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<p>Abstract</p> <p>Traffic and congestion has been an issue that has plagued the city of Los Angeles for years. As the population of Los Angeles has increased, so has the number of private vehicles which has led to slowed mobility. Via my research and writing I address how traffic and congestion has impacted Los Angeles, the systems that are involved, the impacts on health, how sustainability plays a role, the strategic approaches Los Angeles has taken in order to combat congestion and how related innovations in the automobile industry has the potential to change the phenomenon of congestion in the future. The Los Angeles transit system in its very initial phases, began to show signs of implementations just before the early 1900's. Throughout the years, with progress, Los Angeles managed to create a transit system of busses and trains which operates throughout the city. However, such systems have failed to attract ridership and studies have shown that Angelenos have purchased vehicles consistently since the 1980s and that they mostly prefer to commute to work in single occupant vehicles. Los Angeles has tackled the issue of congestion for years, they often find themselves relying on short-term strategic approaches which do not yield favorable results in the long-run. Moreover, long-term approaches such as synchronized traffic lights end up costing the city a fortune. After accessing technological innovation in the automobile industry and the availability of new systems such as Industry 4.0. with the help of scenarios, I was able to create PESTLE tables with narratives in order to allow for the interpretation of the current state of Los Angeles in the future in terms of alleviating congestion and relying on innovation to do so.</p>			
Key words	Congestion, Automation, Machine learning, Industry 4.0,		
Further information			





**UNIVERSITY
OF TURKU**

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THE FUTURE OF URBAN AREAS: URBAN CONGESTION AND RELATED INNOVATION IN THE CITY OF LOS ANGELES

Master's Thesis
in Futures Studies

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The originality of this thesis has been checked in accordance with the University of Turku quality assurance system using the Turnitin OriginalityCheck service.

Table of Contents

1	INTRODUCTION	5
	1.1 Research Questions & Hypothesis	6
2	THEORETICAL FRAMEWORK.....	8
	2.1 Systems Thinking.....	8
	2.2 Urban Planning.....	10
	2.3 The Art of Scenario Building.....	11
	2.3.1 Narratives.....	12
	2.4 Industry 4.0.....	12
	2.5 Discourse Analysis.....	14
3	MATERIAL AND METHODS.....	15
	3.1 Defining Horizon Scanning.....	16
	3.2 The Steps of Horizon Scanning.....	16
	3.3 What is a PESTLE Table?.....	19
	3.3.1 Political Change	20
	3.3.2 Economic Change	20
	3.3.3 Social Change	21
	3.3.4 Technological Change	21
	3.3.5 Legal Change	22
	3.3.6 Environmental Change.....	22
4	AUTOMATION, MANKIND’S BEST FRIEND	23
	4.1 Automation and Machine Learning in Industrial Manufacturing	24
5	AUTOMOBILE INDUSTRY INNOVATION	24
	5.1 What Are Self-Driving or Autonomous Vehicles.....	25
	5.2 Preparing for Autonomous Innovation.....	25
	5.3 The Internal Combustion Engine	26
6	THE HISTORY OF TRANSPORTATION IN LOS ANGELES	27
	6.1.1 The Cycleway	27
	6.1.2 Paving the Way for The Electric Railroad.....	28
	6.1.3 The Jitney Drivers & The “Yellow Car”	29
	6.1.4 The End of Streetcars & The Failures of Taxi Companies & City Planning	30

6.1.5	Motor Vehicle Transit.....	32
6.1.6	Attempting to Establish a Freeway via the Los Angeles River	33
6.1.7	L.A.’s Metrorail	34
6.2	A Visualization of Los Angeles Transit Systems	35
7	URBAN CONGESTION.....	35
7.1	Public Transportation	36
7.2	Angelenos Reliance on Private Vehicles	37
7.2.1	Single Occupant Vehicle Reliance	38
7.3	The Influence of Climate Change	39
7.3.1	The Mayors Stance on a Sustainable Los Angeles	40
7.4	Los Angeles Today	41
7.5	Strategies Implemented by The City of Los Angeles	42
7.5.1	Carmageddon	43
7.5.2	Congestion Tax	44
7.6	Motivation	45
8	A PESTLE ANALYSIS: SCENARIOS OF THE FUTURE OF CONGESTION IN LOS ANGELES	45
8.1	Los Angeles Triumphs Against Congestion	46
8.2	“I Spent My Life on Sunset Boulevard”	48
8.3	2040, Los Angeles Endless Headache, Congestion	50
8.4	“The Techformation of Los Angeles Transit Systems”	53
9	CONCLUSION	55
10	REFERENCES	58

1 INTRODUCTION

Urban development in the United States has progressed slowly in the last decade, cities like Los Angeles have found themselves constantly making the same mistakes when trying to address the issue of traffic and congestion. Congestion has caused unpleasant idling time, contributed to health and climate degradations and has defeated cities every step of the way when attempting to address the phenomena itself. Los Angeles, my target city, is the has been combating this issue for years and only recently has it developed and implemented technology systems which have resulted in very minuscule improvements. I chose this city because it is located in the richest state in the United States and it is home to many of the tech giants in today's world, in other words, this city should have all the resources in the world to combat congestion, yet it has been unsuccessful throughout the years. CBS News reported that in 2017 California was the 5th largest economy in the world and its gross domestic product grew by \$127 billion (CBS News, 2018). Los Angeles also has a public transportation system which has struggled to attract ridership, most Angelenos rely on private vehicles for transportation.

I will begin by defining 3 major concepts which will each play a major role in my research and writing. First, automation, which has been defined by the Merriam Webster as the technique of making an apparatus, a process, or a system operate automatically has been responsible for improving, changing and bettering the lives of mankind since its early inceptions. All too often automation is portrayed as a threat to our economic stability and way of life, however, we seldom stop to consider how drastically automation has improved our daily life and businesses within our society.

My next theme, machine learning, is an aspect of automation which has also played a major role in the development of mankind. Gartner (2018), a fortune 500 company which specializes in client consulting for the preparation of future business has defined machine learning as algorithms which composed of many technologies (such as deep learning, neural networks and natural-language processing), used in unsupervised and supervised learning, that operate guided by lessons from existing information. Deloitte (2017), another major role player in consulting defines machine learning as an artificial intelligence (AI), or cognitive technology that enables systems to learn and improve from experience - by exposure to data – without being explicitly programmed. Moreover, Deloitte (2017) predicts that large and medium sized companies will increase their use of machine learning automation. Congestion will also play a role in my writing, it is defined



by U.S. Department of Transportation (2017) as a term relating to an excess of vehicles on a portion of a roadway at a particular time resulting in the lowering of speeds that are lower than usual which leads to “clogging” or “impedes” the movement of vehicles. These three themes (automation, machine learning, congestion) will all have a presence in my research and writing.

The aim of my research is to shed light on how automation and machine learning has contributed towards innovation within the automobile industry and how those innovations have assisted transportation systems Los Angeles and may have the possibility to provide future assistance in the fight against congestion. I will then elaborate on how said machine learning will contribute towards the change of cities, specifically transportation systems, traffic and congestion. Traffic, heavy congestion, costly infrastructure, increased commuting times, etc. in high density cities has been an ongoing issue that has plagued public government and city dwellers for years; here I seek to analyze, in an explorative method, how automation and machine learning in the automobile industry might change and what the current state of the transportation in Los Angeles is.

1.1 Research Questions & Hypothesis

My first question, how will automation and machine learning effect congestion and transportation within cities? Seeks to shed further light on how automation will continue to make an impact on cities which are facing congestion and traffic issues. Moreover, with this question I seek to explore how the automation innovation in the automobile industry is projected to change cities, these changes may come in the form of automated driving, different strategies that help alleviate the flow of traffic in order to improve the daily commute, etc. I will seek to answer this question by gathering existing data on congestion and then analyzing what actions, if any, have been taken as a result.

My second research question is the following: What type of effects have the solutions or strategies pursued by Los Angeles had on traffic and congestion? With this question I hope to determine if the solutions and strategic approaches taken by the governing bodies of Los Angeles have helped alleviate congestion in Los Angeles or if their efforts have been null. This has been a complex issue that L.A. has struggled with for years, via this question I also hope to gain knowledge on the specific approaches L.A. has taken in order to address the issue, if they have implemented new strategies or continue to rely on the same courses of actions, etc.

My third and final question: Will private companies play a significant role in the development of city planning in the future? This question was born out of a framework that has gained immense traction within the last few years, industry 4.0. Industry 4.0

relies on automation in order to collect data from the physical world, analyze it and then present said analysis to its users so they can determine a course of action. Private companies are already seeking for ways to commercialize this process and experts have already stated that the companies who manage to champion this process will possess massive competitive advantages.

Moving on to my hypothesis, I expect technology in the automobile industry to continue to change and evolve at a rapid pace, especially with regards to machine learning. These innovations will pave the way for improved strategic city planning in order to combat congestion and improve the flow of traffic as modern cities continue to experience rapid growth. However, while these technologies prove to be lucrative, I predict that they will remain expensive until more competitors enter the market thus many cities will not be able to afford them or will have to seek getting into debt in order to be able to do so. The reasoning behind the high costs of these technologies will be due to reasons such as little competition and private companies wanting full control of their products which will also raise privacy concerns. We have seen companies like Tesla insisting and commanding full control of their products which includes the repair process. In the past, automobile companies have and still today continue to be repaired by individual mechanics, but this will shift because as we continue to experience automobile innovation, we will see those companies wanting to have more control of their product throughout its life-cycle. Furthermore, this will not only be an economical concern, automobile companies may also want to access city grids and infrastructure in order to “improve” their products while in return promising that such improvements will allow them to address issues like congestion at a more advanced pace. These “improvements” will lead to further privacy and security concerns because in order to refine their products private companies will seek access to private data such as the driving behavior of citizens, if citizens rely on public transportation to commute to work, which avenues see more visitors at certain periods of the day, etc.

Furthermore, the city of Los Angeles will continue to rely on short-term or ineffective methods to combat congestion while the price of innovative cars and technology remain out of reach. However, private companies with more capital will offer to help develop strategies as a service which will again lead back to privacy concerns because once the private sector is involved in the fight for congestion due to innovation such as Industry 4.0 they will have access to an immense amount of data. Private companies who have access to this data will see a massive increase in profits because legislation, especially in the U.S., will be slow to catch up. Moreover, levels of congestion will not decrease significantly despite help from the private sector until the cost of housing in Los Angeles is addressed.

2 THEORETICAL FRAMEWORK

My theoretical framework will consist of making use of the data I have gathered and analyzed via the use of horizon scanning which is explorative in nature. The structure that will allow me to support my theory will consist of a systems thinking approach which will be complemented by modern urban planning theory. These systems will allow me to introduce the complexity of Los Angeles's transit systems, the issues it faces, the strategic approaches it has taken in order to solve its issues, etc. In other words, my systems and urban planning approach will allow me to explain why Los Angeles has problematic levels of congestions, why its citizens rely on its freeways so heavily and what can potentially be done to help remedy the scale of the problem.

Systems thinking is relevant to my research because transit systems in their very essence are interrelated components which communicate with each other in order to achieve a goal or complete an objective. In the case of transit and transportation in a major metropolitan area, one can conclude that the objective of said system is to move people in a timely yet cost-effective manner.

Urban planning theory allows me to examine other drivers such as road space, why Angelenos purchase vehicles for single occupant usage, why Los Angeles is constantly under development and how the theory may or may not help further said development. Most importantly, urban planning allows me to analyze what attempts an area has already taken, analyze if they have failed and then create possible suggestions or solutions on how a particular area can change or find alternatives to their problems, in Los Angeles case, congestion.

2.1 Systems Thinking

Systems theory or thinking is used in order to comprehend a lot of the complex behaviors that exist within systems in different fields which are interconnected in various ways. With a systems approach, we can hope to better understand the complexity of behaviors with the goal of being able to predict them and control or adjust their outcomes. Furthermore, as the interdependency of systems increase, we must learn to include all people in the decision-making process.

Systems thinking is defined as regularly interacting or interdependent group of items forming to create a unified whole. Moreover, systems traditionally consist of three parts: elements, interconnections and function/purpose. Elements are known to the characteristics of the system, the interconnections are the way these characteristics relate or feedback to one another and the purpose or function, which is the goal or objective and most crucial element of a system. If we were to incorporate the transit system of Los

Angeles into systems thinking than the elements would be the private vehicles, busses, methods of public transportation, scheduling, and anything that helps compose the system. Interconnections would include the state of L.A.'s transit system, how it operates or has trouble operating due to phenomena such as congestion, black swans, etc. Lastly, purpose/goal, the purpose of Los Angeles transit system like most transit system is to directly transport or facilitate the transportation of its citizens in a timely and cost-effective manner to their destination. One could also argue that in present time, Los Angeles also has the reduction of traffic and congestion as a goal which contributes towards reducing the time its users spend on the road, pollution, among other issues caused by a transit system plagued with challenges. Below you will find a visualization of what the literature refers to as a "The Systems Test" which will help further interpret of what the components of a system are (Arnold & Wade 2017, 670).

