

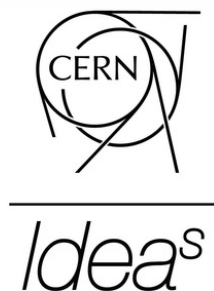
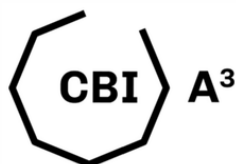
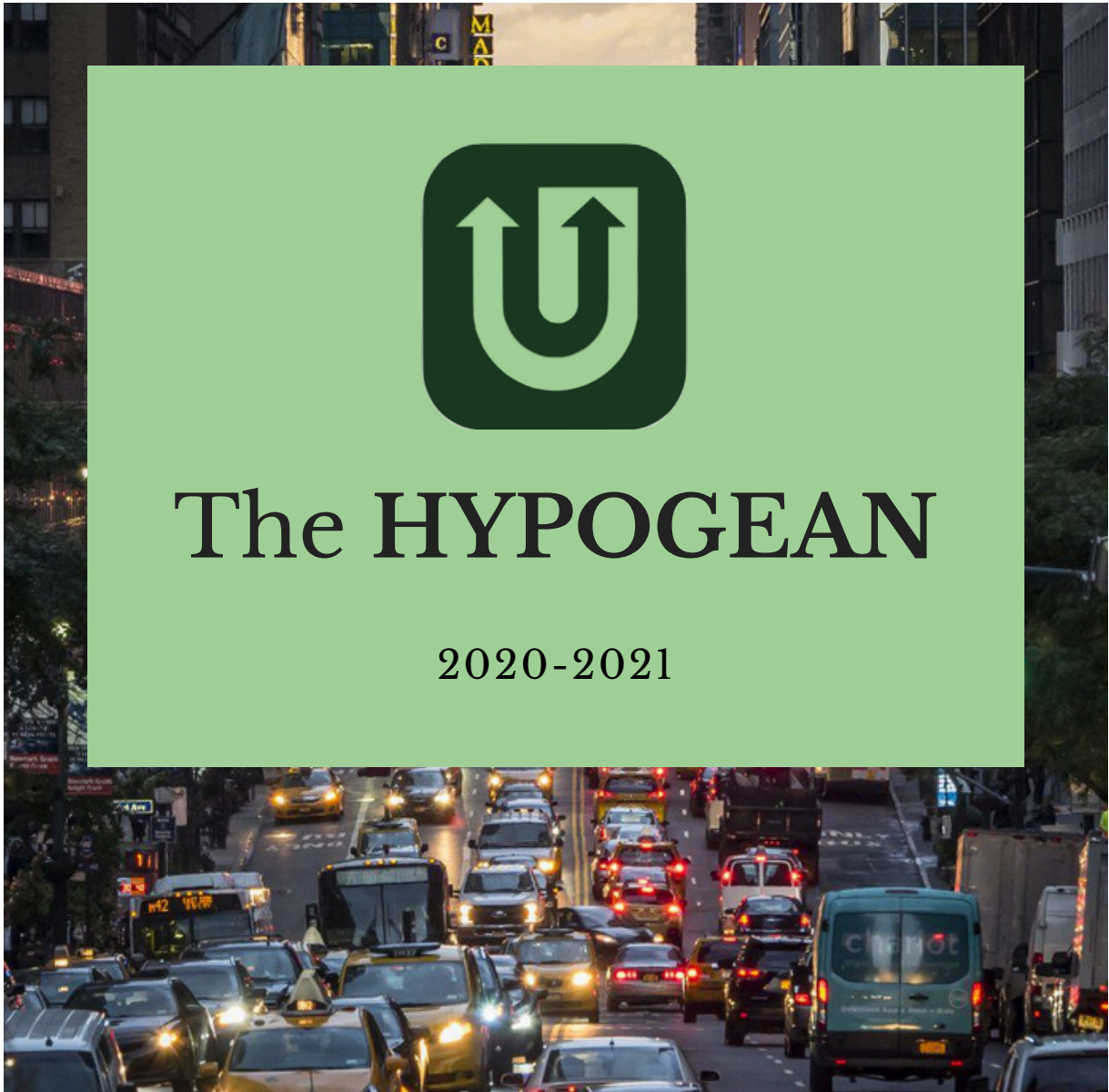


Team WIRED Presents



# The HYPOGEAN

2020-2021





# CBI A3 Program:

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A<sup>3</sup> is a Design Factory Melbourne initiative, which builds on Challenge Based Innovation (CBI). Piling from IdeaSquare CERN, CBI focuses on using design innovation to develop outcomes that connect technology with societal needs in a tangible way.

CBI A<sup>3</sup> was developed by Design Factory Melbourne for the Global Design Factory Network (DFGN). It aims to empower students with the mindset and skills to be change makers, imagining and realizing futures that respect humans and the ecological systems we exist in.

CBI A<sup>3</sup> includes a 6.5 month program of guided curriculum for student teams at Design Factories around the globe to take a UN SDG goal and explore it in relation to their local context, like New York City or Melbourne.

This year, CBI A<sup>3</sup> included students from Swinburne University of Technology (Australia) and Pace University (USA) who worked in their respective teams to develop and prototype ideas for the future, linking CERN technology to UN Sustainable Development Goal 11 - "sustainable cities and communities" and their development by 2030.

In 2020-2021, teams Earthlings (Australia) and Wired (USA) explored possible solutions for 2030 featuring CERN technology to imagine a better future.

# Meet Team Wired



## MARYIA KALODKINA

Maryia was born in Belarus in the heart of Europe. At age 19, she moved to the USA with one suitcase and started her life from scratch. In 2018 she joined Pace University where she has been studying computer science.

Maryia is all about adventures and discoveries, and has love for technology, music and animals in particular.

The idea of getting a unique experience of learning product development in all its possible aspects brought Maryia to NYCDF CBI A<sup>3</sup>.



