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Executive Summary

The central question explored in this foresight project is “How will the implementation of Hyperloop affect worldwide transportation, and what are the potential implications?” Answered in one sentence, the Hyperloop transportation system is a breakthrough invention that could revolutionize the transportation industry through incredible speeds and complete automation, while leaving virtually no carbon footprint.

Hyperloop is a computer-operated, high-speed rail system that runs on electric impulses. The system epitomizes the word “efficient” in every possible aspect, from its reduced travel time to low emission levels. Production of the system is currently underway in Dubai and its surrounding region, as well as New York and Washington D.C. Three major companies are responsible for the push to make Hyperloop a reality: Hyperloop Transportation Technologies, Hyperloop Technologies and TransPod.

If implemented, Hyperloop could remove the need for motorized vehicles, rail transportation, and possibly even aircrafts. With such an efficient mode of travel in play, the pressure of preserving fossil fuels could be relieved, and sustainability efforts could be directed elsewhere. With this, the Hyperloop could become a pioneer in the societal shift towards greener methods of transportation. Additionally, The Hyperloop’s incredible speed of 800 mph could make many goods attainable within a short timeframe, allowing for a rapid transfer of products between businesses and consumers.

Many experts predict that the Hyperloop could be successful due to the social, technological, and environmental drivers currently surrounding its adoption. Consumer preferences and technological trends have paved the way for the highly automated Hyperloop

System. The government's role in regulation and public funding could serve as either a driver or a constraint of the system. The ability of the Hyperloop to attract private investors is also key to its development due to the capital-intensive nature of laying the tracks. A trend towards environmentally sustainable technology could also push Hyperloop to the forefront of innovative transportation systems. The rapid urbanization of the world, coupled with a global trend towards sharing economies, have created an opportunity for the Hyperloop to thrive. The final element that could constrain disruptive change for the Hyperloop is the question regarding eminent domain, and the ability of companies to secure land on which to lay the tracks. Depending on how each of these trends develops, the Hyperloop's path to widespread usage could look dramatically different.

In addition to questions about the how different trends could alter the growth of the Hyperloop, other potential uncertainties of the Hyperloop include the possibility that the system might not translate well to passengers, or that another transportation system may be invented and/or preferred by the population. Land ownership and concerns over eminent domain could also slow the process, and investor interest (or a lack thereof) is also a major uncertainty for the project.

Through a quantitative analysis of different data sets and a thorough examination of expert opinion, a baseline forecast can be derived. It is projected that Hyperloop will be a successful, societal changing venture. Although some of the uncertainties listed above will pose as potential challenges to its success, Hyperloop has the ability to transition into the global leader of mass transportation.

The opportunities in a world containing a Hyperloop system are enormous, ranging from partnerships with advertising companies, to the collection of data regarding individual travel behavior, to the development of multinational corporations capitalizing on the global system. There are also moral considerations that arise with such a wide-reaching system, primarily due to safety concerns and the threat of terrorism, as well as ethical considerations relating to its environmentally-sustainable function. Upon observing the continued growth of Hyperloop systems, businesses should position their strategies in a way that allows them to capitalize on the speed, efficiency, and reach offered by the technology. Whether they are concerned with moving goods or moving people, there would likely arise many opportunities to utilize the technology of the Hyperloop to expand their own business' reach.

Abstract

The Hyperloop is a high-speed form of public transportation that uses electric impulses to travel through pneumatic tubes. In its ideal form, the Hyperloop would be environmentally friendly, affordable for consumers, and extremely efficient. The report answers this overarching question: How will the implementation of Hyperloop affect worldwide transportation, and what are the potential implications? Based on research, statistics, and expert opinion, this report will examine the current state of the Hyperloop, as well as the directions that it could be headed in, depending on the outcome of certain trends. Additionally, the report will analyze the potential implications of multiple scenarios in which the Hyperloop could be introduced to consumers, and the different moral and ethical considerations that would accompany its implementation.

Introduction

Even though the Hyperloop is beginning its slow implementation in different cities worldwide, humans have not yet experienced the phenomena of traveling via pneumatic tubing technology. Although the basic mechanics of pneumatic tubing emerged in the 17th century, they have been mostly used to move goods, rather than individuals. They first found use in the early 1900's as a popular way to transport small packages, with both hospitals and postal services. However, in recent years, pneumatic tubing technology has shifted away from moving goods, and expanded into the potential space of transporting people through systems like the Hyperloop. Due to its tremendous speed and low carbon footprint, the Hyperloop is emerging as a more sustainable and efficient form of long-distance transportation. Its implementation could allow people to live further from dangerously overcrowded cities, thus reducing issues that rapid urbanization brings, while simultaneously offering an environmentally-healthy alternative to long-distance travel (Upbin). By assessing the specifics of Hyperloop's usage, areas of opportunity, and growth inhibitors, one can better understand its potential to revolutionize the way people and goods travel the world.

The first section provides background information on the Hyperloop, discusses the various stakeholders, and identifies the key drivers and constraints of change. The baseline forecast follows, it will include a synthesis of evidence, presentation of an overall summative position, and insight into the uncertainties surrounding the Hyperloop. The scenarios are the third main component, they allow the reader to contextualize and visualize the potential ways that the Hyperloop's implementation could affect the daily lives of consumers. The final component is a

discussion of the strategic implications for business, relating the Hyperloop to the commercial world, and examines the ethical considerations that could accompany the system.

Current Assessment

BACKGROUND

The basics of pneumatic tubing date back to as far as the 17th century, when Otto Von Guericke assembled the world's first artificial vacuum. From there, engineers, scientists and inventors began to see the potential of pneumatic tubing for the transport of goods and passengers. Although the Hyperloop itself has not yet taken off, there are multiple examples of similar systems that have attempted implementation around the world. For example, the idea of a pneumatic subway system in the 1860's was introduced in New York, but it was eventually pushed out by the elevated rail system. Additionally, in 1972 the Rand Corporation published a paper on the possibility of a "Very High Speed Transit System" (VHST) that could operate at more than "14,000 mph" and operate at speeds that would rival those seen only by aircrafts (Salter p. 4). From this concept emerged the idea of a vactrain, which would use a tunnel system and magnetic levitation to rapidly move trains throughout the system (Stewart). This technology went from experimentation to reality when China released its Shanghai Maglev Train, which is capable of moving almost 270 mph in a similarly smooth and environmentally-friendly manner as the Hyperloop is projected to be ("Shanghai Maglev Train"). Additionally, Japan has the Shinkansen line, which is the world's busiest high-speed rail, servicing almost 151 million people every year ("Shinkansen"). The United States has the Amtrak, which runs across the continent (Leeds). Additionally, California has been constructing their form of a bullet train from

Los Angeles to San Francisco, in an effort to link up the two highly-trafficked cities (Hawkins). The emergence of these high-speed systems generated a space for advanced transportation technology to gain popularity. Through the brilliant mind of Elon Musk and the deep pockets of private investors, the Hyperloop emerged.

The Hyperloop is a concept coined by Elon Musk, CEO of the aerospace firm SpaceX, which has now become a term for the combination of tracks, pods, and stations that make up the system. It has the potential to travel up to 800 mph without creating a sonic boom from breaking the sound barrier. Musk's Hyperloop consists of a low pressure tube containing capsules that are transported at varying speeds through the tube, giving passengers the ability to enter and exit Hyperloop at stations throughout the length of the tube (Musk). The idea is to revolutionize transportation by making it safer, faster, sustainably self-powered and resistant. The Hyperloop has dominated the media ever since Musk's proposal release in 2013. There are three main companies that have taken steps to pitch and further develop the Hyperloop concept. Hyperloop One is a California-based company with 200 employees that is engaging with the Hyperloop concept, predicting that it will be capable of moving passengers by 2021 ("Hyperloop One"). Additionally, Hyperloop Transportation

hyperloop | one

Founded: Los Angeles, CA (2014)
Funding: $80 million (Series B Funding)
Vision: Moving cargo by 2020, moving passengers by 2021
Projects: Dubai–Abu Dhabi

HYPERLOOP

Founded: Quay Valley, CA (2013)
Funding: No Private Funding
Vision: Early form of "Innovation Train" ready by 2017
Projects: LA–San Francisco, Vienna–Budapest

TRANSPOD

Founded: Toronto (2015)
Funding: $15 million (Seed Round, Angelo Investments)
Vision: Innovate transportation in high-density emerging markets, commercially available in 3–5 years
Projects: Toronto–Montreal

Technologies (HTT) is striving to implement the technology, with a focus on low construction costs, rider safety, and affordable travel ("Hyperloop"). Finally, Transpod, a Toronto-based startup, has expressed its interest in partnering with Canadian transportation agencies, as well as private groups around the world, to make the Hyperloop the 5th mode of primary transportation alongside cars, trains, planes, and boats. Their vision will be focused on high-density emerging markets in Asia and the Middle-East, in an effort to innovate the aging and slow transportation systems in those regions (TransPod). SpaceX, the Space Transportation company founded by Elon Musk, is also taking an active role in the development of the technology. However, as opposed to HTT and Hyperloop One, SpaceX is not interested in developing a commercial Hyperloop themselves; rather, they are focusing their efforts on running competitions that engage university students and engineering teams to come up with a fast and feasible form of Hyperloop system. Their ideas will be put to the test in 2017, creating an open-sourced environment where brilliant engineers and developers can come together to make Musk's initial moonshot-idea a reality (SpaceX).