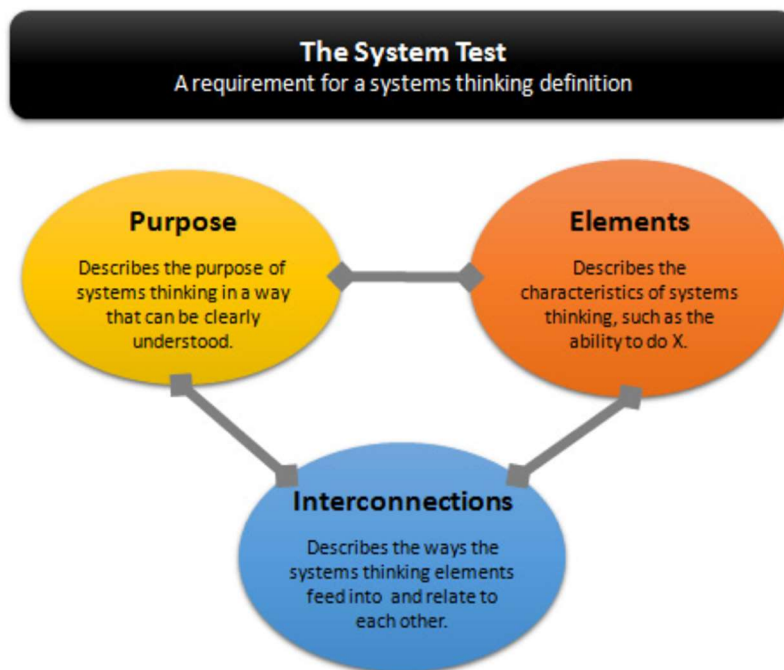


Fig. 1 Ross D. A. & J. P. Wade (2015,671). A definition of Systems Thinking: A Systems Approach. The Systems Test.

<https://doi.org/10.1016/j.procs.2015.03.050>

To reiterate, for purposes of the figure shown above I will go over the three components of The System Test. Purpose, if we apply this test to the Los Angeles transit system then the purpose of said system is to transport or facilitate the transportation of its citizens in a timely and cost-effective manner. The forms of transportation include but are not limited to public transportation (buses, trains, etc.) or via the usage of its roads and freeways by private car owners. The elements of The System Test are the following: buses, trains, taxis, ride-share vehicles, scheduling, rush hour traffic, congestion, private vehicle owners, etc. All of these different elements have the ability to transport people

in their intended form. Now we move on to interconnections, as previously mentioned it describes how all of the elements feed into each other. Public transportation allows for mass-transit at a fraction of the cost of owning a vehicle and they are reliant on functional roads and railways along with a schedule and infrastructure that is in-tact in order to operate.

2.2 Urban Planning

Once can infer an approximate definition of what the term urban planning consists of, planning for the development of an urban area or in simpler terms, allocating land space for the development of a city. While it may sound simple, there are numerous elements that factor into the development of a city and the definition of the term is also more complex than it appears. I will cover the elements of urban development that relate to the theme of my thesis, congestion and how to alleviate such congestion via innovation and proper planning.

Urban planning is conventionally known as a collaborative process which involves dependency on land usage plans which in return serve as a guide for urban development. The process consists of four different elements: (1) the conceptualization of an area that is under development pressure, this is very much the case for the city of Los Angeles as it is continuously searching for solutions to its congestion problems, (2) considering if alternative types of growth patterns are feasible, Los Angeles will have to attempt to encourage further growth in the usage of its public transportation system because at the moment a lot of its citizens still rely on personal vehicle use. (3) the specification of a set of systems related to the development, in this case we refer to L.A.'s transit system which consists of sets of systems such as public transportation and the use of its freeways, (4) the recommendation of a set of standards intended to result in a functional and/or aesthetically pleasing urban pattern (McChesney 2007, 1873).

There are two segments in the definition of the theory above that cause me great discomfort, especially when we apply it to the city of Los Angeles. The first element, conceptualizing an area that is under development process...Los Angeles has been in a development process for decades, the pressure for development has always existed in this city which is plagued by traffic delays and congestion, and the answer, according to sources I have cited throughout my writing has always been to allocate more space which by the way has been proven to be an unreliable solution. My second issue is the 4th element of the theory, recommending a set of standards that are both functional and visually pleasing. These two elements are the very essence of urban planning, in the case of a transit system located in the second largest city in the United States, it has already tried to allocate space in order to combat congestion and improve the movement of its citizens

from one destination to another. So, my question then becomes the following: How does Urban Planning theory provide assistance to cities who are already “in too deep”? The theory seems to refer to cities who are not as developed as areas such as L.A., NYC, etc. McChesney provides some insight by stating that there are numerous elements involved in urban planning which are not always coordinated. Ironically, his example involves adding more roads to accommodate more traffic or improve the flow of traffic which again has been proven ineffective in the case of Los Angeles.

2.3 The Art of Scenario Building

Scenario making is introduced as one of the key role players within the foundation of Futures Studies by my professor Sirkka Heinonen. Heinonen (2017, 60), in her introductory presentation she defines it in three different ways: the first, as an attempt to setup a logical sequence of events in order to show how, starting from the present situation, they may evolve on a step by step basis. The second, as a hypothetical sequence of events constructed for a purpose of bringing attention to causal process and decision making. The third, as instruments which aid decision makers by providing a structure for planning and programming which in return lowers the level of uncertainty and increases the level of knowledge one might have over a phenomenon.

Additionally, Wright et. al. (2018) state that scenario methods are used as tools to synthesize expert opinion on potential futures and the origins of scenario making can be traced back to the work of the American Rand corporation in the 1950s. Furthermore, Wright et. al. (2018) mention that over the following decades three schools of thoughts have emerged from scenario making, Intuitive Logics, La Prospective which is French in origin and Probabilistic Modified Trends.” The authors then go in to describe each scenario, Wright et. al. state that “the latter two school's methodologies share the commonalities of: (i) a focus on probability and the identification of the ‘most probable’ scenarios, and (ii) use of expert consultants who are familiar with the underpinning quantitative modeling tools. In contrast, the Intuitive Logics method is a qualitative, group-process-based approach that is focused on the development of multiple scenarios that explore the ‘limits of possibility’ for the future without regard to issues of probability, as opposed to the development of singular, ‘normative’ scenarios of some ideal future – as in applications of the La Prospective methodology.”

Having described what scenario building is I will incorporate it within my research and writing. I will create a total of four scenarios after my research has been conducted and my data has been analyzed. These scenarios will take into consideration all aspects of my research which will include themes such as: technology, political perspectives, cultural, environmental, social aspects, economic impact.

2.3.1 Narratives

Scenarios are commonly composed of PESTLE tables and narratives; these narratives allow for the writer to elaborate on the content of each PESTLE table and its individual scenario. A significant number of academic articles have emphasized the great potential which narratives possess when being applied to futures thinking and strategic development. Narratives have been crucial in the field of Futures Studies since the field's inception, they are used to investigate patterns of change and describe potential events and conditions via scenarios. (Milojevic & Inayatullah 2015, 152). Moreover, it is important to note that narrative enacts the events of the past, present and the future by opening our understanding across three dimensions which are: making choices, action and possible strategy (Milojevic & Inayatullah 2015, 153). Additionally, in order for a narrative to function and depict a meaningful story it needs to have a beginning, middle and end, it also requires an active protagonist and a moral and evaluative standpoint (ibid). Moreover, narratives are a process of constructing and reconstructing stories, stories which have the power to shape our individual and social reality into a story which we can visualize (ibid).

I will introduce a total of four scenarios, each of them will be accompanied by their own individual narrative. They will begin by mentioning the past state of congestion in L.A., transition to the current state in the scenario and then reach a future state which may be probable, preferable or desired. My narratives will also include a "story" which will feature a protagonist as Milojevic & Inayatullah have mentioned. Furthermore, each scenario will consider different aspects of my research in writing, they will all depict a state of Los Angeles.

2.4 Industry 4.0

Industry 4.0 is being described as the next major step in society and it involves a lot of technological innovation. There has been a lot of discussion regarding what industry 4.0 exactly entails, some even talk about it as a modern revolution involving technology and data that all businesses are bracing for, others refer to it as the 4th industrial revolution. According to Cotteleer & Sniderman (2017, 4), industry 4.0 appears to be changing the way businesses function and, by extension, the stakes by which they are forced to compete by and they also go on to argue that organizations are in a very risky situation because they must decide where to invest new innovation technology and also identify which technology best meet their needs as a company.

Most businesses and systems traditionally rely on linear data and communication channels. Cotteleer & Sniderman (2017, 3) state that the cycle born as a result of a 4.0

industrial revolution means that companies will have access to real-time data between the physical and digital world and they then layout the process which describes how this cycle transpires. They state that the process occurs in three steps and it is referred to as the physical-to-digital-to-physical loop. The first step captures information from the physical world and creates a digital record of the physical operation and supply network. If we apply this to the automobile industry's innovation and the transportation systems within Los Angeles, we can estimate that this process will collect data such as the amount of time cars spend idling at a red light, how long vehicles may take to reach their destination, time of the day in which congestion is the highest, among other statistical data that is physically able to be observed. The automobile industry in return, may optimize their machine learning with regards to their self-driving vehicle technology or adapt other means of innovation which may help urban areas improve their transportation systems.

In analyzing and visualizing, machines talk to each other (machine learning) in order to share information, which in return allows for advanced analytics and the visualization of real-time data across multiple sources. This step is one of analyzing and strategic development, I will later cover a new traffic light system which Los Angeles deployed into its cities grids in order to try and combat the unbearable traffic that LA commuters are faced with on a daily basis. Also, having frequently visited the city of Los Angeles myself, I can tell you that sitting at the same traffic light for 15-20 minutes is very frustrating. In this phase of the process, companies and governments have an immense amount of data at their disposal, via strategic planning and transparent communication they should be able to roll out systems which have the potential to significantly decrease congestions in urban areas.

The next step is labeled as "Generate Movement" by Cotteleer & Sniderman (2017, 3). They state that the purpose of this final step is to apply algorithms and automation to translate decisions and actions from the digital world into movements in the physical world. In other words, this final phase is one of action, here is where we apply or integrate the developed strategy or plan of action into the real world after the data has been collected and analyzed.

While this process has the potential to transform transportation systems within urban cities, personally, I am still quite the sceptic. My main concern with this process is that there is a chance that transportation systems become a privatized monopoly for automobile companies within cities. If the automobile companies are the ones using machine learning via their driverless technology and other innovations to help relieve the congestion this could mean that they are the ones setting prices and that they could have access to billions of dollars/euros worth of private data. From this private data then they can analyze it in their own ways and use it for other businesses outside of transportation systems. Additionally, who is to say that automobile companies will not create divisions to analyze public data collected from transportation patterns and systems, analyze it and

then sell it back to cities. New laws and regulations will have to be put in place in order to assure that cities are not taken advantage of, after all, the ones who will suffer for this are the citizens of said urban areas.

Below you will find a visual representation of the 4.0 process. Physical to digital represents the capture of information from the physical world in order to create a digital record of the data. Digital to digital, shares information and uncovers meaningful insights via the use of advanced analytics, scenario analysis and artificial intelligence. Digital to physical, applies algorithms in order to translate digital decisions into effective data in order to spur change and develop a plan of action.

Figure 1. Physical-to-digital-to-physical loop and related technologies

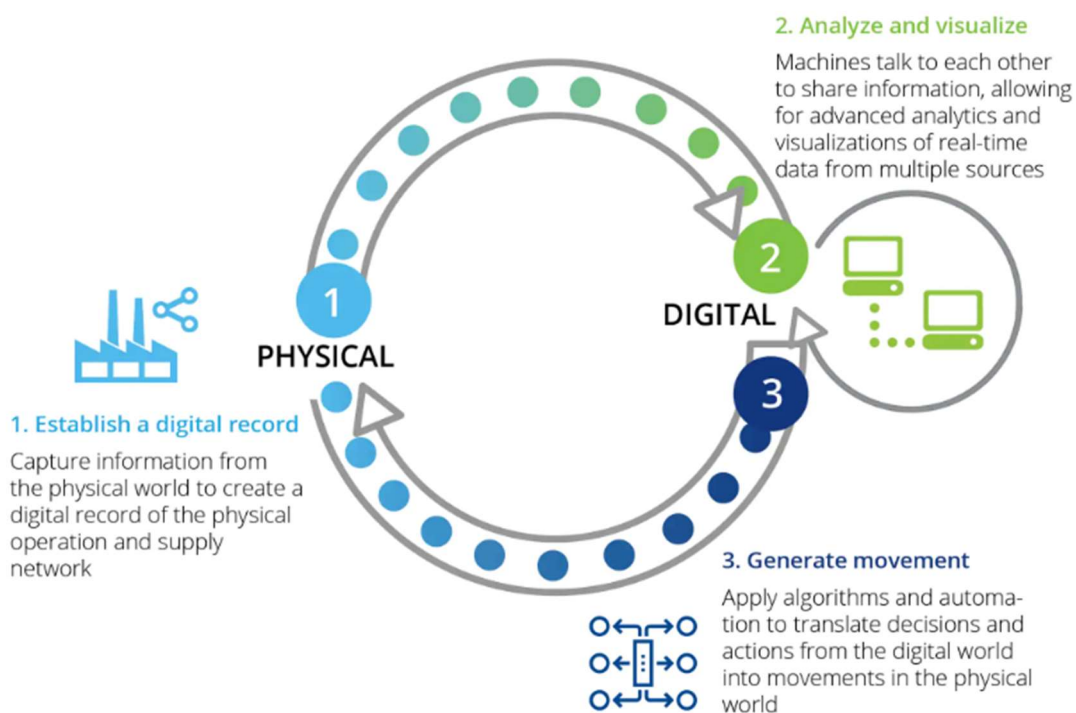


Fig. 2 Cotteleer, M. & Sniderman, B. (2017,3). Forces of change: Industry 4.0.
<https://www2.deloitte.com/insights/us/en/focus/industry-4-0/overview.html>

2.5 Discourse Analysis

In order to examine the data, I have collected I relied on discourse analysis. This method of analysis is multidisciplinary, similar to the practice of Futures studies. Moreover, Manzi states that discourse analysis, fundamentally, refers to language and patterns of speech, is connected with the analysis of social interaction and that it considers the significance of language, conversation, and text along with other social practices. However, Manzi also acknowledges that the concept itself is a little broad because it includes

all types of social and political practices, along with institutions and organizations which has a chance of making the analysis meaningless. While his concerns are valid, for the purposes of analyzing data on congestion and associated innovations I believe this type of analysis will serve its purpose, after all, congestion is a phenomenon that is born by the contributions of different parties (politic, government, citizens, car companies, employer, etc.). Furthermore, Manzi states that our ways of talking play an active role in creating and changing our world, identities, social interactions and that it attempts to understand the discourses which structure social activities, how they are produced, how they function and how they are changed. (Manzi 2012, 354)

I have created an organized table composed of the data gathered from my research material. The data is organized in text form and the language encompasses patterns of speech, keyword or phrases which are commonly used when referring to congestion, transit systems, public transportation, among other themes which are drivers or related to the matter. My phrases or keywords were organized in the following categories: congestion, cost, citizen behavior, safety/policy, theory/method, innovation, sustainability/pollution and employment shift. The table also contains a column for citations which will allow me to refer back to the keyword or phrase when creating my PESTLE tables. Once my data is organized, I will select specific language and use said language to construct my PESTLE tables which will yield four different scenarios which will be explained by their own individual narratives. Each scenario will

3 MATERIAL AND METHODS

Most of my material will originate from academic journals, online databases, and so forth. However, I will also have literature and material from company websites and universities such as MIT who engage in automation research and projects. Additionally, my methods and theoretical framework will come from a commonly used strategic foresight tool called “Horizon Scanning” which I will combine with a PESTLE analysis, also a popular foresight tool along with scenario making. Additionally, with research from my academic material I will be able to decide on what real life data and experiences I will be able to draw from two private entities. I have one potential interview via a colleague with McGregor, which is ship/vessel shipping company and I have another interview which has been confirmed with a robotics division within an American company called Becton Dickinson.

