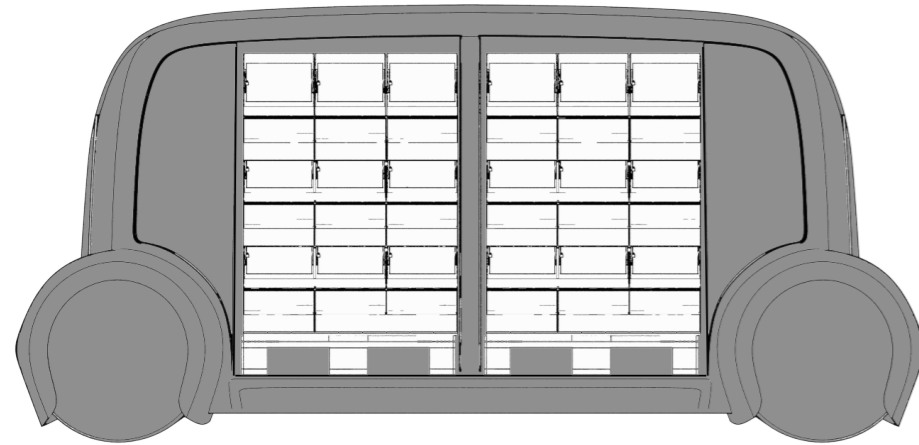*Top*

Perspective
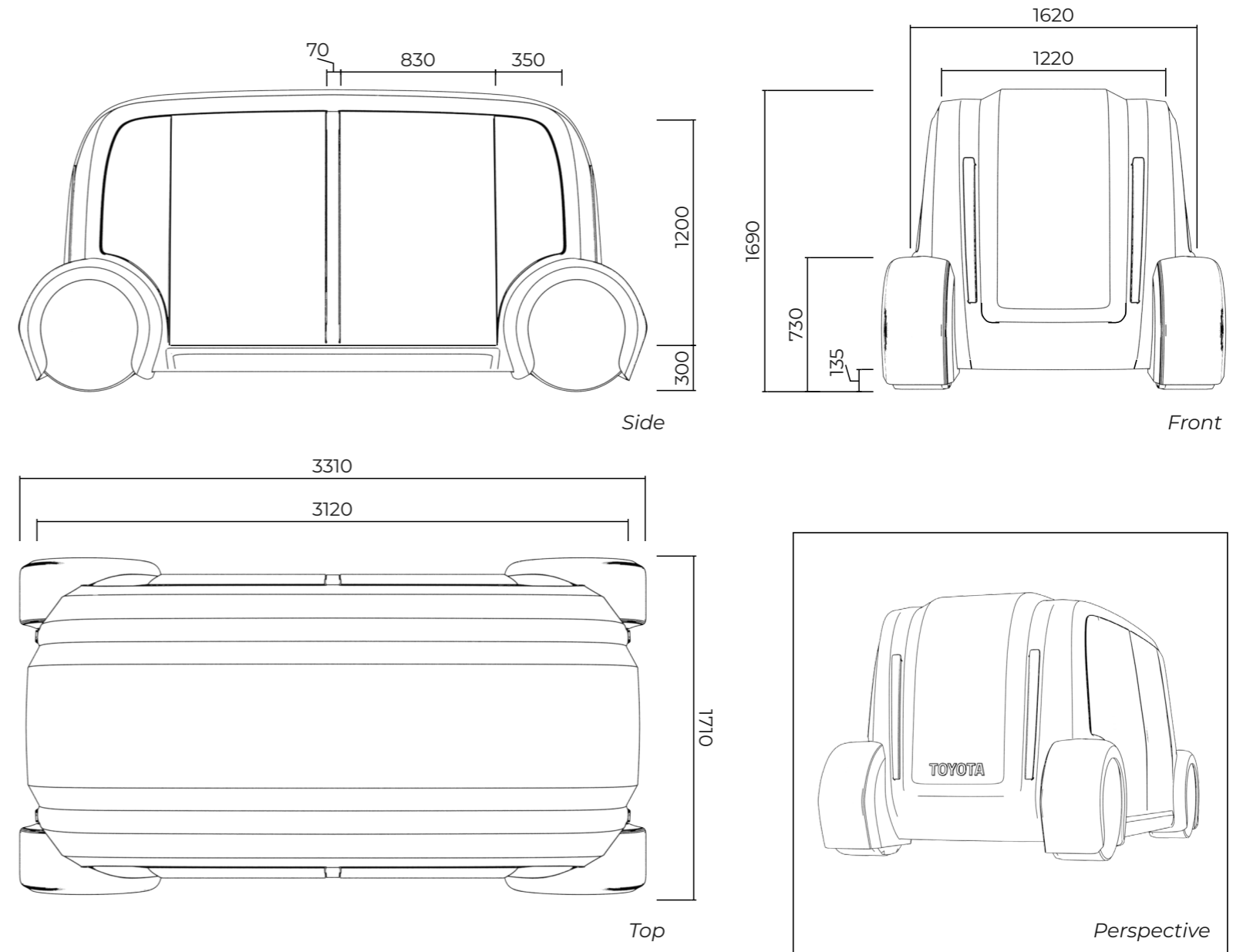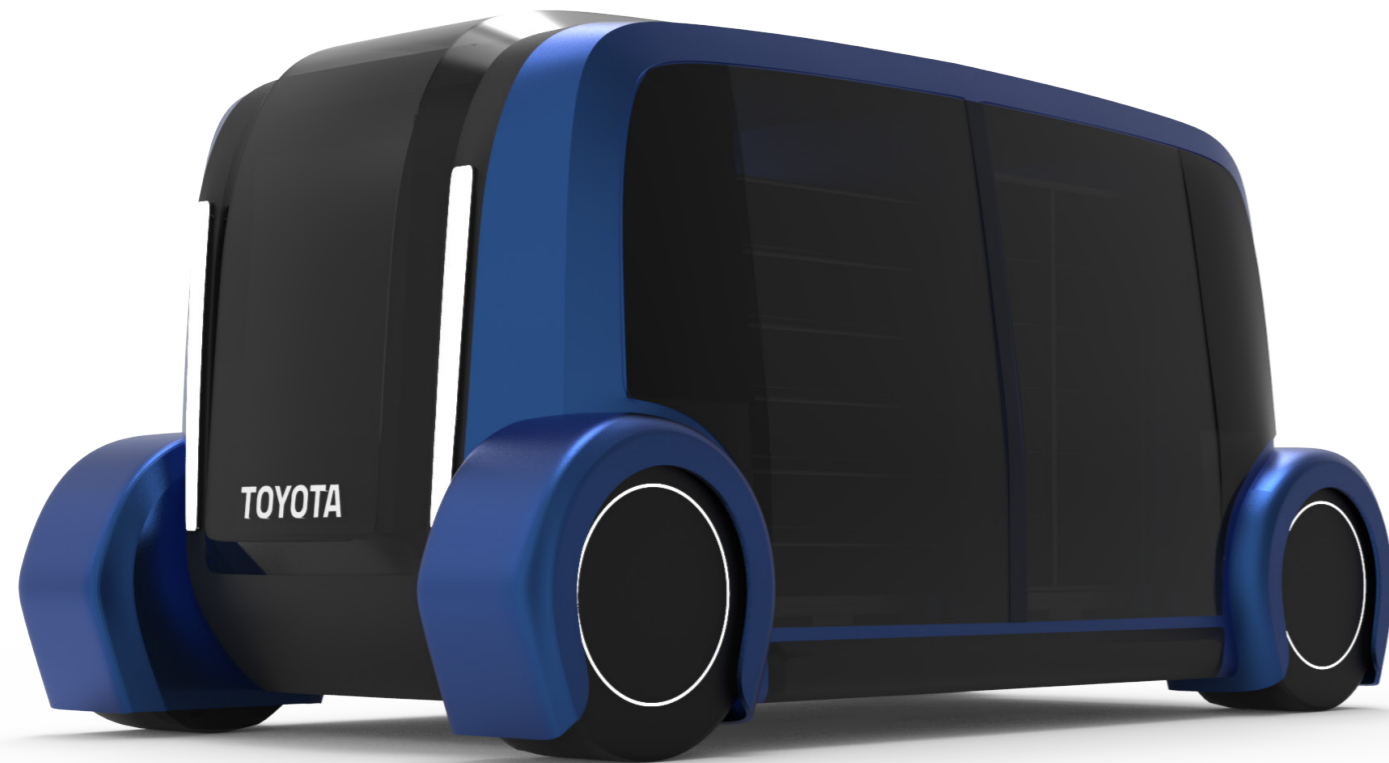
Product

Components

The vehicle was built starting from the **basic EPAL module** which is the fundamental component.