In addition to Musk's efforts to bring Hyperloop out of testing and into commercial use, the city of Dubai has also taken massive steps towards implementing the Hyperloop. They are currently hosting a competition to develop a similar transport system like the one envisioned by Musk, as the concept of fast transportation for long distances is attractive to many countries, especially ones that are as congested as Dubai (Armstrong). Recently, Hyperloop One signed a commercial deal with local transport authorities, and they have proposed a likely route between Dubai and Abu Dhabi, an area that is busy and filled with international travelers (Alkhalisi).

One of the significant components in the timeline of the Hyperloop system has been the funding that each engineering company has received for their product. Currently, Hyperloop One has received the most funding, with $160 million so far; $50 million of which was raised by the Dubai port operator, DP World, in October of 2016 ("Hyperloop One Preparing..."). Hyperloop Transportation Technologies has not received any major funding from investors yet, primarily because they have not yet undertaken any trial runs. HTT CEO Dirk Ahlborn runs JumpStartFund, which collects money for social enterprise projects, and relies on his site and other grassroots methods to raise capital (Wenz). Unfortunately, this has left HTT behind in the race for funding. They are still in the research and development phase, hoping to get the first round of seed capital in the coming months (Degeler). TransPod is somewhere between these two companies, having raised $15 million in seed funding from Angelo Investors. With this capital, Transpod will continue striving to produce a commercial product by 2020. Their next step is creating a test track in Ontario, where they hope to eventually receive governmental funding from the different provinces of Canada (Transpod). Although the various private investments reveal a clear interest in the Hyperloop systems, there has not been a suitable inflow of capital that would propel the system into widespread application.

Hyperloop One recently settled a lawsuit brought up by four ex-employees, lead by former top engineer Brogan Bambrogan, in November 2016. The lawsuit began in July, with Bambrogan claiming Hyperloop's leadership "established an autocratic governance culture rife with nepotism, and wasted the company's precious cash." A week later, a countersuit was filed and claimed the employees were staging an attempt at a takeover. Hyperloop One resorted to a

settlement and is proud to announce the case is closed and had no effect on momentum. Their Hyperloop demonstration planned for next year is still “on track” (Forbes, paragraphs 1 and 7).

The demonstration is intended to attract additional investment. According to Josh Giegel, Hyperloop One cofounder and head of engineering, the funding goal for next year is “something in the hundreds of millions, but not high hundreds of millions.” ("Hyperloop One Preparing New Funding round").

However attractive the concept behind Hyperloop may sound, there are significant debates as to whether or not it will be as much of a success as the hype suggests. As noted above, early in its developments, the idea of an underground pneumatic railway was rejected simply because the venture was too expensive, and would not lead to a large enough return on investment (Pneumatic Tubes). Alon Levy, a researcher in theoretical mathematics, criticizes Musk for his plan, calling Hyperloop a “loopy intercity rail transit idea.” He says that the costs for building these tubes is much too high. Additionally, he argues that a levitating system will not be a comfortable alternative for the passenger (Levy p. 2). As is revealed by the relatively small amount of funding received by the involved companies, access to capital is also a major concern facing the Hyperloop. Venture capitalists are integral to the development, testing, and eventual implementation of the system. Jose Gomez-Ibanez, a professor of urban planning and public policy at Harvard says “I don’t understand where they think they can get their savings—they’re up against the airlines, and airlines don’t need to install hundreds of miles of track” (Bradley p. 2). Researchers have also raised some concern about the physical effects that the Hyperloop might have on the human body. Neel Patel points out, “The problem with the Hyperloop—in its most ideal form—is that any turns it makes will make everyone

uncomfortable" (Patel). Here, he is talking about the incredible forces that would be acting on our body, and the nausea and dizziness that could arise as a result.

The Hyperloop is at a unique position in its story as doubts about high costs, infrastructure challenges, comfort, and physical safety are all surrounding the development of the system. Despite this, the opportunities presented by the system to radically reduce traffic in urbanized cities, lower travel and commute times across popular routes, and dramatically lower our transportation carbon footprint have inspired some of the brightest engineers and entrepreneurs to turn the idea into a reality. Going forward, developers of the Hyperloop will need to find ways to capture the potential value presented by the system in its best form, while remaining cognizant of the challenges that such a large undertaking will likely face.

STAKEHOLDERS

As the Hyperloop rapidly moves away from being a futuristic dream and towards a reality, consideration for the players who are interested in and hold high influence over its development must be accounted for. The Hyperloop brings new technology to the forefront of the transportation industry. It is not surprising then, that companies such as Amazon and Uber, as well as the U.S. Government, are closely monitoring the development of the Hyperloop.

Government

As a regulator of the transportation industry, the U.S. Government is a major stakeholder in the development of Hyperloop. As a key stakeholder, it will be interesting to see the

government's reaction and whether they take steps in accelerating or thwarting Hyperloop's progress. At Texas A&M's Hyperloop Design Weekend, the U.S. Transportation Secretary Anthony Foxx said that the Hyperloop could potentially receive research funding from his department. Originally a skeptic about Hyperloop, Foxx said that the "Government must resist the urge to reflexively say no" and that they are "looking to play a constructive role in embracing new technologies" (Morris p. 9). It is likely that Hyperloop will be under the power of a new watchdog agency in much the same way as airlines fall under the FAA and food and pharmaceuticals fall under the FDA. Going forward, they will have to regulate this industry to ensure that traveling in these tubes is safe and up to regulation standards. Some areas of concern that would need to be addressed before Hyperloop is fully operational are, whether or not it is safe to travel at speeds up to 800 mph, and how weather and natural disasters (such as hurricanes, tornadoes, and earthquakes) affect the Hyperloop system. Another possible concern is how the Hyperloop system will be operated solely by computers; yes this removes the potential for human error and crashes, but opens the door for probable security breaches, hacks, and disruptive power outages.

Department of Transportation

The United States Department of Transportation has a number of agencies within it that are linked to the Hyperloop, a major one being the Intelligent Transportation Systems, or I.T.S. Some of their goals include automation, emerging capabilities, and a commitment to wider-scale deployment in coordination with other transportation agencies (U.S. Department of Transportation). This group would be a large stakeholder in any Hyperloop system, and their union with any of the organizations attempting to build a Hyperloop system could mean

increased funding and research, helping to accelerate the development process. Another Department of Transportation group that could play a major role is the Office of the Assistant Secretary for Research and Development, an organization that partners with different transportation groups to advance technology within the industry and develop policy related to such innovation (U.S. Department of Transportation).

National Transportation Safety Board

One group that could serve to slow the progress of the Hyperloop is the National Transportation Safety Board. The N.T.S.B is charged with assessing potential transportation accidents, and promoting transportation safety in the U.S. Their role as a government agency offers them tremendous power to either support or oppose the Hyperloop system based on its adherence to safety guidelines (National Transportation Safety Board).

Although these agencies and departments were specific to the United States, every country that is looking into adopting the Hyperloop will have some governmental group that plays a role in its developmental process, indicating that government regulation and legislation can play a crucial role in the rate and magnitude at which the Hyperloop grows.

Businesses

In the same way that the captains of industry revolutionized shipping with trains, Hyperloop is set to once again put train travel at the forefront of the transportation industry. If Hyperloop can make it so that using their system would be cost effective, it could significantly decrease the expenses that companies, such as Amazon, pay yearly for truck drivers, gas, and toll roads. A high-speed rail system could reduce overall shipping times for companies, and allow for goods to move from producers to distributors at incredible speeds. In this sense, businesses

would likely be positively affected by a Hyperloop system, due to its potential effect on shipping logistics- although their role in its development and construction would be minimal.

Transportation Companies

Another facet that could have a considerable amount of impact on the progress of the Hyperloop are transportation companies. Although it is a relatively new company, Uber has grown rapidly and has expanded its services to include UberRush and UberEats, both delivery services that meet the need for rapid and on-demand movement of goods and food. The co-founder and executive chairman of Hyperloop One, Shervin Pishevar, is a strategic advisor for, and an early investor in Uber. This could lead to a partnership between the two that would allow people to hop in an Uber, ride to the Hyperloop station, and finish their trip on the high-speed pods, creating a fusion between the systems that would completely eradicate the need for other transportation. Both companies are focused on reducing the traffic in congested areas, and cutting down on pollution.

However, depending on whether or not the Hyperloop becomes a commuter-system with a focus on shorter rides, the two companies could directly compete for riders. Besides Uber, normal transportation companies such as metros and buses could see their ridership numbers decrease as the Hyperloop grows in popularity. Nonetheless, if these companies strive to develop partnerships with the Hyperloop and help spur on its growth, they could fuse their operations in a way that might create a competitive advantage for both groups.