3.1 Defining Horizon Scanning

I seek to use the futures tool known as horizon scanning in order to gather my data, which is known to be, in nature, an explorative tool. The European Commission (2015), in partnership with Fraunhofer a German foresight organization, TNO Innovation for life which is an organization from the Netherlands and VTT Technical Research Centre of Finland have defined horizon scanning as a tool which takes a systematic outlook approach in order to detect early signs of potentially important developments. Moreover, The European Commission (2015) states that these developments can be in the form of early or weak signals, trends, wild cards or other developments, persistent problems, risks and threats, etc. Additionally, the commission mentions that horizon scanning can be completely explorative and open or be a limited research for information in a specific field; it seeks to determine what is constant, what is subject to change and what is constantly undergoing change.

Horizon scanning has also been defined by other organizations in similar ways. The government of the United Kingdom (2013) has defined it as “A systematic examination of information to identify potential threats, risks, emerging issues and opportunities, beyond the Parliamentary term, allowing for better preparedness and the incorporation of mitigation and exploitation into the policy making process.” They have also added that horizon scanning is a tool for analyzing the future and that said analysis may come in the form of considering emerging trends which may or may not impact policy making within their country. The European Futures Platform (2010) stated that horizons scanning has intellectual origins which can be traced to Ansoff’s 1975 celebrated work on the recognition of weak signals and that it refers to a search process, which is extended at the margins of ‘the known’ environment and possibly beyond this with the aim of identifying emerging issues and events which may present themselves as threats or opportunities for society and policy.

3.2 The Steps of Horizon Scanning

Horizon scanning like all futures tool is a method of different steps, each which serve their own specific purpose. These different steps will help initiate the use of the method, it will help it transition towards a goal and it will then provide us with different possible scenarios or a specific product. In the following paragraph I will describe the six different steps of horizon scanning which will allow for the reader to gain a concise and clear understanding of how the method may work. The European Commission (2015) lists six steps which help compose Horizon Scanning. Kate Delaney (2014) also mentions six different steps for horizon scanning, she is an experienced consultant for John Robinson

Consulting Service and has explained Horizon Scanning in a form which can be used for the public sector.

The *first* step listed by Delaney (2014) is referred to as “*Purpose*” and she states that this step is in the very early stages and it entails identifying the overall purpose of your scanning, the participants or experts who will take part in the process and the time and resources which will be available for the scanning process. Below you will find a table in which she provides an example of objectives or purposes for different organizations or companies.

Types of objectives in foresight projects				
Bourgeois et al 2014	Generate information	Generate action	Cooperation & networking	
UK Commons Science & Technology Committee 2014	Support strategy development	Make policy-making resilient	Improve operational delivery	
Nicolini & Bagni 2012	Build strategic visions and create a shared sense of commitment	Informing policy-making	Build networks	Develop capabilities including a “foresight culture”
Peter Ho 2010	Identify emergent risks	Develop policy and new capabilities	Build global networks & partnerships	Develop policy and new capabilities
Georghiou & Keenan 2006		Provide policy advice	Build advocacy coalitions Provide social forums	

Fig. 3 Delaney, K. (2014,20). A practical guide: Introduction to horizon scanning in the public sector. Examples of objectives for horizon scanning activities.

https://www.researchgate.net/publication/264534064_INNOVATION_TOOL_KIT_-_Horizon_Scanning

Moving on to *step two*, which Delaney (2013) states is called “*Participation*”. This step according to Delaney (2013) consist of inviting participants to allow for the facilitation of the process, she goes on to say that participation in scanning activities is going to be partly dictated by the objective of the scanning and the products of the scan.

Step 3 is known as “*Collecting*” and Delaney (2014) states that this is the part of the process in which scanners look beyond the normal and known drivers of change, trends, forces and developments which are often well interpreted and monitored within organizations. Moreover, she states that when deciding to look for or collect data we

must consider three factors: (1) the nature of the information, (2) the types of procedures and (3) the means of dissemination.

There is also the mention of considering emerging issues, Delaney (2014) indicates that emerging issues tend to be perceived as weak signals and that looking for these signals at times requires looking away from traditional academic/research based evidence associated with said issues or trends. She mentions that they, at times, may be outcomes which might happen but make one high uncomfortable when considering what could take place as a result. Below is a chart which according to Delaney (2014) provides assistance in identifying weak signals.

Rule of thumb	Description
Follow key people	Record ideas from conferences and meetings. Monitor theories of exemplary thinkers - on macro-patterns of change, the sweep of history. Pay attention to people who influence public opinion or decision makers. Look for voices that express different values and ideas (artists and youth)
Track what has happened elsewhere	In other jurisdictions the future of one place is often the history of another. Conversely, it is important to find issues from places that are generally not considered leaders
Use already aggregated information	Consider how you can tap into others who are already horizon scanning / aggregating relevant content. Trade and industry associations often précis relevant news on their websites and in newsletters. There are many specialised bloggers. There are some excellent cross-disciplinary e-newsletters
Conduct literature reviews	Look for 'meta-reviews' or seminal papers in selected periodicals and in a wide(r)-range of peer-reviewed journals)

Fig. 4 Delaney, K. (2014,27). A practical guide: Introduction to horizon scanning in the public sector. Information/data sources and short-cuts to identify weak signals (mainly from Inayatullah 2013) https://www.researchgate.net/publication/264534064_INNOVATION_TOOL_KIT_-_Horizon_Scanning

According to Delaney (2014) This step is referred to as “*Analyze*”, Delaney (2014) states that in this step horizon scanners are focussed on giving everyone a heads up approach or telling them to brace themselves for incoming change. Moreover, she goes on to mention that this is the stage in which we generally find the synthesis, analysis and interpretation.

From my own understanding, the analyzing step of Horizon Scanning is where all the data is concentrated. This looks like one of the most crucial steps in the process as it is where you attempt to understand what is going on in the field you are studying and how will try to explain the changes projected to occur. Delaney (2014) actually mentions something similar to my thought process, she states that this step is responsible for indentifying problems and solutions.

Delaney (2014) uses the word “tricky” to describe this step, the step of “*communication*”, which is the step that determines how to communicate your results without losing your audience. Moreover, Delaney (2014) goes on to suggest that good communication is central to successful horizon scanning because the conveying of the results need to be clearly communicated, accessible and easily interpreted. She also makes reference to a survey which provides us with a criteria on communicating results. The survey in which Delaney (2014) refers to mentioned that in order for one to communicate results successfully we must: (1) identify the target audience with precision, (2) include input from the target audience in setting the agenda and at different stages in foresight process, (3) ensure that the output is targeted at them, (4) communicate clearly and directly in language accessible to the target audience, (5) maintain close ties with the senior decision-makers and policy-makers, (6) establish clear links between foresight topics and today’s policy agenda.

The *sixth* and final step of Horizon scanning, according to Delaney (2014) is known as the ability to influence decisions or “*influence decisions*” as she titles it in her research. She states that decision influencing is a critical issue for horizons scanning because of access to the early stages of the decision process and to the final decision process making. Moreover, Delaney (2014) mentions that getting management to listen or act is always the most problematic issue for any organizational horizon scanning system. Additionally, she makes reference to an imminent danger in horizon scanning which I am inclined to agree with. She states, and I quote “A danger is that scanning (is perceived to) waste time – for those assigned the scanning task and for those it seeks to inform. To inform decisions, skilled scanners investigate more than the things that their organization already keeps track of, it is important not to re-hash old ground”.

3.3 What is a PESTLE Table?

PESTLE analysis is a tool used to engage in foresight, the Futures Research Centre of Finland uses an internal tool called a PESTEC table which is similar to the one I will be using to analyze my data. The PESTLE analysis is tool that is commonly used as for the development of strategy within corporate entities and I will expand on what the tool consists of momentarily.

A book concerning key marketing skills and he mentions that PESTLE analysis exams the big picture of impacts around different forces: political, economic, social, technical, legal and environmental forces. Additionally, its author mentions that these factors are mostly information which we are exposed to on a daily basis and that the marketer is in charge of making sure that whomever he or she may be representing is not caught off guard by a surprise and that said marketer is seeking to identify advantages after recognizing specific patterns of change thus providing them with a competitive advantage. I will now move on to cover each individual stage of the PESTLE analytical tool (Cheverton 2004, 72).

3.3.1 Political Change

Political change is defined by Cheverton (2004, 73-74) as a force which can bring large-scale revolution but said changes do not always need to be of dramatic nature. Cheverton also goes on to mention that changes in government can also be indicative of a shift in values and priorities within a government or country, even if they are not directly causing them. Moreover, he makes sure to mention that economist tend to refer to government intervention as distorting markets, however, political institutions are directly woven into commercial life just like suppliers, customers are. (Cheverton 2004, 73-74)

The University of Central Florida also weighs in on what the political aspect of the PESTLE tool should consist of. They mention that examples of political drivers within the category should be the following: government type and stability, freedom of press, rule of law, levels of bureaucracy and corruption, regulation and de-regulation trends, social and employment legislation, tax policy and trade and tariff controls, likely changes in the political environment (UFC 2019), These examples fall into the definition which Cheverton has provided and I will now move on to cover the next stage of the PESTLE table.

3.3.2 Economic Change

When referring to the economic contents of the PESTLE we proceed to examine what Cheverton (2004) depicts as the “big picture” within growth cycles, said growth cycles tend to be within markets and also typically have a domino effect on a lot of other things within an economy. Cheverton (2004, 74) also mentions an example which portrays the loss of profit (shares) for a private entity after due to a raise in oil prices, thus, providing us with a real time example of a domino effect. He also goes on to provide other domino effects such as the raise of private healthcare when economies are in

recession, etc. There are winners and losers, the customer here may be depicted as the loser while the owners of the product or the services are portrayed as the winners if we observe this from a business standpoint. The same can be said for technological advances in some cases, the individuals who have the resources to capitalize on innovation, whether this be a private citizen, government or company/organization are, at times, able to harvest the fruits of those innovations while others who do not have the resources sit on the opposite end of the table. This analogy relates back to a portion of my thesis which will elaborate on potentially displaced public transportation employees as a result of automation innovation and machine learning (Cheverton 2004, 74).

3.3.3 *Social Change*

The social aspect of the table refers to, but is not limited to, numerous aspects within cultural, economic and political realms. Cheverton (2004, 75) states that social changes may be instances such as the increasing number of “double-income” families without kids; these families find themselves more economically prosperous but often do not have the time to enjoy such prosperity. Among other examples used by Cheverton (2004) are ones which refer to grocery chains losing profits because particular diets become trendy or popular at some point in time. The best example of such occurrence is Cheverton’s (2004, 75) reference to the “Super-Size” menu offering which fast food chains such as Burger King and McDonalds offered, these have now become obsolete and the businesses have done away with these meal sizes as a result of public pressure and social change.

A lot of the modern social shifts that we see today include the fight against climate change. We often read and see in the media, throughout organizations and individuals who make changes and place a lot of emphasis towards a greener tomorrow in response to social pressure from citizens around the world who believe we should act as soon as possible to stop our planet from getting warmer. Moreover, there are numerous changes that occur within cultures and societies as a result of mounting pressure for social change, at times even a mere Tweet or a news article is enough to force a government or corporation to change directions or alter their actions or way of thinking.

3.3.4 *Technological Change*

This is a major driver for the premise of my writing and has been an element solely responsible for the development and advancement of mankind for as long as we can all remember. According to Cheverton (2004, 75-76) technological change has been the

status quo for the past 100 years and the evolution of technology is well engrained into the process of marketing. Cheverton's reasoning immediately stands out to me despite having written his book at the dawn of the new millennium, automobile companies will have to market their innovation to cities and governments, whether their new technology be in form of new busses, engines, devices that help control or alleviate congestion, infrastructure for smart cities, etc. Furthermore, cities are always looking to control or reduce costs, therefore this is something in which technology and automation (machine learning) will have to keep in mind when they are developing new products and marketing these products for public use.