Given the initial limits, it was noted that it was possible to insert **two** EPAL modules in each machine.
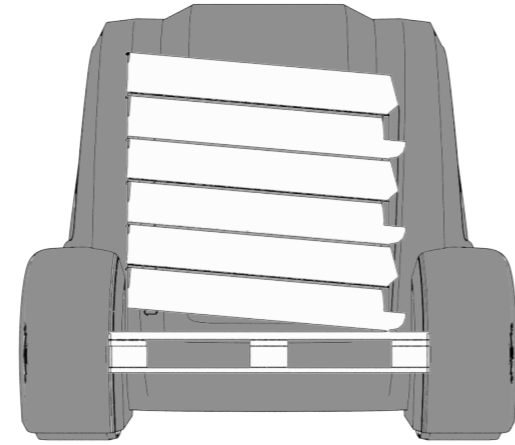
movable glass - opening
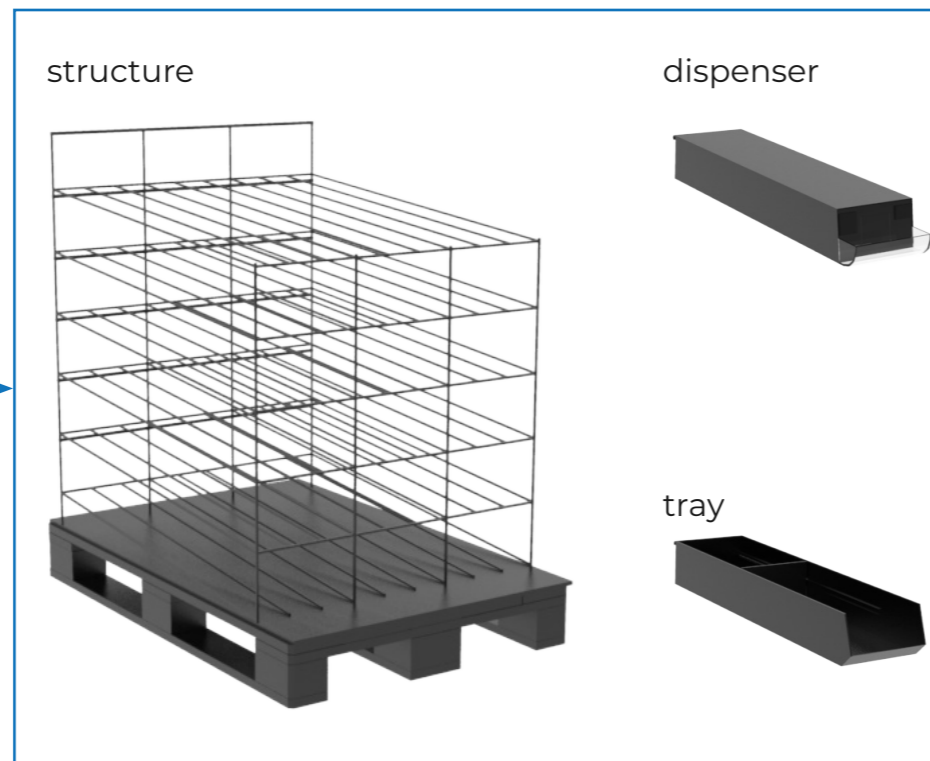
lighting

fixed glass - interface

brand

wheels

basic EPAL module

Product
Basic EPAL module

Side

Front

Structure

980   150

1400

800   1200

structure

dispenser
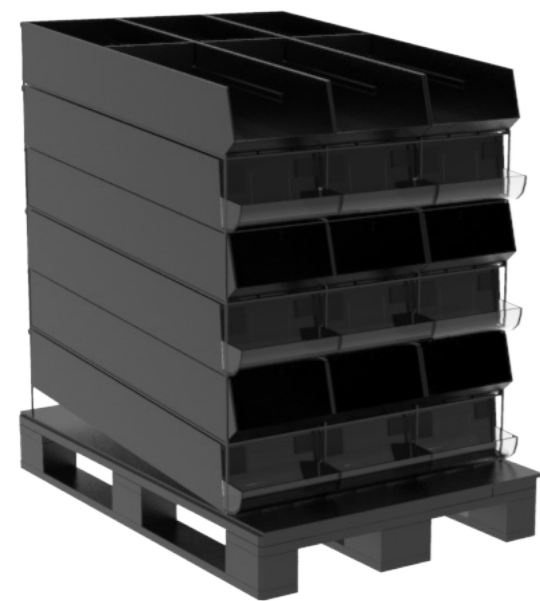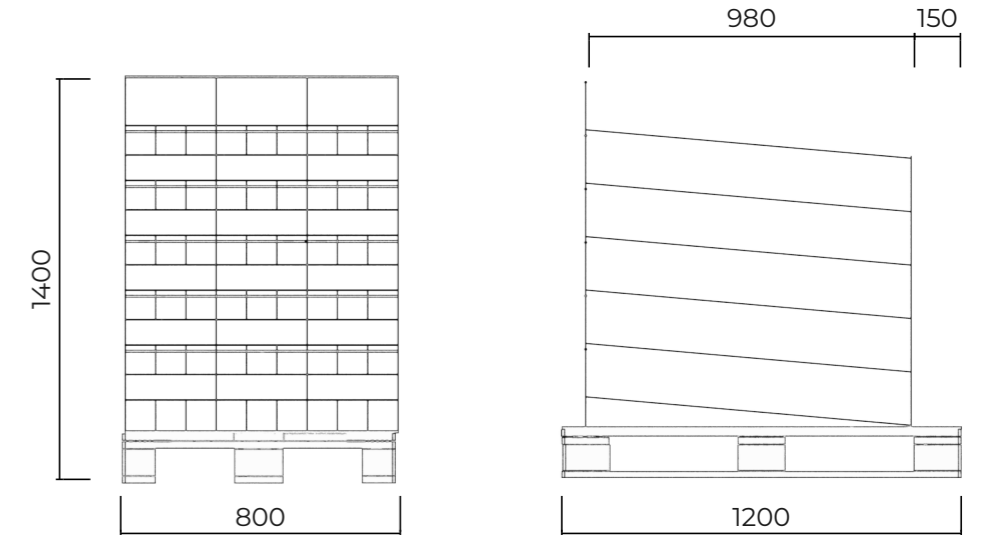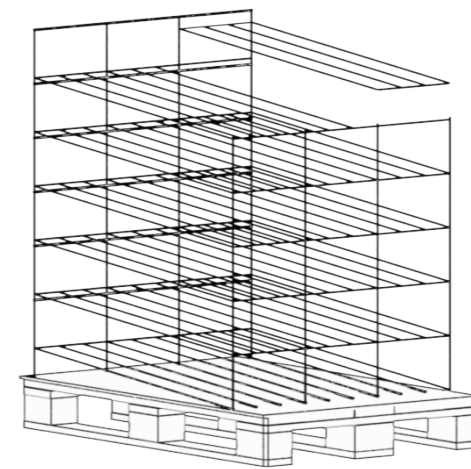
tray