## GRACIE MCGREEVY

Born in Columbia, Maryland, Gracie has always loved New York City. Now she is an Honor Student majoring in economics with a minor in computer science at Pace University.

Charismatic and creative with a deep love for music, singing and theatre, Gracie joined NYCDF CBI A<sup>3</sup> to practice and develop her design thinking skills and to contribute to an important project that works towards a sustainable world.



## KAREN JOY

Coming a long way from India with five languages in her pocket, Karen is pursuing her dreams as a Graduate Student in information systems at Pace University. Genuinely in love with people and tech, she strives to understand and to improve the connection between them even better.

Keen on technology, human psychology, books and music, Karen joined NYCDF CBI A<sup>3</sup> with a hunger for knowledge and a passion to learn aspects that exist, however cannot be learnt or taught in a regular classroom.

# Future Scenario

*There are drastic and strong changes required to better today's world.*



Our current lifestyle is not sustainable. Many aspects of our daily life point towards a more dystopian future because of the lack of understanding of current problems.

Sociocultural	Political	Social	Technological	Economical	Ethical	Legal	Environmental
Poor quality of life due to car culture	Lack of government support for infrastructure	Aggressive population	No Privacy	People in poverty can't get around because of driving tolls → Lower socioeconomic mobility	Poor health due to carbon emissions	Lawsuits over traffic accidents	Piles of garbage taking over
Poor unhealthy habitual behaviors		Tired people	Unsecure Transactions	The government spends large amounts on congestion and traffic	Increased commute time → Poor work-life balance	Lawsuits over casualties	Excessive carbon emissions
							Smog covering cities

Figure 1. Our future is headed in the direction outlined in this table. If we want to avoid this, New York City needs to make decisive changes and invest in its future.

*In 2030, imagine a future where we will need to drastically change our lifestyles for survival because humanity waited too long to make strong changes.*

# Problem Space

There are many local issues in relation to sustainable development in New York City. The three key problems are the security of delivery systems, traffic congestion, and the last mile delivery carbon emissions.



## 01

### DELIVERY SECURITY

Package delivery can quickly turn into a privacy issue. Many people feel uncomfortable giving their address to strangers online when they order from smaller sellers. It can also be a great source of discomfort especially for those who live alone.

Doorstep delivery is inherently unsecure because most packages are left unattended for hours. 43% of Americans who shop online experience package theft and an estimated 90,000 packages disappear daily [4]. Especially in an apartment building where people pass by each other's packages every day, someone can easily consciously or unconsciously pick up a wrong package that doesn't belong to them.

The current delivery system is also a home security issue especially for those who live in apartment buildings with a door buzzer system. This common security system operates by requiring visitors to buzz at the front door, and residents to unlock the door from their apartment, before the visitor can come inside. However, since delivery drivers don't have mail access to these buildings, it is common practice for them to buzz all apartments in hopes that someone just lets them in. Because of this, anyone could ring at any time and tenants would likely unknowingly let them in thinking they were a package delivery for themselves or one of their neighbors.

## 02 TRAFFIC CONGESTION

As any New Yorker could say, driving and parking in the city is nearly impossible. With millions driving through the city every day, driving has become inefficient and time consuming. This hurts both the citizens and the economy. The average New Yorker spends 91 hours stuck in traffic jams every year (Forbes) [3], and in 2019, our economy lost a reported \$11 billion due to traffic congestion [2].

There is so little parking available that many vehicles, especially large trucks, end up parking illegally or blocking entire lanes and streets. The Forum's analysis suggests that effective double-parking enforcement or allowing the use of express lanes for delivery vehicles could reduce congestion by up to 29% and 18%, respectively. In New York City, UPS, FedEx, FreshDirect, and Peapod accumulated 28% more summonses for parking violations in 2018 than they did in 2013 [1]. Some drivers are even personally responsible for paying tickets even when they deliver things to places that have no parking options available. As we rely more and more on online shopping the number of delivery trucks in the city will only continue to grow. One estimate projects 36% rise in the number of delivery vehicles in the top 100 cities globally by 2030, and researchers estimate emissions from delivery traffic will increase by nearly a third and congestion will rise by over 21% [1].



## 03

**LAST MILE DELIVERY EMISSIONS**

Last mile delivery refers to the very last step of the delivery process where a package is transported from a local hub to its final destination. This portion of the package journey is inefficient, costly and unpredictable. While this is only a small portion of the package journey it is a large source of emissions.

Greenhouse gases are a major contributor to climate change. These emissions are detrimental to both our environment and the health of our population. Over a million tons of greenhouse gas emissions are produced annually in Lower Manhattan alone which is only a small portion of the entire city(Cornell).

The NYC Department of Health and Mental Hygiene estimates show that each year, pollution in New York City causes more than 3,000 deaths, 2,000 hospital admissions for lung and heart conditions, and approximately 6,000 emergency department visits for asthma in children and adults [7].

Transportation is the largest source of greenhouse gases in New York State, accounting for 30% of all emissions [5]. Large delivery trucks greatly contribute to this issue. Not only are these large trucks often huge sources of emissions themselves, they also take up so much space on the road that smaller and more efficient cars are forced to be on the road longer, generating even more emissions.

Without any intervention, by 2050 we can expect shipping emissions to increase by 120% and account for 10% of global GHG emissions[6]. So far the government's only tactic to solve these problems is to tax NYC drivers instead of questioning and updating the failing infrastructure and systems in place.

*How Might We streamline delivery processes because New York City citizens need to send and receive packages in a safe, reliable, and sustainable manner.*

# Design Solution

## *The Hypogean*

*Team Wired's solution to make cities more sustainable by completing the last mile delivery underground.*

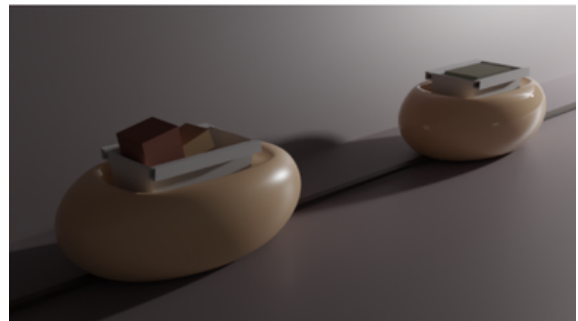


*Our underground delivery system helps online shoppers who want to receive their packages efficiently by avoiding damaged, lost, or delayed items and improving environmental and city conditions.*

# System Components

## 01

### TRAIN INSPECTION MONORAIL (TIM)



Train Inspection Monorail (TIM) was originally designed by CERN in order to provide unmanned operations in the Large Hadron Collider tunnel.