Additionally, technological advances have companies racing to find develop autonomous vehicles in the near future which will be something they will need to find a market for as well. Eisenstein (2017) who writes for NBC news published that taxi companies and ride share giants such as Uber and Lyft are struggling to find drivers so they key players in the push for driverless technology. Among other facts, Eisenstein (2017) reported that there are about 3.5 million professional truck drivers in the U.S.A. alone and that those drivers are expected to be mostly replaced in the next decade, this draws back to my statement of the those who are at risk of losing their jobs as a result of automation innovation within the automobile industry.

3.3.5 *Legal Change*

Changes in laws and regulations are always part of the PESTEL table's significance. Cheverton (2004,76) argues that legal changes can have an immediate impact on an environment, and he uses the example of the banning of beef on the bone and the deregulation of the transport industry. While legal changes at times, in the business realm especially, tend to have a negative stigma we should keep in mind that a lot of these changes in law tend to protect us as citizens. Cheverton (2004,76) also mentions that safety is an important issue to the public when referring to the deregulation of the transportation industry and then states that safety is important to the public therefore the government must swiftly act to make said needs.

3.3.6 *Environmental Change*

One cannot make a call for change without the consideration of the environment. Today, this is a heavily debated theme among all nations and consumers throughout the world. Environmental issues and concerns have major impact on businesses and some of these impacts include the banning of lead in petrol or the

restrictions placed on genetically modified food. Additionally, environmental factors and technological shifts appear to be clear proponents of gaining a competitive advantage in your field of business (Cheverton 2004, 77)

4 AUTOMATION, MANKIND'S BEST FRIEND

In earlier times, automation was rarely discussed and when it was discussed it was in affiliation with farming and the agricultural industry. After the new millennium and in today's modern world we tend to think about robots and artificial intelligence for our daily lives, for the office and for a lot of routine tasks which society performs. In the next chapter I will innovation within the automobile industry. Additionally, I will briefly write about fields in which automation has also allowed mankind to prosper as a whole, these fields include automation in the industrial sector and in the automobile industry. Some of these focuses may include the realm farmers saving time due to new automated harvesting machinery, the industrial manufacturing industry developing automated machinery which aids numerous businesses, etc. In each theme I will introduce the trajectory of the given field and then elaborate on how they have evolved which will help compliment my focus on the machine learning and transportation within cities.

Furthermore, most of today's industries, including the automobile industry are waiting for a new industrial revolution being titled "The 4th Industrial Revolution or Industry 4.0". Companies and organizations have been trying to strategically plan what technologies they will be able to take advantage of in order to remain competitive in an entirely new environment. Additionally, industry 4.0 will certainly impact transportation systems within cities, the amount of available data will allow for cities to develop strategies which may aid the combat on urban congestion and the automobile industry will also have data which will allow them to further enhance their automated and smart vehicle technology.

The automobile industry has had a major impact on the lives of mankind, these impacts have been in an economic, social, cultural form and even in a political or policy making standpoint. According to Orsato and Wells (2007) the commercial value of new vehicles sold, at the time was estimated to be \$1.1 trillion a year. Furthermore, they mention that car manufacturing has been the driver for industrialized politics in countries like Korea, Japan, Germany, USA, Italy and France. Additionally, Orsato and Wells (ibid.) state that automobile technology not only involves the production of cars, but it also encompasses, under its umbrella, the following aspects: maintenance, recycling of parts, job creation and the creation of infrastructure. (Orsato and Wells 2017, 994)

4.1 Automation and Machine Learning in Industrial Manufacturing

Boisset (2018) who works for KingStar, a company who develops software which is used to control machinery states that:

“Automation in the manufacturing industry has evolved from the use of basic hydraulic and pneumatic systems to today’s modern robots. Most industrial operations are automated with the goal of boosting production and reducing the cost of labor. Since its inception, industrial automation has made great advances among activities that were previously carried out manually. A manufacturing organization that uses the latest technologies to fully automate its processes typically sees improved efficiency, production of high-quality products and reduced labor and production costs.”

Boisset also goes on to use the history of The Ford Motor Company as an example and states that in the year 1913 the company introduced a car production assembly line which is considered to be one of the pioneer types of automation in the manufacturing industry. This assembly line improved Ford’s production rates drastically, assembly time was reduced from 12 hours per car to about 1 and a half hours, as a result of these massive cuts in product costs Ford’s profit margins of the company also skyrocketed. (Ibid)

5 AUTOMOBILE INDUSTRY INNOVATION

When the topic of innovation within the automobile industry presents itself, we often find ourselves immersed in readings and videos regarding autonomous vehicles or self-driving cars. These conversations in the early 2000’s was deemed as science fiction, however, today the world is anxiously waiting their arrival and companies have already been testing their automated driving systems for years.

According to Guerra (2015), self-driving cars are no longer science fiction and he also states that most car manufactures already market and sell high-end vehicles with features such as automated breaking, self-parking, lane-departure warning systems, variable-speed cruise control and that most companies are racing to develop fully autonomous vehicles. Nissan has already promised to introduce cars with automated steering, braking and acceleration into the mass-market by the year 2020.

The topic of innovative technology within the automobile industry immediate re-directs me to one of my research questions in which I task myself with finding what impact said innovations will have on workers within the transportation system or industry. I was originally inclined to believe that bus and train operators would be among the first group of workers to be displaced but after further research I have learned that truck drivers are at a much bigger risk. According to Guerra the freight and transit industries will likely be the initial adapters of driverless technologies because higher vehicle cost will be offset

with lower labor costs, in other words companies will no longer have to pay salaries and benefits to truck drivers because there simply will not be a driver in the cockpit. In other words, the vehicles are projected to cost more but companies will not have to pay salary and benefits over the career span of the drivers, the profit margins for companies and local government in these industries have the ability to increase substantially. Unless of course new regulations are set in motion which force companies to provide severance, training or an alternative for the employees in which they will be displacing. (Guerra 2015, 210)

5.1 What Are Self-Driving or Autonomous Vehicles

Autonomous vehicles are made possible via three technologies: sensors, connectivity and software/control algorithms. The first, sensors, are already available today and are used in safety features such as blind-spot monitoring, lane-keep assistance and forward collision warning. Moreover, sensors for other features such as radar, ultrasonic and cameras provide the required input to navigate the car safely. (Gupton 2018)

The second and most complex component, connectivity, ensures that cars have access to the latest traffic, weather, surface conditions, construction, maps, adjacent cars and road infrastructure. This data is then used to monitor a car's surrounding operating environment to anticipate braking or avoid hazardous conditions. The third technology encompasses software and algorithms, these are needed in order to accurately capture the data from sensors and connectivity and then make decisions on steering, braking, speed and route guidance. (Ibid).

It appears that the technologies already existing within modern vehicles are many of the prerequisites that form a fully autonomous vehicle. Technology such as the ones mentioned previously are also using physical data which they then process and produce physical data in form of a safety precaution. In other words, vehicles being produced today are already engaged in using the mechanisms of Industry 4.0. New questions rise like: Where is the software pulling this data from? Is it from data that is publicly available? Is the data being stored by stored after autonomous software uses it? Who is storing this data and who will be responsible for this data in the future?

5.2 Preparing for Autonomous Innovation

Autonomous vehicles are expected to be in the mass market very soon. We have already seen Tesla roll out their autopilot feature in their vehicles. Guerra (2015, 210)

states that within the next twenty years, fully autonomous vehicles will be commercially available and driving themselves on streets and highways, this will become the new norm for society. Additionally, Guerra says that by removing humans and human error from the task or job of driving, autonomous vehicles have the potential to reduce congestion and traffic collisions by a significant amount; he also mentions that self-driving freight, transit and personal vehicles may also alter how people and goods move, it may also drastically change policies and regulations, plans, etc. (ibid.)

We already know that these changes in our transit system, as a result of autonomous innovation, are right on our doorstep. However, congested cities are still trying to get a grasp on their current challenges, they are perhaps not preparing at all for the drastic change or allocating very few resources towards preparation. According to Guerra (2015), despite a history of planning and projecting for the future, the planning profession tends to have a poor track record of preparing for new transportation technologies. Moreover, he argues that planners lacked the ability to foresee the impact of private cars at the beginning of the 20th century and this led to inadequate development of roads in some cases. Now how does this impact cities? He states that planners fail to influence relationships between cities and new transportation technology by either misunderstanding driverless cars or seeing them as a solution for contemporary planning problems such as road congestion or climate change. (Ibid.)

After twenty years of consistent research on self-driving vehicles there has been a dramatic increase in the number of papers and projects about autonomous driving, however, most of the work solely focuses on the technology, laws and regulations, safety and highway capacities. Some of these focuses fail to consider the impact this innovation will have on cities, especially their transportation systems. The discussion seems to focus on what benefits self-driving vehicles may provide in terms of time reducing accidents, increasing safety, perhaps combating congestion but there is very little mention on how well prepared the roads and its infrastructure will be. (Ibid.)

5.3 The Internal Combustion Engine

The innovation that led to the creation of this engine is responsible for revolutionizing the automobile and transportation industry. The internal combustion engines are a family of engines that confine fuel in a chamber and the burn it which result in high energy release. There are many varieties of this engine, however, the most common version of it is known as the Otto Cycle or the four-stroke engine which is used in virtually all automobiles and trucks produced today (Jindrich 2007, 944).

This engine along with the automobile has made its mark on society in numerous forms. The introduction of the automobile initiated a major shift in the urbanization of America, it changed the traditional city full of walking pedestrians and closely tied neighborhoods into noisy and “dangerous machine spaces” designed to facilitate efficient movement of motor traffic (Jindrich 2007, 945). If you refer back to the chapter which elaborates on the history of Los Angeles transportation system you realize that the book describes L.A.’s early transit system as one where everyone walks or uses a bicycle to get to their desired location. However, when entrepreneurs who are also city dwellers come along, they realize that machinery may help accelerate traveling, the transportation system and its efficiency.

Additionally, the introduction of the internal combustion engine marked the end of an era which relied on animal-powered technology and gave rise to automobiles, busses and trains which lowered transportation costs and the cost of travel over time. Furthermore, affordable personal transportation is now an essential component of the American dream because and it has transformed the city of Los Angeles into an iconic car culture, and a model city for urban development in relation to freeways (Jindrich 2007, 945).

6 THE HISTORY OF TRANSPORTATION IN LOS ANGELES

Before we dive into the current status of congestion in the city of Los Angeles, I have to cover its transportation history. Charles Hobbs in his book titled “The Hidden History of Transportation in Los Angeles” covers the very first ideas and implementation of early transportation systems and then proceeds to write about the transportation system in modern times (Hobbs 2014). I will be relying on his writing and research which came from his experiences traveling via L.A. freeways, learning to read maps and listening to radio traffic reports to help you visualize how the transportation system in Los Angeles has evolved over time eventually reaching its current state. Via historic facts, Hobbs experiences and annotations, I will cover the transportation system in its infancy, i.e. bicycles, through engineering developments leading to trains and trolleys all the way to its present state.

6.1.1 *The Cycleway*

The very first idea of transportation for the city of L.A. was known as “The California Cycleway”. The idea was drafted and planned by Horace M. Dobbins, a cyclist enthusiast who is famous for the quote “The foot that moves the pedal is the foot that moves the world.” This cycleway was supposed to be an elevated wooden bike path that

would connect from the streets of Pasadena to the city of Los Angeles, however, he was unable to obtain funding to realize his idea, so the infrastructure was not built at the time. This bicycle craze was very much alive during the 1800s, especially since transportation was limited to walking, horseback riding, horse drawn carriages for those of wealth and in larger cities, at the time, those of status would travel in mule-drawn street cars. Moreover, what gave birth to this bicycle craze was the launching of a new bicycle known as the Safety Bicycle which instantly became a popular form of transportation across the United States. (Hobbs 2014, chapter 1). In 1897, Horace Dobbins founded his own company called the California Cycleway Company which eventually lead him to the realization of being able to build the cycleway from Pasadena to Los Angeles. On January 1st, 1900 the cycleway opens and very much like today's highways or roads it was surrounded by businesses in order to try and attract cyclers while on the commute. Unfortunately, this idea went on to lose popularity and collapse with the introduction of the electric trolley, thus, street cars and electric trains dominated the transportation industry for years to come. (Ibid.)

As a reader, the moment I read this chapter I could not help but compare the cycleway to today's demands for more sustainable ways of transportation within urban areas. An idea birthed in the 1800s, although having lost its momentum with the introduction of new engines and forms of traveling, is still very much alive today and as popular as ever due to modern issues such as climate change and the theme of conducting ourselves in a sustainable manner. Additionally, this cycleway was also born because commuters were not content with the poor road conditions which plagued a lot of the areas within Los Angeles.