The structure has removable grids to **facilitate the insertion and extraction** of dispensers and trays during the loading-unloading phases. It has a slight slope in order to keep trays and dispensers **tilted** to facilitate the display and release of products.
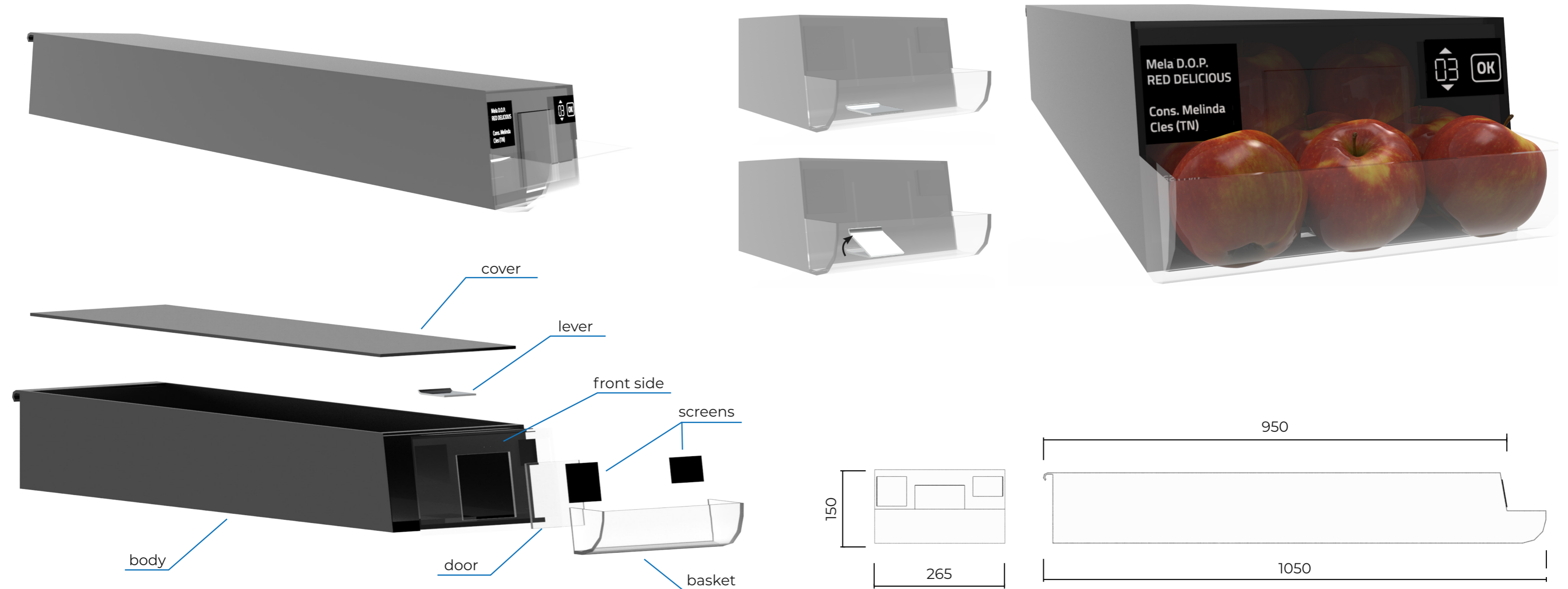
The **dispenser** allows you to dispense **bulk** food products that can be easily sorted mechanically while keeping the products hygienic because it avoids direct contact.
The **tray** accommodates all the other products that need to be packaged. The packaging involves **sustainable** packaging in compostable cellulose fiber or pulp. It is also possible to insert paper bags in the trays to pack the products. they are also assumed to be sustainable in PEFC (Program for Endorsement of Forest Certification) certified paper.
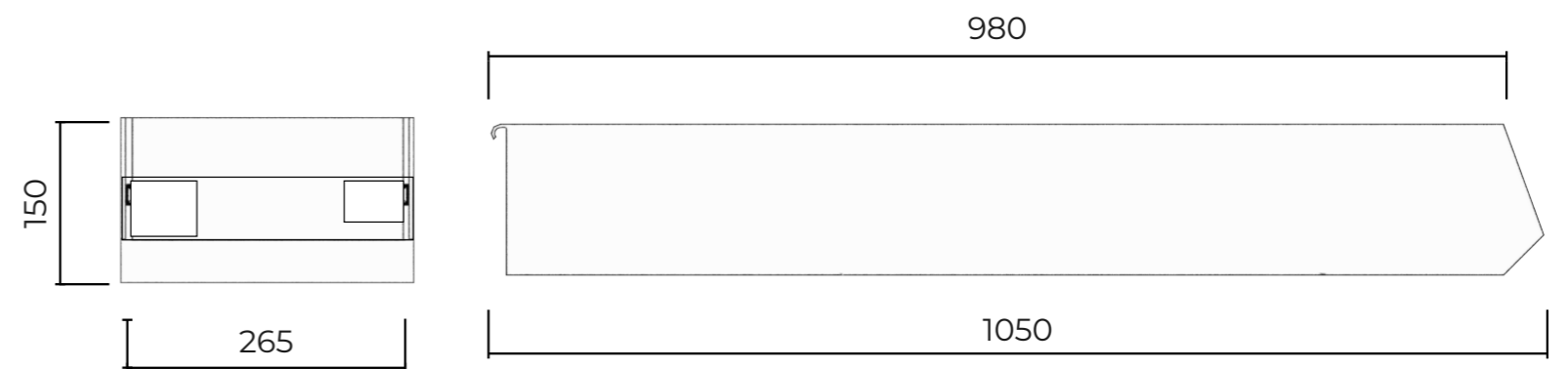
Product

Basic EPAL module

Dispenser

cover

lever

front side

screens

body

door

basket

Mela D.O.P.
RED DELICIOUS

Cons. Melinda
Cles (TN)

150

265

950

1050

Product
Basic EPAL module

Tray

plate

thrust system

body

front cover

screen

Ciliegie
Cons. ciliegia IGP di Vignola
Vignola (MO)