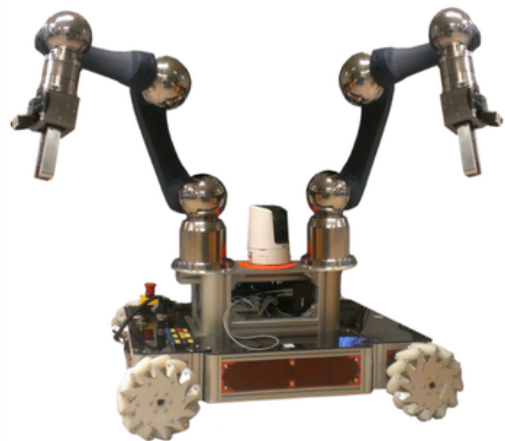
The train works on a monorail because of its modular design. Thus, it aligns with our specific intentions. After a little redesign we made it one of our main components which helps to transport packages underground.

## 02

### CERNBOT

CernBot is another CERN's invention. This is a robot with two arms. Its entire structure can be deployed without any mechanical assistance and it can perform complex operations without human presence.

In our system CernBot is used to sort packages into lockers and to log location. This allows the system to send users a notification when their package is ready for pick up.



## 03 WAREHOUSES

The warehouse's main function is to be a sorting hub from which all packages are sent out. These buildings are located outskirts of New York City, and also serve as the location in which all packages entering our system are given a barcode label and entered into our database for tracking throughout the delivery process.



## 04 NYC MTA SUBWAY



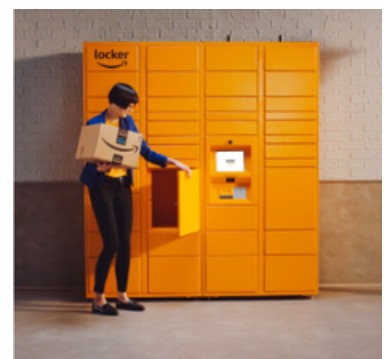
NYC MTA Subway plays significant role in our design, as we are planning to add an extra car to the end of each train. This car will be inaccessible to the public, and used for the sole purpose of moving packages around the city. By using subway cars we reduce the amount of construction that needs to be done for the implementation of the Hypogean system.

## 05 LOCKERS

The last component is smart lockers. We are hoping to collaborate with Amazon to build on their existing locker system.

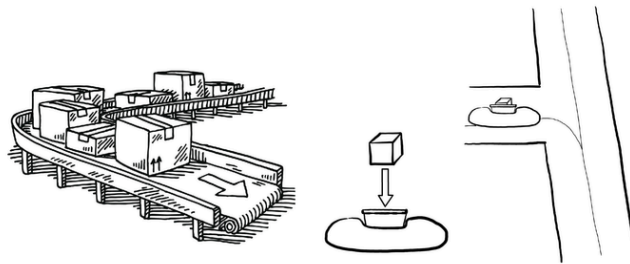
Lockers will be a substitution for doorstep delivery, and will serve as a place for customers to pick up or drop off their packages.

Lockers will be located at most subway stations as well as at some popular public places like shopping centers and office buildings.



# Package Journey

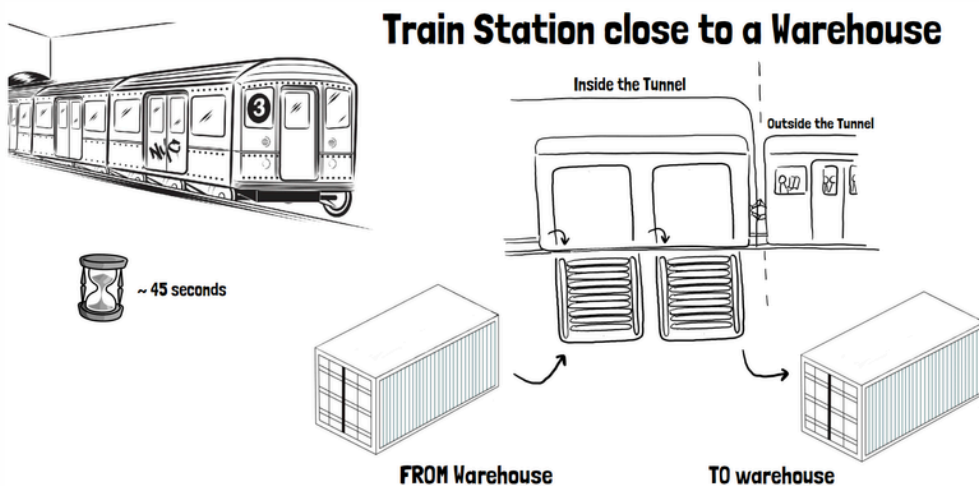
Once a package arrives at the outskirts of New York City, it gets dropped at one of our warehouses. In the warehouse packages get scanned, sorted, and measured, all while being tracked with the label they have from prior carriers or relabeled with Hypogean system label if needed.

