



PNEUMATIC DELIVERY SYSTEM

GROUP REPORT

PROFESSIONAL ENGINEERING PRACTICE AND
INDUSTRIAL MANAGEMENT

Josh Bhare, Afnan Al- Rahman, Aiash, Adibh

W1641292. W1634728

CONTENTS

Group vision and introduction.....	2
Background////current conditions	3
Concept	3
Conceptual idea	4
Technical design considerations.....	5
Ethical considerations and factors.....	6
Refrences	7

GROUP VISION AND INTRODUCTION

The internet allows us to connect with our friends, family, clients, the entire world practically. To use the internet, we need technology which allows us to connect with the world. This connection with the world allows us to create more sustainable and efficient opportunities which has a major impact on our daily lives. Now in 2020 5G is available, the cloud is growing, artificial intelligence is evolving, and analytics and machine learning is more immense. It is this connectivity, this global system that our group values, the connectivity which helps society to interact, work, play and truly resonate with one and each other.

Aspects of everyday life show inefficiencies on a day-to-day basis, many parts of our life can be improved even in the smallest scales. Many factors of life affect the planet around us on a physical scale; modern systems of delivery, shipping and manufacturing. Like many people, we value the world we live in and depend heavily on the current state of the planet for all my life, down to the quality of food that ends on our plates. It is clear to us and many people that there needs to be radical change in our lifestyles to ensure the planet is habitable for our inheritors; and ensure that the means of which to ensure such can start on even the smallest scale by today. We value the planet we live on, and I want to make sure that this planet will survive artificial environmental impacts by reducing carbon footprint on an international scale. It's unclear when the tipping point is for when earth becomes uninhabitable¹, but if Co2 levels stay at the rate they are climbing it is obvious there'll be a point of no return. We hope that most countries consider how they are polluting the planet we are on, mostly China, The USA and India are the largest polluters², and we can expect this to continue unless radical improvement to systems enhance the ability to recycle products within these large continental countries.

We want to use this connectivity and utilize it within modern day systems of delivery and shipping. More and more people are ordering/ selling products which all uses different methods of shipping and delivery. These companies all have one main feature which is they use transport vehicles to deliver products. Through this system we noticed it contributes to climate change and have taken account of our environment. We value the environment we live in and want to ensure that carbon footprint is reduced on an international scale.

¹ <https://theconversation.com/the-sun-wont-die-for-5-billion-years-so-why-do-humans-have-only-1-billion-years-left-on-earth-37379>

² <https://gulfnnews.com/photos/news/who-are-the-worlds-biggest-polluters-1.1572250802844>

BACKGROUND////CURRENT CONDITIONS

Large delivery companies such as DHL, DPD, Royal Mail, FedEx, USPS deliver products daily and offer a variety of postal service of yours choosing. For these companies to run they need an external business which chooses their postal services and uses its delivery/ shipping service. From there the products are shipped to the chosen destination via transportation vehicles. Traffic in all countries is increase due to the increase use of postal services. As we know there is a direct correlation of CO2 production caused by delivery drivers within the top 100 cities. CO2 levels is predicted to increase by 36% of overall global production³. Throughout the year's delivery companies have become complacent and incompetent, there are now cases when delivery drivers handle the items in an aggressive manner and the items are delivered broken. Cases where the drivers would steal and not deliver promptly. This impact customer satisfactory. Furthermore, these companies have given employees more hours than they have wanted to work, and decrease pay.

Large widescale delivery systems are currently based upon warehouse shipping and receiving; meaning that you have 3 main systems in play: the product being sent to a vendor, the vendor sending the shipment to a postal service which then sends the product to the buyer. Amazon, eBay, AliExpress and Alibaba all use different shipment methods and aren't industrially standardised throughout online businesses. Each of the companies may use similar methods or even the same postal services, however an industrial standard may make things easier to design online shipping methods in the future.

The argument of locally shopping is also dying out, as most high streets across London are slowly going bankrupt as online shopping booms both pre and post covid19⁴. Furthermore, systems in place are inherently flawed, these systems of physical delivery expend traffic, exhume pollution and are widely enhanced by pure human error through the delivery driver and cost of inherent human error through overworked hours⁵ and likeliness to steal the products they are supposed to deliver⁶. There's a large carbon footprint of these large corporations, and there's a very real need and use case for a different type of system. Cities suffer from stagnating air quality and delivery vehicles dramatically increase traffic throughout these cities that already suffer from poor control of road space due to delivery vehicles.

CONCEPT

Our concept stems from our mission statement and values. We want to create a connectivity between products and customers which is efficient, sustainable and reliable.

Like the pneumatic tube systems used in global corporations within the mid 1900's⁷ our concept is a large scale, multi-tiered independently maintained maglev or vacuum tube system that can be used for delivery straight to the outside of the end users house or corporate business. There is a very valid use case for this, however; large cities and city centres such as London, Beijing and New York City come as some of the highest on the air quality index⁸, therefore something like an electronically or pneumatically controlled tube delivery system can be more effective in these use case scenarios.

In the 1900s a pneumatic tube system was used for delivering mail across building to building or across one building⁹. This system has not been touched in such a large-scale in this way. Our product will be used in

³ <https://www.scientificamerican.com/article/delivery-vehicles-increasingly-choke-cities-with-pollution/>

⁴ <https://www.dailymail.co.uk/news/article-8838435/Britains-lockdown-boomers-ASOS-profits-QUADRUPLE-142m-Just-Eat-sales-soar.html>

⁵ <https://www.vice.com/en/article/m7j7mb/amazon-delivery-drivers-are-overwhelmed-and-overworked-by-covid-19-surge>

⁶ <https://www.dailymail.co.uk/news/article-6481033/Prime-suspect-Amazon-delivery-driver-caught-stealing-packages-home-delivered-to.html>

⁷ [https://en.wikipedia.org/wiki/Pneumatic_tube#:~:text=Pneumatic%20tubes%20\(or\)%20capsule%20pipelines,conventional%20pipelines%2C%20which%20transport%20fluids.](https://en.wikipedia.org/wiki/Pneumatic_tube#:~:text=Pneumatic%20tubes%20(or)%20capsule%20pipelines,conventional%20pipelines%2C%20which%20transport%20fluids.)

⁸ <https://waqi.info/#/c/32.594/-43.51/3.8z>

⁹ [https://en.wikipedia.org/wiki/Pneumatic_tube#:~:text=Pneumatic%20tubes%20\(or\)%20capsule%20pipelines,conventional%20pipelines%2C%20which%20transport%20fluids.](https://en.wikipedia.org/wiki/Pneumatic_tube#:~:text=Pneumatic%20tubes%20(or)%20capsule%20pipelines,conventional%20pipelines%2C%20which%20transport%20fluids.)

delivery/ shipping sector. We have taken this initial idea to upscale it, and create an inter-city or inter-country system that allows delivery of items much more quickly and efficiently. The vendor/ storage station has a temporary storage room underground with items within capsules ready to be delivered. Our pneumatic tube system will serve as a vendor for postal delivery companies, and we offer our system to be leased out to other companies which are not postal services. I see our concept to be revolutionary, impactful on the environment, it creates this connectivity between the products and the customer as they feel more comfortable receiving the item in a small-time frame. The most similar product we have as mentioned are delivery through vehicles by the companies mentioned beforehand, which may can be construed as an outdated style of delivery. There are obvious benefits to our system, less energy used, better cost effectiveness over time and no limit by human error.

CONCEPTUAL IDEA

A pneumatic tube system works by transferring items encased in capsules, through a network of tunnels that leads to a different destination. These capsules move within the tubes by air being compressed and causing a high pressure inside the tunnel, creating a vacuum and forcing the capsule to move.

In this design, what we see is a section of what is a deployment system, using a similar method of transportation which hyperloop is based on¹⁰ we can use a vacuum based transferring system to move goods throughout a tube network system. For usage case, the red cannisters and deployers can be assessed in large scale warehouse facilities, like an amazon warehouse and the blue being the destination or customer recovery destination, which can also be used bi-laterally to send and receive products; where one red cannister deployment system is set as “send” and one set as “receive”. Alongside with these customers there might need to be a purchase of cannister-like packages, that can be used for the relevant travel of through these tube systems that can either be terranean or sub-terranean in deployment. Each tube may have 3 or 4 sub-connected tubes that allow for interpolated delivery of multiple things at once, or delivery of smaller items both back and forth.



Figure 1: conceptual idea of a tube delivery system showing 2 send tubes[with red capsules] and 1 receive tube[blue], the receive tube can send back to either of the tubes based on certain manual input

Using this idea, we can upscale it and use a similar method of the hyperloop. The hyperloop is an idea to be used as transportation, removing bus and train transport systems that are used these days. The large tunnels are created underground a delivery/collection station. As we are creating a network, each starting tube will relate to 3 or 4 sub-connected tubes that allows interpolated movement of delivery. This allows the ease items to be sent back and forth, and the being able to deliver multiple items at once. The large-scale system can be built having 10,000 tube systems branching off with approximately 30,000 subsystem tunnels, giving us a ratio of 1:3 tube to sub-tube.



Figure 2: modern use of pneumatic tubes to send mail through large corporate workspaces

¹⁰ <https://brilliant.org/wiki/hyperloop/#:~:text=Physics%20of%20the%20Hyperloop,-Design%20of%20a&text=To%20achieve%20Musk's%20proposed%2035,below%20the%20speed%20of%20sound>

TECHNICAL DESIGN CONSIDERATIONS

Taking in consideration of what is needed for pneumatic tube system, and to turn it into a large delivery system we considered:

- Technical aspects of the physical properties of the tube itself
- Mechanisms of how the tube will deliver
- Packaging of goods to go back and forth down the tube systems
- Large scale development of the pneumatic system integration, terranean or sub-terranean
- Ensuring that there's not backlogging with delivery systems.

The mechanism¹¹ of which the tube operates on will follow the same technical aspects of pneumatic tube that propels tubes through the network by using partial vacuum and airflow to make the cannister of goods reach the proprietor without damaging the goods sealed within the cannister. Furthermore a tamper proof evident tape can be used on the cannisters to show that they have not been intercepted by any external source before reaching the end use, such tape can be cost effective enough that it can be accosted for partly through the delivery cost of the cannister. Cannisters, once primarily used can be upcycled to go back to large scale distribution centres that can re-use these cannisters to ensure systems operate with high levels of efficiency.

There are two main ways of which the system can be integrated, terranean or sub-terranean. In the former, one thing that needs to be put into consideration is aesthetics. There's a fair reasoning to believe these tubes will be aesthetically displeasing, especially on such a large-scale format as described. Secondly in a system that takes multiple sub-divided tubes within tubes we might see different types of technology to distribute these cannisters, such as part vacuums or full vacuums. The tube system will be created underground, this network can be expanded further to reach nearby stations. This forms an inter-city where it is away from buildings and other important infrastructures

Between the station and destination, there are junctions which swallows airflow to create a vacuum, the vacuums are the key feature that allows one directional flow when using this delivery system. Vacuums also helps us preventing back logging, the use of bi-lateral tubes for delivery can ensure that backlog is nullified, two or more tubes can be acquired to reduce the amount effect of two tubes being sent and received at the same time. Therefore, sub-divisions are likely going to be used.

As mentioned before the large-scale development will be created above and underground. The tube system will be created underground, this network can be expanded further to reach nearby stations. This forms an inter-city where it is away from buildings and other important infrastructures. When building these tubes, they will be built with material that causes less static charge between the material of the tubes and the capsule. The material for the tubes will be durable and sustainable. Nevertheless, the dimensions of the tubes will differ, as we have sub-tubes. We agreed to have the diameter of the tube be 18 inches, to support the capsules we use. But the diameter of the capsule will be 17.5 inches as this is required for the capsule to support the pneumatic tube system. Sub tubular systems will be diverted and have different sizes, 10-inch 5 inch and for mail 3-inch tubes with 9.5,4.5- and 2.5-inch capsules respectively. Due to the large-scale development the time frame of items will be quick and efficient, allowing items to be sent in perfect condition. On the capsules there will be tamper proof evident tape showing the item has not been opened prior to its delivery. In our station the interfaces in our computer system will be all connected, allowing free flow movement at ease. Furthermore, we considered we will need a large data base and integrate it with the ever-evolving cloud.

¹¹ <https://www.explainthatstuff.com/pneumatic-tube-transport.html#:~:text=Artwork%3A%20How%20a%20pneumatic%20transport,cannisters%20in%20the%20opposite%20direction>

ETHICAL CONSIDERATIONS AND FACTORS

The main ethical factors at play are those of primary deployment and secondary employment. Firstly, this product will need large scale development on a large-scale format, similar to how the internet was born, we will need trillions of dollars for the initial development phase, if we base the number on how much it costed for the internet to be developed in the United States¹². The reason for this, if we consider the money involved on creating the internet and expanding it, we can determine that this project is with its accomplishment. We see this project as a gradual increase and will take many decades to pay-back investors, but it will create hundreds of thousands employment worldwide. With the employees they will transition from a low skill to a very high skilled job. Even though this project creates job opportunities, there will be a drastic change to the default delivery services we use. Our project removes transportation vehicles, this impacts the environment positively. It decreases CO2 production and toxic gas emitted from these vehicles and decreases climate change; it also makes sense from the environmental impact that it will radically reduce worldwide pollution factors by a third¹³.

After a few more meetings, we noticed there can be external employment for construction companies due to our expansion and creating an inter-city network. On top we saw that this product can aid small to large companies with our project, effectively turning them into billionaires the likes of which beyond any billionaire of the early 21st century. By forming partnerships with large and wealthy organizations we expand, creating tons of opportunities. Alongside this, the mass employment of people to manufacture miles of transportation tube and environmental costs to create these working parts will be inherently tall. The cost of the product will be multi-generational also, therefore finding investors to fund such a huge project on this scale will be sparse and few between, although in the generational aspect, the product profits itself similar to a corporation like amazon or even operate on the international level as these mega-corporations we've come to familiarise ourselves with like Disney; Microsoft and the Alphabet group.¹⁴ What this project will do to the highest of society will only deepen the wealth inequality by effectively shaping people into corporate gods like those we've seen with Jeff Bezos and Mark Zuckerberg¹⁵. Giving such power through profit to those shareholders, which to be honest will make the modern day One percenters look favourable in comparison, modern day trillionaires and their inheritors will divide people on the wider aspect.

This product will inherently improve many people's lives, at the cost of their possible freedom, and that's a question that's significantly raised with this product, does the significant progress of humankind come at the cost of freedom? If one was to say "yes, the product inherits significant benefits more-so than drawbacks" then the most effective steps forward is the development of this system. However, if the question to this is "no, human rights are more important" then the inherent steps to make is either trimming aspects of the project down from the international level to a Continental or even country level, but then opens up the suspicions of government intervention; sub diving what was meant to be a continental/transcontinental level. Both sides have serious contention and it's unlikely there'll be a scenario that this project will ever reach the physical and only stay in the theoretical.

Resonance will have revolutionized the delivering/ shipping sector, impacting the social and environmental society we live in. People will be able to use or should I say resonate with their items much quicker. This inter-city will create a new connectivity across the globe, allowing more of a connection. We hope this connection better the lives and spreads more peace of mind.

¹² <http://cis471.blogspot.com/2012/08/seeding-internet-cost-government-1245.html>

¹³ <https://www.scientificamerican.com/article/delivery-vehicles-increasingly-choke-cities-with-pollution/>

¹⁴ <https://www.weforum.org/agenda/2017/01/worlds-biggest-corporate-giants/>

¹⁵ <https://www.theweek.co.uk/people/57553/top-billionaires-who-richest-person-world>

References

BI4ALL - Turning Data Into Insights. 2020. The Impact Of Technologies On The Environment | BI4ALL. [online] Available at: <<https://www.bi4all.pt/en/news/en-blog/the-impact-of-technologies-on-the-environment/>> [Accessed 11 November 2020].

Hydraulics & Pneumatics. 2020. CHAPTER 5: Pneumatic And Hydraulic Systems. [online] Available at: <<https://www.hydraulicspneumatics.com/technologies/other-technologies/article/21884114/chapter-5-pneumatic-and-hydraulic-systems>

> [Accessed 11 November 2020].

Maxine Joselow, E., 2020. Delivery Vehicles Increasingly Choke Cities With Pollution. [online] Scientific American. Available at: <

<https://www.scientificamerican.com/article/delivery-vehicles-increasingly-choke-cities-with-pollution/>

> [Accessed 11 November 2020].

Medium. 2020. To Jeff Bezos, From An Amazon Delivery Driver. [online] Available at: <

<https://medium.com/the-post-grad-survival-guide/to-jeff-bezos-from-an-amazon-delivery-driver-5ccf39d5df7d>

> [Accessed 11 November 2020].

News, A., 2020. Sheriff: Amazon Driver Stole Gifts He Should Have Delivered. [online] ABC News. Available at: <

<https://abcnews.go.com/US/wireStory/sheriff-amazon-driver-stole-gifts-delivered-67689285>

> [Accessed 11 November 2020].

Ranger, S., 2020. What Is Hyperloop? Everything You Need To Know About The Race For Super-Fast Travel | Zdnet. [online] ZDNet. Available at: <

<https://www.zdnet.com/article/what-is-hyperloop-everything-you-need-to-know-about-the-future-of-transport/>

> [Accessed 11 November 2020].

ResearchGate. 2020. (PDF) Pneumatic Capsule Transport. [online] Available at: <

https://www.researchgate.net/publication/306051031_Pneumatic_Capsule_Transport

> [Accessed 11 November 2020].

Sky News. 2020. Coronavirus: Funding for Drone Firms Helping To Deliver COVID-19 Tests And Supplies. [online] Available at: <

<https://news.sky.com/story/coronavirus-funding-for-drone-firms-helping-to-deliver-covid-19-tests-and-supplies-12128207>

> [Accessed 11 November 2020]

<http://cis471.blogspot.com/2012/08/seeding-internet-cost-government-1245.html/>

<https://www.scientificamerican.com/article/delivery-vehicles-increasingly-choke-cities-with-pollution/>

<https://www.weforum.org/agenda/2017/01/worlds-biggest-corporate-giants/>

<https://www.theweek.co.uk/people/57553/top-billionaires-who-richest-person-world>

<https://brilliant.org/wiki/hyperloop/#:~:text=Physics%20of%20the%20Hyperloop,-Design%20of%20a&text=To%20achieve%20Musk's%20proposed%2035,below%20the%20speed%20of%20sound>

<https://www.scientificamerican.com/article/delivery-vehicles-increasingly-choke-cities-with-pollution/>

<https://www.dailymail.co.uk/news/article-8838435/Britains-lockdown-boomers-ASOS-profits-QUADRUPLE-142m-Just-Eat-sales-soar.html/>

<https://www.vice.com/en/article/m7i7mb/amazon-delivery-drivers-are-overwhelmed-and-overworked-by-covid-19-surge/>

<https://www.dailymail.co.uk/news/article-6481033/Prime-suspect-Amazon-delivery-driver-caught-stealing-packages-home-delivered-to.html/>

[https://en.wikipedia.org/wiki/Pneumatic_tube#:~:text=Pneumatic%20tubes%20\(or%20capsule%20pipelines,conventional%20pipelines%2C%20which%20transport%20fluids.](https://en.wikipedia.org/wiki/Pneumatic_tube#:~:text=Pneumatic%20tubes%20(or%20capsule%20pipelines,conventional%20pipelines%2C%20which%20transport%20fluids.)

<https://waqi.info/#/c/32.594/-43.51/3.8z>

[https://en.wikipedia.org/wiki/Pneumatic_tube#:~:text=Pneumatic%20tubes%20\(or%20capsule%20pipelines,conventional%20pipelines%2C%20which%20transport%20fluids/](https://en.wikipedia.org/wiki/Pneumatic_tube#:~:text=Pneumatic%20tubes%20(or%20capsule%20pipelines,conventional%20pipelines%2C%20which%20transport%20fluids/)