980

150

265

1050

Product

Other components

control module

battery module

refrigetation module
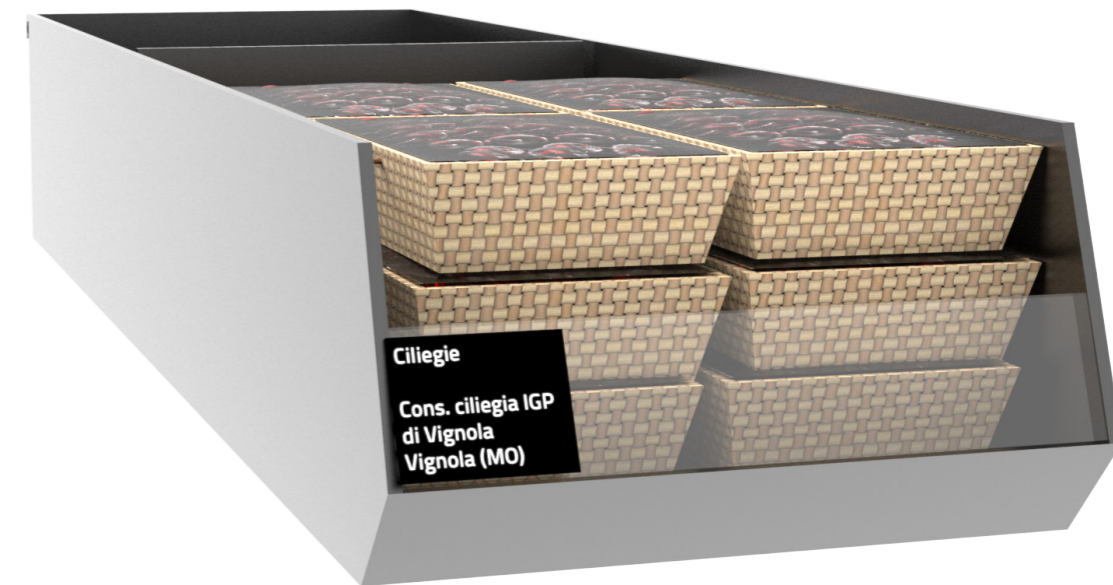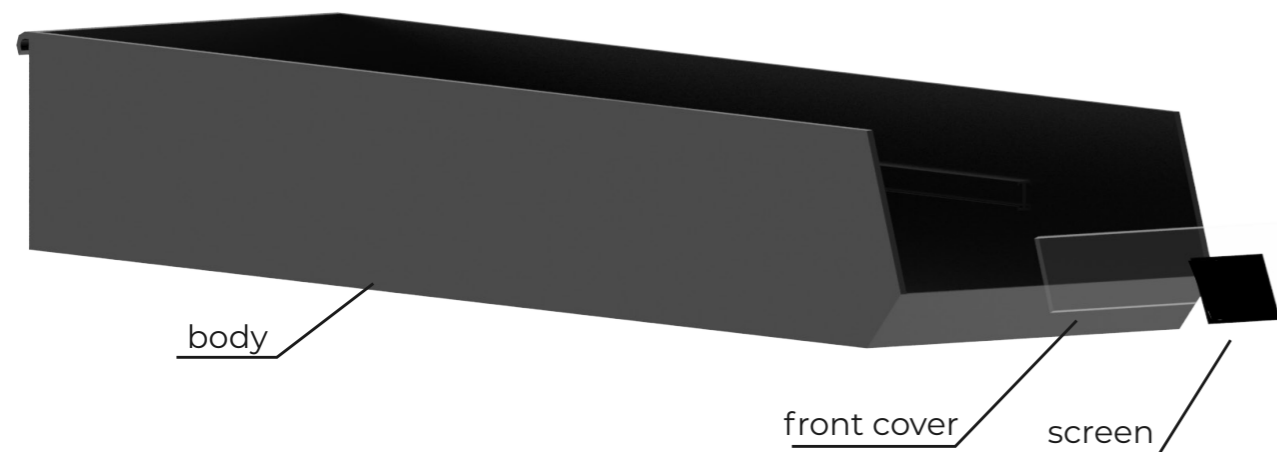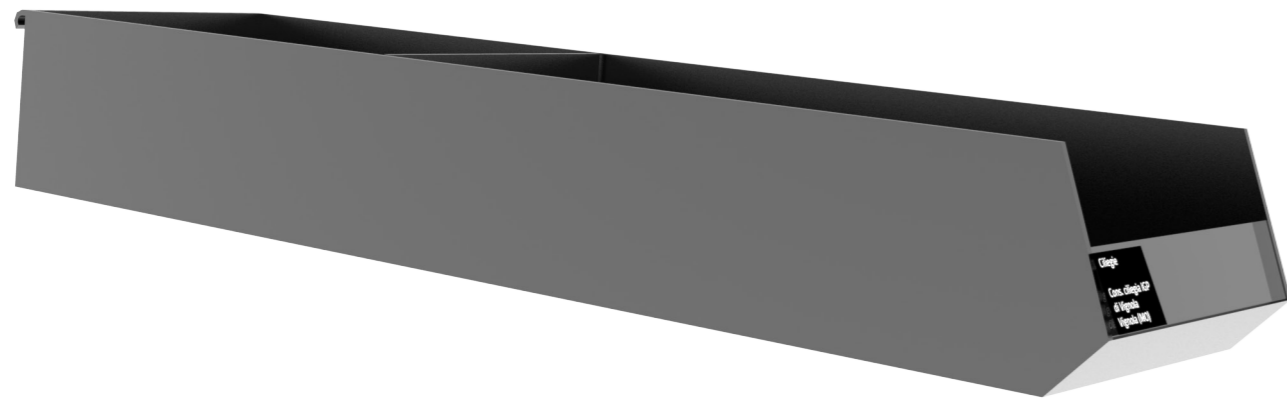
front screens
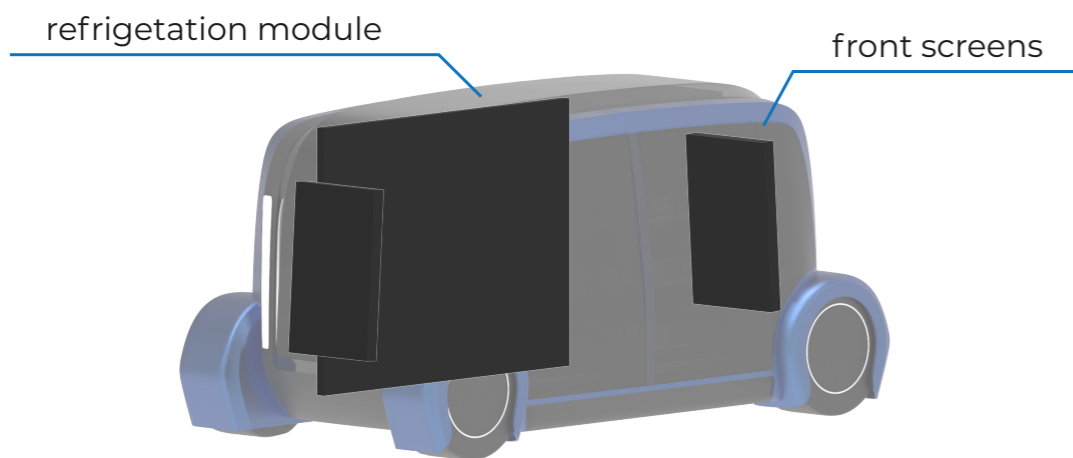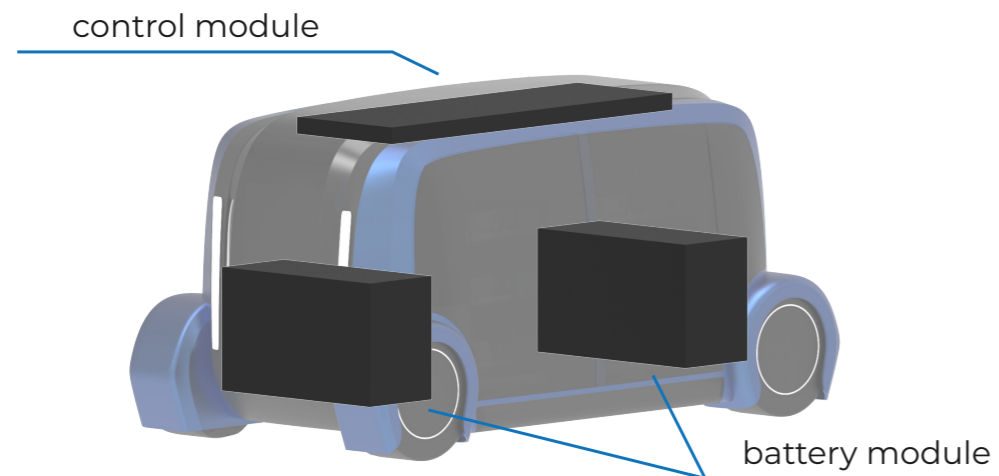
- The **control module** is located at the top of the vehicle to ensure easy access to the parts for wiring