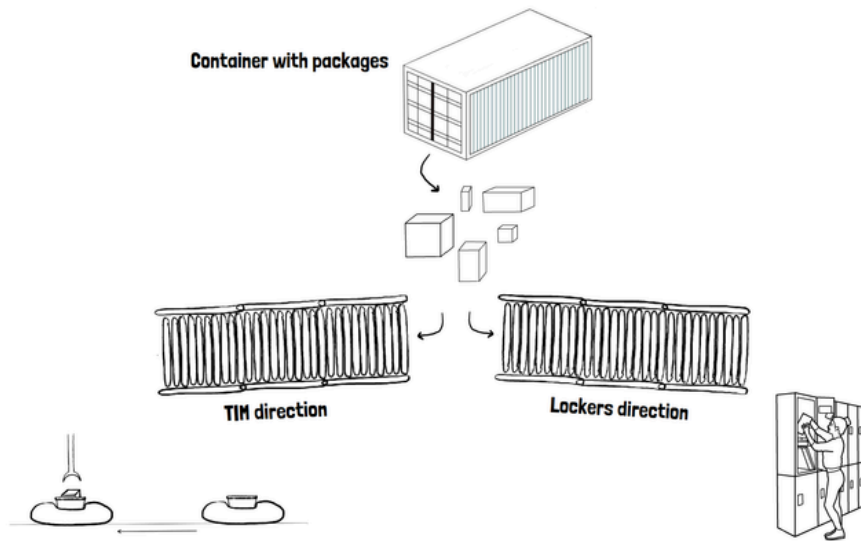


After being sorted, the package travels via conveyor belt and is placed into a TIM pod. If multiple small packages are going to the same locker station they can be put in the same pod. This TIM pod will travel underground on the monorail towards the closest train station. While en route, there are multiple checkpoints where the package's barcode is scanned to update logs and ensure it is traveling in the right direction.

Once it reaches the train station, an automated arm sorts packages into shipping containers, each container having a predetermined destination of another subway station further down the line.

The shipping container is then loaded into the last car of a MTA subway train. This process is done beyond public reach to ensure security of packages. As the doors to the final car open inside the subway station's tunnel, the container with packages from the warehouse moves in through the left door and the container with packages going to the warehouse moves out through the right door to be transferred to TIM. This process is done in less than 45 seconds.

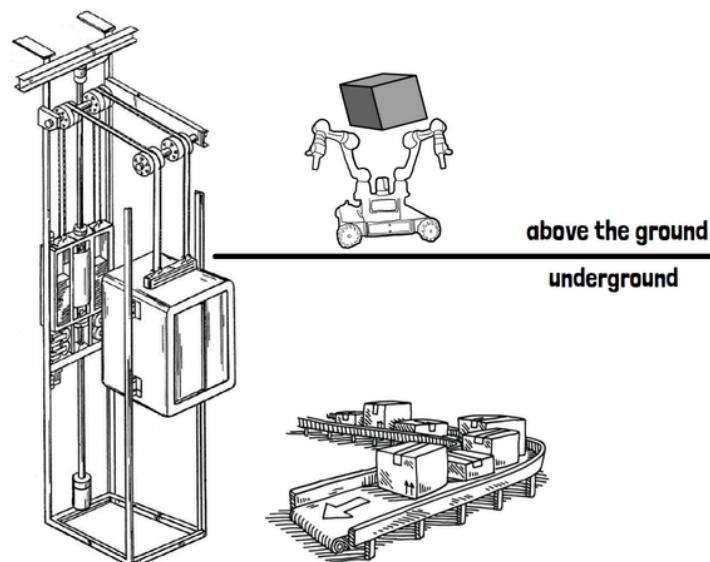




Once the subway reaches its predetermined station, the same in and out process is repeated to transfer the containers.

Once the container is out of the train car, the packages are taken from the container, and each individual package is either directed towards TIM to continue its journey to its final stop or directed towards the lockers to be picked up by the user.

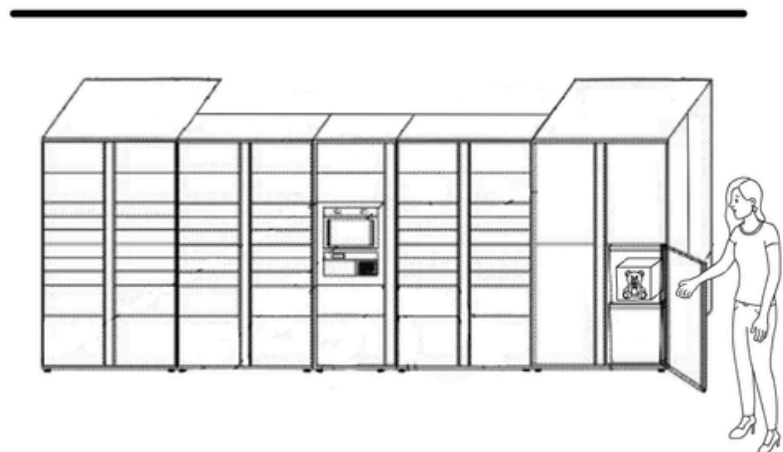
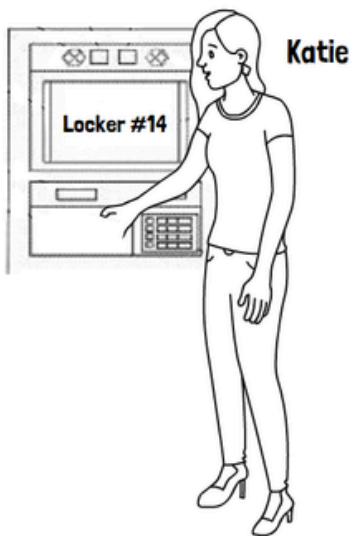
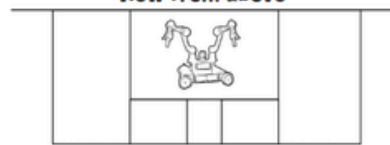
Once the package reaches its final destination, it is moved on a conveyor belt towards the direction of the lockers. When necessary each one is separately placed in an elevator which brings the package above the ground to CernBot. CernBot will sort all packages to different lockers and update the information to send users the notification that their package has arrived and is ready for pick up.



Since the user was notified that their expected package had arrived, they are able to pick it up from their local lockers. When the user comes to the kiosk, all they need to do is log in by scanning their physical card, using their virtual card on our app, or using their login credentials and choose which package they want to pick up. The designated locker opens automatically, and the user is able to get their package.