Innovators

As a result of the open-sourced structure that Elon Musk proposed for the Hyperloop, engineers and innovators play a vital role in its ongoing development. College campuses, think

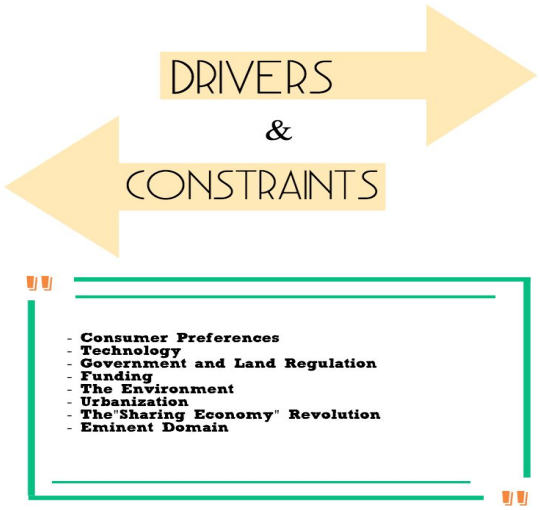
tanks, and engineering firms could fabricate prototypes and designs for the Hyperloop, helping to make the idea a reality. Through their resources, human capital, and commitment to innovation, these groups will likely be some of the earliest influencers in the test-track construction process. Innovators would likely play a major role in these test runs, and without the simulations, Hyperloop cannot demonstrate its safety and feasibility. As a result of this, entrepreneurs, engineers, and innovators are, and could continue to be, major stakeholders in the transition of the Hyperloop from computer-animated designs to a physical track on which tests can be run.

Consumers

At its core, the Hyperloop is a system designed to revolutionize the transportation of goods and people, suggesting that consumers are a major stakeholder in the development process. As previously mentioned, the Hyperloop is attempting to transform all types of travel, from short commutes into the city, to lengthy distances across the country. The vision of all of the Hyperloop companies is to develop a system that is not only advanced but also relatively inexpensive, further widening the customer base that could utilize the system. Ultimately, all consumers will be the ones who benefit if the structure lowers carbon emissions, reduces traffic congestion in cities, and offers a faster, low-cost alternative to other forms of transportation. If the focus ends up being on short-distance travel, the largest stakeholder subgroup would be commuters and local travelers. However, if the system expands globally, there would be tremendous implications for international travelers and businesses.

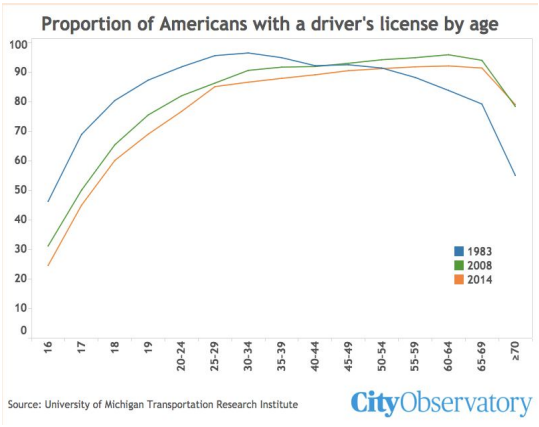
Evidence Based Foresight Forecast

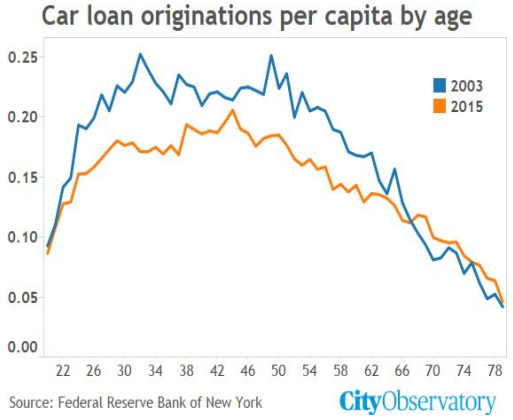
Drivers/Constraints of Change Trend Projections



I. Consumer Preferences

The first drivers of change that could lead to the widespread implementation of a Hyperloop system are consumer preferences, specifically as they relate to demand for transportation systems. The Hyperloop would fall under the umbrella of public transportation, and an important indicator of its potential success is the future demand for public transportation compared to the demand for private vehicles. Unlike in the past, when car ownership was a social norm, current and future generations are far less likely to own their own vehicle. Car loans, new vehicle purchases, and the percentage of people aged 16-34 in America with driver's licenses is the lowest it has been in over 10 years (Cortright paragraphs 1 and 10).

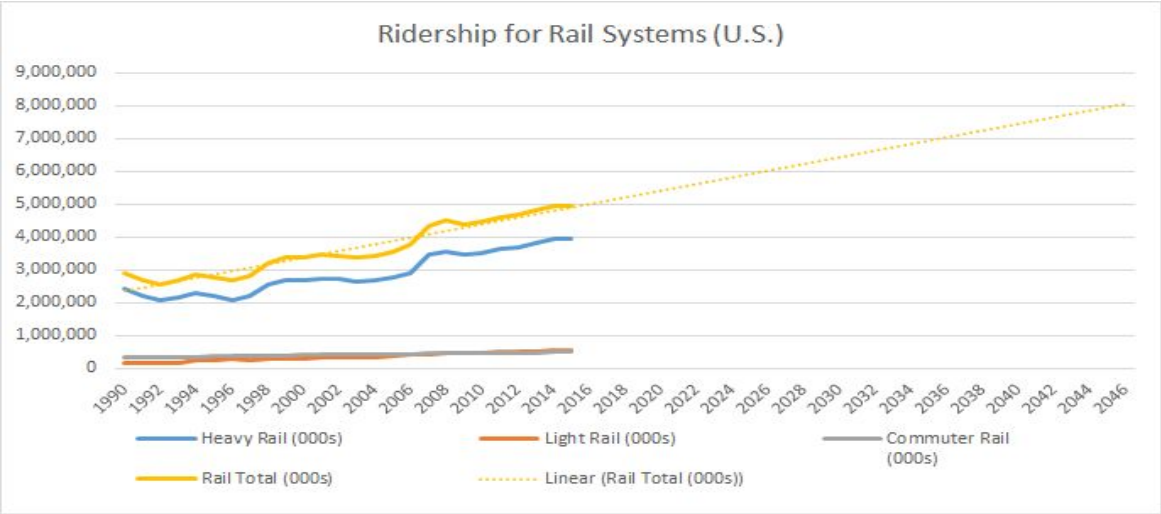




However, this does not mean that the younger generations are traveling less; numerous alternative and appealing methods of transportation still exist. As individuals shy away from buying cars, they will inevitably begin to adopt other methods of transportation, which is where a Hyperloop system could attract a new generation of riders. There are social norms at play with the idea of consumer preferences, and social media has overtaken car ownership as a primary way to express one's freedom and social status (Ross). People are no longer as concerned with how their mode of transportation reflects their economic or social position, and instead are concerned with how they can travel to their destination quickly. In fact, Palo Alto recently voted to enact funding towards lowering single-occupancy vehicles through better-established public transportation, a trend that will move people away from single vehicles and towards bus and rail systems for commuting and traveling (Sheyner). This new consumer mindset and willingness to travel through new, more efficient methods opens the door for a transportation system that prides itself on speed and ease of use, such as the Hyperloop.

While there is certainly a social trend towards public transportation, it is important to examine the specific forms of public transportation in order to evaluate whether Hyperloop has a future in the market. In the world today, people have a number of different options on how they will get from one location to another. One might use a city's bus system, an underground train, or request the more-recently developed personal car services like Uber or Lyft. Because there are so many different options for transportation, any company that is striving to enter the market must ensure that there is sufficient demand for their specific method. The different Hyperloop designs, when compared to the various forms of transportation in existence today, most resemble the light and heavy rails that exist in many cities. They both prioritize speed, have the capacity to

run aboveground or underground, have a large carrying capacity, and operate on a fixed track. Because of their similarities, it is possible to analyze data about the existing rail systems, in order



to forecast the potential demand or usage of a Hyperloop system in the future. (Data Source: (Dickens)

As can be observed from the numbers the Appendix B graph, the ridership of light, heavy, and commuter rail systems has seen a steady increase over the past 15 number of years in the United States. Because the projected timeframe for the widespread use of the Hyperloop is 30 years, it is crucial to examine the forecasted demand for rail systems in 2046, assuming the same growth rate of the past 15 years. As revealed by the graph, there is a growing demand for rail-based forms of transportation, which could ultimately help drive the growth of the Hyperloop as a system with many similar characteristics and rider markets.

Another method of understanding and anticipating consumer preferences, and how they can drive innovation, is observing competitors that are attempting to implement similar technology. Although the Hyperloop may not be fully implemented for another 20 years, there are currently a number of rail systems throughout the world that have similar aspirations to the

futuristic idea. As mentioned before in the “Stakeholders” section, China, Japan, and the United States all have utilized or proposed the idea of either a maglev train or bullet train system. Related to these, there has been a large push for automated metro lines around the world, a style of transportation that resembles an infant Hyperloop system. It is projected that there will be nearly 2,000KM of automated metro lines by 2025, which would lend itself well to an automated Hyperloop system in the years following (See Appendix C- "WORLD REPORT ON METRO AUTOMATION - JULY 2016.", p.5). While the development and construction of high-speed rails could take years, it is clear that the demand for such innovation exists. In this way, consumer preferences for fast and efficient travel methods, and a trend towards more advanced public transportation, are both driving forces for implementation of the Hyperloop.

Figure 11: Total growth in automated metros (km of lines operated in full automated mode)

Although there are many ways in which consumer preferences can drive change, they can also serve to limit change. With a system as new and abstract as the Hyperloop, there will likely be fear and uncertainty surrounding its adoption. At such rapid speeds, there are evidently concerns about nausea and the effects that such g-force would have on the human body, so consumer fear or uncertainty could serve as a major constraint to change as well. The tendency of consumers to flock to the “next best thing” is an additional factor that could constrain change,

as the Hyperloop would likely face threats from companies attempting to produce an even faster or more efficient transportation system.