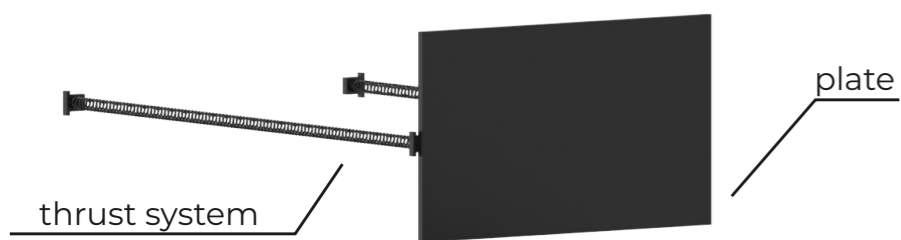- The **battery module** is in the front and is located at the bottom for a good management of the center of gravity. It is made up of lithium-ion batteries. which are also found in Toyota Material Handling forklifts

- The **refrigeration module** is located on the back of the EPAL basic modules

- The **front displays**, on which the Toyota logo has been inserted and on which the name of the service will be positioned, can also act as an information or advertising display (OLED technology)

Product
Other components

autonomous driving sensors

cameras module

interface screens

lifting module
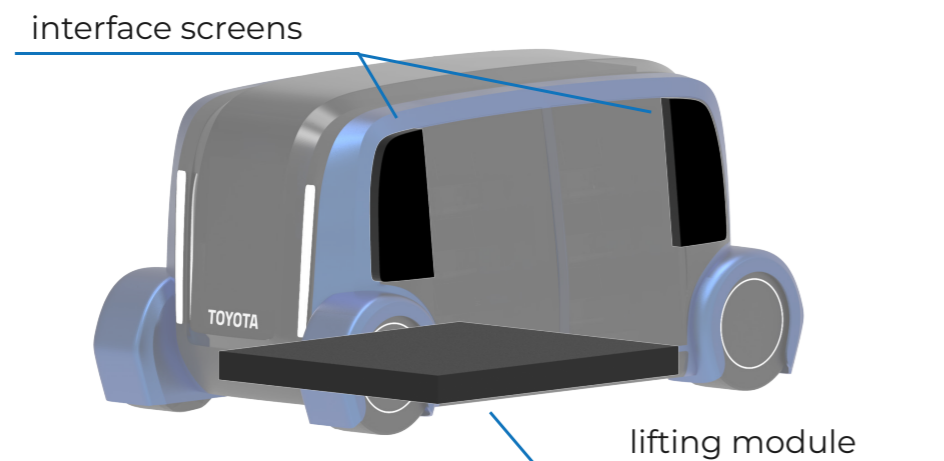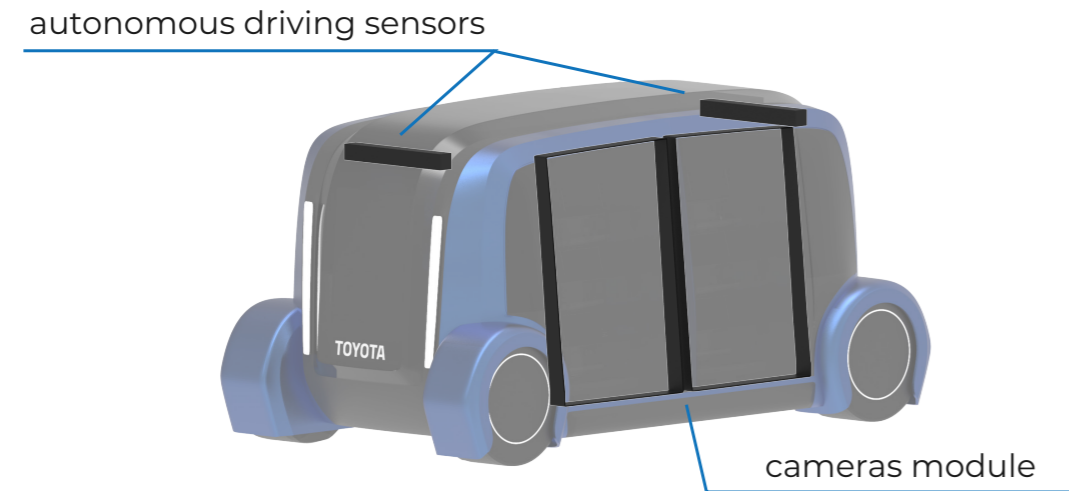
- The **autonomous driving sensors** (lidar, GPS, and cameras) are placed at the top front

- The **camera module** for product tracking consists of a depth camera system

- The **interfaces** are placed laterally next to the respective EPAL modules (OLED technology)

- The **lifting module** is located under the EPAL modules and is a platform that is activated for loading-unloading activities

System

Inspired by lockers and shops without cashiers, the service consists of a **fleet of vehicles** that are positioned at **checkpoints** that are identified based on **places of interest** with large flows of people: squares, near public transport stops, car parks, petrol stations, residential areas with a high demographic density, areas with a high concentration of offices and near points of commercial or cultural interest.
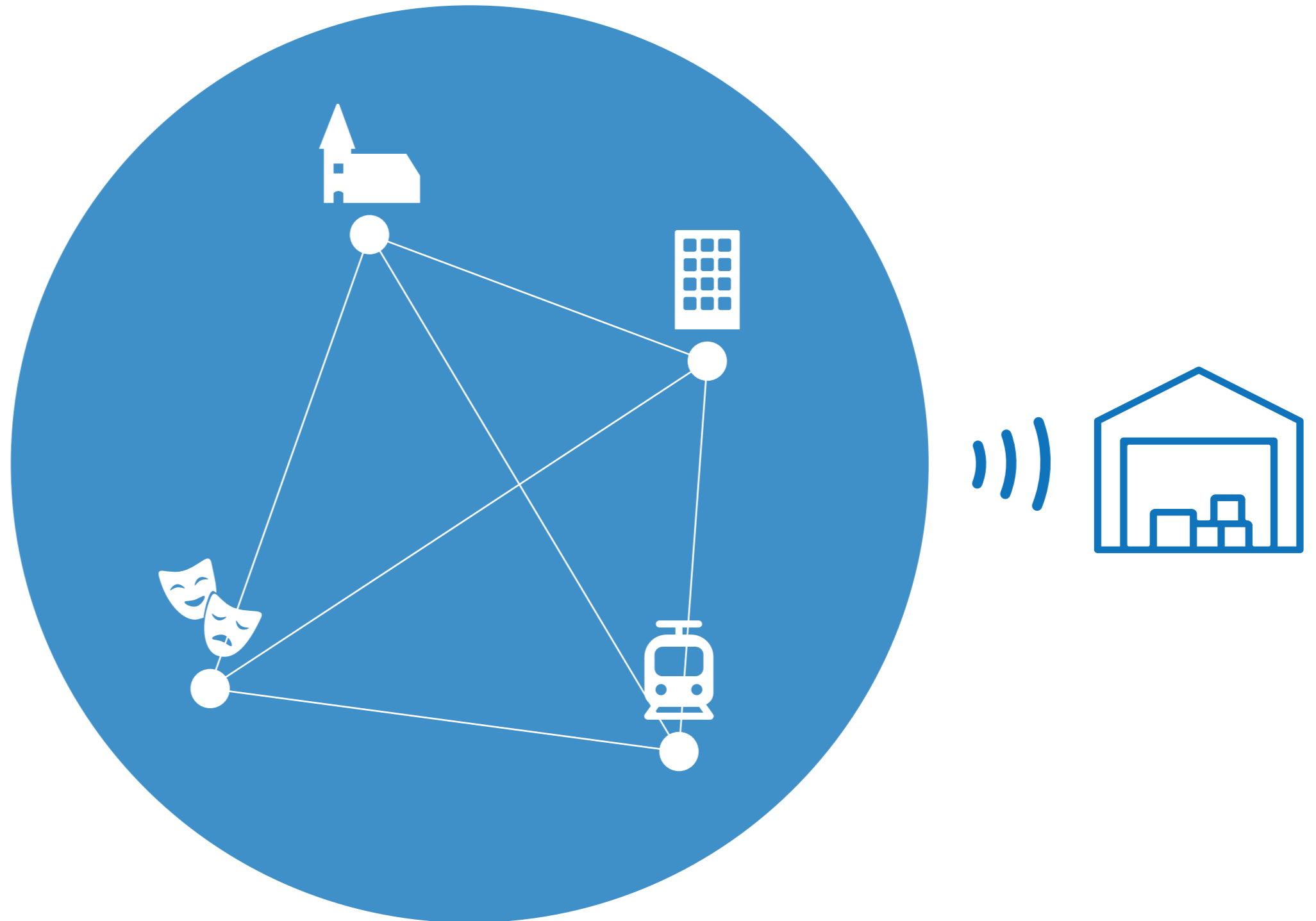
System