## Lockers Pick up/Drop off

view from above



# User Touchpoints

## *Personalized Case Study 1*

 <p><b>Trevor Mosby</b> 20, Manhattan</p> <hr/> <p>Student</p> 	<p><b>Personality</b></p> <ul style="list-style-type: none"> <li>- Big spender</li> <li>- Flamboyant</li> <li>- Shopaholic</li> </ul>	<p><b>Biography</b></p> <p>Trevor is a college student living in Manhattan and taking classes online.</p> <p>Since most of his expenses are covered by his parents, he spends most of his part-time job's salary on fun.</p> <p>He's a frequent online shopper from all of his favorite stores.</p>	
	<p><b>Shops</b></p> <div style="display: flex; justify-content: space-around; align-items: center;">    </div>		
	<p><b>Goals</b></p> <ul style="list-style-type: none"> <li>- Easy ways to keep track of many packages</li> <li>- Low shipping prices</li> <li>- Pick up packages on his own schedule</li> </ul>	<p><b>Frustrations</b></p> <ul style="list-style-type: none"> <li>- Missing deliveries when he's not home</li> <li>- Needing to buzz in delivery drivers while he's in class</li> <li>- Neighbors stealing his packages</li> </ul>	

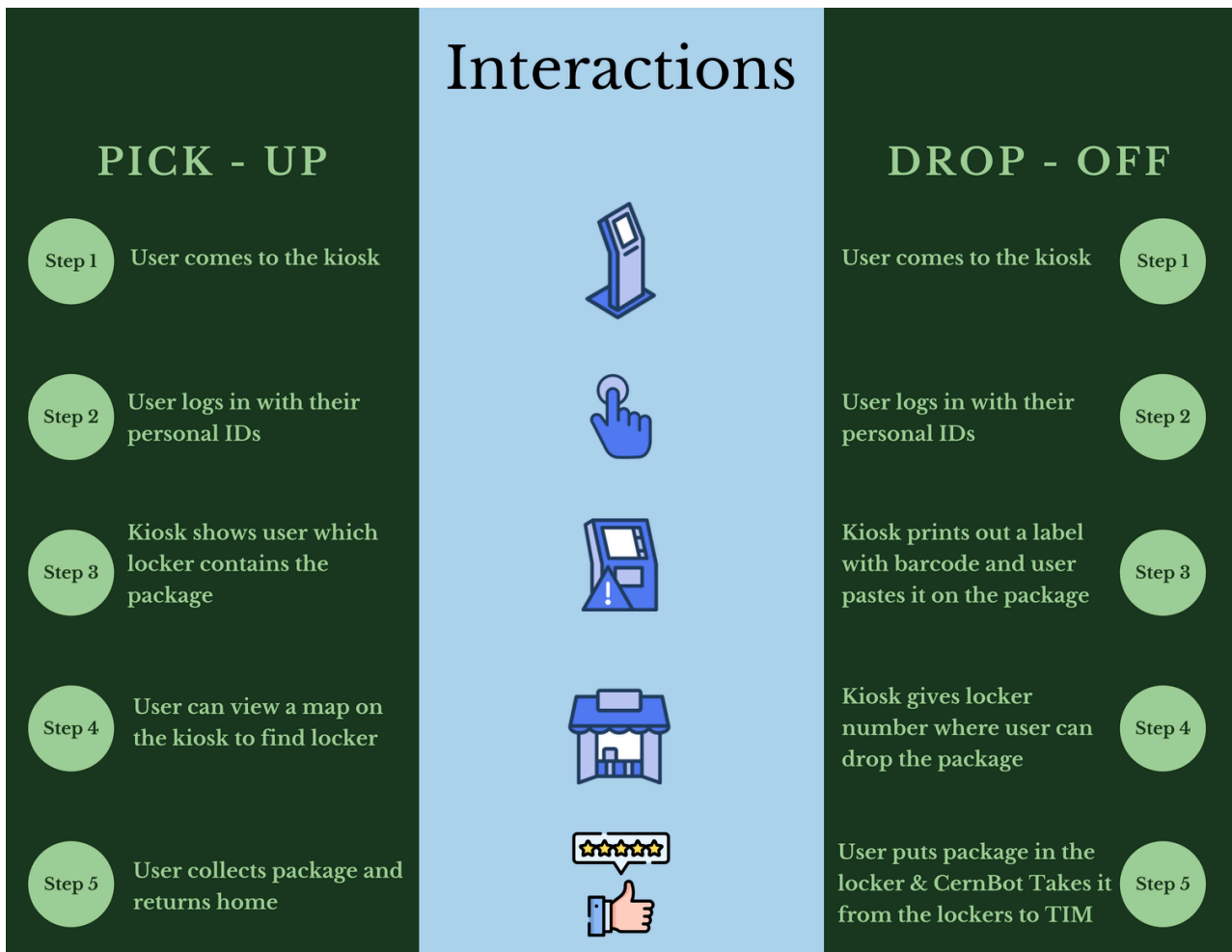
Trevor, a college student living in Manhattan, will be able to maintain a busy Manhattan lifestyle with no delivery interruptions. He can easily shop online, track his packages, and pick them up on his way home from university. Trevor doesn't have to plan his life around being home to receive packages or worry about a delivery driver interrupting his online classes to be let in his building.

## Personalized Case Study 2

 <p><b>Charlotte Walker</b> 52, Queens</p> <hr/> <p>High School Teacher</p> 	<p><b>Personality</b></p> <ul style="list-style-type: none"> <li>- Smart with Money</li> <li>- Frugal</li> <li>- Ex- Smoker</li> </ul>	<p><b>Biography</b></p> <p>Charlotte is a high school teacher in Queens.</p> <p>She likes to order gifts and presents for her grandchildren</p> <p>She is very frugal with money but she is an avid reader so she treats herself with a new book every other week.</p>
	<p><b>Shops</b></p> <div style="display: flex; justify-content: space-around; align-items: center;">    </div>	
	<p><b>Goals</b></p> <ul style="list-style-type: none"> <li>- Privacy and security</li> <li>- A world with better air quality</li> <li>- Low shipping prices</li> </ul>	<p><b>Frustrations</b></p> <ul style="list-style-type: none"> <li>- Unsafe feeling when delivery drivers come to her house while she's alone</li> <li>- Inability to breathe because of poor lungs and air quality</li> <li>- Inability to go to the book store during the pandemic</li> </ul>

Charlotte, a high school teacher and loving grandmother, is able to order and receive gifts for her grandchildren without halting her work day. Even though she lives in a transit desert on the outskirts of Queens, her local pickup is close by at her favorite grocery store. During the Covid-19 pandemic, she is able to minimize her outings but still order the gifts as well as her bi-weekly book by picking up her packages during her weekly grocery store trip.

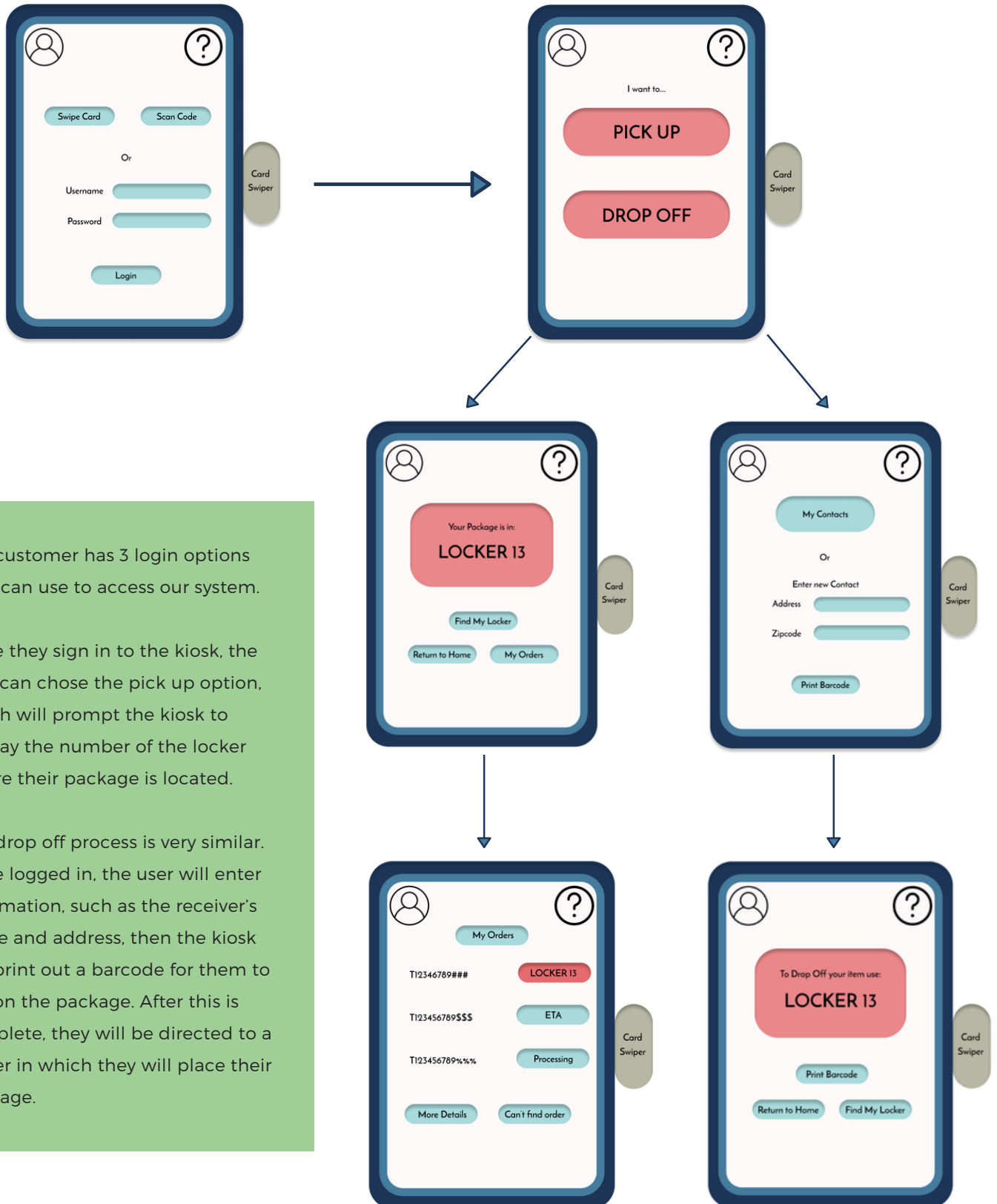
## Customer Journey



Each user has a simple interaction with our system if they want to pick up or drop off a package.

This 5 step process emphasizes how minimal interaction the user has with the delivery process, thus ensuring safety of the consumer as well as ease of use with the system.

# User Interface



The customer has 3 login options they can use to access our system.

Once they sign in to the kiosk, the user can chose the pick up option, which will prompt the kiosk to display the number of the locker where their package is located.

The drop off process is very similar. Once logged in, the user will enter information, such as the receiver's name and address, then the kiosk will print out a barcode for them to put on the package. After this is complete, they will be directed to a locker in which they will place their package.

# Implementation

## *Partnerships:*

Our system requires a collaborative effort from multiple partners. Because of this, the Hypogean would be a quasi-private corporation, similar to the Metropolitan Transportation Authority (MTA), the company that runs the NYC Subway. The Hypogean would operate in the public sector, supported by the government, as our service would benefit NYC, but would still be privately owned.



### **Amazon**

In the past, Amazon has done lots of research into unconventional methods of delivery. Amazon is interested in developing alternatives to the current delivery system, so we think our system is one they'd be interested in collaborating with. Although the upfront costs are high, the ability to lower labor costs and inefficiency associated with parking, driving, and other unknowns in big cities, means this would be a good investment opportunity. Their established logistics and lockers perfectly pair with our system. Since we can promise technologically advanced and efficient last mile delivery within the city, this would be a mutually beneficial partnership.

### **MTA**

The Metropolitan Transportation Authority is an essential collaborator for the Hypogean. The use of the final subway car is integral to how our system functions. We plan to capitalize on their existing infrastructure to minimize costs and disruptions. The MTA is updating current infrastructure and we plan to merge our projects together. By collaborating, we can split the construction costs.

The MTA is not a profitable organization. By collaborating with the Hypogean, we can subsidize the maintenance and daily costs of running trains. In addition to this, clearer roads means faster and more efficient transportation for their buses. Therefore the success of the Hypogean directly benefits the MTA.



*Partnerships:*



**New York City Government**

Because of the positive impacts that Hypogean brings to New York City's environment as a whole, we hope to get the NYC government as our partner. They can help by mandating or bringing in policies that incentivize the use of Hypogean. In the same way the city subsidizes the MTA we hope the government would invest in the development of our infrastructure since it would help the greater population.

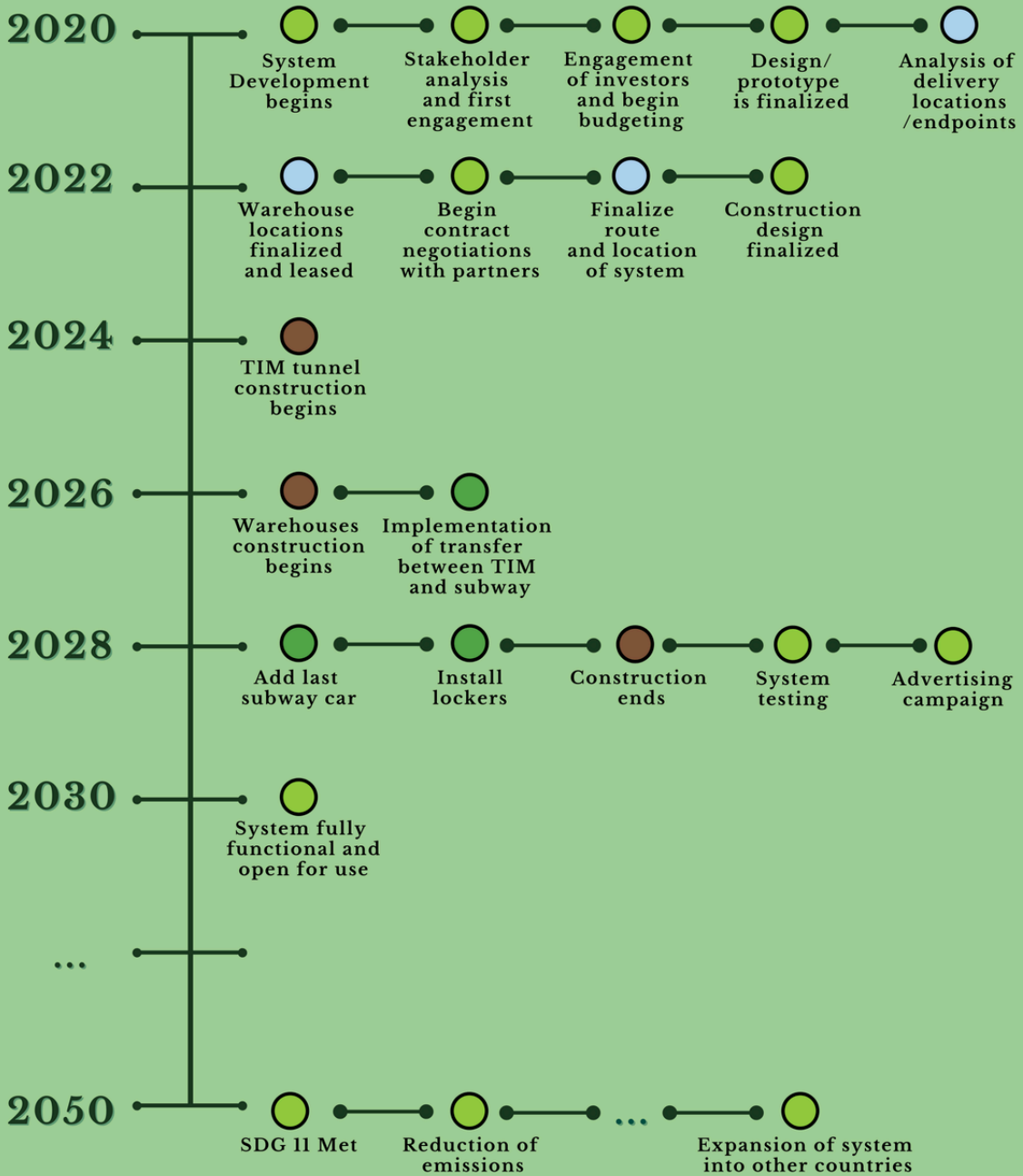
**Other Carriers (FedEx, UPS, USPS)**

Our partnership with the local government will ensure cooperation between our system and other carriers such as FedEx, UPS, and USPS. These companies will handle the portion of the delivery that is out of the NYC area and leave the last mile delivery to us.





# Timeline:



# System Value

*Our underground delivery system helps New York City residents send and receive packages in a safe, reliable and sustainable manner.*

*By reinventing the last mile delivery we create...*

## 01

### **MORE SECURE PACKAGE DELIVERY**

Through our locker system, packages are only accessible to the designated recipients. Therefore, the Hypogean will lead to a reduced amount of package theft. We also eliminate the issue of delivery drivers or unwanted guests gaining access to people's buildings.

## 02

### **LESS TRAFFIC CONGESTION**

The underground nature of our system alleviates traffic conditions. Since large delivery trucks are no longer on the road there is more space for buses and cars to drive and park.

## 03

### **REDUCED CARBON EMISSIONS BY DELIVERY SECTOR**

With reduced traffic, delivering packages with the Hypogean creates less CO2 emissions than traditional delivery systems.

# Conclusion

## 'HYPOGEAN' LIFE UNDERGROUND

NYC's underground delivery system  
powered by CERN Tech

### PROBLEM SPACE

The main source of greenhouse gases in NYC are transportation (36%) and buildings (30%). 1,000,000 tons of greenhouse gas emissions in Lower Manhattan annually. \$11 billion lost due to traffic congestion. 91 hours stuck in traffic jams a year.



### DESIGN SOLUTION

HYPOGEAN is an underground delivery system which enables online shopper who wants to receive their package or any user who wants to send their package - to have an efficient way to do either - by avoiding damaged, lost, or delayed items and improving environmental and city conditions.



### STAKEHOLDERS

Online shoppers, anyone who wants to send and receive mail packages, delivery companies, packaging companies, tracking and location services, etc.



### VALUE PROPOSITION

The NYC Department of Health and Mental Hygiene estimates show that each year, pollution in NYC causes more than 3,000 deaths, 2,000 hospital admissions for lung & heart conditions, & approximately 6,000 emergency department visits for asthma in children and adults.

HYPOGEAN will reduce this number by a ton!



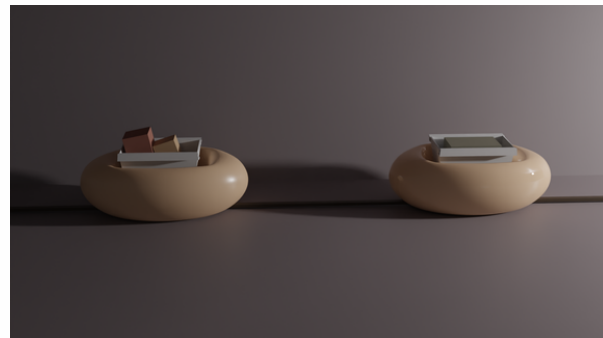
### SOCIAL BENEFITS

Accessible to each and every person in the society who wants to send and receive packages, tracking systems with checkpoints for updates, reduced loss of packages, and security with privacy guaranteed.





Pollution is a rising concern in metropolitan areas around the world, including in New York City. Growing populations lead to more traffic, more shopping, and more deliveries, which in turn impact air quality. With no interventions we can expect a 32% jump in carbon emissions from urban delivery traffic by 2030.



*The Hypogean is a system designed using CERN technology to alleviate traffic congestion and carbon emissions by delivering residential packages underground.*

# References

- [1] <https://www.cnbc.com/2020/01/14/last-mile-delivery-push-will-worsen-commutes-hurt-the-environment-world-economic-forum-says.html>
- [2] <https://www.statista.com/chart/21085/annual-economic-losses-from-traffic-congestion/>
- [3] <https://www.forbes.com/sites/niallmccarthy/2018/02/08/the-cities-where-u-s-drivers-spend-the-most-time-stuck-in-traffic-infographic/?sh=28b5d0a616d8> [4] <https://www.crresearch.com/blog/2020-package-theft-statistics-report>
- [5] <https://www.nyserda.ny.gov/About/Publications/EA-Reports-and-Studies/Energy-Statistics>
- [6] <https://www.transportenvironment.org/what-we-do/shipping-and-environment/shipping-and-climate-change>
- [7] <https://www1.nyc.gov/assets/doh/downloads/pdf/eode/eode-air-quality-impact.pdf> (quote from video)
- [8] <https://www1.nyc.gov/html/dot/downloads/pdf/truck-deliveries-11189.pdf>
- [9] <http://a816-dohbesp.nyc.gov/IndicatorPublic/traffic/index.html>  
<https://www.sciencedaily.com/releases/2020/06/200624172045.html>
- [10] Utopia/Dystopia (<https://www.istockphoto.com/vector/winding-road-on-a-white-isolated-background-gm691946426-127734953> and <https://veronicasicoe.com/2013/04/15/utopia-and-dystopia-the-many-faces-of-the-future/>)
- [11] TIM (<https://kt.cern/technologies/train-inspection-monorail-tim>)
- [12] Components of the System Images: <https://www.strategicsourceror.com/2020/06/the-rising-demand-of-warehouse-space.html>
- [13] [https://commons.wikimedia.org/wiki/File:MTA\\_NYC\\_Subway\\_Q\\_train\\_arriving\\_at\\_Beverly\\_Rd\\_\(2\).jpg](https://commons.wikimedia.org/wiki/File:MTA_NYC_Subway_Q_train_arriving_at_Beverly_Rd_(2).jpg)
- [14] <https://www.amazon.com/primeinsider/tips/amazon-locker-qa.html>
- [15] <https://www.security.org/resources/stolen-packages-survey/>
- [16] Fedex Picture: <https://www.bloomberg.com/news/articles/2019-06-20/fedex-s-next-year-outlook-may-be-weighed-down-by-trade-war>
- [17] Delivery Security: <https://www.pcmag.com/how-to/how-to-protect-your-front-door-deliveries>
- [18] Problem Space: Fedex + Ups pic = <https://www.bloomberg.com/news/articles/2019-07-23/ups-to-add-sunday-deliveries-in-2020-matching-fedex-7-day-move>
- [19] Traffic Congestions: <https://www.nydailynews.com/news/politics/majority-nyc-voters-oppose-congestion-pricing-plan-poll-article-1.3903472>
- [20] Parking problems (FedEx truck): <https://www.nytimes.com/2019/10/27/nyregion/nyc-amazon-delivery.html>
- [21] <https://www.newgeography.com/content/002462-smart-growth-livability-air-pollution-and-public-health>
- [22] <https://www.nydailynews.com/new-york/ny-de-blasio-clear-curbs-trucking-20201113-dswjhgwwvzhell6mvkofyxvafi-story.html>
- [23] <http://www.fresnostate.edu/studentaffairs/studentinvolvement/usu/amazonlockers.html>