II. Technology

The second force driving the acceptance of Hyperloop as a feasible transportation system are the technological changes facing our world, and the way in which automation and advanced materials can lead to disruptive changes for the industry. The rate that our world accepts and integrates technological change is faster than ever before, which has given ideas that were once thought to be "moonshots" the opportunity to become a reality. Technology is a driver of the Hyperloop's development for a number of reasons: better technology would likely mean safer trains, more predictability with scheduling, and better materials at a lower cost. More importantly, it would lead to a more rapid adoption of the new system, which is crucial considering the lengthy process of tunneling, laying track, and creating stations out of which the Hyperloop could operate. While technology on a micro-scale is important to the construction of the Hyperloop, the more significant element of this driver of change is the way in which we are entering into a stage of technological automation. Whether observed with self-driving cars, smart buildings, or automated cleaning systems, our cities are trending away from open, chaotic, human-operated systems, towards more cybergenic, closed systems controlled by computers. Duncan Jefferies, an expert in automation and a writer for *The Guardian,* recently wrote a piece that detailed the way in which "smart cities" are closer to becoming a reality than we might think. These consist of automated parking services, street cleaning, waste collection, and especially transportation systems that include driverless trains and buses (Jefferies, p.1). The world appears to be entering into an era where human drivers are no longer needed, and the

Hyperloop has this feature built into its model. Each company that is building a version of the Hyperloop has made it clear that the pods will be operated by a computer system, leading to fewer delays, more predictable timing, and the reduction of human error. Even the rise of automated cars will serve to initiate interest in the Hyperloop, because it will affirm the notion that safe and efficient transportation can be achieved by computers, thus freeing individuals to spend their time commuting and traveling as they please. Overall, a technological shift towards more cybergenic, computer-controlled cities would be a powerful force of change as it relates to the development of the Hyperloop because the efficient, computer-operated pods would fit perfectly in such a system.

Technology could also play a major role in the development of the Hyperloop due to the intense infrastructure needs of the system. Unlike autonomous vehicles and drones, two technologies that are on the rise, the Hyperloop cannot be implemented without a massive, resource-intensive effort to construct tracks throughout the world. In this sense, technology could drive the implementation of Hyperloop by making materials and processes more inexpensive, and also more feasible on a large-scale.

Although the concept of federal funding will be explored later, the construction of the Hyperloop system would evidently be very expensive, and any technological developments that could lower material costs, or improve tunneling techniques, could make the project more financially feasible. All in all, technology will likely serve as a major driver of change for the Hyperloop system by increasing the likelihood of cybergenic cities, and making construction of the massive system economically possible through more cost-effective and innovative measures.

III. Government and Regulation

One group with immense power to either promote or stall Hyperloop are the various governments in each country attempting to implement the system. For one, the government would be concerned with the safety of this system, and would likely impose regulation to ensure that the Hyperloop posed no risks for riders. Additionally, the government would take an interest in its ability to move people and goods throughout the country, and would need to create an agency similar to the TSA, or extend the reach of the TSA, to would prevent terrorist activity on the journeys. Finally, the government would likely be in favor of a system that could reduce traffic, lower greenhouse gas emissions, and lower human-error related transportation accidents. For all of these reasons, government will likely be a major driver of change for the Hyperloop system. If policy leaders are resistant to the system, pass legislation that slows or inhibits the process, and/or require extensive construction permits in the building phase, its development could be slowed, and government would be viewed as a constraint to change. On the other hand, if the government provides funding, limits restrictive legislation, and takes other measures to support the technology, then the Hyperloop could spread at a much quicker rate.

Hyperloop One executive chairman and cofounder Shervin Pishevar expects governments to comply with the new system, noting that regulation of a brand new technology may be easier to develop. "Once governments see what the potential is, they will basically accelerate the regulatory process," Pishevar said.

IV. Funding

Building a Hyperloop system would not be cheap. Hyperloop Transportation Technologies estimates that a track from Los Angeles to San Francisco would cost between $7 billion and $16 billion. Elon Musk provides a similar estimation of approximately $6 billion to

construct the system (Costs picture). Although these numbers seem relatively inexpensive compared to the cost of California's High Speed Rail ($68 billion), the project would still be capital intensive, and would likely rely on funding from both private investors, as well as involved governments (HTT).

At the moment, the Hyperloop is a private venture, being pursued by companies that are not specifically affiliated with the government. This means that each company is tasked with the challenge of finding the funds to create, develop, and implement a system that looks to be extremely capital-intensive, from a labor and infrastructure point of view. As articulated in the Background section, TransPod, HTT, and Hyperloop One have all sought out funding from private investors and venture capitalists. However, the money they have currently raised is nowhere near the estimated costs of actually building the system, which highlights the way in which funding could potentially be a major constraint for the Hyperloop system. Once they transition from their research and testing phases into the actual construction phases, companies will face immense capital needs, and may encounter obstacles in acquiring sufficient funding.

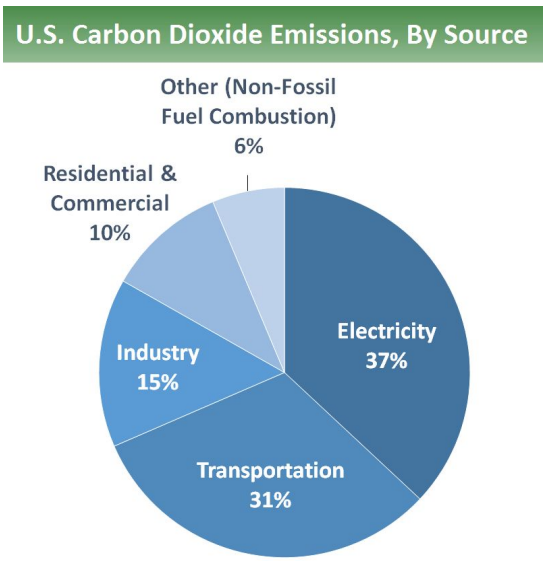
Despite this, as described in a PwC article from 2015, "Transport infrastructure investment is projected to increase at an average annual rate of about 5% worldwide over the period of 2014 to 2025"..."[Railways] are forecast to have a relatively strong growth in

those advanced economies with mature transport markets like Western Europe where there is a growing opinion in favor of public transport" (PwC p. 4-5) (See Appendix K). As mentioned previously, public transportation, particularly in the form of rail systems, is rising in popularity, and PwC's forecast on the growth in infrastructure investments over the next ten years highlights one possibility for the Hyperloop to capitalize on such an environment.

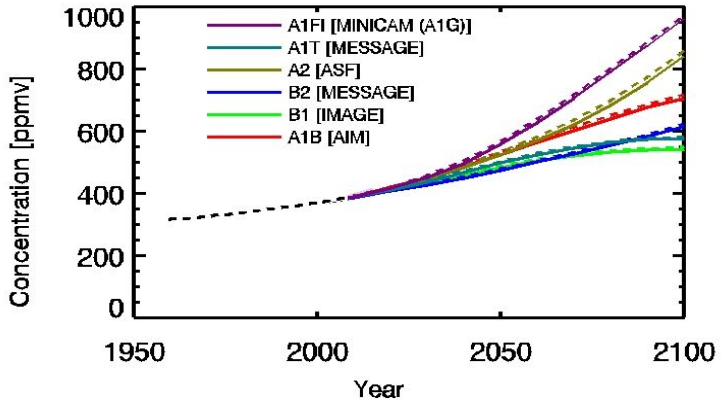
V. The Environment

The need to protect the environment is one of the largest drivers for the Hyperloop system. Opposed to contemporary transportation that uses fossil fuels, Hyperloop systems would employ solar energy, coupled with electric propulsion, neither of which uses fossil fuels. Elon Musk, who originally envisioned the Hyperloop, described "By placing solar panels on top of the tube, the Hyperloop can generate far in excess of the energy needed to operate" (Musk, paragraph 32). Even if the system chose to utilize some form of coal or gas power, the efficiency with which the system operates would still make it a far more environmental friendly option. However, with the solar power that Hyperloop plans to use, the emissions of the transportation system would be near zero (Hunt, paragraph 14).

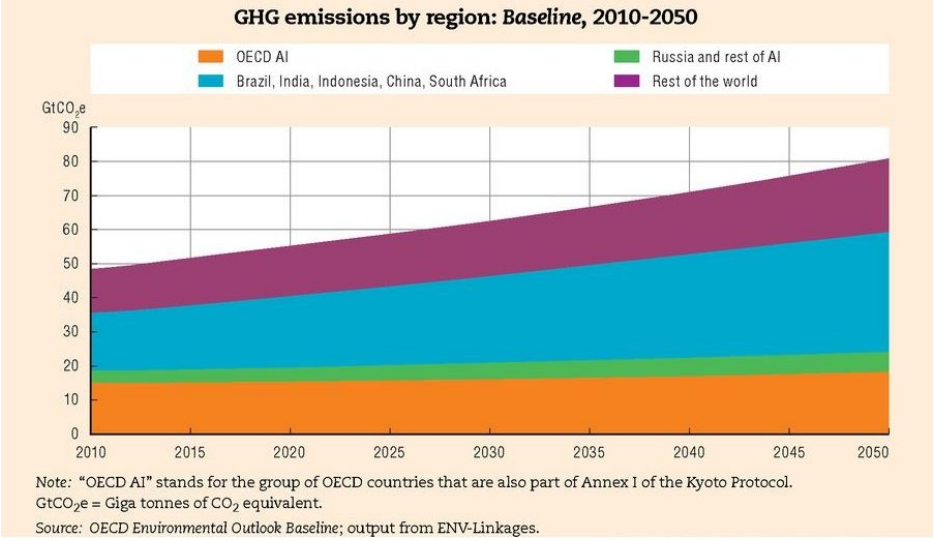
The need to replace current modes of transportation is at an all-time high; transportation is currently responsible for 31% of carbon dioxide emissions in the world ("Overview of Greenhouse Gases", paragraph 1). In 2013, the amount of carbon dioxide in the atmosphere also reached a record high, passing 400 part per million (ppm). Dr. Erika Podest,



a carbon and water cycle research scientist at UCLA, stated that “CO2 concentrations haven't been this high in millions of years. Even more alarming is the rate of increase in the last five decades and the fact that CO2 stays in the atmosphere for hundreds or thousands of years. “Climate change is a threat to life on Earth and we can no longer afford to be spectators” ("NASA Scientists On 400 Ppm CO2", paragraph 5). The projected rate of carbon dioxide in the atmosphere is as frightening as Dr. Podest depicts; it is estimated we will be reaching 500 ppm by the year 2050 ("Carbon Dioxide: Projected Emissions and Concentrations", paragraph 4).



With the Hyperloop, which has a nearly nonexistent carbon footprint, carbon dioxide emissions from transportation and carbon emissions as a whole can be drastically reduced. The *Organization for Economic Co-operation and Development Environmental Outlook to 2050* agrees with the above prediction, predicting that greenhouse gas in the atmosphere will steadily increase due to emissions



from all regions of the world (OECD 2012, p. 72).

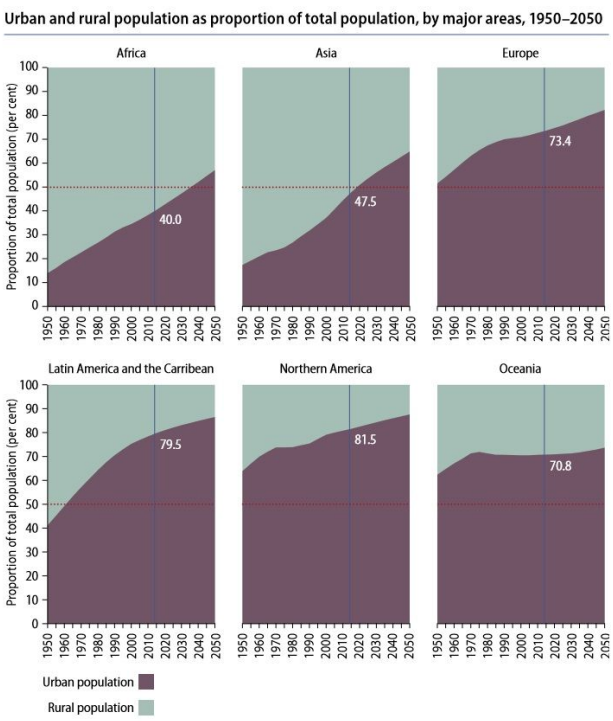
The unique aspect of the environmental driver is that the stakeholders include every single person on Earth. Without a healthy environment, the future of the human race quickly becomes an irrelevant question. A more specific set of stakeholders include oil and fossil fuel companies, because their product is running out. With little fossil fuel availability, energy prices are skyrocketing, but if transportation is replaced completely by environment-friendly sources, then a major customer of theirs also disappears. The Earth has a maximum of 50 years worth of petroleum reserves left so oil companies may actually resist the eco-friendly shift to Hyperloop until they have sold all of the Earth's resources at top dollar (DiLallo, paragraph 1).

VI. Urbanization

A major demographic shift that shows no signs of slowing is urbanization, or the movement of people from rural to urban areas. The Cities Alliance, a global organization working to decrease urban poverty, estimates that "nearly two billion new urban residents are expected in the next twenty years" ("World Statistics Day: A Look at Urbanisation.", paragraph 3). The UN predicts an even greater number, revealing in their World Urbanization Prospect report that "continuing population growth and urbanization are projected to add 2.5 billion people to the world's urban population by 2050, with nearly 90 per cent of the increase concentrated in Asia and Africa" ("World Urbanization United Nations Prospects Highlights.", p. 5).

The Hyperloop could potentially relieve the infrastructural pressure that will be put on urban cities worldwide. Travel and transportation of goods will significantly increase in response to the population growth, and an efficient, high-speed rail system such as the Hyperloop has the potential to satisfy the immense needs of such a population. Megacities and dense countries will especially be in need of the Hyperloop system, due to the logistical difficulties of traveling in such an environment.

"By 2030, the world is projected to have 41 mega-cities with more than 10 million inhabitants. Just three countries—India, China and Nigeria—together are expected to account for 37 per cent of the projected growth of the world's urban population between 2014 and 2050. India is projected to add 404 million urban dwellers, China 292 million and Nigeria 212 million" ("World Urbanization United Nations Prospects Highlights.", p. 5).



Beyond having massive populations, China and India rank fourth and seventh in the world for largest countries by geographical area, respectively (Kästle, paragraph 2). Without the proper transportation, cities may become extremely inefficient and"backed up" with goods and people who do not have the means to travel to their destinations. Hyperloop systems are

currently being built in large cities for this very reason; a track between Washington D.C. and New York is underway, as well as a budding track to connect the greater region of Dubai.

VII. The "Sharing Economy" Revolution

Jeremy Rifkin, a renowned author and economist, stated "25 years from now, car sharing with be the norm, and car ownership an anomaly" ("Millennials Infographic.", paragraph 8). This "sharing economy" trend has become more of a revolution; an entire generation is hesitant to buy items when they can rent, borrow, or share access to items with the same capabilities is shifting the way future generations and economies might function.

Esther Martos, a Sharing Economy PhD Researcher at the Charles University of Prague, stated "...in the following years we will see a much more connected sharing economy. That means a huge open network in which known web pages as LinkedIn, Twitter, Facebook will engage in certain way p2p platforms performing an important part on it. As we can see nowadays it is common to log in via Facebook, find the nearest shared car via Google Maps or pay via Bitcoin. That will be increased along the next years" (Howard, paragraph 20).

Hyperloop will fit perfectly into this increasingly shared economy, because it further minimizes need for vehicle ownership. Future generations will enjoy this ability to use transportation on demand, as well as having the general freedom to travel farther and faster than ever before. As mentioned previously, car ownership is slowly dropping, and if the "sharing economy" continues its growth, any transportation system that offers riders an easy and efficient way to travel will likely have success in such an environment.

VII. Eminent Domain

In order to become as widespread and successful as Hyperloop companies desire, the transportation system will require permission from the government to exercise eminent domain. Obtaining private land will be necessary to building an extensive rail system, and without government support the spread of the company would be nearly impossible. This factor serves as a major constraint for the companies that are trying to invent and popularize this mode of transportation that could potentially replace current rail systems completely.

Hyperloop One CEO admitted in a May 2016 interview that he thinks “first and foremost it's going to take government support to create a regulatory framework to make Hyperloop a possibility,” adding, “We're seeing some very good support from federal transportation authorities and state and local transportation groups around the world. We'll need a supportive environment for regulations” (Baldwin).

Purchasing the necessary land could cost the Hyperloop companies an obscene amount of money, considering they will be required to compensate the landowners fairly in order to legally acquire the property to build the rails on. Fair compensation needs to be at market value - which could quickly become a huge addition to the Hyperloop’s budget ("History Of The Federal Use Of Eminent Domain").

Baseline Projection

I. Synthesis of Evidence (Expected Future)

“Transportation that could revolutionize travel” **- Elon Musk**

Through the examination of these influential drivers and constraints to change, and the way in which they might interact, it becomes possible to develop a baseline projection for where

Hyperloop is likely headed in the next 30 years. Of course, it is important to consider the possibility that disruptions could lead to alternative scenarios when doing forecasting, but for the baseline projection, understanding the relationship and projections that arise from the drivers and constraints will aid in projecting the expected future for the Hyperloop. Based on emerging trends, and the likely future outcomes of these factors, it is projected that Hyperloop could be positively integrated into society in the next 30 years. Through financial, legislative and social support from the government, investors and consumers, the Hyperloop could emerge as the first player in a wave of high-speed, fully-automated transportation systems.

The previously-listed factors serve as drivers and constraints due to their role in determining the direction that Hyperloop could take in the coming years. As mentioned before, data on car ownership suggests that younger generations are leaning towards more shared transportation methods, rather than autonomous vehicles. This has caused the creation of alternative transportation methods such as Uber and Lyft, and has led to an increase in the usage of established light and heavy-rail trains. This is significant as both forms of transportation share vital competencies with the Hyperloop, and their growth suggests an opportunity for the Hyperloop to grow alongside the millennial group that will begin to demand it.

The new technology that comes with the Hyperloop may not quite align with traditional consumer preferences as they are understood today, since the system is extremely innovative. However, as mentioned above, consumers are beginning to accept technological advancements at much quicker rates. When considering the state of technology in automation, society appears to be trending towards a world of cybernetic, closed systems. In all, **the** Hyperloop is projected to

be gradually integrated into society as a new mode of track-based transportation, capitalizing on the "sharing economy" as well as the rapid rate that technology is adopted by consumers.