6.1.2 Paving the Way for The Electric Railroad

This next chapter in the history of transportation in Los Angeles is one that fails to develop into a physical form of transportation that is embraced by the public at the time, however, it succeeds in leaving a blueprint for others in the transportation system to follow in the future. This next step in Los Angeles transportation history was created by Joseph Wesley Fawkes, a Pennsylvania native who spent a lot of his free time engaging in innovation, one of his first creations was an electrically illuminated advertisement sign which he patented in the year 1901. After this Fawkes moved on to his next invention which would be called the Aerial Swallow, the aerial trolley car was powered by an aircraft propeller, attached to railing which was above it, powered by an air-cooled Franklin engine. It was made out of aluminum which was considered to be a rare metal at the time, and it was about forty feet long allowing it to sit about fifty-six passengers. Unfortunately, support for Fawkes aerial trolley car was nonexistent, citizens were already

occupied with the “Red Cars” which were electric trolleys who had already began operating specific routes at the time. Although Fawkes pitch to incorporate his aerial trolley car had failed, he managed to leave behind an interest in monorail which would influence the future of transportation in Los Angeles. (Hobbs 2014, Chapter 2)

6.1.3 *The Jitney Drivers & The “Yellow Car”*

Automobiles, this is the next installment in L.A.’s transportation history. The first automobile in Los Angeles made its appearance in the year 1897, before the popular Ford Model T captivated the world. It is important to note that in these times, the automobile was considered to be a “rich man’s toy” and that the average person was unlikely to ever ride or own one; the majority of people either walked or relied on railway transportation. However, these trolleys and streetcars were often severely overcrowded and were notorious for maximizing their profits over passenger convenience by allowing these cars to be loaded way over its human capacity and ignoring passenger complaints. (Hobbs 2014, Chapter 3.)

As a result, Los Angeles experience its first jitney drivers (jitney was L.A. slang for a nickel or 5 cents), which can be compared to what today we refer to as a taxi. Jitney drivers offered rides to people waiting at streetcar stops in 1914, they charged the same fare as street cards, 5 cents at the time. Within a year, everyone was offering rides and becoming a jitney driver, all you needed was a valid driver’s license and a car. These drivers worked either full time or part time and would drop people off for a fare and they offered conveniences such as dropping passengers off at locations which were not on the trolley routes and a comfortable ride. (Ibid.)

Yet again we are seeing another element of transportation that is still very much alive today and can be found in contemporary Los Angeles and in other modern city around the world, these jitney drivers were no different than ride share drivers today who work for companies such as Uber. Uber was founded as a result of the frustration its founders experienced when not being able to ride a taxi at their desired location and also the need for more comfortability and better service. This is precisely what jitney drivers offered their riders who were frustrated with the state of transportation in Los Angeles, the only difference is that todays “jitney riders” operative via mobile devices and technological innovations.

Eventually, jitneys start to cause an array of issues for the city of Los Angeles as a result of competition for fare collection. The competition reached drastic levels of intensity causing drivers to operate without regard for the safety of passengers or pedestrians. Among other problems included were: drivers racing each other to streetcar stops, running over pedestrians, collision with other vehicles, overloading the automobiles to the

point where passengers were hanging from its windows, drivers ignoring the required maintenance of their vehicles which created additional safety hazards, racial discrimination, groping and sexual harassment, theft and robbery, etc. As a result, jitney cars face heavy scrutiny by the press, citizens and politicians and end up being banned from L.A.'s busiest streets when the United States entered World War I by 1917. (Hobbs 2014, Chapter 3)

6.1.4 The End of Streetcars & The Failures of Taxi Companies & City Planning

Streetcars ceased all operations in the year 1963 and were replaced by diesel buses. Furthermore, the publicly owned Southern California Rapid Transit District (RTD) replaced numerous privately-owned transit companies and further extended their service routes. However, the mayor of Los Angeles and other city officials were looking for additional ways to improve the state of public transportation and approved jitney styled companies to operate as a solution for demand, one of these companies was called Yellow Cab. Although the Yellow cab company was unsuccessful it contributed to the founding of other taxi companies such as Express Transit District (ETD) and Maxi-Taxi which proposed further expansion of commuter routes within the city of L.A. While both companies managed to secure certifications from the Public Utilities Commission (CPUC) for the expansion of commuter routes they ended up going bankrupt as a result of competition and series of regulation violations and investment fraud scandals that inundated ETD specifically. The figure below will provide a visual representation of what the routes were between 1982 and 1983. (Hobbs 2014, Chapter 3)

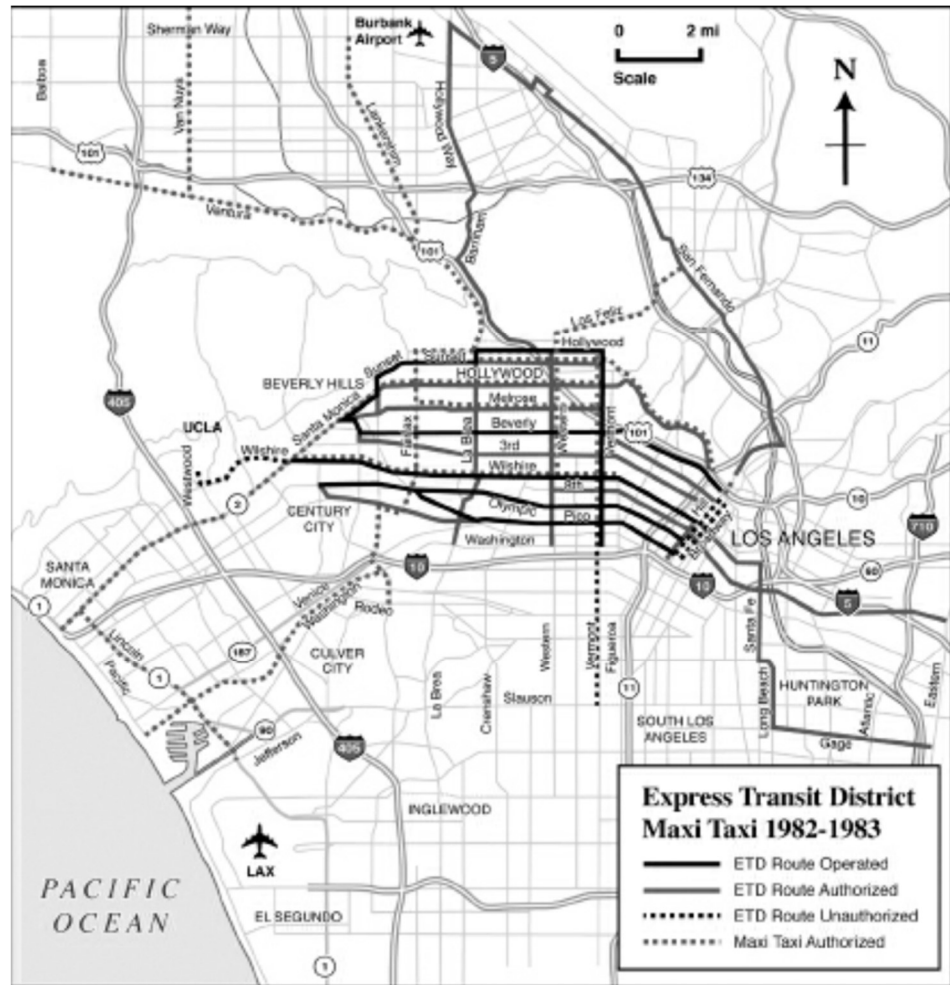


Fig. 5 Hobbs, C. P. (2014, Chapter 3) Express Transit District Maxi Taxi, *Hidden History of Transportation in Los Angeles* Charleston, South Carolina: The History Press

In the 1990s we start to see discussion regarding city and transportation planning in order to improve the transportation system in L.A. Planners struggled to design a transit system which combined the proficiency of coordinated bus routes and the flexibility of the automobile or taxi – this is where the “Smart Shuttle” made its debut. The Smart Shuttle originated in the University of California, Los Angeles Urban Innovations group and it consisted of small busses which ran along major streets using Global Positioning Systems (GPS) and Automatic Vehicle Location (AVL). (Hobbs 2014, Chapter 3)

Afterwards, in 1997, the Metropolitan Transportation Agency (MTA) and the Los Angeles Department of Transportation (LADOT) launched a pilot Smart Shuttle program in three areas of L.A.: Koreatown, South Central L.A., and the San Fernando Valley with a \$10 million-dollar start-up package from the MTA; this shuttle program was expected to be self-supporting within 2 years of operation. However, these shuttles never came close to being self-funding and its staff constantly modified the shuttles routes and hours

of operation leading to confusion among riders and eventually the shutdown of the Smart Shuttle in 2001. (Hobbs 2014, Chapter 3).

Here we start to see the early use of city planning in combination with technology that was considered to be advance at the time. These technologies still exist today, and it is still very much the case where technological advances in Los Angeles are available yet time and time again city planning fails to develop the appropriate strategy to combat the problems the transit city of L.A. faces and has faced throughout its history. Hobbs here is providing us with problems that crumble in comparison to the congestion and traffic issues which L.A. faces today. These issues mentioned by Hobbs attempt to help us understand how L.A. has never been able to fully plan and implement appropriately for its transit system. However, what urban city has been able to successfully tackle all of the issues that their transit system(s) face?

6.1.5 *Motor Vehicle Transit*

In this chapter I elaborate on the how the bus made its entrance into Los Angeles's transit system. Olive Ransome Fuller started the Motor Transit bus company which operated a single route of service between L.A. and Fullerton in the year 1916, within a decade it went on to become the largest bus company in California. Motor transit busses became the solution, many early automobile owners used their vehicles to generate income by offering rides in exchange for a fair and as the number of passengers increased so did the size of their vehicles; drivers transitioned from regular sized cars, to larger car and then eventually end up setting up bus bodies on truck chassis in order to move more passengers. These buses were called "motor stages", operated along highways moving passengers between towns and cities and also competed with the railroad transit systems. Furthermore, these busses operated with little to no regulation, after regulation was drafted and passed L.A. bus and railroad companies began to merge in order to provide better service in the form of expanded routes that also reached areas like San Francisco which are outside Los Angeles. (Hobbs 2014, Chapter 4)

These private bus companies eventually become public and operated by Los Angeles County Metropolitan Transit Authority (MTA or Metro). The transit system in Los Angeles was always pushed to its limits and reinvented by entrepreneurs who served as pioneers for technologies and business ideas. Every time a business idea regarding transit or the transportation of a mass amount of people was put into action the system further developed or reinvented itself to address the issues it faced in the past and its present state. Today, L.A. still experiences this type of evolution via the implementation of different urban planning and technologies that contribute towards said planning.

6.1.6 *Attempting to Establish a Freeway via the Los Angeles River*

Los Angeles also considered ferries and transit via its waters along with helicopters, while that is also a form of transit it deviates from what I am covering via my writing, I seek to further elaborate on congestion, which in its ultimate form is typically affiliated with automobiles/busses. More forms of railway transportation such as Caltrain were also introduced and eventually ended up closing or failing. In this chapter I will provide insight on how the freeway for the Los Angeles river was proposed. and what the rationale among entrepreneurs and city officials was at the time with regards to freeways. At this point we start to see Los Angeles start to consider physical space and traffic or congestion inside the city.

Richard Katz first suggested that the river in Los Angeles be used as a freeway around 1989. He mentioned that the river in Los Angeles was dry for at least 200 days of the year and suggested that it be used as a reversible carpool lane between west San Fernando Valley and Los Angeles. Katz reasoning behind his proposal was that he believed the dry river would allow buses and carpools to travel in the morning and evening and also allow trucks to haul freight which in return would reduce the traffic on the harbor. Below you will find the proposed river freeway which is not implemented as a result of unforeseen flooding, issues such as trash being dumped in the river and over environmental challenges and issues. (Hobbs 2014, Chapter 16)

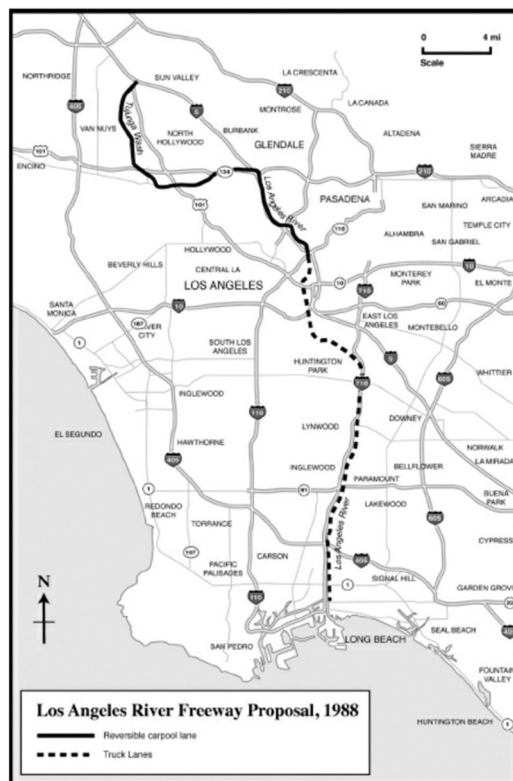


Fig. 6 Hobbs, C. P. (2014, Chapter 16) Los Angeles River Proposal, Hidden History of Transportation in Los Angeles Charleston, South Carolina: The History Press

6.1.7 *L.A.'s Metrorail*

Metro systems, whether above or below ground are also an essential part of a transportation system. Los Angeles initially struggled to pitch the idea of a metro to its citizens, but it eventually succeeded. According to the Los Angeles Metro website the first train line was operation on July 14th, 1990. Today the metro system in L.A. is one of the biggest in the United States and a book review conducted by Michael Manville takes into how the metro was established, what challenges its supporters faced and the pros which are now offered by such system.