The vehicles communicate with the warehouse to exchange information on the **status of the stock of the EPAL modules** loaded on machines, on the **status of the vehicle** and on the **routes to reach the checkpoints** where they are stationed until stocks last.
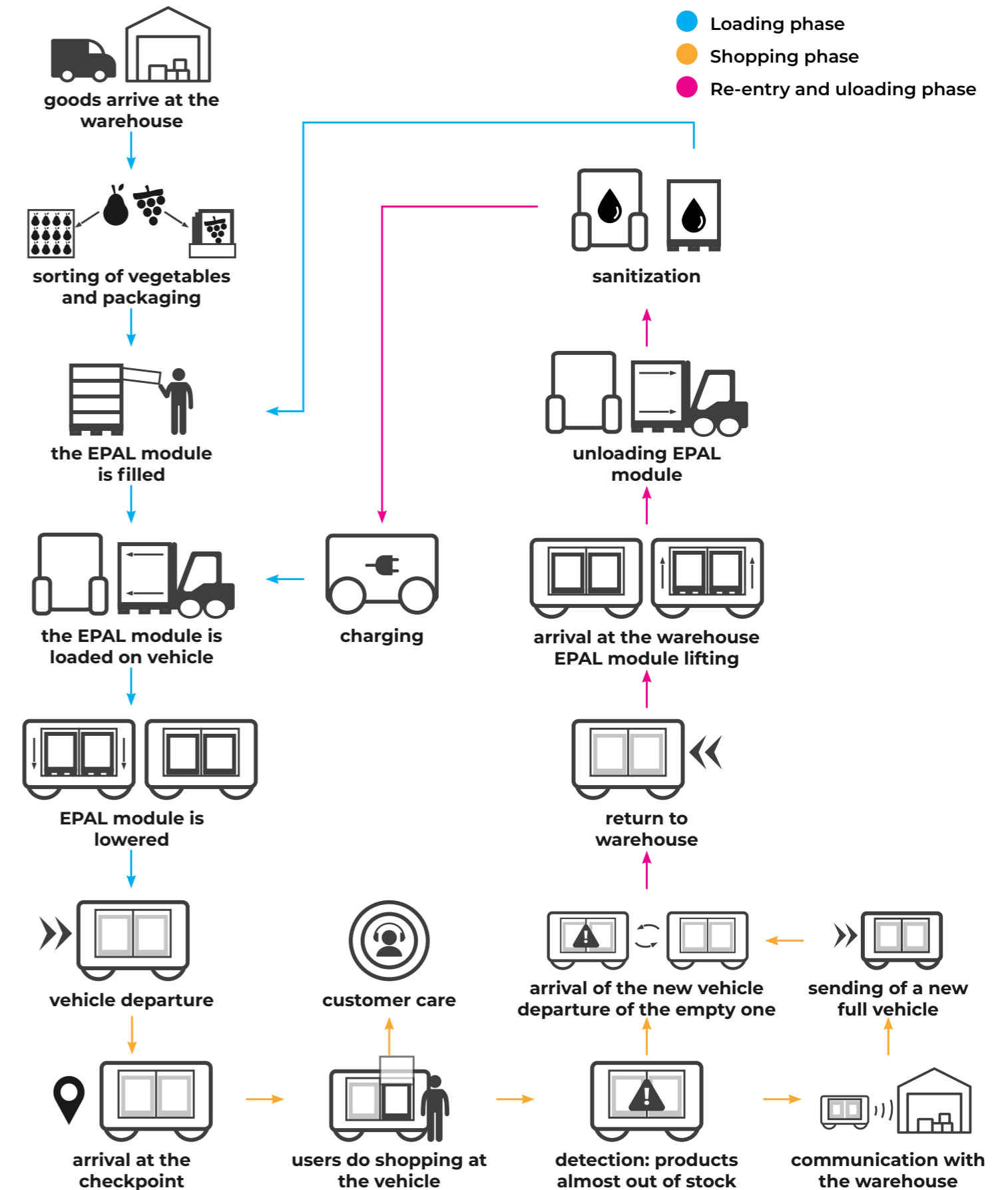
Loading phase

The workers place the food supplied by the farmer in the basic EPAL modules which are then picked up and **loaded with the forklifts** inside the vehicle. The vehicle closes the doors and drives to the checkpoint.

Shopping phase

Once the checkpoint is reached, the vehicle **remains parked** to allow users to **purchase the products**. Through the interface, consumers interact with the vehicle and from that moment the transaction is activated, the tailgate opens. The user picks up the products that are automatically added to a virtual cart.

Re-entry and unloading phase

When the products are about to finish, the vehicle sends the **information to the warehouse** which sends a load machine to the checkpoint. Once it arrives, the empty one returns to the warehouse to be sanitized and **load new products**. When the empty vehicle leaves, the full one takes its place, guaranteeing continuity of service.

37

- ● Loading phase
- ● Shopping phase
- ● Re-entry and uloading phase

goods arrive at the warehouse

sorting of vegetables and packaging

the EPAL module is filled

the EPAL module is loaded on vehicle

charging

EPAL module is lowered

vehicle departure

customer care

arrival at the checkpoint

users do shopping at the vehicle

detection: products almost out of stock

communication with the warehouse

sending of a new full vehicle

arrival of the new vehicle departure of the empty one

return to warehouse

arrival at the warehouse EPAL module lifting

unloading EPAL module

sanitization

Identity

HIVE

Titillium regular

HIVE

HIVE

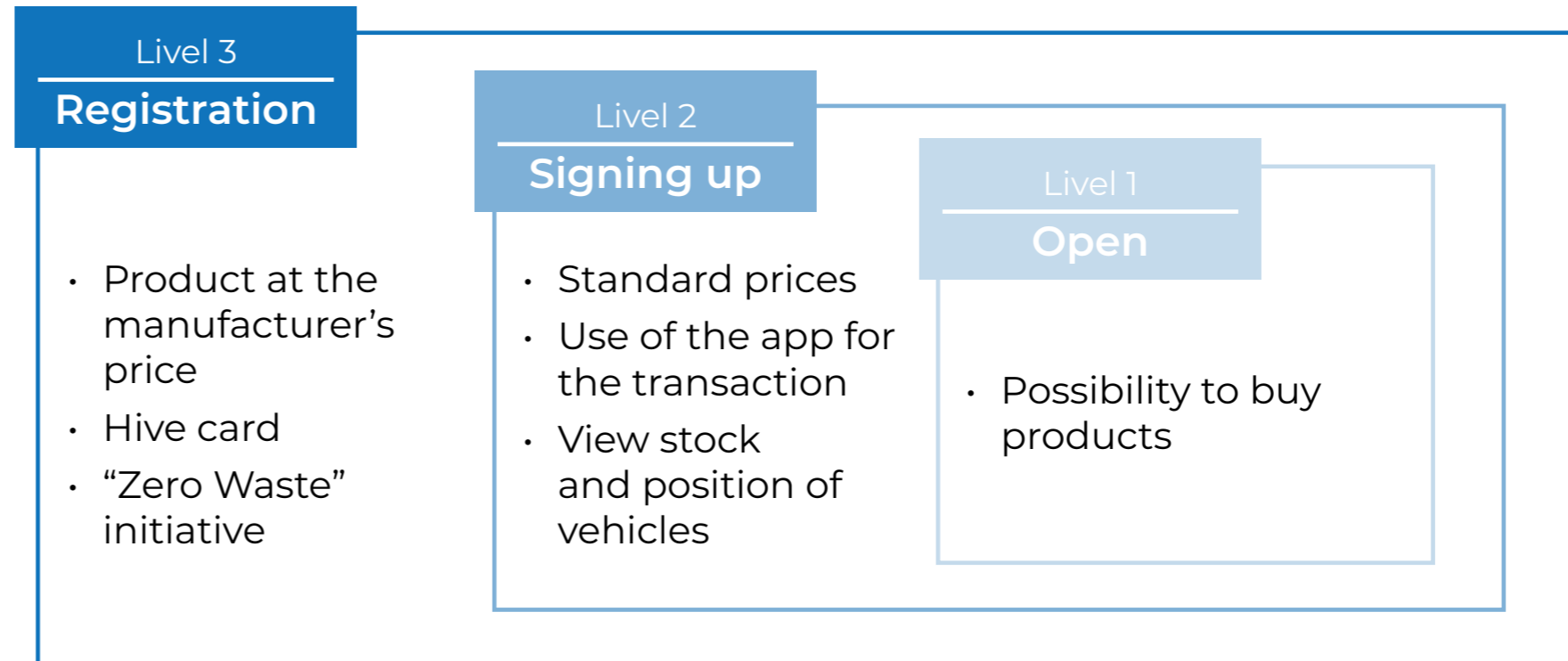| R: 29 | R: 141 | R: 210 | R: 225 |
| G: 113 | G: 182 | G: 225 | G: 225 |
| B: 184 | B: 219 | B: 240 | B: 225 |

The system consists of **fleets of vehicles** that transport food and products from the warehouse to the checkpoints, then return to the warehouse to refuel.

This system resembles that of the **hive**: many bees that perform tasks, move away from the hive and then return with the necessary resources in a harmonic system.
The parallelism led to the choice of the name **"Hive"**.
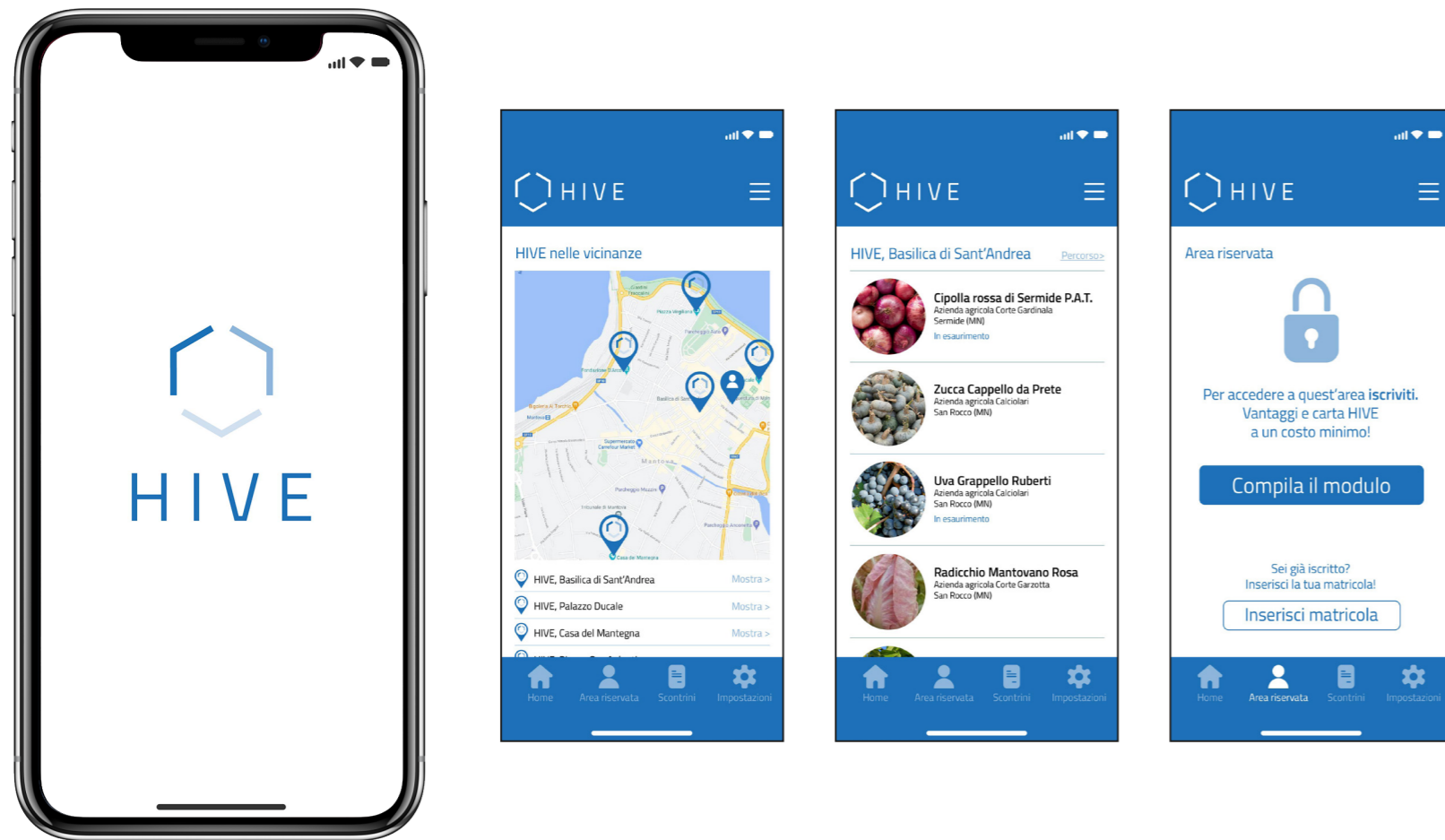
Service

Service structure

The service is structured on different **levels of accessibility** to guarantee advantages linked to the strength of **customer loyalty**.

Level 3
Registration

- Product at the manufacturer's price
- Hive card
- "Zero Waste" initiative

Livel 2
Signing up

- Standard prices
- Use of the app for the transaction
- View stock and position of vehicles

Livel 1
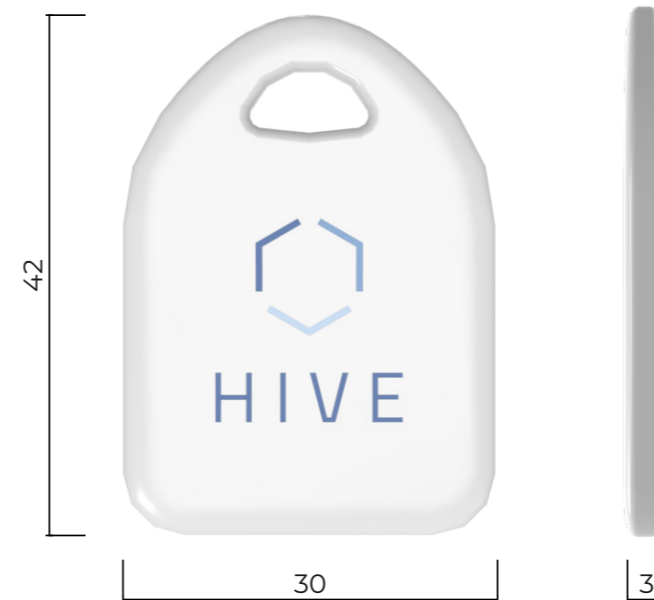**Open**

- Possibility to buy products

Service
App and Hive card

App

Hive card

Through the application, the user can create a profile. In this way he will be able to see the **position of the vehicles** in real time, check their **stock**, **pay** from the device by viewing the **receipt directly from the app** to limit the use of paper.

Registered users will receive the **Hive card**. This allows you to **streamline the experience** by carrying out the shopping without having to use the application, payment card or any other device used for contactless payment.
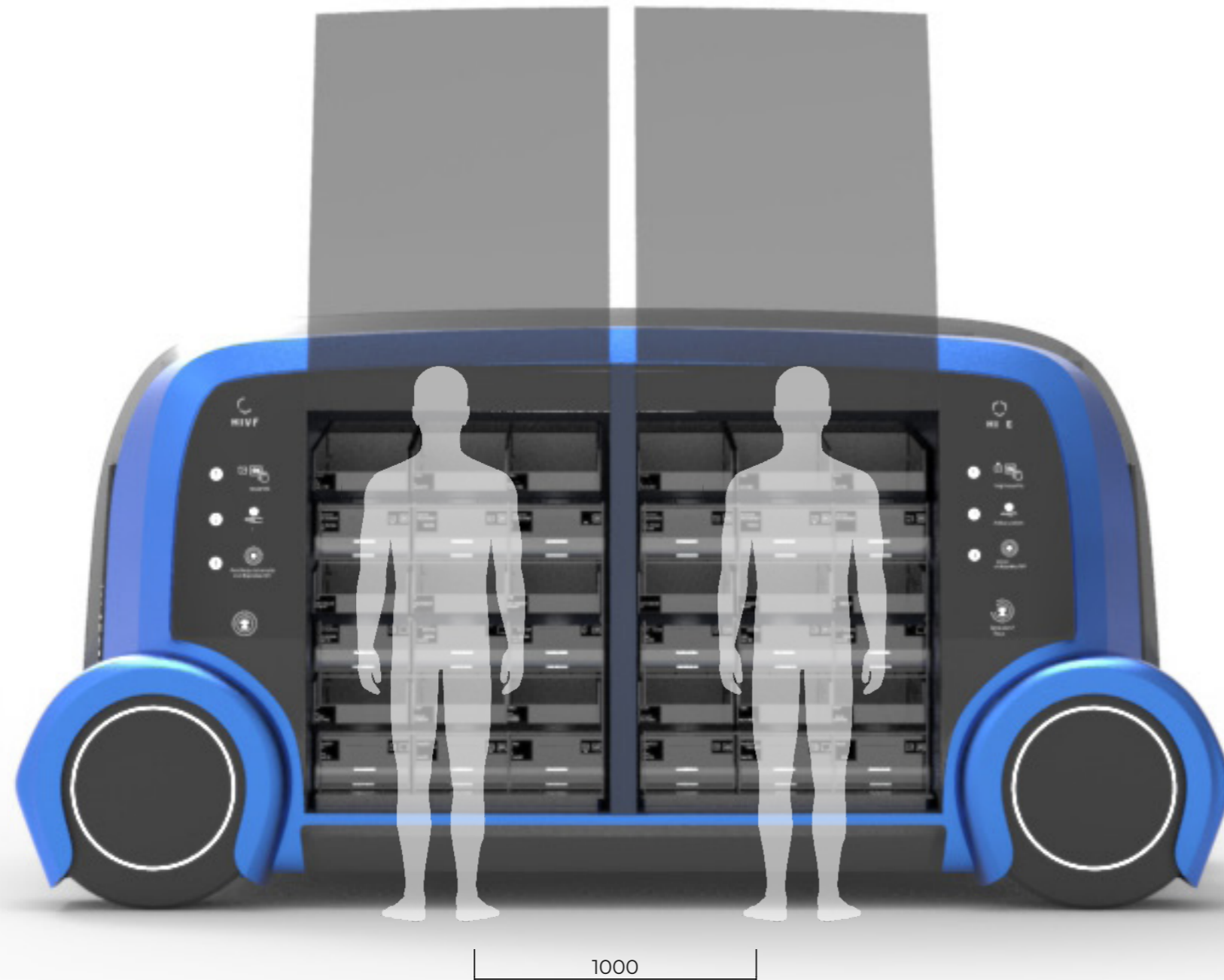
Loading - unloading
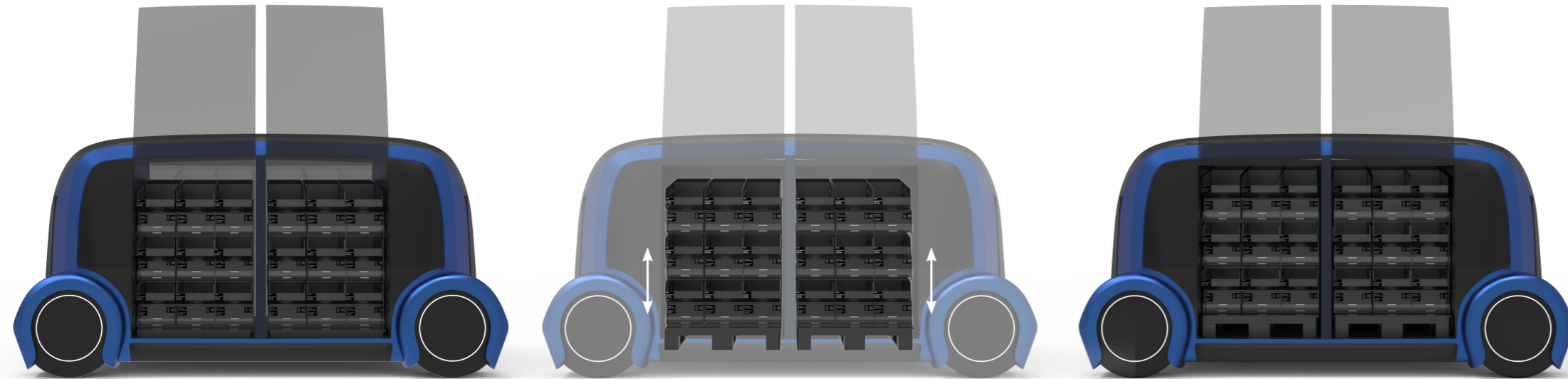
Interfaces

User experience

1000

- The **interface** guides the user making it easier to approach the new purchasing method
- The vehicle can be used by two users at a time ensuring **social distancing**
- The totally **contactless** approach ensures hygiene
- Checkpoint positioning allows you to easily reach vehicles according to your schedule, **saving time**

Scale prototype

5. Conclusions

Future scenarios and conclusions

Thanks to the **modularity** of the EPAL basic modules, Hive can be **customized** according to needs.

- Evolution of the sales model not only for foods but also as a **support to small artisans** to expand their users.

- The vehicle could be used as a **locker**, to strengthen **home deliveries** that have also developed among small artisians, grouping orders for area.

- Evolution of an **"on call" service**, regardless of the type of item sold, to provide a profitable service even to **people with reduced mobility**.

Conclusions

Hive is a new sales model for **proximity trading inspired by Solidarity Buying Groups**.

It aims to improve the quality of life by providing **sustainable service and products** thanks to the support of **enabling technologies**.

This allows to satisfy the **new needs of customers** that are born with the Covid-19 pandemic that are destined to remain.

Thank you.