By examining technology and government regulation as both drivers and constraints, a projection about the feasibility of the project can be made. As new materials like nanotubes are tested and become more widespread in manufacturing, engineers could find safer, more efficient ways to build and implement Hyperloop. This would, in turn, give the government more of an incentive to fund and enact legislation that accelerates the progress of the Hyperloop. However, if the expenses of the technologies required to sustain this project are too high, or the issue of safety remains a major concern, the government may not deem it as worthwhile. The necessary funding might be restricted, or legislation to hinder the development could be passed. Ultimately, it is anticipated that the government would support this project due to its environmental, social, and economic benefits, although it is difficult to establish a concrete projection on their level of involvement throughout the process.

Concerns regarding the environment prove to be some of the Hyperloop's most impactful drivers. There is an increasing need for methods of transportation that help reduce the worldwide carbon footprint. Additionally, the Earth is experiencing a lack of fossil fuels that could potentially cripple the progression of society if alternative forms of energy do not become widespread. Because the Hyperloop is designed to cater to these pressing issues, it could serve as the future of green transportation. The Hyperloop is projected to gradually replace the transportation systems that are harming our world's environment, including cars, trucks and trains**.** This projection can be further enhanced when considering consumers as stakeholders. Consumers are being forced to think about how the systems around them are affecting the

environment, since there is no longer a question about the correlation between the state of the environment and human survival. The Hyperloop presents an option that is not only designed to fit consumer preferences and desires for automation and speed, but is also much less harmful to the environment. It is a bundled option that very few competitors are able to offer.

Moreover, the continued population growth and trend towards a more urbanized society have presented themselves as key drivers for the Hyperloop system. Because the Hyperloop can provide relief to the infrastructural pressure that will be put on these urban cities, it is projected to be find tremendous success in megacities facing rapid urbanization and population growth. Although the idea originated out of Musk's desire to design a method of transportation that could transport people from Los Angeles to San Francisco in 30 minutes, current trends suggest that it could be most effective in countries with emerging megacities. These places truly need an innovative way to alleviate the congestion and transportation difficulties that result from urbanization, and Hyperloop could serve as an impactful solution.

Alongside the drivers and constraints, considering expert opinion is extremely useful in making projections about the Hyperloop. As the future of the system remains relatively abstract, experts have proposed their personal projections on whether or not the Hyperloop will be a success or a failure. In one article posted by Mobility Lab, the author contemplates the reality of Hyperloop and the necessary steps that would need to be taken. The author observes that experts have mostly used public concern as the primary constraint to Hyperloop. A startup expert noted that "every major paradigm shift relating to transportation has been met with great resistance" (Mackie, paragraph 18). This is supported by historical examples of society's hesitance to innovate in transportation. When the first automobile was introduced, it was initially met with

bans from many city streets. In more recent years, when the Tesla was first brought to market, it was ridiculed by consumers as an excessively-advanced and spaceship-like automobile. Yet Tesla is now widely accepted as a key player in the transportation industry, and has paved the way for companies trying to replicate their business model. Tesla achieved this success by adapting to competitors, maintaining a consistent and focused strategy, and putting the safety and satisfaction of consumers above all (Steen). For the Hyperloop to be successful, the issues of safety, adaptability, and consumer trust are crucial in its quest for widespread adoption.

When constructing a baseline forecast for a company based around innovation, it is particularly important to consider the role of investors. Like any emerging product, business, or technology, there is always the pressing need for financial support, and this will require Hyperloop companies to reach out to investors. So far, Elon Musk has garnered a lot of success with past projects (Tesla and SpaceX), so name recognition has brought Hyperloop to the attention of potential investors. The ability of Hyperloop startup companies to successfully attract these investors could dramatically shape the future of the system. In this baseline projection, it is expected that Hyperloop companies will manage to acquire sufficient financial support from investors, allowing their test tracks and simulations to be transformed into commercialized transportation systems.

Overall, companies striving to develop the Hyperloop are expected to encounter challenges including government regulation, funding, public concern and consumer preference. Despite this, it is projected that the Hyperloop could transform the way that individuals travel, simultaneously paving the future of mass transportation. The trends regarding consumer preferences, technological acceptance, shared economies, and urbanizations suggest a desire for

environmentally-friendly innovation such as the Hyperloop. In addition, it is forecasted that influential expert opinions and support from investors could help the technology overcome or mitigate many of the pressing constraints. Therefore, the future of Hyperloop is anticipated to be profound; it could ultimately change the way society views transportation, and alter the way that goods and people move throughout the world.

II. Summative Position

The central question is as follows: "How will the implementation of Hyperloop affect worldwide transportation, and what are the potential implications?" The timeframe being analyzed spans 30 years into the future, anticipating widespread adoption by 2046. In the preferred scenario, the Hyperloop would become one of the most widely-used modes of public transportation of the future. Questions about scope and scale could introduce discussions of the Hyperloop as a means of commuting to work and traveling around the city, while simultaneously exploring the future possibility of it being used in cross-continental travel. Over time, the central question will likely evolve to focus less on how Hyperloop could be implemented, and more on how it can continue to expand to different industries and geographic locations, becoming more than a simple transportation service. Strategic partnerships with other innovative companies is likely, and Hyperloop travel could become the primary method of moving people around the globe.

If the Hyperloop is able to withstand the uncertainties and constraints listed above, then its future is almost limitless. However, even if the Hyperloop itself turns out to be unsuccessful, experts believe that it will have significantly impacted the development of future transportation systems. Dave Lee, North America technology reporter for BBC, published an article voicing his

opinion on the future of Hyperloop after visiting an MIT Hyperloop convention. Even though he concedes that the numerous constraints might inhibit the development of the ideal form of the Hyperloop, he describes, “the hope is that developing Hyperloop will create *something*, even if it's not the transportation of the future” (Lee, paragraph 4). For example, if companies are unable to build Hyperloop systems that could safely transport humans, they could still be a viable option for cargo shipping. In fact, one of the world’s largest port-terminal operators, DP World, and Hyperloop One are working together to utilize the Hyperloop to unload ocean-container cargo at the Jebel Ali port in Dubai (Phillips 2). This highlights the versatility of the Hyperloop system, a characteristic that is crucial to the continued success of innovative and visionary technology.

Identify and Prioritize Uncertainties

1. Government regulation
2. Consumer acceptance
3. Land ownership
4. Alternate forms of transportation
5. Depletion of nonrenewable resources

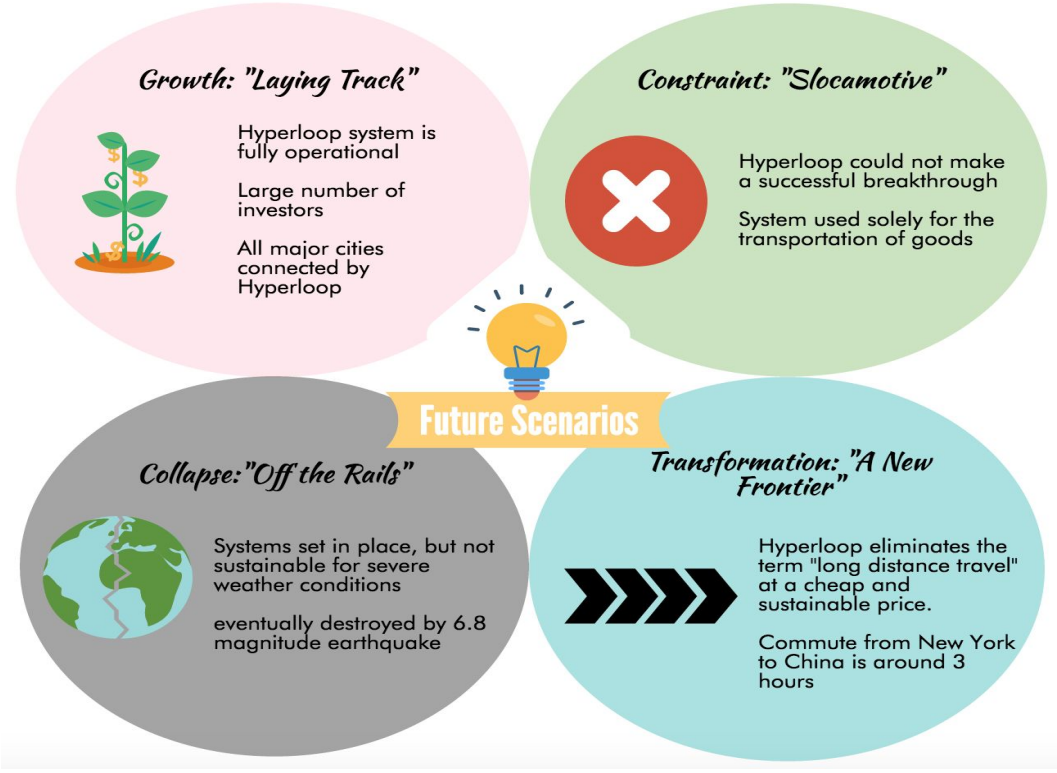
Although many experts believe the Hyperloop could be a feasible form of future transportation, and global trends suggest its compatibility in our world, there are a number of uncertainties that could disrupt its development. In order of priority the uncertainties are: government regulation, funding, consumer acceptance, land ownership, alternate forms of transportation, and depletion of nonrenewable resources. Governmental regulation of Hyperloop is an uncertainty due to concerns about passenger safety, and whether or not restrictive legislation will be enacted that halts the expansion of the Hyperloop. Funding stands to be one of Hyperloop’s major challenges as well, since the source from which it will come is currently

unclear. Its implementation is almost fully dependent on raising sufficient capital, and there is uncertainty whether private investors or governments will deem the project worthy of funding.

Another uncertainty would be consumer acceptance, specifically relating to issues that may arise over people grasping the full potential of the Hyperloop. Some individuals might be hesitant to abandon their personal vehicles for shared transportation forms, or a disruptive new form of travel such as drones could completely supersede the need for the Hyperloop. Land ownership is another uncertainty due to the challenges of laying the tracks on private land, and the issues are similar to those faced in highway and rail construction relating to eminent domain.

The last uncertainty is the depletion rate of nonrenewable resources, as scientists lack conclusive evidence to make a definite prediction on the amount of these energy sources remaining on Earth. If scientists come across additional reserves of nonrenewable resources, then the rush to make the Hyperloop a reality from an energy-standpoint might not be as pressing.

Future Scenarios



The following scenarios will be used to highlight the direction that the Hyperloop could likely be headed into the future. By examining a possible growth scenario, constraint scenario, transformation scenario, and collapse scenario, there arises a clearer picture of the different possible futures on the Hyperloop's horizon. Depending on a number of different uncertainties, challenges, and outcomes of certain trends, the timeline for the Hyperloop's implementation could vary tremendously. The following four scenarios depict possible futures and timelines for the Hyperloop, and will be depicted as a historical retelling of the events that brought the Hyperloop to its established place in society.

"Laying Track" (Growth)

In 2017, nearly four years after Elon Musk proposed the initial idea for the Hyperloop, a group of college students from Stanford came up with a functioning version of the tunnel and pod system, winning the "Official SpaceX Hyperloop Pod Competition" put on by Elon Musk. As a result, Hyperloop Transportation Technologies hired the group of student engineers, and began construction on an expansive test track in central California. Meanwhile, the architects at Bjarke Ingels Group (BIG) and Hyperloop One capitalized on their agreement with the Dubai Roads and Transportation authorities, and began construction on a system that would connect Dubai with Abu Dhabi. In just 5 years the system was fully constructed and operational, and despite the lengthy building process and heavy investment, the future of Hyperloop was clearly bright. After extensive safety tests and trial runs, the system was fully operational, and reduced the 2 hour drive between cities to a mere 12 minute train ride. Once investors back in the United States saw that the technology was feasible, they began pouring even more money into research and testing, and by 2025, Hyperloop Transportation Technologies had expanded to the Bay Area

with a system connecting Palo Alto to San Francisco. Demand for more Hyperloop systems grew steadily due to the amount of human capital and educated minds in the area who saw this as the future of transportation, and the reach of the Hyperloop grew. As cars and vehicles powered by fossil-fuels began to diminish due to the depletion of nonrenewable resources, transportation technologies with low carbon footprints continued to thrive. Local and state governments worked alongside Hyperloop companies to enact legislation to ensure traveler safety, and began offering governmental subsidies to encourage cities to adopt the environmentally-friendly systems. By 2035, many major routes, such as Los Angeles to San Francisco, New York to New Jersey, and Chicago to St. Louis were covered by the Hyperloop. However, due to the large capital requirements and investment needs, the Hyperloop was unable to fully replace other commuter systems, and was seen mostly as a form of long-distance travel. Finally, by 2046, almost every route between major cities around the world were connected by the Hyperloop.

“Slocomotive” (Constraint)

Change does not traditionally happen overnight; the Hyperloop’s development in the modern world is a testament to this. The irony of the implementation of a rapid transit system being painfully slow was not lost on investors, and they soon grew frustrated with their lack of financial returns. Although places like Moscow and Dubai were able to implement Hyperloop

systems in the early 2020's, most other countries were simply unable to generate enough widespread investor interest to make the idea a reality. Research was costly, the construction of the system was costly, and purchasing the rights to the land on which the tracks would be laid was also costly, and there was simply no exigency in adopting the Hyperloop. On top of this, the government was wary of the high-speed system, and passed legislation that would limit the velocity that the pods could travel, effectively diminishing the competitive advantage imbedded in the system. Over time, however, as carbon emissions reached an all-time high, and massive urbanization made living in cities almost unbearable, citizens began to regain interest in a clean, fast, and efficient form of transportation that could replace outdated cars and buses. Natural resources were running out, and the major selling point for the Hyperloop became its operation through solar-power.

Although never completely out of the game, the Hyperloop had been sidelined for nearly 10 years, until a newfound investor and consumer interest led to research and eventual breakthroughs in the mid 2020s. However, due to the uncertainty surrounding the system, progress was slow, and cities were hesitant to put stock in a transportation system with very little credibility. Little by little, the Hyperloop spread from its roots in California across the rest of the country, and became a way for people to travel conventional routes in a much shorter time. Although it never experienced the ridership numbers that investors had originally projected back in 2013, it was seen as a novelty system for specific types of trips, and by 2035, every major city in the country had some form of a Hyperloop system. Every once in awhile, technical problems or injuries to riders would cause shutdowns that led to people doubting the future of the system, but most of the kinks had been ironed out by the 2040s. Despite its growth across the country,

other forms of transportation such as drones and autonomous cars distracted people from the true potential of the Hyperloop, and it remained a relatively minor form of transportation in the 2040s. Due to a sustained lack of interest and inability to attract passengers, investors decided to pivot, and sold the systems to shipping companies that would use the Hyperloop pods to transport goods rapidly throughout the country.

“Off the Rails” (Collapse)

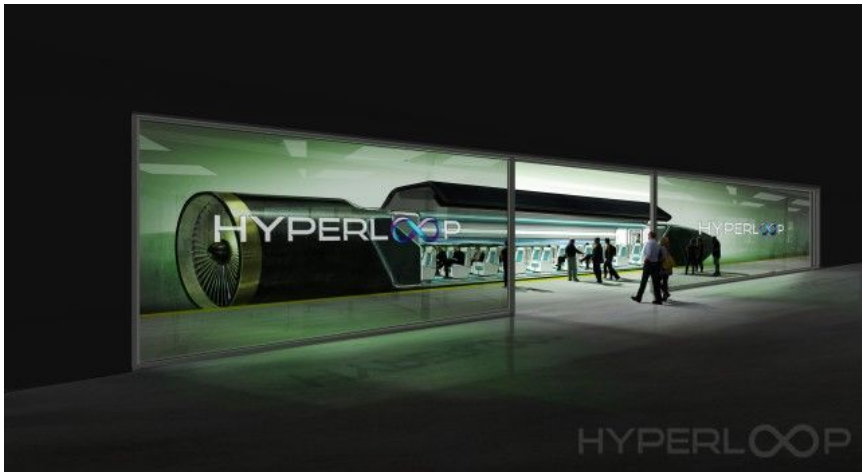
Safety was always a major concern for developers of the Hyperloop. The Hyperloop system was complex, fragile, and autonomous, which meant that any environmental factors could prove to have a major effect on its functioning. If a hurricane or snowstorm knocked out power, and the proper controls were not put into place, then riders could be tragically trapped inside the Hyperloop tunnels. Because of that, investors and engineers decided to test the first system in California, where the major environmental factor would be heat. By 2020, the numerous college competitions had produced a prototype that was constructed in San Jose, California, and set to initially transport goods between cities in South Bay. The system expanded into San Francisco as the years went on, and eventually investors grew interested in further monetizing the system by opening up the trips to human passengers. Angel investors throughout Silicon Valley began pouring money into Hyperloop One and HTT, trying to make sure that they were ahead of the curve on the innovative technology. The San Jose local government, hungry for innovation, avoided passing any legislation that might slow the progress of the system.

Numerous test runs and simulations revealed high g-force numbers, but nothing that was any more intense than roller coasters. With this, companies began sending test riders on trips to ensure that it was safe enough for everyday rides. The results were mixed, with certain individuals experiencing high levels of nausea and dizziness with the high speeds. This caused the Department of Transportation to institute regulation that would limit the speed of the Hyperloop, removing one of its major competitive advantages. Despite this hiccup, all the involved parties were eager to push forward as nonrenewable resources ran dry and the race for sustainable transportation was well underway. With that, the first commercial Hyperloop was opened up between San Jose and Palo Alto. The system ran seamlessly until February 19th, 2035, when the San Andreas Fault enacted its revenge on those who had discredited climate change as a potential incubator for destructive earthquakes. The 6.8 magnitude earthquake shook the entire coast, and the light, sleek tunnels housing the Hyperloop pods were not strong enough to withstand the blast, a shortcoming that additional testing would likely have uncovered. Numerous lives were lost as the tunnels crumbled in on themselves, and the Hyperloop's lack of earthquake mitigation made it the subject of national news. Although investors tried to revive interest in the system after the quake, individuals were too weary of the safety concerns, coupled with the infrastructure instability, and voted to enact legislation that would ban the construction of future Hyperloop systems.

“A New Frontier” (Transformation)

2017 proved to be a turning point in Hyperloop’s story. Through numerous competitions, international adoption, and incubator research, great minds came together to put forth a prototype of the Hyperloop that could travel even faster than experts initially predicted. The next three years saw numerous tests and studies of Hyperloop tracks that were laid out in different areas of the country, and it soon became clear that the technology to make the Hyperloop a widespread form of transportation already existed. Living up to its promise, Dubai had established a fully-functioning Hyperloop system to Abu Dhabi by 2022, and Moscow followed suit shortly after. By 2025, numerous other Hyperloop routes had been established overseas, causing investors to continue pouring money into U.S-based Hyperloop countries trying to bring the technology to the States. The Hyperloop spread much like traditional railroads; shorter tracks that began by carrying cargo, transitioning into shorter journeys taken by humans, transitioning into extended routes that spanned the entire continent. Hyperloop Hubs were in almost every major city by 2035, and by 2040, construction had begun on international routes. One could hop on a Hyperloop in New York City and be in China in roughly 3 hours. Traditional vactrains soon became obsolete once people realized that there were faster, safer, and cheaper journeys to be taken on the Hyperloop. Through economies of scale, companies began to mass-produce

Hyperloop parts, and what was once viewed as a form of long-distance travel soon turned into a form of commuting, allowing people to journey quickly from their suburban home into the city in which they worked.



Insight: Strategic Implications for Business

"Laying Track" (Growth)

Although the Hyperloop system was unsuccessful in its pursuit to dominate short travels and commutes, it eventually became the mainstream form of long distance travel. By 2046 almost all routes between major cities in the United States and around the world were connected via Hyperloop. Even though it saw widespread growth, the Hyperloop system still faces potential threats that could emerge with its continued use. While Hyperloop systems may currently maintain the majority of the market share for long distance transportation, there is the threat that advancements in technology could bring about an entirely new mode of transportation, thus

making the Hyperloop obsolete. If the newer systems promise increased speed, safety, or convenience, then consumers would have little reason to maintain loyalty to the Hyperloop. The system itself would provide major opportunities for businesses, as its complexity involves many elements in the production and operation process. Because it is fully computer-operated, there would be opportunities for technology companies to partner with the Hyperloop, to operate and collect data on the rides. They would also be responsible for ensuring the system ran smoothly and on-schedule, reducing the waiting times in the Hyperloop stations. The possibility for human error and resulting accidents would be drastically reduced, and a major selling point of the system could be the reduced deaths and injuries that result from highly-automated system. There are many opportunities for growth as well in this scenario, particularly through partnerships with ridesharing services like Uber or Lyft. Through this, consumers could secure rides to and from the Hyperloop Hubs. The increased connectivity of cities could lead to increased communication between businesses, and goods, as well as knowledge, would flow more freely. As transportation becomes more computer-operated, public services could follow, and cities could see many of its maintenance functions become fully automated. Massive amounts of data could be collected from these computerized functions, and cities could easily analyze and manipulate useful data on variables spanning from ridership of public transportation, to breakdown of waste collection, to traffic activity. Evidently there are ethical considerations over the usage of this collected data, and whether cities would be violating the privacy of individuals by tracking these variables. Another business opportunity facing Hyperloop companies would be the ability to generate additional revenue by leasing or renting out space for advertisements within their cars.

There are various signposts that would reveal progress towards this growth scenario. For one, the world would likely see Hyperloop test tracks appearing throughout, in an effort to run simulations and trials to promote the eventual commercialization of the system. Additionally, a movement away from cars and towards more autonomous transportation systems could also signify a shift towards the Hyperloop system, as it would confirm consumer acceptance of travel methods that are computer-operated. The depletion of natural resources would also likely serve as a signpost for this scenario, as it would force the emergence of alternative, green transportation methods, such as the Hyperloop. Finally, the physical Hyperloop tracks being laid would also serve as signposts for this growth-scenario, confirming that there was sufficient funding and capital to turn the vision into a physical reality.

"Slocomotive" (Constraint)

By the 2040s, the Hyperloop had regressed to a relatively unpopular form of transportation, and ridership numbers were on the decline due to a perpetual lack of interest. The decline in popularity was primarily driven by safety concerns, as the company experienced several temporary shutdowns due to technical issues and rider injuries. In this way, consumer perception of the system was the largest threat that caused the demise of the Hyperloop as a popular human transportation method. There are certainly business opportunities to open up restaurants in the pods, and sell advertising space to businesses, but based on low rider demand, it would likely be challenging to find buyers. As a result, Hyperloop and its investors made the decision to pivot and sell the systems to shipping companies that would use the Hyperloop pods for commercial use. New business opportunities would emerge in the shift to become a shipping company, and revenue growth would come through partnerships with online retailers and large

goods distributors. A major ethical consideration here would be concerns over eminent domain, and whether private individuals should be required to allow the construction of Hyperloop tracks on their land.

The primary signposts of the constraint scenario are alternative forms of transportation that are less costly for investors, less dangerous for riders, and less land-invasive for the cities trying to adopt the systems. Essentially, the growth of rival systems would likely be a major component of the constraint to growth that the Hyperloop faces. This scenario would likely see Hyperloop tracks being laid across popular, long-distance routes, but would never experience the Hyperloop as a commuter-system for everyday use. Hyperloop stations would pop up in these cities, but would still be seen as a novelty for the most part. If the technology faces persistent resistance from consumers and investors, as this scenario suggests as a possibility, then the world could see it used more as a shipment method for goods. UPS and FedEx trucks would be taken off the streets, as companies flock to the faster and more efficient Hyperloop systems.

“Off the Rails” (Collapse)

After the terrible Hyperloop accident in 2035, the government enacted legislation that would ban the construction of future Hyperloop systems. Investors had tried and failed to revive people’s interest in Hyperloop after the accident, primarily due to safety concerns. Because of this, there is little opportunity for business growth and partnerships. However, if investors are still interested and willing to contribute, the Hyperloop may be able to make a comeback by shifting its focus to transporting of goods. This tragedy did bring to light the ethical concerns regarding safety testing, and the ways that companies might sidestep certain processes in order to expedite the commercialization process. The lack of concern for thorough safety measures in the

face of the multiple environmental challenges facing the Hyperloop ultimately led to its downfall.

The first signpost that would indicate the occurrence of this scenario would be the creation of Hyperloop test tracks in Northern California. Individuals would be able to drive by these areas and observe numerous simulations that were underway, preparing the Hyperloop to be ready for human users. There would likely be a progression from perceiving the Hyperloop as a way to ship goods up the coast of California, to a system that could move individuals at rapid speeds, and there would likely be growing pains in this adoption process. Additionally, this scenario could see the increased usage of drones and autonomous vehicles in transportation services, which would put increased pressure on companies that were deeply invested in Hyperloop. All of these factors, coupled with a desire to be the first to commercialize the system, could cause companies to look past certain testing or research conclusions on the dangers in the system, thus permitting the Hyperloop to spiral "off the rails".

"A New Frontier" (Transformation)

By the late 2040s, the Hyperloop system connected all major cities in the United States, as well as many other major cities internationally. Because the Hyperloop is now the mainstream form of transportation, they will likely face threats of terrorist acts and natural disasters. Additionally, because of its success, Hyperloop companies face the threat of copycats and imitators, as well as new transportation technologies that could put them out of business. On an international level, the construction of overseas tracks has dramatically increased global travel, as it is now cheaper and faster than ever before. As a result, the world has seen increased decentralization of national culture, as a global culture begins to emerge as through the frequent

crossing of continental borders. With this, a new international transportation agency would need to emerge to regulate the system, ensuring rider safety and uniform travel standards. As more people travel internationally, it is likely that goods would follow, and multinational companies could thrive from increased access to foreign markets. On the flip-side, the possibility for increased imports could threaten U.S. businesses, leading to ethical considerations on whether governments should impose trade barriers like tariffs or quotas. With the rapid growth of investment in the system, the demand for Hyperloop parts has skyrocketed. This presents an opportunity for businesses to create factories to mass-produce the parts that make up the Hyperloop system. Consequently, if a company can become the sole producer of any component of the Hyperloop along the value-chain, they would stand to make tremendous profits. There are also environmental implications for the adoption of the system, as its low-carbon footprint would fit well in a world plagued by fossil fuel emissions and unsustainable energy sources.

The major signpost for this scenario is the complete integration of the Hyperloop into the everyday lives of consumers. Instead of operating simply as a form of travel, it would likely become an experience, something that riders became accustomed to on their daily trips. Hyperloop systems would likely use the screens in their advanced pods to show advertisements, screen movies, and inform riders of events occurring in the area to which they were traveling. Hyperloop stations could link with other transportation systems, and it would not be uncommon to see someone ride an autonomous car to the Hyperloop station, transfer to a vacant pod, and ride the Hyperloop to their final destination. Developers could come out with apps that tracked the timing of different Hyperloop pods to ensure for seamless travel, and all payments would

likely be done on mobile devices. With this, the Hyperloop would become central in the day-to-day lives of its users.

Conclusion

In its ideal form, the Hyperloop could exist as a technology that would allow companies to satisfy the triple bottom line. Stakeholders could be served by the massive revenue and growth opportunities, society could be served by its ability to connect people all over the world, and the environment could be served through its solar-powered energy form, and low emission levels. At the same time, if prohibitive legislation or a lack of investor interest plagues the system, then it may never be anything more than a moonshot idea. The plethora of uncertainties and forces affecting its development make it challenging to determine the exact role and function that the Hyperloop could play in society. Although the Hyperloop's journey to becoming a dominant force in the transportation industry will likely face numerous obstacles along the way, its ability to satisfy a number of different societal needs makes it an ideal form of futuristic transportation.

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