The vision of the metro was introduced by Los Angeles mayor in 1973, Tom Bradley, contrary to previous transportation systems and innovations which were introduced by entrepreneurs. Bradley had been primarily elected on the promise of building a subway with the purpose of combating the city's congestion problem. However, the citizens of Los Angeles rejected the proposal citing that they were in disagreement with the taxation required to fund the system in the first place. Political issues were not the only opposition the mayor was facing, there was also conflict regarding which were the best routes, the most cost-effective routes and the most politically acceptable routes, here we observe some elements of urban planning being present. (Manville 2016, 385)

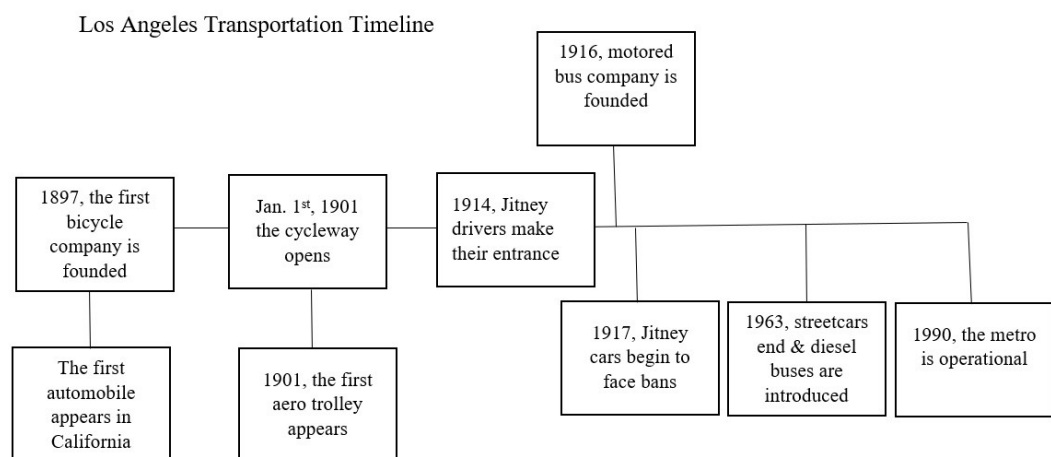
Eventually, L.A.'s transit agency managed to convince its opponents with compromises that stitched together political and financial concerns, unfortunately this resulted in trains running on poor routes. Nonetheless, in 1980 the construction of the rail program finally begins, and voters approved a tax measure to help fund it. The construction of the program encountered problems such as gas explosions causing federal fund shortages for the program, part of Hollywood Boulevard also collapsed causing construction issues. Eventually all these delays result in the accumulation of debt and the rail system begins to take from the bus system in order to keep the program afloat and the program then finds itself suspended by federal authorities in the year 1996. While fight for a railway system is an element which would perhaps help alleviate the work load other systems such as bus routes had, I believe Los Angeles took a step in the wrong direction when they decided to reduce the resources of the bus system in order to fund the railway. Not only did this fiasco lead to a law suit, which was previously mentioned led to the suspension of the program in 1996 but one could also assume that the bus systems started to perform poorly because Manville mentioned that part of the reasoning for the suspension of the railway program was in order for the city to reinvest in its bus system. (Ibid.)

While I am not opposed to the building of a metro system in Los Angeles, I again express that it was handled poorly despite the need for more details. Additionally, I have concerns such as the cost of this program and I am not sure how this metro helps congestion being that the city's major problem is that its dwellers buy cars and drive too much, I also do not see what would attract somebody to use the metro in comparison to the bus

or driving. Manville also expresses similar concerns, his first critique of the book titled *Railtown: The Fight for the Los Angeles Metro Rail and the Future of the City* is that the book does not acknowledge the cost of the metro, Los Angeles has spent almost \$12 billion dollars on the construction of the railway since 1980 and he goes on to say that ridership is basically the same as it was since the metro system was introduced, which is an issue that I cover in another section of my writing. Manville also mentions that he does not see how L.A.'s future rests on the metro system because the issue is that Angelenos drive too much not that they ride the train too little. Unfortunately, this is a system that costs Los Angeles too much money and continues to do so, although it is used by the citizens of L.A. was the initial investment warranted and can funds be allocated to tackle the root causes of congestion. (Manville 2016, 386)

All these different transitions and implementations of transit systems within Los Angeles were mostly led by entrepreneurs who were seeking to improve the state of transportation for themselves and the citizens of Los Angeles. While all these pioneers envisioned systems of transportations that offered commodities, they also believed that these systems would yield significant profits. Therefore, as a result of their business mentality Los Angeles was able to, while not perfect, make improvements to its transportation systems in order to arrive to the current state of their transit system which also has many significant problems of its own.

6.2 A Visualization of Los Angeles Transit Systems



7 URBAN CONGESTION

As civilization has developed so has the concept of urban areas and large cities. Most of us may have visited metropolitan cities or at least know of them via the media,

television or movies that we have watched. Every time the city of New York or Los Angeles is presented as entertainment, the main observation, we as viewers can easily make is the mass number of vehicles which these cities are often plagued with.

Urban congestion was already being referred to as a “vexing problem” in the early 2000’s. According to Wachs (2002, 43) traffic congestion is a vexing problem felt by residents of most urban areas. Additionally, he states that years’ worth of efforts and billions of dollars have been spent trying to combat congestion in urban areas and yet, congestion only seems to be getting worse. He also reports that between 1980 and 1999 that the volume of vehicles in U.S. highways increased from 10.331 million to 14.757 million (43 percent). (Ibid)

Furthermore, congestion, in the United States tend to be tied to economic growth. Wachs states that traffic congestion is often associated with prosperity rather than poverty, business and population growth. Moreover, he also states that congested city centers tend to be the most exciting and high-rent of all urban environments, home to dynamic business and industries, main attraction for tourism and cultural activities, etc. So, the question becomes what do you do as a government if congestion continues to increase yet your region’s economy continues to prosper? This almost appears to be a trick question in a sense. Wachs mentions, that policy makers have a poor comprehension of the mechanics of traffic congestion. He proceeds to elaborate on that by mentioning that over 90 percent of our roads are uncongested for over 90 percent of the time, and, that up to one third of all traffic delay is caused by incidents that are difficult to foresee, such as accidents, road spills, or construction equipment. (Ibid.)

In order to combat congestion in the early 2000’s cities turned to public transportation innovation. According to Wachs (2002, 46) the innovation that addressed urban congestion was improved public transportation, in its infancy it was powered by horses, later elevated or underground and powered by cables, steam, and eventually electricity. Furthermore, affordable and reliable public transportation meant that people could live farther from where they worked and travel much more. He also mentions that initially, only the rich could move away from the city-center, but the prices of fair steadily fell in relation to incomes, thus more and more people found it affordable to rely on public transportation to commute to and from work.

7.1 Public Transportation

As I have previously mentioned, public transportation systems were developed in order to combat the massive congestion which cities were facing. In these next chapters I will briefly elaborate on the state of transportation systems in Los Angeles, Bogota and

Bangkok and I will also, in this section briefly go over the general history of public transportation, specifically in the United States.

According to Thompson (2008, 1), who prepared a publication on the history of public transportation for the World Bank, the development of mass transportation in the United States goes as far back as the year 1630 with the introduction of chartered ferries and horse cart services in Boston, MA. He states that in the 18th century, urban stage-coaches were introduced in New York City, Boston and a number of other large American cities. Furthermore, later in the 19th century, mentions that rail-based, horse or cable operated systems started to appear in cities which then again undergoes a major overhaul in the 20th century. In the early 20th century, modern subways and motor-powered busses began to make their mark within transportation systems; most of these urban transit systems were operated by private companies. (Ibid.)

7.2 Angelenos Reliance on Private Vehicles

California is historically known as a state of rich car culture, a culture so popular that automobile companies dedicate marketing to areas such as the city of Los Angeles. Angelenos, along with Californians own or buy more vehicles than the citizens of many other urban areas combined. While there has been a push towards encouraging the citizens of L.A. to rely on the use of public transportation in order to commute one can argue that in some cases this message, regardless of reasoning and goals has had a minuscule effect.

The vast majority of transit agencies, especially public transportation, have reported a reduction in ridership. These numbers have revealed that there has been 25% decrease in ridership and officials have attributed the decrease to cheap gas, transit security, gentrification, change in immigration patterns and the rise of car sharing services such as Uber and Lyft. While the previous may be reasons for a decrease in ridership among L.A.'s transit system it still does not explain why there has also been a surge in vehicle ownership. A study on U.S. Census data conducted by UCLA Institute of Transportation reported that from 2000 to 2015 the residents of Los Angeles, Orange, Riverside, Imperial, Ventura and San Bernardino counties purchased as many as four times as many cars per resident in comparison to the years 1990 to 2000.

Furthermore, ownership was greater among immigrants who have historically been habitual users of transit systems in California, immigrant households which did not own a car decreased by 42% over a 15-year period. Researchers reported that reasons included the following: the introduction of zero interest loans allowing for low-income families to make vehicle purchases, neighborhoods with a high concentration of transit

riders grew wealthier and also had fewer immigrants, low-income residents forced to move to areas where transit services were less frequent, etc. (Nelson, 2018).

7.2.1 *Single Occupant Vehicle Reliance*

While vehicle ownership has increased, and the use of California's transit systems have diminished, I also want to discuss what type of vehicle is most used among Angelenos and California's work force. Considering the current state of traffic and congestion one would consider that it would be more beneficial to avoid having to own a car and drive to work on a daily basis, at least for those of us observing the situation on the outside. I personally, would rather use an Uber if I was not going to using any sort of public transportation offered by California's transit system.

Data from the U.S. Census Bureau which the California Center for Jobs & The Economy refers to has shown that reliance on single occupant vehicles has grown consistently from 1980 through 2014, with the exception of 2008-2009 which were years of economic recession. Moreover, it is important to note that the numbers of workers relying on carpooling is the same in the year 1980 and 2014, these numbers have had very little fluctuation throughout the years as well. The fact that carpooling numbers among commuters has not increased significantly is bizarre, especially when you consider innovation such as Uber, Lyft and other car sharing companies who have been around for quite some time. I would have anticipated that innovative services such as carsharing would make a significant impact on these figures. Furthermore, the census also reports that the total numbers of workers using public transit had nearly doubled since 1980 as well, however, while the numbers increased researchers did not seem satisfied with the numbers, in 2014 figures had still not reached over 1 million which considering the tone of the report are poor numbers.

Citizens in L.A. show an increasing trend of vehicle ownership since the 1980s with a significant spark at the start of the year 2000. At the time of this trend towards ownership we also start to see public transit usage slightly decrease, remain unchanged and then make a very insignificant gain in the year 2009. Moreover, carpooling figures for Los Angeles take a heavy downward trajectory in the year 2000 reaching almost single digit percentages by the year 2014.

Furthermore, the census states that an alternative has been the increasing numbers of workers who work from home thus not having to rely on transit because carpooling, public transportation and other means such as the use of bicycles which have failed to attract workers. Moreover, there is a correlation with the price of housing in California, the increasing cost of housing has forced Californians to look for more affordable

solutions at greater distances thus enabling the need to commute long distances in order to get to work. (California Center for Jobs & The Economy, 2016).

California and Los Angeles have been fighting congestion for years yet judging from the report mentioned above it is quite evident government and planners have been losing the fight. If car ownership, for the sake of being the sole driver has gone up since the early 2000s, reliance on public transportation has remained stagnant and the use of carpooling has plummeted perhaps government and planning has been tackling this idea in the wrong manner. Clearly, attempting to direct the flow of transit, building bigger roads, etc. has not been working. What I have gathered from the report mentioned is that there needs to be policy, specifically economic policy which deters city dwellers from relying on cars to commute to work. Something must be done to encourage not only low-income workers to stop buying cars and resort to carpooling or public methods of transportation but also for those citizens in Los Angeles who are of different economic status. A potential solution, like the report suggest is to tackle the ever-increasing costs of housing in California, providing a solution for this is not something that seems to be mentioned when speaking of congestion. The rationale behind the cost of housing infers that without affordable housing prices, whether it be for a purchase or rent, citizens are forced to live outside of the city in order to live a comfortable life. This is common in the city of Boston which I have lived in for the past 8 years or so. Bostonians cannot afford to live in the city, so they move to surrounding suburbs knowing very well that they will have longer commutes into the city.

7.3 The Influence of Climate Change

In recent years the fight for global warming has become heavily discussed in many areas of innovation and development. Metropolitan areas are also in this discussion given that the accumulation of vehicles is bound to produce air-pollution that goes against the sustainability agenda. Eric Garcetti, the current mayor of Los Angeles, along with its citizens is a supporter of sustainability and has introduced a series of policies and initiatives in order to affirm his position. However, once again the housing crisis finds itself the middle of this complex issue. Affordable houses are needed in the second largest city in the United States and unfortunately this has led zoning regulations to become overlooked as a result.

A report published by NBC Los Angeles earlier this year reported that Los Angeles county's exposure to pollution from cars had increased 250 percent more when compared to the San Francisco bay area and up to 60 percent more vehicle pollution than the state average (City News Service, 2019). The report's findings also found that minority communities are exposed even further, they are exposed to about 40 percent more to particles

or PM2.5 which is spread by cars, trucks and buses. The emissions being spread, or PM2.5 is released from the muffler (tailpipes), during vehicle refueling and from the burning of gasoline or diesel, however, most of the toxins are produced from an atmospheric reaction. Moreover, PM2.5 is known to have the biggest impact on human health, the particles are small, penetrate into our lungs and bloodstreams and have been linked to acute and chronic heart and lung disease, asthma attacks, lung cancer and in some cases even death. (Ibid.)

Climate change further complicates urban planning for the city of Los Angeles because it now has to be incorporated into its transit system and any other systems which are in dire need of innovation and development. However, as a supporter of climate change it is comforting to know that cities such as Los Angeles are acknowledging the issue and joining its cause. The solutions that are being offered and will continue to be offered by Los Angeles must include climate change and housing when attempting to solve the complexity of traffic and congestion in its city.

7.3.1 The Mayors Stance on a Sustainable Los Angeles

Eric Garcetti has been the mayor of Los Angeles since 2013 and in the year 2015 introduced the city's first Sustainable City Plan consisting of bold and ambitious goals. After just three years the plan has achieved the following goals: a reduction in 45% of greenhouse gases, becoming the #1 solar city in the United States, joining the Paris Climate agreement. Among other initiatives, mayor Garcetti has also pledged to only purchase zero emission busses starting in 2025 and he also led L.A. in becoming the first city to implement an electric car share program designed to serve low-income residents. (City of Los Angeles, 2015).

An initiative that caught my attention was one titled "Electric Avenue" though I will admit the title was misleading it also caused me to think about electrical roadways. At the moment, this Electric Avenue initiative is in collaboration with Los Angeles Department of Transportation and the Metro's fleet with the goal of increasing the procurement of electric trucks and busses in order to continue the march towards zero emissions. (Ibid.)

All of these sustainable policies are what the residents of Los Angeles have voted for, hence the current mayor. Despite the United States excusing themselves from the Paris Climate Agreement, Los Angeles has decided to champion forward and pursue its ambitions zero emissions goals. As I previously mentioned, the Electric Avenue initiative is something which I took literally, what if Los Angeles partners with an automobile company to develop roads that are exactly that, electric, in my mind these roads would power or charge the vehicles it serves with a goal of reducing the necessity of building charging

stations which take up space around the city. Another result of car-charging roads and freeways would be charging on the-go, vehicles would no longer need to reduce speed, pull over or stop in order to reach a charging station. While this idea may be far from development or implementation it does not need to be deemed impossible, after all, autonomous vehicles were said to be science fiction just a decade ago.

7.4 Los Angeles Today

The city of Los Angeles is one of the most populated cities in the world. In order to understand their public transportation system, the congestion related challenges that have plagued them for ages, what strategic action the city has taken in attempts to alleviate their congestion issues we must first examine how the population of Los Angeles has increased over the years. The Los Angeles Almanac (n.d.) who publishes statistical data gathered from the United States Census Bureau on the population of Los Angeles reported, that, in the late 1980's the population of the city of Los Angeles was 2,950,010, this number then increased by about 530,000 people in the next decade. Moreover, the United States Census Bureau (n.d.) reported that in 2017 the population of Los Angeles will exceed 4 million people.

According to Sorensen et. al. (2008) who write on behalf of the RAND corporation, congestion in Los Angeles is the worst within the United States, it takes a toll on quality of life, economic competitiveness, fuel economy, driving safety, social justice and air quality. The RAND Corporation then published what they believe are some of the issues causing congestion in Los Angeles and also provide strategical recommendations, they also mention that congestion is continued to increase in the long-term. (Sorensen et al., 2008, 1)

One of the challenges listed by RAND Corp. relates to the prospects for building more roads. They state that the city of L.A. has failed to increase state and federal fuel taxes to keep pace with inflation, thus, as a result available revenue for the transportation department has not increased. After reading this first challenge, I immediately start to think what the automobile industry may develop that could help cities, while the product and innovation itself is important, the affordability of said innovation is also crucial for its implementation by cities and local governments. Furthermore, RAND Corp states that the issue is not just the availability of funds because even if more funding were available the roads in Los Angeles are already among the most expansive in the country and there is little space to further increase the size of these freeways. (Ibid.)

RAND Corp states that L.A. residents drive more than residents in most large metropolitan areas and that the most reasonable plan of action would to be attempting to reduce the demand for driving during peak hours. RAND Corp is making the solution to

this issue sound quite simplistic. How do you redirect a city of almost 4 million people? You would also potentially need to change the working hours of residents who work in public transportation (bus drivers), truck drivers, employees who rely heavily on driving for work purposes, etc.

Afterwards, RAND Corp states that most congestion reduction strategies do not remain effective over time. According to them when a congestion relief strategy is implemented traffic delays are reduced, however, travelers who have avoided certain travel routes will simply return to their usual travel patterns and before you know it the strategy has become null and ineffective. This strategy is referred to as “triple convergence” by RAND Corp and this concept explains why traffic flow improves for short periods of times when new lanes are added but then these roads return to being congested only after a few years at most. The concept of triple convergence seems to be a band aid fix, it simply plugs the small leaks on a pipe until the pipe explodes. All these short-term solutions, in my opinion, make the problems worsen and can potentially reduce the time or resources spent on seeking long-term solutions. (Sorensen et al., 2008, 1-2)

Last, RAND Corp suggest that the only way to combat congestion in a long-term scope is to rely on pricing strategies. They state that this pricing strategy is referred to as “congestion pricing” and it involves charging drivers more for their use of roadways when travel demand is the highest and they then proceeded to provide the following examples: higher toll prices for driving during peak hours, collecting high fees for parking in particular areas during rush or peak hours. The ultimate goal of this strategy is to force drivers to alter their travel patterns and deter others from converging on available road space when prices rise with increased road demand. (Sorensen et al., 2008, 2)

7.5 Strategies Implemented by The City of Los Angeles

The city of Los Angeles has developed and implemented many different strategies to combat congestion, but the most recent rollout of a new synchronized traffic light system is what has helped alleviate congestion in the city. According to an NPR podcast anchored by Chan (2013) the city of L.A. introduced a synchronized traffic light system that via motion sensors and camera help monitor flows of traffic, said monitoring detection helps battle congestion. Moreover, Chan’s guest on the show, Tom Vanderbilt states that in cities the size of Los Angeles we should want more intelligence on the road and he provides support for his statement by informing the listeners of the podcast that for example, the system adjusts traffic lights if there is a public bus that is running behind schedule in order to prevent traffic build up, etc.

While this system sounds lucrative, I again refer back to the cost of such systems, Los Angeles might be able to pay a hefty price for smart technology such as this, but will

other cities such as Bogota and Colombia be able to do the same? Chan reported that this traffic light system cost the city of Los Angeles \$400 million dollars over the course of 30 years (ibid.). Additionally, I would like to add that Tom Vanderbilt, like RAND Corp also states that adding roadways to L.A. or any major city suffering from traffic and congestion issues is not the proper solution.

7.5.1 Carmageddon

The story of Los Angeles congestion is not complete without covering carmageddon which was arguably predicted to be one of the most horrific gridlocks commuters in L.A. has ever experienced. This situation was forecasted as a result of poor city planning and poor communication from city officials towards the citizens of Los Angeles. These closings were expected to cripple the city and cause a scene which was described by some as “the Apocalypse”. Los Angeles and everyone watching was essentially preparing for the worst outcome.

In 2010, the city of Los Angeles began to plan for a weekend closure of a 10-mile (16 kilometer) stretch of their 405 Freeway which linked the Westside of L.A. to the San Fernando Valley. Public officials spread the message via public channels throughout L.A. and hoped that citizens would pull together to minimize the impact that this freeway closing would have. Furthermore, there was plenty of emphasis placed on what may occur of motorists failed to avoid the free areas which were going to be affected. (Wachs & Taylor 2012.)

While everyone braced for disaster what actually occurred was the complete opposite. Traffic volumes decreased by 61% heading north and there was a decrease of more than 73% in the southward direction. Additionally, the reduction of traffic volumes was not specific to the surrounding roads near the freeway or the detours that were setup but also all throughout Los Angeles stretching for almost 80 miles (128 kilometers). While the results and responses were quite dramatic it was temporary, travelers went back to their usual commuter behaviors after receiving notice on the status of the roads. (Ibid.)

Wachs & Taylor stated that instead of describing closures in a threatening manner it would actually help if the message sent was one of positive tone or one that appeals to the citizens of Los Angeles. Their reasoning for this was that it would have had the ability to lift public spirit in order for citizens to pull together for a second round of Carmageddon which is expected to occur in the near future (at the time) – hopeful messages are far more likely than fearful messages to help the community. (Ibid.).

7.5.2 *Congestion Tax*

If you know anything about Americans, you know that a lot of us do not respond well to the word tax. Los Angeles has recently introduced the idea of possibly implementing a tax on congestion in order to try and combat traffic in, essentially it would be charging a price in order to force commuters to not use the roadway unless they absolutely have to.

Mantle (2017), the host of the podcast known as AirTalk states that the southern California Association of Government, a regional planning agency, wants to create a pricing zone tax system where users who drive in areas clogged with traffic would pay a fee and those fees would go to things such as public transportation, etc. He also goes on to mention that this type of pricing plan has been introduced in other cities such as London and Stockholm and yielded positive results in the fight against urban congestion.

The podcast also includes Michael Manville, an assistant professor of urban planning from the University of California, Los Angeles who has done extensive research on transportation, land use and local public finance. He states that roads are essentially free to use in terms of transportation and that despite the city of Los Angeles giving away a lot of land for the construction of roads we still cannot tackle congestion properly and suffer continued road shortage which he expresses is the definition of congestion. Furthermore, he states that congestion is caused by underpriced roads and that existing taxes for usage of road such as the gas tax go towards creating/building the roads and maintaining them, however, they do not go towards allocating space on the road, the purpose of this new congestion tax is to help the roads perform well and address congestion – he says the tax essentially charges a tax to change behavior, in this case, commuter behavior (Mantle 2017).

Throughout this entire podcast, all of the callers (citizens of L.A.) quickly expressed their opposition for this congestion tax. They mentioned that this tax only hurts the working class and another driver with a truck company mentioned that he is already being taxed left and right and that this additional tax would put further strain on his wellbeing despite the purpose of the tax is to fix the transit systems in L.A., especially public transportation (Mantle 2017).

7.6 Motivation

Automation has been one of the biggest catalysts for the improvement of mankind. From its early inception it revolutionized farming, allowing for produce to be harvested and shipped throughout the world, from moving on to changing industrial manufacturing in ways of traveling, new hydraulic components, assembly lines for faster and cheaper production of cars, and moving into technology since the early 1990s. The movement of automation into technology has not only transformed cities, businesses and economies but it also has allowed for us to become more productive as a whole and to have a better way of life. Automation, whether it be in the form of public transportation improvements, technology that bring commodity and simplicity to our lives has elevated mankind, providing us, a better way of life, more efficiency, better personal services, easily accessible transportation systems, etc.

While automation has yielded so many fruits providing us a modern, more productive and comfortable world it also produces a series of what I would call unintended negative effects. It is at this point which I am motivated to argue about its socioeconomic consequences, displacement of employees, eliminating low-skilled labor which many members of populations have depended on for generations, etc. I believe that change has and always will require sacrifice. Unfortunately, we do not live in a utopia where everything is perfect, everybody benefits, and nobody is left behind. Nonetheless, I do not argue or wish for those members of society to be left behind. We live in a world where older employees struggle with adapting to new technology, markets, or work as they get older and technology continues to rapidly advance. However, this does not mean that society should stop producing innovations which help mankind. Perhaps we can find other ways to educate and train those whose jobs have become or will become obsolete due to advances and innovations within automation and machine learning.

8 A PESTLE ANALYSIS: SCENARIOS OF THE FUTURE OF CONGESTION IN LOS ANGELES

In the next subchapters I will introduce a total of 4 different scenarios which will be accompanied by their own individual narrative. These scenarios feature a protagonist and will also tell a story or narrative encompassing the content which is included in my PESTLE tables. The content from the PESTLE tables has been researched and analyzed over time via my methodology and theoretical approaches. Each theme, political, economic, social, technological, legal and environmental will contain projections which may be possible, preferable or undesirable for the purpose of each scenario and their respective goals. Note that my scenarios are possible outcomes, they do not state a future which

may be 100% accurate but attempt to state a future which may be possible in order to server as material for a decision-making process if readers wish.

8.1 Los Angeles Triumphs Against Congestion

PESTLE 1	
Political	<ul style="list-style-type: none"> Funding measures for the purpose of addressing congestion are passed without any opposition Elected government carries on policies that support urban planning from previous administrations Government finds ways to encourage ridership of public transit & reduces reliance on cars Housing cost in Los Angeles drop to fair rates due to government intervention
Economical	<ul style="list-style-type: none"> California sees an increase in their GDP because the success of Los Angeles is shared among other metropolitan areas in the state Angelenos work longer times and multiple jobs because they no longer have to waste time sitting in traffic More tax dollars are available
Social	<ul style="list-style-type: none"> The cost of living in Los Angeles remains affordable for the majority of its citizens Health hazards caused by congestion are at historically low rates Angelenos no longer need to look for affordable housing outside of the city leading to a major reduction in private vehicle ownership
Technological	<ul style="list-style-type: none"> Industry 4.0 plays a key role in the development of the automobile industry Technology that synchronizes the entire grid of Los Angeles is embraced by city planners and implemented strategically Automated vehicles are affordable. While private citizens are attracted by the price and commodity offered by these vehicles the city of Los Angeles takes full advantage and the public transit system of LA is now fully autonomous Public vehicles are also equipped with innovative tech which produce or store solar energy
Legal	<ul style="list-style-type: none"> Private companies are required to be fully transparent in the handling of data their technology collects from traffic patterns, software behavior from autonomous vehicles, routes or destinations entered by drivers, etc. Per strict regulation, private companies must meet yearly with the government of L.A. in order to prove that they are operating and handling private data in a lawful manner or risk losing government contracts Businesses must adhere to Los Angeles sustainable regulations or risk losing licenses and the ability to operate in the city
Environmental	<ul style="list-style-type: none"> Los Angeles is known as the most environmentally friendly city in the world

- Sustainability and climate change concerns are addressed in every decision made by city regulators
- Climate change is something Angelenos are proud of resulting in other green initiatives such as new recycling systems or methods, consumer packing, etc.

Narrative 1:

The alarm clock starts to ring for Jon, its 7 A.M. and time for him to get ready for work. Once he walks out of his bathroom, he heads down to his living room and opens the curtains of his Glendale apartment, at a glance he notices the electric vehicle charging stations which are setup all around the city and his neighborhood. He is immediately faced with the decision of either driving his Tesla, which would provide him with the opportunity to catch up on work emails during his commute and get to work quite early, or, he could ride the bus which will allow him to do the same without having to worry about parking or searching for an available charging station. Jon decides to ride the bus and is grateful for how far the city of Los Angeles has come in addressing transit and traffic issues, he could not help but think how different Los Angeles was in 2019. In 2019, Jon would have to wake up 3-4 hours early to make it to work on time and avoid the frustrations of congestion which besides the loss of time would have also come with health consequences, not to mention, the use of public transportation was not an option, it was simply too slow and ineffective.

It is Friday, Jon is viewing his finances on his mobile device, he has 10 more months of mortgage payments to make and he will have full ownership of his new home while at the same time planning a vacation for him and his family. Additionally, unlike most Angelenos, Jon only works one job, and this is not because other citizens in Los Angeles are struggling to make ends meet but simply because most of them no longer waste 4 hours on average while commuting home, instead they dedicate the time they've gained to working overtime or working additional jobs.

The bus arrives on schedule, Jon boards and presents his phone to the automated payment screen which greets riders as they board the bus. He usually prefers to sit in front of the bus where an info-screen displays simplified traffic patterns, wait times for traffic lights at main intersections and avenues along with what tech companies are responsible for certain sections of the city and their respective traffic grids. The screen also allows for riders to change the screen in order to identify available electric scooters, bicycles and other sustainable methods of transportation in case they want an alternative method of commute back home or to their additional jobs. Moreover, when riders resort to these alternative methods of transportation they produce energy via innovations which are installed into bicycles or scooters, in return they contribute to their sustainable environment and receive points which are seen as rewards and can be exchanged for goods or directly for cash. This system is one of many which was developed by the government

of Los Angeles, Jon was directly involved in its development and the goal behind this initiative and others alike was to encourage everyone to behave sustainably and have direct involvement in the act of behaving responsibly sustainably.

Jon works for one of many Tech giants in California, when he is not directly involved in sustainable developments, he is busy creating strategic approaches to combat congestion with other segments of his department implement into their autonomous software. Jon is also responsible for drafting reports which are presented to the government bodies of Los Angeles in order to ensure full transparency in the way his employer utilizes the data they collect.

When it is time for Jon to head home, he makes sure to check any available scooters near his work place. It takes him about 5 minutes to locate an available scooter which is affordable, he spends about \$3 dollars to ride home and makes almost 1\$ dollar back via the sustainability initiative he has helped implement. On his ride home he reflects on the major transformation Los Angeles has taken in order to arrive to its present state and he is grateful that his children will also have a chance to contribute and be part of this phenomenal sustainable utopia as he could describe it to those who have not yet visited Los Angeles.

8.2 “I Spent My Life on Sunset Boulevard”

PESTLE 2	
Political	<ul style="list-style-type: none"> • Politicians are unable to agree on sufficient funding figures • Public transit areas do not see increased funding over time • Governments with different beliefs and methods are elected making the efforts of previous administrations null • The cost of housing in L.A. has increased to drastic amounts, the average Angeleno needs to make six-figures if they want to afford to live in the city • Government continues to expand roads and ignore the rules of urban planning
Economical	<ul style="list-style-type: none"> • People in L.A. increasingly work from home in order to avoid traffic and the frustrations of commuting • The economy of California remains stagnant for years, Los Angeles congestion issues spread to neighboring cities • Angelenos see insignificant increases in their wages • Cost of vehicle decreases but ownership costs have increased
Social	<ul style="list-style-type: none"> • More Angelenos are forced to live in areas outside of L.A. which have poor public transportation • The use of public transportation has remained unattractive to the citizens of L.A., ridership levels see no significant increases

	<ul style="list-style-type: none"> • Co2 emissions and other hazardous chemicals spread by vehicles impacts the overall health of Angelenos • Angelenos continue to purchase private vehicles at steady rates despite ownership costs
Technological	<ul style="list-style-type: none"> • Innovation in the automobile industry make substantial innovative leaps but government does not purchase such innovations for transit purposes, especially public transit • The cost of technological advances remains high, companies run monopolies on innovations that assist in controlling the flow of traffic, creating strategy for the city grid • Innovations from auto manufactures rely on mass data to operate effectively
Legal	<ul style="list-style-type: none"> • Automakers autonomous vehicles store private data from citizens without any legal repercussions • Private companies' police themselves & lobby for regulations which favor their own interests
Environmental	<ul style="list-style-type: none"> • L.A.'s Green Agenda remains intact but does not receive additional funding • The majority of the initiatives that are already in place (bicycles, eco-friendly car sharing, electric avenue, etc.) deteriorate as a result of poor funding • CO2 emissions raise to intolerable levels, especially on major freeways and avenues

Narrative 2:

The end of the month is near, Tyler's moving company has barely made any profit and he is getting mentally prepared to sit in traffic for over 3 hours, after all, like most blue-collar workers Tyler cannot afford to live in Los Angeles where his business operates which in return forces him to live outside of the city and commute to work. As he takes a sip of his morning coffee, we're talking 4 a.m. which is usually when Tyler's mornings start if he wants to be on time for work, he reads last week's paper which reports on a variety of issues. The main issue, which Tyler can directly relate to, is the cost of vehicle ownership, he has found himself paying more taxes for roads and for gas and this adds up when you have multiple moving trucks which need to operate on a daily basis. Among other issues in the paper Tyler finds the following: deteriorating conditions of electric bike stations, health officials recommending Angelenos wear face masks to avoid health complications as a result of high pollution levels, private companies soaring profits while employee salaries do not increase, etc.

While Tyler sits in bumper-to-bumper traffic the smog is so dense that cars need their lights on at all times in order to remain visible, he can also absorb traffic lights at some intersections which collect traffic and congestion data for analysis purposes. Traffic is moving slow if at all so Tyler, per his morning rituals, turns on the radio and tunes in to a live podcast on congestion. The hosts of the podcasts are currently discussing the

allegations made against several tech giants who are accused of violating privacy laws and regulations in order to sell traffic pattern data to third parties. He listens carefully to the podcast while attempting to block the noise coming from construction machines who are expanding the freeway on the opposite side, something which the podcast also mentions has never worked when addressing congestion in Los Angeles.

While the podcasting is still on-going Tyler decides to make a call into the show itself which the hosts encourage. After waiting for approximately 7 minutes his call is answered and he is greeted. The first question Tyler asks is the following “If all these experts and tech giants are collecting so much data from us why do I spend countless hours in traffic on a daily basis, why are the costs of vehicle ownership going up and why are our politicians unable to come to an agreement on what color the sky is!?” The hosts then proceed to answer the question by addressing the current state of political affairs in L.A., salaries and company profits, unethical behavior by tech giants and the terrible state of pollution L.A. is currently in. Tyler is so infuriated that he turns off the radio and for the rest of his commute he focuses on traffic and think of ways to either leave Los Angeles or work from home.

8.3 2040, Los Angeles Endless Headache, Congestion

PESTLE 3	
Political	<ul style="list-style-type: none"> • Housing markets have operated with little to no financial regulations • New governments undo or strip previous regulations which help alleviate congestion • Congestion tax becomes popular but the funds it yields are funneled to other areas of the city • Government continues to expand roadways in attempts to alleviate congestion • Public transit systems are deteriorating, and government and city planners have failed to increase ridership
Economical	<ul style="list-style-type: none"> • Los Angeles sees an overall decrease in tourism and shoppers. Families are not coming into the city to shop or spend money due to traffic & congestion • Despite congestion being tied to economic prosperity L.A. reaches congestion levels so frustrating that said prosperity becomes a myth and it begins to experience the opposite effect of prosperity • Employers begin to deduct from employee’s paycheck if they are late to work due to traffic and transit issues
Social	<ul style="list-style-type: none"> • The cost of housing in L.A. has increased to drastic amounts, the average Angeleno needs to make six-figures if they want to afford to live in the city

	<ul style="list-style-type: none"> • Angelenos forced to leave Los Angeles and California altogether due to housing costs, health threats, intolerable traffic patterns, poor public transit • Plans for new schools or for school renovations are canceled because Los Angeles is continuing to expand its roads
Technological	<ul style="list-style-type: none"> • Innovation in the automobile industry is rapid but Los Angeles lacks the funds for implementation • The cost of autonomous vehicles is beyond the reach of middle-class families, they are too expensive • Autonomous buses and trains are introduced to the market, but L.A. does not purchase any due to lack of funds
Legal	<ul style="list-style-type: none"> • Private companies, including automobile makers offer strategic approaches to congestion and traffic as a service in return for access to the data of private drivers without legal consent • Tax loopholes are abused by automakers claiming they will use the funds to improve infrastructure for the cities their vehicles operate in
Environmental	<ul style="list-style-type: none"> • Anyone visiting Los Angeles is advised to wear pollution masks • Sustainability initiatives are shut down or postponed in order to fund a failing public transit system • Urban planning only concerned with creating and searching for more space to build roads and do not take climate change into consideration

Narrative 3:

Jamie is home on a cloudy Saturday afternoon browsing the internet for a new apartment outside of L.A. and reading the Los Angeles Times. As he is skimming through pages he comes across a headline which reads “City Moves Forward With Increase in Congestion Tax” and then proceeds to sigh and murmur “oh great, another way to take more money out of our pockets”. Jamie is tired of being taxed to “fix” the roads and address congestion, he is also tired of hearing the notion of taxes which stem from road and vehicle usage are going towards the fight on climate change, especially since L.A.’s government has put that topic on a shelf, in the last 2 mayoral and governor elections they have not even been a topic of discussion.

As Jamie searches for his car keys with his right hand he uses his left hand to grab his face mask, he then proceeds to unlock his phone in order to check for any news on gridlock traffic before he decides to go shopping for a few necessities near the city center. He knows that the hardest part will be maneuvering through bumper-to-bumper traffic because there has been road construction for further the expansion of the freeway for the last 4 months. As he finally reaches his exit, 2 and a half hours later, he notices yet another public school which is being demolished for road expansion purposes. Upon reaching his destination he easily finds a parking spot; Angelenos have stopped visiting shopping areas and reports state that some sectors have seen up to a 40% yearly decrease in shoppers.

He walks down the street and notices that bus stops are poorly maintained, some have graffiti that has never been cleaned, others have benches that are broken or in poor conditions and any sustainable infrastructure such as electric scooters, bikes, shared electric vehicles were removed due to “funding issues”. Jamie does not come to the city center often despite cheaper prices on the products he usually shops for, his reason is mostly due to the fact that most of the city center is full of vehicle dealerships trying to lure in potential buyers and it becomes an annoyance since he is usually in a rush to get where he needs to be. Additionally, these new autonomous vehicles are massively expensive for your average Angeleno, so Jamie does not even bother to glance in that direction. In the last 5 years car manufactures have spent so much money lobbying for regulations that favor them. This has led to tax cuts in their favor and using traffic and congestion data which they’ve collected to strategically setup car dealerships around Los Angeles.

Jamie has finished most of his errands in the city and it is now time to head back home. He needs to make it back home before 8 p.m. in order to get enough sleep and not feel exhausted when his alarm clock rings at 4 a.m. He has been late to work 3 times this month and his current employer removes 5% off his paycheck each time he is late, this

has been rules imposed by companies lately which regulators have claimed as “legal although unethical”. Nonetheless, Jamie rushes to his vehicle and sets up the GPS on his phone to the best route, he uses his phone mostly because unlike vehicle navigation systems his cellphone application is free of influence from tech companies.

8.4 “The Techformation of Los Angeles Transit Systems”

PESTLE 4	
Political	<ul style="list-style-type: none"> • Governing parties have left the issue of congestions to tech giants who provide strategical approaches as a “service” • Issues of housing costs go unaddressed by political parties • Government is convinced that tech giants can also run public transit system more effectively • Tax breaks for tech companies who aid government against congestion are approved • Tech giants provide funding for the development of infrastructure in L.A.
Economical	<ul style="list-style-type: none"> • L.A. moves up the GDP ladder • The average Angeleno sees an increase to their salary and wages • Angelenos spend less on gas and transportation costs overall • Angelenos use of public transit systems increase due to improved strategic approaches offered by tech companies, thus, less money is needed for transportation
Social	<ul style="list-style-type: none"> • In return for improved transportation conditions privacy is sacrificed • Health conditions related to congestion (emissions from vehicles, etc.) improve • Citizens know they risk being monitored by tech companies • Citizens know their privacy is forfeited as soon as they exit their homes, while it makes them nervous/paranoid they accept it in exchange for historically low congestion levels
Technological	<ul style="list-style-type: none"> • Tech giants develop automated software so far it tracks every aspect of the users of L.A.’s transit system • Autonomous vehicles use systems that gather extensive data on driver behavior • Data gathered by autonomous systems are sold to third parties • Insurance companies also provide driver behavior data to tech giants in order to “improve” their software • Tech giants sell traffic and congestion patterns to third party companies

Legal	<ul style="list-style-type: none"> • Laws and regulations fail to catch up to innovation thus unethical business practices become the norm • Tech giants face minor penalties, a fine at most if caught “violating” privacy rights • Companies exhibit aggressive lobbying patterns in order to continue providing their “services” with little regulation and barriers to privacy concerns • