# (Dis)embarking Hyperloop

***Design of process and infrastructure for passengers (Appendices)***

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# Appendix A: Competitors

## Hyperloop One

Hyperloop One, founded in the US in 2014, has now grown into a 200-employee company with 160 million dollars fund up to November 2016. Unlike Hardt using electromagnetic suspension: the vehicle with electromagnet will be attracted to the steel track on top and suspend with a constant gap between the vehicle and the track; Hyperloop One makes use of passive magnetic levitation with permanent magnets on vehicle: forward motion of the permanent magnets induces magnetic field so the vehicle is repulsed from the ferromagnetic track (Handmer, 2016).

It has been focusing on the testing of technical feasibility. The propulsion has been tested in 2016 ("Hyperloop One", 2017) and a 500-meter test track is being built in the Nevada desert since March 2017 (Techcrunch, 2017). Agreements on feasibility studies have been made with Finland and the Netherlands (CNBC, 2016). A concept video of Hyperloop between Dubai and Abu Dhabi has been made concerning the passenger experience and station configuration (Techcrunch, 2016a).

## Hyperloop Transportation Technologies

Hyperloop Transportation Technologies (HTT), founded in 2013 is a close competitor to Hyperloop One in the US. It has more than 700 employees, mostly being crowd source. Over 100 million dollars has been raised by the end of 2016 (Techcrunch, 2016b). It uses similar passive magnetic levitation system as Hyperloop One (Boyer, 2016).

Comparing to Hyperloop One and Hardt, HTT is ahead in user experience. Collaborating with the University of California, Los Angeles (UCLA), the user experience in HTT system, from pods to station architecture to boarding and ticketing have been studied since 2014 (Wikipedia, 2017). In March 2017, HTT announced the beginning of constructing the full-scale Hyperloop passenger capsule by releasing an empty-interior vehicle prototype (CNET, 2017). An agreement has been made with the Slovakian government to perform feasibility studies regarding routes connecting major cities in East Europe (PR Newswire, 2016).

# Appendix B: (Dis)-embarking flow research


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***Figure 1. A snapshot of the video recording for data analysis.***

## Research setup

The research goal is to find out people's behaviour during (dis)embarking both with and without luggage. Research questions are: what is the (dis)embarking efficiency in the train? How do people behave while boarding and what influences that?

The researcher observed passengers getting in and out 11 trains at Schiphol and 15 trains in Utrecht Centraal with video recording. Passengers (dis)embark trains with all their belongings and this is the most similar situation to the defined Hyperloop (dis) embarking. At Schiphol train station, most of the passengers are travellers with big luggage; at Utrecht Centraal, the busiest train station in the Netherlands, most of the passengers are commuters with only personal bags. At both stations, three types of trains were observed. Comparing the variables, the reasoning behind passengers' behaviours can be concluded. By a frame-to-frame analysis of video recordings *(Figure 1)*, the efficiency of passenger flow (number of passengers passing through the door per minute) was calculated.

# Result

***Large luggage slows down the flow***

By analysing the videos of (dis)embarking 11 trains, the relationship between suitcase rate (suitcase per passenger) and passenger flow Q (passenger per minute) can be seen in *Table 1*. Q is ranked within each type of train and the suitcase rate is increasing as Q decreases, meaning that the suitcases slow down the passenger flow under the same condition (train type, embark or disembark etc.). Through observation, suitcases and large strollers are the main luggage that influences the passenger flow. *Figure 2* is one example of a stair chart that shows how long it takes for each passenger to embark. Passengers with backpacks and travel bags

| | Q (Pax/min) | Pax Number | Suitcase | Suitcase/Pax | Remarks |
|---|---|---|---|---|---|
| **A2** | Q1=72 | 10 | 1 | 10% | |
| **A1** | Q1=38.23 | 12 | 5 | 42% | |
| **B1** | Q1=36 | 6 | 1 | 17% | |
| **B2** | Q1=32.73 | 6 | 3 | 50% | |
| **B4** | Q1=30 | 3 | 2 | 67% | |
| **B2** | Q2=22.19 | 9 | 5 | 56% | Embark |
| **B3** | Q1=21.95 | 6 | 4 | 67% | |
| **B4** | Q2=18.7 | 15 | 5 | 33% | Join flow |
| **B1** | Q2=16.36 | 13 | 6 | 46% | 46% elderly |
| **C1** | Q2=62.75 | 19 | 3 | 16% | |
| **C1** | Q1=45.52 | 22 | 14 | 64% | |

▲

***Table 1. Passenger flow (Q=Pax number/min) in Schiphol for three types of trains. Q1=disembark; Q2=embark. Train A has medium door width with stairs; Train B has small door width with stairs; Train C has wide doors without stairs. Numbers behind the letter is the numbering observations for the same type of train. Within each type of train, the table is ranked is by passenger flow Q.***

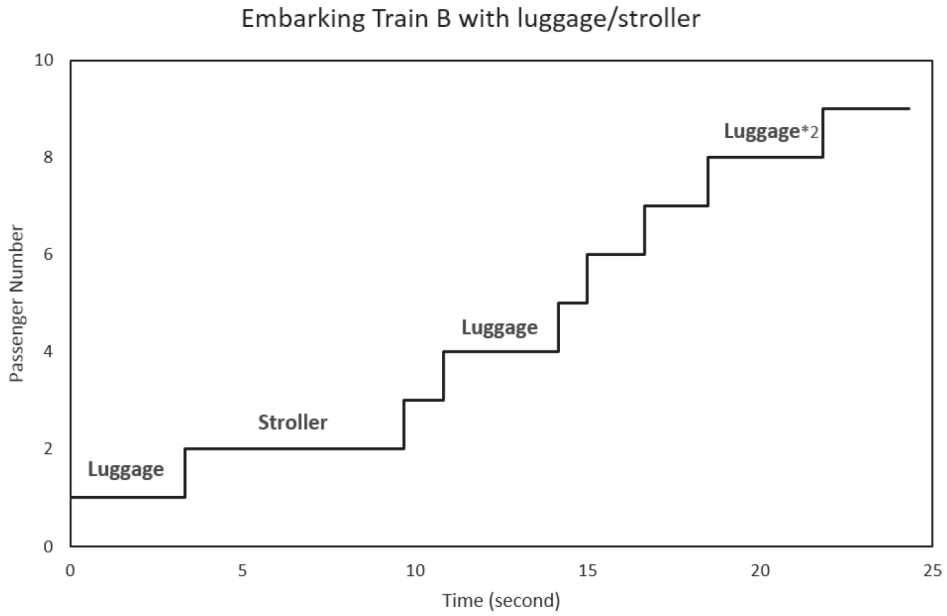


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***Figure 2. Embarking Train B with luggage and stroller. The vertical axis is number of passengers passing through the door and the horizontal axis tells the time it takes for each passenger to embark.***

do not stand out from passengers with no luggage; passengers with suitcase(s) take approximately twice as long to embark and passengers with stroller take three times as long.

### *People hesitate to give way to 'the inconvenience'*

Observation shows that passengers hesitate to (dis)embark when they see other people with large suitcase, strollers or disability. Sometimes those people take the opportunity to go first while more times they just wait and go when they are ready or when the timing is 'right'. It also happens in the plane when people are placing the luggage in the overhead cabin or when they collect their luggage from the cabin before disembarking.

One passenger per second without luggage

Of the 15 trains observed in Utrecht Centraal station during rush hour, the average embarking and disembarking time is calculated. The average passenger flow is 60 passengers per minute, despite the train type, total passenger number and the difference between embarking and disembarking. Comparing to the result in Schiphol, the passenger flow Q reduces when suitcases are involved during (dis) embarking.

### *Stairs are difficult for suitcases*

*Table 2* shows that passenger flow without luggage for Train A and C is similar. While *Table 1* shows that for passenger flow with luggage Train A is generally slower than C, meaning that stairs slow down the (dis) embarking flow when there are suitcases.

Other findings worth mentioning is that passengers disembark one by one while embarking with more people at the same time. However, this does not influence the overall flow. Like the bottleneck theory by Helbing, the flow becomes slow when there two flows joining during boarding. Concerning the hesitation mentioned by Li in the interview, observations also find

| | Q (passenger/min) | | Passenger |
|---|---|---|---|
| | Q1=disembark | Q2=embark | |
| A3 | | Q2=58.06 | 15 |
| A4 | 60.00 | | 19 |
| A4 | | 60.00 | 20 |
| A5 | | 43.90 | 15 |
| A6 | 56.17 | | 22 |
| A6 | | 78.75 | 21 |
| A8 | 66.21 | | 48 |
| A8 | | 60.00 | 9 |
| A9 | 51.89 | | 16 |
| A9 | | 53.68 | 17 |
| A10 | 62.86 | | 22 |
| C2 | 53.33 | | 12 |
| C2 | | 62.86 | 22 |
| C3 | | 62.50 | 25 |
| C4 | 66.32 | | 7 |
| average A | 59.43 | 59.07 | |
| average C | 59.83 | 62.68 | |

***Table 2.Passenger flow (Q=Pax number/min) in Utrecht for two types of trains. Q1=disembark; Q2=embark. Train A has medium door width with stairs; Train C has wide doors without stairs. Numbers behind the letter is the numbering of observations for the same type of train.***

out that the more choices people have the more time they spend making decisions. For example, people change between two train doors and hesitate to go left or right, up or down when entering the train.

# Discussion

The (dis)embarking efficiency can be influenced by the size of the bottleneck (doors), passenger hesitation space, large luggage percentage and stairs. The current passenger flow per regular train door is at most 60 passengers per minute. Theoretically, if the influence of luggage can be minimized for Hyperloop, even with the regular boarding method, the total disembarking and embarking time will be 100 seconds with one door, meaning that to reach the throughput (a vehicle departing every 30 seconds), only three tracks are needed to operate at the same time. By increasing the number of doors, one track can easily handle the amount of throughput.

Utrecht Centraal station, being the busiest train station in the Netherlands, has a departure frequency of 1 train/min during rush hours. Each train stops for 4 minutes, which is way longer than needed for (dis) embarking. This is most probably because some trains need to wait for people that transfer to the train. Anyway, in theory, only 4 tracks are needed if everything goes right. However, there are 21 tracks in total at the station. They are for passing trains that do not stop, maintenance, trains surpassing each other or simply as back up platforms when the system needs to deal with a large number of delays etc.

Therefore, the passenger (dis)embarking time might not be the deciding element in the system for Hyperloop.

# Appendix C: Luggage Research

## Research setup

The goal of the research is to give insights on the location (where) and procedure (how) of placing passenger luggage on Hyperloop by answering: what do people want to do with their baggage and what influences their decisions? What influences the type and number of luggage passenger bring?

Observations were carried out on the train (including two types of trains in the Netherlands: Intercity and Sprinter) to and from Schiphol Airport, on the airplane between Schiphol airport and Olbia Airport in Italy, on the buses travelling between Schiphol Airport and Amsterdam city centre, in the taxi from Leiden to Schiphol and on the shuttle bus transiting people between Schiphol Plaza and Long Parking area. The researcher observed the placement of passengers' luggage quantitively and their conscious or unconscious behaviours towards the luggage during the journey. During the research, 15 passengers from different locations were interviewed about their travel details, luggage types and placement and the reason on how they place or interact with their luggage.

## Result

There are different kinds of baggage people bring with them during travel. Personal bags, used for everyday travel including business bags, purses, school bags etc., shopping bags, travel backpacks for short stay; suitcases in different sizes; odd-sized luggage for example skiing equipment; strollers for travelling with young kids, wheelchairs. Commuters only have personal bags; business travellers with a stay of 2 to 5 days are common and they usually bring a personal bag and a cabin-sized suitcase; leisure travellers' luggage differs a lot. For travellers staying for more than a week, they have more than one large suitcase per person; for weekend trips up to 5 days, some people only bring one travel bag, some couples and friends share a large suitcase and some people bring both a travel bag and a suitcase. Families travelling with kids and older travellers usually have more luggage per person comparing to the other travellers.

In the following paragraphs, the placement of different luggage in different transportations and the considerations that influence the behaviour will be described.

***Train***

In the trains, most of the personal bags are placed on the lap. Bigger and heavier personal bags, like most of the backpacks, are placed on the next seat, opposite seat or on the floor between the legs. Most of the big suitcases, strollers and wheelchairs or simply a lot of luggage tend to sit or stand by the door during short travel especially when they travel along or with two *(Figure 3)*. It is considered more convenient by all interviewees for embarking and disembarking and to save the hassle of bringing it through the aisle and finding a suitable space to keep it without bothering other passengers. When the train is less full, people bring small and medium sized suitcases through the aisle to the seat and place them next to their seats. They like to pick the four-person face-to-face seats *(Figure 4)* or the single-person seat where there is extra space for luggage. In Sprinters, where space is more open and the aisles are wider, more often people bring suitcases to the seats and they prefer the seats in two rolls along the side with luggage in front of them for the same reason. All luggage is either completely within eyesight or is in contact with the passengers (hands, legs or even sitting on it) for the safety of their belongings and to prevent it from moving around as the train accelerates and decelerates.

Overhead racks are rarely used in the Intercitys and sometimes used in Sprinters. Among over 100 people observed in the Intercitys, none of them was using the overhead racks *(Figure 5)*. The interviewees showed dissatisfaction with the design. The half-opened cabin makes it hard to place luggage. The baggage is not fully visible on the rack, chances are that they can be stolen and passengers might forget to take it when leaving the train in a rush. Furthermore, it only fits backpacks boarding

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***Figure 3. Travelers by the train door with their suitcases.***

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***Figure 4. Travelers making use of the space in a four-person face-to-face seat.***

suitcases and those are the luggage that is small enough to place next to the seats. Unlike Intercity luggage racks, Sprinter has an open and spacious luggage rack that fits most suitcases *(Figure 6)*. Observation in four Sprinters shows that personal bags and backpacks were not placed on the rack at all while some medium and small sized suitcases were placed on the rack. In part of an 83% full Sprinter from Amsterdam to Schiphol where there were 39 travellers with backpacks, travel bags or suitcases, 12.8% of them were making use of the luggage rack

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***Figure 5. Intercity overhead luggage rack.***

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***Figure 6. Sprinter overhead luggage rack.***

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***Figure 7. Overhead cabin in the aeroplane.***

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***Figure 8. Belongings under the seat and in the magazine bag in the front.***

and they were all suitcases or large travel bags. The rest claimed that it was too much work for a 15-minute trip.

### *Airplane*

For air travel, there are check-in luggage, overhead cabin, under seat storage space and front-seat storage bag. Check-in luggage is considered time-consuming, it takes up around 30 minutes for the dropping and collecting process (PASSME). Business people are not in favour of it due to their full schedule while it was not mentioned by the interviewed leisure travellers as a problem. An observation of on flight luggage was conducted on a flight from Schiphol to Olbia, Italy (April 2017). All suitcases and travel backpacks (suitcase/travel bag=5/3) were in the overhead cabin *(Figure 7)*, personal bags were kept either on the lap or under the seats because of easier accessibility and to prevent the damage to their personal belongings in the cabin *(Figure 8)*. 70% of the jackets were placed in the cabin while the rest was placed under seats and on

the lap. In the front storage bags, books, bottles, cameras, phones and food are stored for easier access *(Figure 8)*. Strollers and wheelchairs are in use until the boarding gate, then wheelchairs and bigger strollers are checked-in by the gate and smaller strollers are folded into hand luggage size and stored in the overhead cabin.

Comparing to people's perception in the train, safety is considered a minor problem for both checked-in luggage and cabin luggage by 80% of the interviewees because it is a closed space in flight, people cannot take away the belongings. However, two travellers mentioned that damage to the check-in luggage is a concern for them. In the plane, people keep as fewer belongings with them by their seats for comfort during the two-hour flight.

***Bus and Taxi***

On the buses, interaction with luggage is similar as in the train. All luggage is next to passengers. Some people also prefer standing with luggage in the standing zone next to the doors just like train travellers staying between train coaches.

In the shuttle buses that shuttle passengers from one place to another without stops in between, most of the passengers place their suitcases and travel bags on the luggage rack in the middle of the bus. They would sit facing the luggage rack keeping an eye on it *(Figure 9)*. Odd-sized luggage is not kept on the rack because the shape does not fit on the rack, therefore, they tend to move during the trip, causing damage to the luggage or danger to the other passengers.

Touring buses have the separate luggage storage place underneath the passenger seats. Suitcases and large travel bags are placed in the luggage cabin first by the driver and then passengers will embark the bus; the

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***Figure 9. Luggage rack in a shuttle bus.***

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***Figure 10. The driver brings out luggage from a touring car.***

other way around for disembarking *(Figure 10)*. The capacity of a touring bus is 50 to 70 passengers. Passengers arrive first hand over their luggage to the bus driver, carefully watch the bus driver placing their luggage in a spot in the cabin and then walk to the door. The next couple of passengers walk to the driver with their luggage and same thing repeats. When they arrive at the destination, all passengers disembark and wait at the luggage cabin. The driver brings luggage down the bus one by one. When passengers see their luggage, they walk through the

crowd, get their luggage and walk out of the crowd. The rest will stay around the bus until they get their luggage. It is a similar process and interaction for Taxis (4-6 seats) and shuttle cars (7-10 seats).

***Discussion***

This is a discussion to answer the research questions. The types and number of luggage travellers bring depend on their travel purpose. Luggage for commuters and business travellers is more predictable while it varies among leisure travellers. Families and older people tend to have more luggage and the longer the duration of stay is, the more luggage passengers have.

Key values for passengers concerning the luggage result in their behaviour and preferences towards luggage. Safety, accessibility, personal space, avoiding damage, influence on other passengers are the values for all travellers; convenience, comfort and efficiency are the values that differ per person and per trip; intuition unconsciously influence passengers. Elaborated discussions on each value are in the main report.

There are some other findings that are not regarded to luggage specifically. Group travellers like to be in the same area near enough if they can see each other. Families on the other hand always stay closely next to each other. Another interesting behaviour of passengers (or perhaps any individuals) is that they hesitate on each decision they make. For example, when getting on a train, they hesitate which train door to get in, probably the closest one of the right class. While they are in the queue, they look at the door next to them and compare if the other one could be faster and might move to the next door. When getting on the train, there is left or right, upstairs or downstairs. People take some time to look over the whole coach and decide where to go. In a train coach, they hesitate which seat etc. people also tend to let the inconvenient (people with wheelchair, strollers, trolleys or big luggage) go first during embarking or disembarking and people with inconvenience will hesitate for a few second whether to take the opportunity.

# Original data

The original data from the observations and interviews are presented in the next page.

| | On the train | | Main Journey | | | | Luggage placement | |
|---|---|---|---|---|---|---|---|---|
| Origin | Destination | Travel D | Trip purp | Trip Dur | Baggage | Placement | Reason | Remarks |
| Delft | Schiphol | 30min | holiday | 4 days | backpack*1 | next seat | /keep it close=safe<br>/reach range for getting things like water during the trip<br>/no need to lift from floor or reach from the rack when leaving | /between leg<br>/Over head r<br>more baggag<br>because it's<br>- too small<br>- close but ca<br>take it<br>- forget belo |
| Schiphol | Leiden | 20min | holiday | 4 days | /backpack*2<br>/suitcase*1 | Next to the door, sitting on the door | /more space<br>/short journey<br>/to be with luggage=safe<br>/convenient | /doesn't mat<br>see it<br>/with only ba<br>/with touring<br>down but loo<br>when there's<br>/can't see it |
| Rotterdam | Schiphol | 40min | holiday | weeken | /suitcase*3<br>(2L+1M) | /large suitcases: between two rows of seats<br>/medium suitcase: next seat | /safe that we can see it | /too heavy t<br>/check-in for<br>- don't need<br>- don't have<br>- consider it |
| Den Haag | Schiphol | 30min | business | 2 days | /suitcase*1 | /next to him in the 4-person seat | /naturally placing it next to him<br>/convenient | /overhead if<br>/not check-in<br>takes time |
| Den Haag | Schiphol | 30min | business | 4 days | /laptop bag<br>/suitcase | /laptop on the lap<br>/suitcase next to the single person seat | /security | /nearby over<br>/inconvenien<br>to toilet |
| Schiphol | Amsterdam centraal | 15min | holiday | 11 days | /large suitcase<br>/backpack<br>/large suitcase*2 | /sitting by the door | /simpler than bring into narrow aisle<br>/ok comfortable | /stairs are di<br>/bellow the s<br>eye on it |
| Schiphol | Amsterdam centraal | 15min | holiday | 5 days | /small suitcase*1<br>/backpack*1 | sit by the door | /difficult to pass the aisle<br>/safe and spacious to have everything around | /heavy and c<br>/check-in sui<br>concerns abo |
| Schiphol | Amsterdam centraal | 15min | holiday | 1 week | /suitcase*2<br>/big backpace | /one suitcase on top<br>/one between legs<br>/bag on the floor | /bag is too heavy to put on the rack<br>/put some on top to have space for legs | /when there<br>put luggages<br>/don't want |
| Amsterdam Centraal | Schiphol | 15min | holiday | 1 month | /big backpack<br>/bag | /next seat in a 4-person seat | /too big and heavy for over head<br>/secure<br>/might need things from bags | /comfortable<br>/no problem |
| Amsterdam Centraal | Schiphol | 15min | holiday | 1 week | /big luggage | / next to seat | /too big for the rack on the train | /rather put i<br>can sit |

On the shuttle bus

| | | Insights | |
|---|---|---|---|
| | Ideal situation | Findings | Quote |
| gs if the train is full<br>ack: use when with<br>ges, but not preferred | /safe<br>/take everything to seat with arm reach range | | "My friend experienced it on the train last time, a guy was trying to take stuff out of his bag when he placed it next to the seat in the aisle." |
| ant see, people might<br>ngs from the rack | /convenience for placing it, do not need to pass everyone with luggage and everyone is in the way | /safety: close and in sight<br>/reachable: water etc.<br>/convenience: moving with luggage | "I tend to forget things if I have multiple bags on the rack. Would be nice if I have my own cabin for me, my friends and luggages." |
| tter in the plane if can't | | /space: stand in the joint with a suitcase<br>/convenience: by the door | |
| ags sit in the train<br>g buses, put big luggage<br>ok at it through window<br>s a stop<br>over head | /convenient to find a place and get stuff if I need<br>/safe | /comfort doesn't metter for short trip<br>/safety: see it or no one sees it; stop in between makes it unsafe | "We don’t want to walk in the train with the suitcase. We are just lazy." |
| o put them over head<br>plane:<br>it | | /sit in the 4 person seat<br>/safety: see it with no people around, which is tiring | "Last time they took our luggage from the over head rack." |
| to carry it<br>safe | /safe, do not have to watch it all the time | /safety: check-in is safe nobody can take it | "I don’t know what they do wity your (check-in) suitcase, but still I check-in everything" |
| the train is full<br>n on plane because it | /fast<br>/convenient | /placing next to you on the floor is intuitive<br>/time matters with check-in luggage | "Oh I haven't thought about it (placement), I just put it there as I sat here."<br>"I won't check-in luggage, it takes at least 20 min to have it back." |
| rhead on the plane<br>nt not clean when going | | /moving with luggage around is inconvenient<br>/steps for luggage are difficult, especially for old people, they cant't go with their luggage at the same time | |
| fficult for luggages<br>seat in plane to keep an | | /it's ok not travelling in group for short time | "It's definitely more convenient to put it by the door than travelling in that narrow aisle." |
| difficult with stairs<br>tcases fell very hard,<br>out damage | | /damaging the suitcase<br>/more suitcases can't bring at once | "Our suitcase fell really hard when it came out of the conveyor belt, I'm worried about the wheels and if the suitcase will break." |
| are a lot of people will<br>on top<br>to bother anyone | | /not bothering people<br>/luggages are too heavy for overhead rack | |
| e<br>with getting in and out<br>t on top so other people | /better place<br>/secure | /people want a place for luggage where its secure and convenient | "I would place it on the rack if it fits so that other people can sit next to me." |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Long Parking Area | Schiphol Plaza | 15min | holiday | 9 days | /suitcase*6 /laptop bag | /suitcases on the luggage rack (standing next to it) /laptop bag in hand, or on the floor between legs | /very safe here, I can see it /valuable things in hand afraid of damage during turnings | /in the train eye on it |
| | In the taxi | | | | | | | |
| Leiden | Schiphol | 22min | holiday | 4 days | /backpack | /backpack between legs /girlfriend's bag on the seat | /want to leave and arrive fast to catch the flight /sit on the right, right handed, more natural and faster to take to put in legs, girlfriend sits on the left and put baggage on her right | /for long jou in the back s /one bag per to get out, m much more t |
| | In the plane | | | | | | | |
| Amsterdam | Olbia | 2h | holiday | 4 days | backpack | /up the cabin | /my girlfriend and me both put luggages up | /prefer putti can reach th people /when I'm al much about |

| | | | |
|---|---|---|---|
| | | | "no safety issue on the bus, I'm keeping an eye on it." |
| also on racks, keep an | | /trains stop and different people, shuttle bus people travel from parking to airport, it's safer | "I've been sitting in the car for 3 hours, I enjoy standing for 10 min." "It's absolutely different from the train." |
| | | /one bag per person is much faster /right hand easier to put on the right | "I can't take all the bags at the same time, so that slows down the process." |
| rneys (>40 min), I'll put it | | | "If im not in a hurry, I would value comfort more" |
| o I can strech my legs | | /comfort is valued when not in a hurry | "I'd be the slowest person in the system, if I'm fast, the system is fast, if I'm slow, the system waits for me." |
| person is easy and fast | | | |
| ore than that it takes | /people do it for me | /prefer people carrying it in and out for him | |
| ime | /system is fast, I can be slow | | |
| ng it between legs so I | | | |
| ings and not bother | | /accesibility /not bothering people | |
| one I don’t care that | | /less safety problem in plane, it's closed | "under seat is as bad as overhead, I don’t have access to it easily." |
| comfort | | | |

# Appendix D: Context factors

## Technological factors

• A human is able to identify with another human on an emotional level better than a robot can (Tech Insider, 2015)(state)

• As machines begin to eliminate the most menial tasks (development), people are left with more time to deploy creative abilities (Tech Insider, 2015) (trend)

• Fully autonomous vehicles will be launched around 2020 (Driverless future, n.d) (development)

• Congestions and vehicle fatalities will decrease with the connected autonomous vehicles (Viereckl, 2016) (development)

• Connectivity among multimodal transportations (state) allow people to transfer more easily and seamlessly (Viereckl, 2016)(trend)

• The possible applications of drones are ranging from fun flights to military usage, emergency healthcare and supply chain (PwC, 2016)(development)

• Virtual reality enables people to feel fully immersed in a simulated 3D world (Gartner, 2016)(trend)

• Augmented reality is overlaying a digital layer on the physical world and changes the way people interact with digital systems and blends the boundaries between the digital and physical world (PwC, 2016)(trend)

• The internet makes human desires more easily attainable by making things fast and easy, not making people think (Ev Williams, n.d)(trend)

• App download numbers continue to rise, however, the rate at which numbers are growing is decreasing swiftly. (Statista, modified, 2017) (trend)

• Augmented Reality will allow personalized, real-time, on-demand customer service. (development)

• Smart devices "seamlessness" is still highly unachievable. (development)

• Automation is skyrocketing productivity, killing jobs (development)

• Big data collection and analysis is focused on quantitative data (development)

• Big data is revealing the real value of

personal information. (development)

• 85% of executives anticipate making large investments in AI within the next 3 years. (Accenture, 2017) (development)

• Strongest technology players, create relationships with their users and attain a solid, stable user base. E.g. Apple, Google, Uber. (state)

• A viable strategy for long term growth is ecosystem development. (Accenture, 2017) (development)

• If technology works for people, they'll use it, else, they won't (trend)

• Facebook's privacy policies have declined in 22 out of the 33 PPR (Patient Privacy Rights) measures since 2005. (Shore and Steinman, 2015) (development)

• Only 17.8% of people read the Terms of Service for online platform use. (Morrison, 2015) (state)

# Socio-cultural factors

• People's logic is overly influenced by what other people think yet they don't notice (Kahneman, 2014)(principle)

• Collaborative consumption is the trend of sharing consumer products and services. The reinvention of traditional behaviour of renting, lending, swapping and sharing (Botsman, 2015)(trend)

• The sharing lifestyle arises on-demand products and services that directly match customer needs by providing immediate delivery and personalized services (Botsman, 2015)(state)

• The next generations are digital in borns and more and more highly educated people make technology more acceptable (Frog Design, 2016) (trend)

• People are constantly checking on things because of the fear of missing out (Quora, 2015)(state)

• Special treatment makes people feel special and appreciated (Dreyfus, 2010)

• People are overwhelmed, distracted and stressed through a continuous digital experience and there is a need of focusing on the real world around us (Fjord, 2015)(state)

• There will be more virtual companies and a growing number of remote and flexible workers (Fast Company, 2016)(trend)

• Work-life balance is becoming harder to maintain because of flexible working (Fast Company, 2016)(trend)

• Commuting time stays constant even as distances change (MIT, 2014)(state)

• People expect radical transparency as information is more accessible (Dan, 2014) (trend)

# Psychological factors

• People would rather have a human judgement over a judgement based on database (Tech Inside, 2015)(state)

• People want to be challenged and perform at the maximum of their capacities (Hekkert, 2011)(principle)

• The intuitive part of people's mind is fast and automatic and is responsible for most of the things that people say, do, think and believe (Kahneman, 2014)(principle)

• The "present bias" causes us to pay attention to what is happening now, but not to worry about the future (Kahneman, 2014) (principle)

• People tend to look for information that confirms what we already know (Kahneman, 2014)(principle)

• negative events are far more easily remembered than positive ones (Kahneman, 2014)(principle)

• People suffer from "decision fatigue" when being a decision maker for oneself, but feel fun and liberating as an adviser for someone else (Polman, n.d)(principle)

• People want to feel in control even if it's an illusion and it makes them healthier physiologically and more successful (Bright, 2008)(state)

• Personalization reduces the feeling of information overload (Bright, 2008)(state)

• People have a shorter attention span in the overwhelming world (Fuggle, 2016)(trend)

• hesitation in the crowd will cause a chain of reaction delay and slow down the flow or even create conflicts and stampedes in the crowd (Helbing, 2015)(principle)

• Anxiety occurs when people are unaware of or uncertain about the situation (interview with J. Li, 2017)(principle)

• When people are in a hurry, they make more intuitive decisions (Kahneman, 2014) (principle)

# Biological factors

• Elderly have to step and grasp more than younger (interview with P. Vink, 2017) (principle)

• Speed physiologically and psychologically make people excited (Art Markman, 2009) (principle)

• Older people are slower with physical actions (interview with P. Vink, 2017) (principle)

• Children require more attention thus bring more effort to parents during travel (interview with P. Vink, 2017)(principle)

• Larger entrances make (dis)embarking faster (Helbing, 2005)(principle)

• Handicapped has more inconvenience (Helbing, 2005)(state)

• People hesitate who to go first in a narrow entrance/exit (Helbing, 2005)(state)

• Independent living is important for old people (Unity care solutions, n.d) (state)

# Economic factors

• We feel the pain of a loss much more than we feel the pleasure of a gain, twice as much (Kahneman, 2014)(principle)

• Machines that automate tasks are slowly taking over human labour completely for some industries (POMG Connectivity Team, 2016)(development)

• 18.4% Inland freight transport in EU-28 in 2015 was moved by rail, 74.9% by road. (Ec.europa.EU, 2017) (development)

• Around 879 million passengers travelled by air in the European Union in 2014, of whom 74 million used London's Heathrow Airport alone, of which 25 million travelled intra-EU-28 (Ec.europa.eu, 2017) (state)

• 48% of total passenger transport in 2015 was to/from EU-28 (Ec.europa.eu, 2016) (state)

• London, Paris, Frankfurt and Amsterdam are Europe's busiest airports connecting more than 110 million passengers within the EU-28 (Ec.europa.eu, 2017) (state)

• Intra EU-28 air mail and freight transport grew by 7.2% in 2014-2015 (development)

• Flight prices have dropped approximately 50% in the last 30 years. (Thompson, 2015) (development)

• Big data driven business opportunities are more and more common (development)

• Big data allows for massive personal reach. (Motherboard, 2016) (development)

• Millennials are big money savers, and careful with their expenses. (Transamerica Centre for Retirement Studies, 2014) (trend)

• 51% of inland Europe energy consumption is purchased. (Eurostat, 2016) (state)

# Political factors

• There will be more effective security in a more efficient way for public transportation (EU Commission, n.d)(development)

• Growing nationalism means more border control in EU (The Guardian, 2016) and growing border security globally (Global, 2015)(development)

• Nationalism is increasing in Europe, due to large immigrations. (Time, 2017) (development)

• Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry's share of employment and gross domestic product, in line with national circumstances, and double its share in the least developed countries (United Nations, 2017) (development)

• Technology outpaces policy.(Accenture, 2017) (state)

# Ecological factors

• Paris agreement will encourage nations to pursue sustainability on their own terms. (trend)

• EU has set itself the target of 60% GHG (Green House Gases) reduction from 1990 levels by 2050 (Eea.europa.eu, 2017) (trend)

• Except for intra-EU aviation, the remaining transport modes will need to contribute to the 30 % reduction effort for the sectors excluded from the EU Emissions Trading Scheme, such as buildings, agriculture, small industry and waste. (Eea.europa.EU, 2017) (development)

• By 2030, increase substantially the share of renewable energy in the global energy mix (United Nations, 2017) (trend)

• By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries. (United Nations, 2017) (trend)

• One of the goals of the Energy Challenge is to create a single, smart European electricity grid. (EU, 2017) (trend)

• Renewable energy produced in Europe is not constant and requires storage or more interconnection to use all of it (Business Insider, 2016) (development)

• Major airlines committed to integrating renewable jet fuel into operations. (Renewable Energy World, 2017) (development)

• Policy makers will work not only with energy production but also energy storage. (Renewable Energy World, 2017) (trend)

• Distributed Energy Resources has become reliable enough to factor in urban energy management. (Greentechmedia.com, 2017) (development)

• "Green" is about money. (Greentechmedia.com, 2017) (trend)

# Appendix E: Concept selection

The following paragraphs explain how the scores were defined.

## Concept performance

According to the conditions and requirements, a primary calculation of passenger capacity per 10 meters (with the same conditional diameter) for each concept was made. The used parameters are not validated yet with ergonomic research but are sufficient for making a comparison at the concept decision step. An overview of the comparison is shown in *Figure 11*. Shift has the largest capacity while Turn-in and Walk-through are scored relatively low in capacity.

Regarding (large) luggage space per passenger, Turn-in has the highest score because of its spacious and luxurious design with approximately two large suitcases per passenger; Shift scores the next because luggage cabins are separated from passenger space; while Walk-through and Carry-on score the lowest.

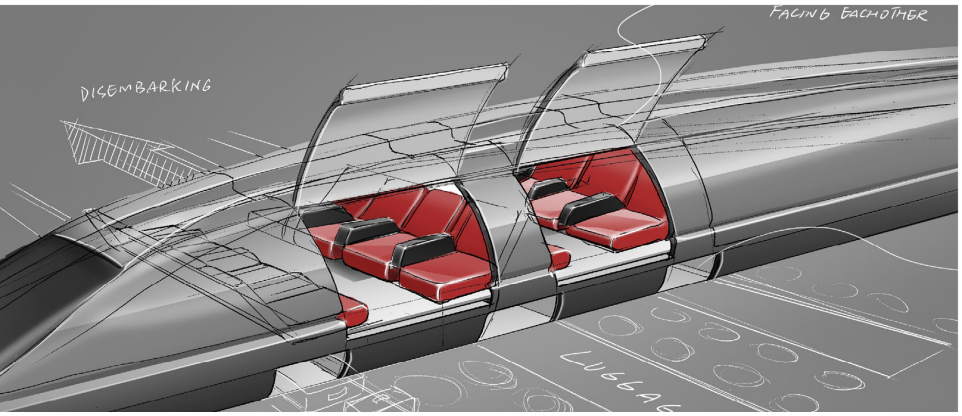
'Time efficiency for system' measures how long the vehicle needs to stop at the platform waiting for passengers to disembark, embark and get seated for departure. Carry-on scores the highest because the carriers only need to drop off or pick up the pods at the station. Shift scores also high because of the efficient passenger flow.

Walk-through scores the best on 'inclusiveness for passengers with reduced mobility' because of the one-wide-aisle design connecting smoothly with the station platform. Also, it is the easiest concept to integrate wheelchairs into the seat layout. Shift also scores relatively high because of the short aisles.

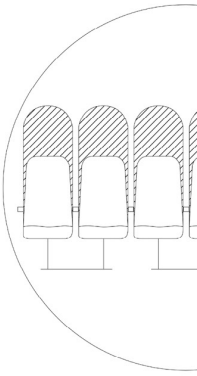
In general, Shift is scored best in performance and Carry-on scores the second best.

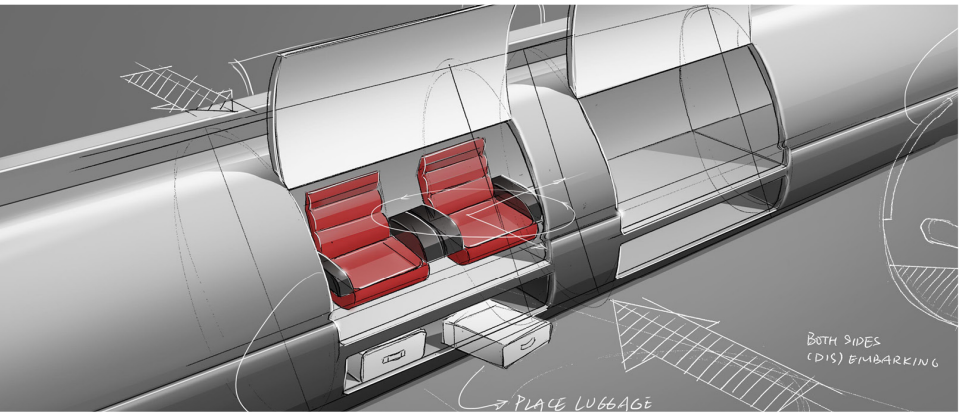
## User experience

In this category, the qualities stated in the design brief, hospitality and adventurousness, were scored for the concepts. This was done by interviewing 10 potential users. The participants were asked to rank the concepts by hospitality and adventurousness and to give reasons to their choices. Then the score was given based on the users' responses.

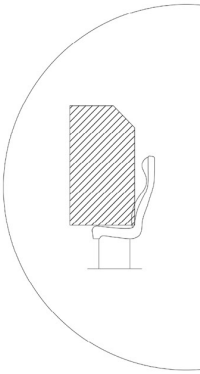


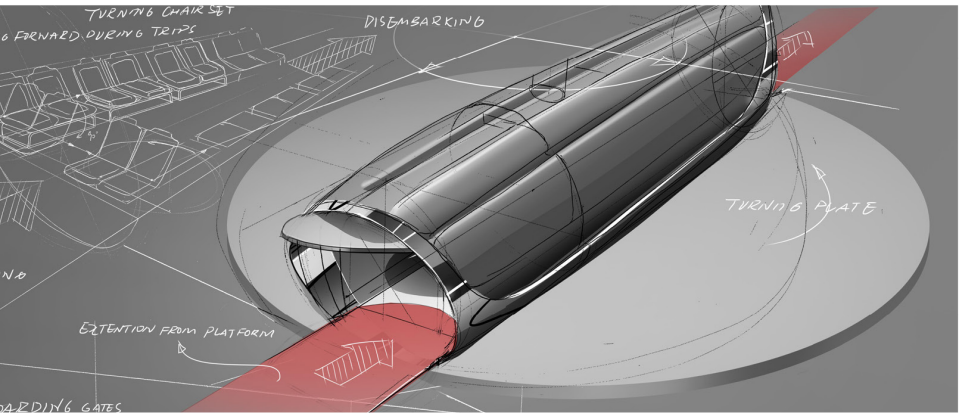

60
SHIFT



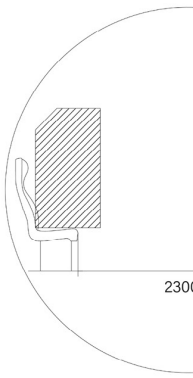


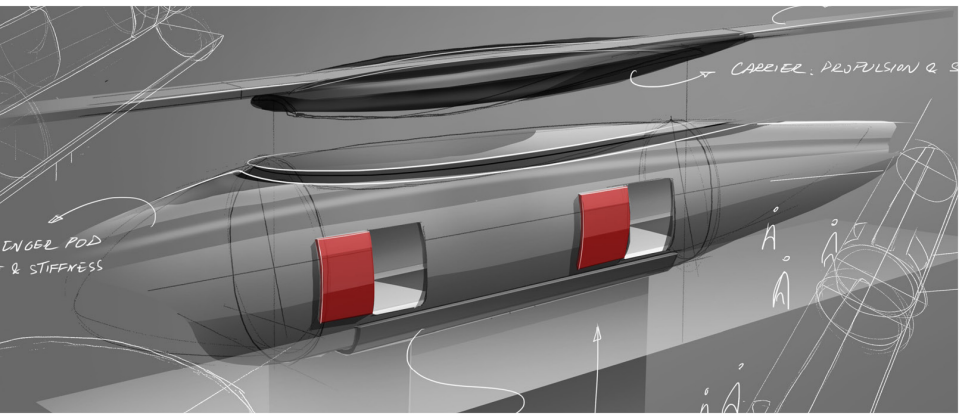

24
TURN-IN



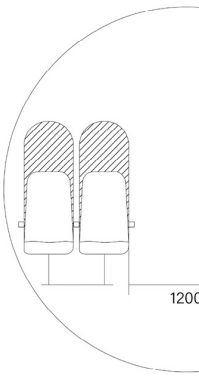



30
WALK-
THROUGH

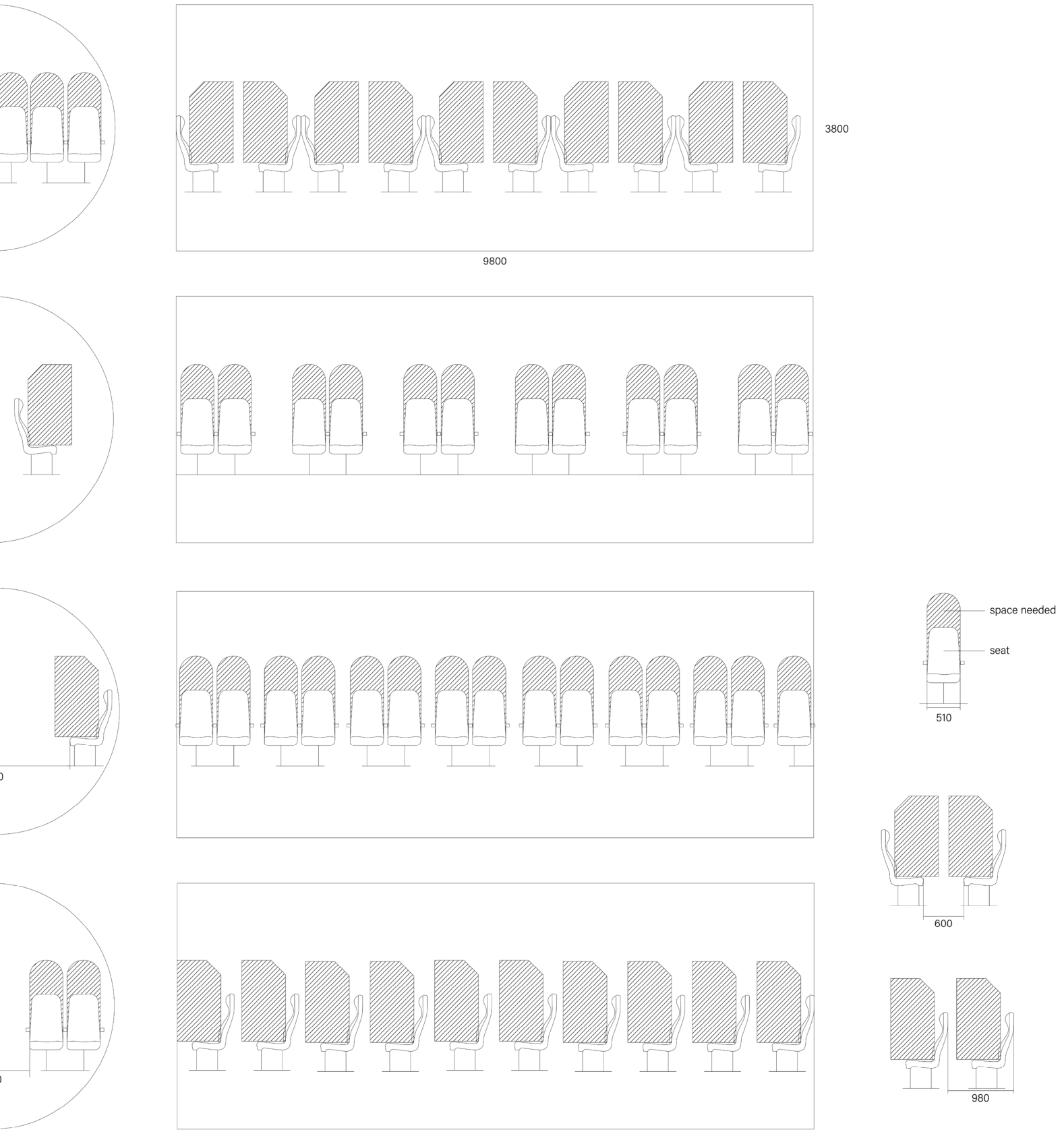



40
CARRY-ON



▼ ***Figure 11. Capacity comparison between four concepts.***



Shift is considered to have the highest hospitality because of the openness for embarking and disembarking. Passengers can be aware of everything that happens during embarking and disembarking. Also, a small group of people sitting face-to-face in a 'cabin' feels warm and welcoming. Turn-in scores the next best because the seats are always facing the most convenient way for passengers. Walk-through is considered less inviting because people are going through an unknown closed area which is intimidating. Carry-on is considered the least hospitable because the pod itself arouses negative connection to traditional boarding methods and passengers are moving around like cargos by the carrier.

Turn-in and Carry-on are ranked the most adventurous concepts because of the moving seats in Turn-in and the futuristic station vision of Carry-on. Shift and Walk-through score low in adventurousness because they remind people of the existing (dis)embarking experiences like trains and metros.

The other aspects were scored using the result of the field research and my own experience as a designer. The aspects include clarity of the process, comfort during waiting, (dis)embarking and travelling and convenience regarding how effortless and efficient it is for passengers to (dis) embark, place and collect their luggage, as well as passengers' accessibility to the lavatory, entertainment, information and their belongings. In the category of user experience, Shift scores the highest and Turn-in is the close second.

These next three parts were scored in collaboration with the development team of the company. Complexity and cost was scored base on the structure complexity to withstand the pressure difference in the tube and the cost of vehicle, station and interior; system integration was scored upon the potential to integrate with the rest of Hardt's hyperloop system, including suspension, propulsion, ventilation system and the possibility to integrate cargo transportations; emergency safety was based on the consideration of on board safety equipment and evacuation flow during emergencies.

The innovative selling point was scored considering the feedbacks from potential users and the company. The higher it scores, the bigger chance that the design will help the company to stand out among their competitors.

The overall result shows that Shift has the most potential regarding performance, user experience and feasibility (complexity and cost). Therefore, the preference of both me and the company goes to this concept. Shift concept will be elaborated and evaluated in the next chapters. Additionally, Carry-on scores the second best in general with the highest integration and innovation points. The company also sees great value in the idea of having 'carriers' and 'pods' due to its high originality and the ability to holistically reach the ultimate vision of a door-to-door service. However, since this is an idea more on the operating level than on passenger flow (the focus of the assignment), we reached the agreement that it will not be developed in this project but will be a valuable recommendation to the company.

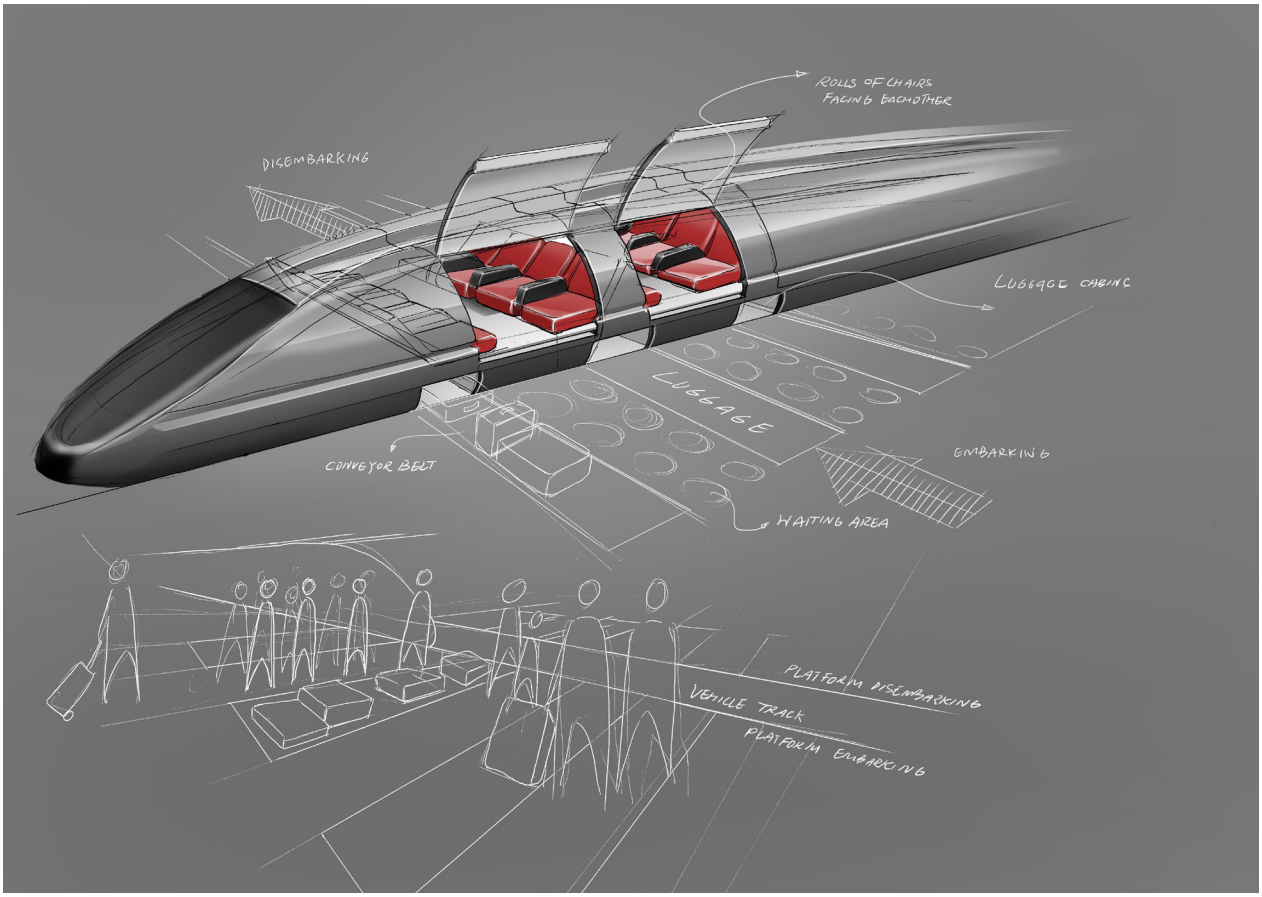
# Appendix F: Questionnaire for validating

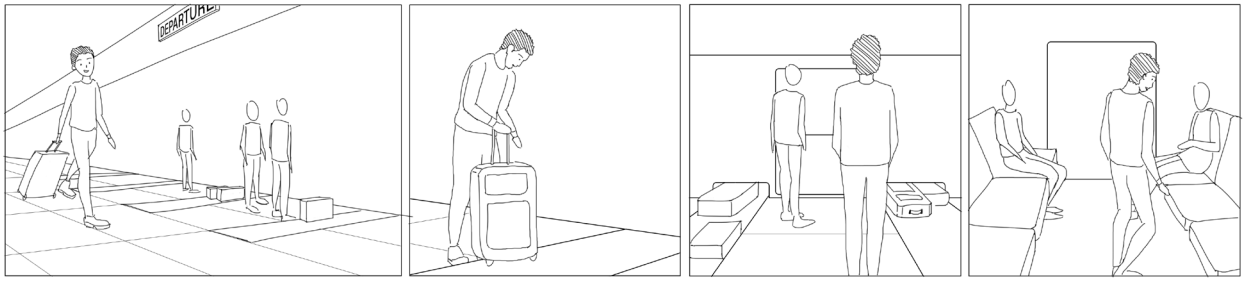
## Boarding Hyperloop

This is a preliminary concept for embarking and disembarking Hyperloop (a future high-speed tube transportation with magnetic suspension). You are invited to experience and judge the boarding process with this questionnaire.

*Required

### The concept




**1.** WALK TO THE PLATFORM IN DEPARTURE STATION **2.** PLACE LUGGAGE ON THE BELT **3.** LUGGAGE GOES INTO THE VEHICLE **4.** WALK IN AND FIND A SEAT


**5.** THE VEHICLE TRAVELS TO DESTINATION **6.** WALK OUT FROM THE OTHER SIDE **7.** COLLECT LUGGAGE AT PLATFORM **8.** LEAVE THE STATION WITH YOUR LUGGAGE

Comparing to luggage experience for trains, what do you think of the designed luggage experience: hold luggage (like suitcases and large travel bags) being automatically transferred to luggage cabin and personal bags can be placed on-board?

1. **I think it's very convenient** *
   *Mark only one oval.*

| | 1 | 2 | 3 | 4 | |
|---|---|---|---|---|---|
| I don't agree | ◯ | ◯ | ◯ | ◯ | I agree |

2. **It's a natural action (intuitive) placing hold luggage on the luggage place on platform in step 2** *
   *Mark only one oval.*

| | 1 | 2 | 3 | 4 | |
|---|---|---|---|---|---|
| I don't agree | ◯ | ◯ | ◯ | ◯ | I agree |

3. **I don't have a concern about losing it** *
   *Mark only one oval.*

| | 1 | 2 | 3 | 4 | |
|---|---|---|---|---|---|
| I don't agree | ◯ | ◯ | ◯ | ◯ | I agree |

4. **It makes boarding time-efficient** *
   *Mark only one oval.*

| | 1 | 2 | 3 | 4 | |
|---|---|---|---|---|---|
| I don't agree | ◯ | ◯ | ◯ | ◯ | I agree |

5. **It's fine not having access to my hold luggage for a trip less than 2 hours (personal bags are always with you on-board)** *
*Mark only one oval.*

| | 1 | 2 | 3 | 4 | |
|---|---|---|---|---|---|
| I don't agree | ◯ | ◯ | ◯ | ◯ | I agree |

6. **In general, I prefer** *
*Mark only one oval.*

- ◯ This luggage solution (preload hold luggage in a separated cabin)
- ◯ Bringing hold luggage with me on-board

7. **When the doors open and I (with my travel companion) am standing in the short queue among a couple of other passengers, what would you do most probably in step 4?** *
*Mark only one oval.*

- ◯ I would follow the person in front of me and sit in the furthest seat possible so it's more convenient for other people behind me
- ◯ I would pick my own seat
- ◯ I don't really mind, it depends on what other people do
- ◯ Other: _____

8. **Concerning the rows of seats facing each other** *
*Mark only one oval.*

- ◯ I don't mind that much which direction I'm facing
- ◯ I don't mind sitting on the row facing backwards if it charges less
- ◯ I don't mind sitting on the row facing backwards if there isn't a window
- ◯ I only want to sit facing forward because I will feel sick otherwise
- ◯ Other: _____

9. **Concerning on-board lavatory, it's fine not having a toilet on-board for** *
*Tick all that apply.*

- ☐ A 10-min trip (like Delft to Den Haag HS by Intercity)
- ☐ A 15-min trip (like Delft to Rotterdam Centraal by Sprinter)
- ☐ A 20-min trip (like Delft to Leiden Centraal by Intercity)
- ☐ A 30-min trip (like Den Haag Centraal to Rotterdam Centraal by Sprinter)
- ☐ A 40-min trip (like Delft to Schiphol by Intercity)
- ☐ It depends on whether I am informed of this before boarding
- ☐ It depends on if there is free toilet on the platform
- ☐ Other: _____

10. **Open remarks about the concept**

## Further Participation

11. **It's a very interesting topic and I might want to participate in user tests later. Here is my email:**

## Demographic Data

12. **What's your gender?** *
*Mark only one oval.*

- ◯ Male
- ◯ Female

13. **What's your age?** *
*Mark only one oval.*

- ◯ 25 or under
- ◯ 26-40
- ◯ 41-55
- ◯ 56 or older

14. **I spent most of my lifetime in** *
*Mark only one oval.*

- ◯ Europe
- ◯ Asia
- ◯ North America
- ◯ South America
- ◯ Africa
- ◯ Australia
- ◯ Other:

# Appendix G: Questionnaire for user test

PART 3: Conclusion and recommendation (For interview)

In general, I prefer: A ☐ B ☐

Why?

What could be improved for B?

When the door size of B got smaller, did you feel any inconvenience? (While waiting/while boarding/while disembarking)

HARDT

# (Dis)embarking Hyperloop

## USER TEST QUESTIONNAIRE
## JUNE 22, 2017

PART 1: Participant Information

Name _____
Gender M ☐ F ☐
Age _____
Nationality _____

The film taken during this user test will be only used as research propose. If in any case, the film needs to go public, we will send you an e-mail for permission.

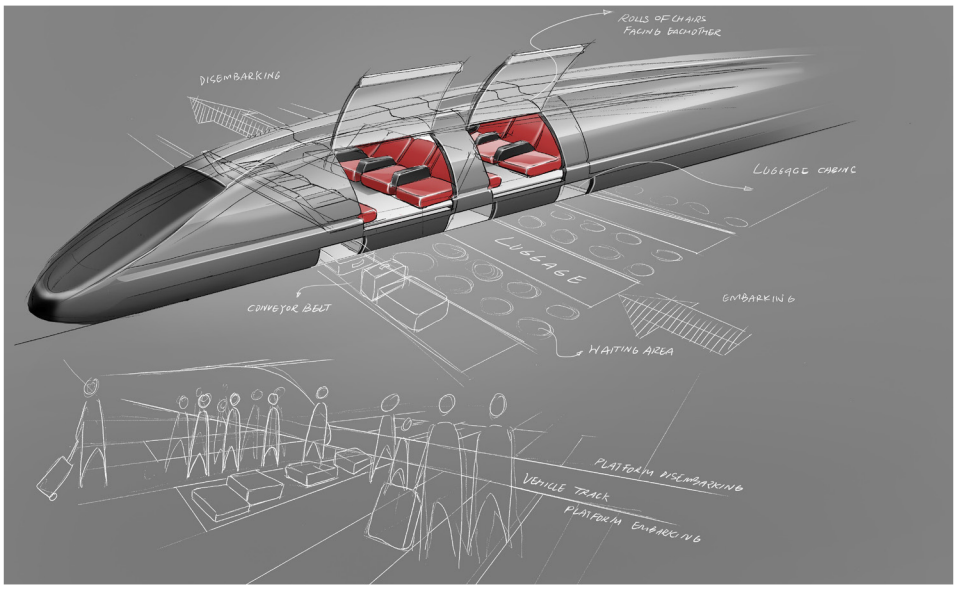
☐ I agree

PART 2: Questionnaire

Test A

| | Strongly Disagree 1 | 2 | 3 | 4 | Strongly Agree 5 |
|---|---|---|---|---|---|
| *When I was on the platform:* | | | | | |
| It was clear what to do | ☐ | ☐ | ☐ | ☐ | ☐ |
| It was comfortable when waiting for the vehicle | ☐ | ☐ | ☐ | ☐ | ☐ |
| The experience was pleasant | ☐ | ☐ | ☐ | ☐ | ☐ |
| *During boarding and disembarking:* | | | | | |
| It was clear what to do | ☐ | ☐ | ☐ | ☐ | ☐ |
| It was convenient to get in and get seated and the other way around | ☐ | ☐ | ☐ | ☐ | ☐ |
| The experience was pleasant | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Regarding the way to place and collect my large luggage:* | | | | | |
| It was clear what to do | ☐ | ☐ | ☐ | ☐ | ☐ |
| It was convenient | ☐ | ☐ | ☐ | ☐ | ☐ |
| I felt comfortable doing so | ☐ | ☐ | ☐ | ☐ | ☐ |
| It was a good luggage solution | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Overall experience:* | | | | | |
| It was time efficient | ☐ | ☐ | ☐ | ☐ | ☐ |
| It was a seamless journey | ☐ | ☐ | ☐ | ☐ | ☐ |
| The process was clear to me | ☐ | ☐ | ☐ | ☐ | ☐ |
| It was an inviting and friendly (dis)embarking experience | ☐ | ☐ | ☐ | ☐ | ☐ |
| It was an exciting (dis)embarking experience | ☐ | ☐ | ☐ | ☐ | ☐ |

Test B




| | Strongly Disagree | | | | Strongly Agree |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| *When I was on the platform:* | | | | | |
| It was clear what to do | ☐ | ☐ | ☐ | ☐ | ☐ |
| It was comfortable when waiting for the vehicle | ☐ | ☐ | ☐ | ☐ | ☐ |
| The experience was pleasant | ☐ | ☐ | ☐ | ☐ | ☐ |
| *During boarding and disembarking:* | | | | | |
| It was clear what to do | ☐ | ☐ | ☐ | ☐ | ☐ |
| It was convenient to get in and get seated and the other way around | ☐ | ☐ | ☐ | ☐ | ☐ |
| The experience was pleasant | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Regarding the way to place and collect my large luggage:* | | | | | |
| It was clear what to do | ☐ | ☐ | ☐ | ☐ | ☐ |
| It was convenient | ☐ | ☐ | ☐ | ☐ | ☐ |
| I felt comfortable doing so | ☐ | ☐ | ☐ | ☐ | ☐ |
| It was a good luggage solution | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Overall experience:* | | | | | |
| It was time efficient | ☐ | ☐ | ☐ | ☐ | ☐ |
| It was a seamless journey | ☐ | ☐ | ☐ | ☐ | ☐ |
| The process was clear to me | ☐ | ☐ | ☐ | ☐ | ☐ |
| It was an inviting and friendly (dis)embarking experience | ☐ | ☐ | ☐ | ☐ | ☐ |
| It was an exciting (dis)embarking experience | ☐ | ☐ | ☐ | ☐ | ☐ |

# Appendix H: Calculation energy cost

This document calculates the simplified operational energy cost to compare the cost difference between the Shift concept(10 doors) and the traditional concept(2 doors). The relevant operational cost is the electricity cost for propulsion (levitation does not cost energy in theory). The variables are assumptions provided or proved by Hardt.

```
> restart;
```

## Variables

Speed of the vehicle

$$> v := 200\ \frac{\mathrm{m}}{\mathrm{s}};$$

Mass of the vehicle per passenger for traditional concept

$$> mppax := 500\,\mathrm{kg};$$

Mass per additional door

$$> mdoor := 100\,\mathrm{kg};$$

Number of passengers per vehicle

$$> np := 50;$$

Number of doors for Shift concept

$$> ndshift := 10;$$

Number of doors for traditional concept

$$> ndtra := 2;$$

Cost of electricity per kwh in the Netherlands (EUR)

$$> electricitycost := \frac{0.117}{\mathrm{kWh}};$$

Motion efficiency (energy recharge during deceleration)

$$> \eta := 0.8;$$

## Calculations

### Electricity cost for propulsion: traditional concept

Mass of the traditional vehicle

$$> mtra := mppax \cdot np;$$

Energy used to accelerate for traditional concept

$$> Eatra := \frac{1}{2} mtra \cdot \left(v^2\right);$$

Energy use per trip for traditional concept

$$> Etra := Eatra \cdot \left(1 - \eta^2\right);$$

Energy cost per trip for traditional concept (EUR)

$$> Energycosttra := electricitycost \cdot Etra;$$

> $combine(??, 'units')$

$$5.850000000 \quad \textbf{(2.1.1)}$$

## Electricity cost for propulsion: Shift concept

Mass of the Shift vehicle

> $mshift := mtra + mdoor \cdot (ndshift - ndtra);$

Energy used to accelerate for Shift concept

> $Eashift := \frac{1}{2} mshift \cdot (v^2);$

Energy use per trip for Shift concept

> $Eshift := Eashift \cdot (1 - \eta^2);$

Energy cost per trip for Shift concept (EUR)

> $Energycostshift := electricitycost \cdot Eshift;$

> $combine(??, 'units')$

$$6.037200000 \quad \textbf{(2.2.1)}$$

## Energy cost difference

Extra energy cost of Shift concept per trip (EUR)

> $\Delta Energycost := Energycostshift - Energycosttra;$

> $combine(??, 'units')$

$$0.1872000000 \quad \textbf{(2.3.1)}$$

Extra ticket price of Shift concept per passenger (EUR)

> $\Delta ticketprice := \frac{\Delta Energycost}{np};$

> $combine(??, 'units')$

$$0.003744000000 \quad \textbf{(2.3.2)}$$

Extra cost percentage

> $extrapercentage := \frac{\Delta Energycost}{Energycosttra};$

$$extrapercentage := 0.03200000000 \quad \textbf{(2.3.3)}$$

# Conclusion

The electricity cost for Shift concept(10 doors) is 3.2% more than the traditional concept(2 doors), which is 0.19 Euros more per trip per vehicle and 0.004 Euros more per ticket. However, the calculation is only an estimation with limited assumptions.

# Appendix I: Final Evaluation Interview Transcript

## Participant 1

***Age:17, from California***

[00:00:43] Hyperloop is designed for a one-trip journey (no stops), they are fast. I really don't see the difference just between putting your bag on top of the train than having a really complicated process (like airports). It's necessary to have the process I think. (In the video), that's really streamlined. It's a really good idea that you guys have.

[00:01:08] We have these big bags and we usually on the train just put them in the overhead luggage compartments that they already had but if you really have really precious materials you would probably want to put them in a safe spot.

[00:01:26] (What I really like about the concept is that) it was really streamlined, it was smooth. It was really cool.

[00:02:04] Do you get a pre-given number ( for the doors you are going and the luggage)? [00:03:06] (For transfers) you should have a system where like in airport where just underground, the system just takes the bag from one flight and go underground and come up the next flight. The passengers don't have to be worried and you probably have the numbering system so you have a designated seat. And if I just go to that designated seat, I am able to know that my luggage has been handled properly. It would be nice to combine with the app that your luggage will be delivered according to the ticket number of your next trip.

[00:03:55] For embarking and disembarking, I thought it was a really good concept. it really looks like a process where the customers would enjoy.

# Participant 2

***Age 65, from France***

[00:00:10] That was actually nice. [00:00:16] It is very efficient. [00:01:36] (What do you mean by better security and better safety, is it for luggage?) So you just put it in there right? So you don't have to worry about somebody picking your luggage or I'm sure that system has some sort of checking in to the content of that. [00:03:07] Considering the (luggage) pickup and delivery system, how do you guarantee that somebody is not going to use the system and put something in there to damage the train.

[Participant wrote down] Efficient and convenient, helps to carry luggage around. Better security and safety, help passengers can walk around or browse area with more comfort. Will screening luggage be considered?

# Participant 3

***Age 28, from Afghanistan***

(No recording, only interview notes) It facilitates everything. Luggage solution seems really fast and I like the part that everything is automatic with luggage drop and pick up. It's dramatic.

# Participant 4

***Age 23, from the Netherlands***

[00:00:05] I like the overview it gives. Comparing to a normal train, you see immediately what is about to happen to you and what is expected from you. It's very clear and structured like this. You don't have to take any corners. You can just immediately see when you walk into that door where you can sit and where you will go out again.

# Participant 5

***Age 16, from Spain***

[00:00:06] I think it's easy to use. You have more confidence using it because you can be surer of not losing your belongings. In the future, it could be a very useful thing. [00:01:30] It looks faster.

# Participant 6

***Age 21, from Spain***

[00:00:05] I really like that the way that you can book it by the phone. I would prefer that I can reserve my seat by my phone. [00:01:44] I also like uber and that kind of things you can book it and you don't need to just go there and wait for a long queue. [00:00:45] (Regarding the luggage solution) I really like it because you don't have to put it on top of the train. Sometimes it's uncomfortable.

# Participant 7

***Age 57, from the Netherlands***

[00:00:24] It's very quick. Everything is so quick. (Do you have concerns about your luggage safety?) No, you also have it with aeroplanes. [00:01:34] It's really nice and you can sit relaxed without worrying anything. It's a nice idea.

# Participant 8

***Age 20, from the Netherlands***

[00:01:47] I really like to be always in contact with my luggage but with really big bags it can just go into the luggage compartment. [00:03:14] I already see people getting confused. My mother, for example, she would just read it wrong and go to the

wrong door. [00:04:11] The luggage gets out easily, that would be better than this system (airport). It can take ages.

# Participant 9

***Age 18, from Australia***

[00:00:20] I think it's very good compared to the train now where you have to take your luggage on board with you. Finding a seat is also very difficult if you have a big bag. They don't usually have areas to put big luggage like a suitcase. You have to put it on the overhead thing. Putting it underneath is so much easier. [00:00:51] (I like) the fact that you could go on luggage free. You don't have to worry about your luggage and you know it's safe. [00:01:05] It's also attractive that you don't need to go to customs and all of that. [00:01:28] Possibly that it might not be much room as on the trains and planes. You might could not take as much luggage as in trains. Would be a problem for some people sitting at their backs towards others but to me, it's not a problem.

# Participant 10

***Age 18, from Australia***

[00:00:15] I could understand where to place your luggage and pick it up. It was quite easily laid out. [00:00:30] I found it more attractive because it didn't seem like you need to be in different places. In airports, you have to travel quite far distance between different check points. This is pretty central. [00:01:50] I like the fact that your luggage goes underneath the thing. I think it's quite clever. And I like the fact that it comes out pretty much in several strips because you know where your luggage is at all time and it doesn't get shuffled around the whole plane (vehicle). It's just the little location that it comes out from the location you put it in.

[00:01:00] I think it's very how it works in the video. I understood quite nicely and I think it's more attractive than an aeroplane. And I also like the fact that there are several different exits not just one. I think it's just more efficient. Probably works better because you don't have to stand in queues for ages to get there.

Participant 11-12

Age 35 and 30, from Austria

[00:00:23] It looks like an improvement. [00:00:38] The thing that I liked is that the moment that people go out of the train, they are right there with their luggage. [00:00:56] It looked really organized. Good structured. [00:01:20] What I'm really not sure is can it work in practice.

[00:02:31] Looks like you can get A to B very quickly. It's organized. [00:02:43] (The luggage solution is) much better than now.

Participant 13

Age 25, from the Netherlands

[00:00:05] It seems quite clear and quite simple. [00:00:20] There's less hassle with luggage. you don't really have to deal with luggage in a sense that you just put it down and it's been taken care of. [00:01:15] Seems there's less of a queue to stand. [00:01:18] There's less of a bottle neck. It's a very open design. Seems you don't have to wait for people. Saves time. [00:02:25] It's also nice you know where you will stand before hand. [00:02:45] It's nice because you can just make lines there.

[00:01:55] What if the luggage is like a big bag that changes volume easily and it doesn't fit into the luggage belt.

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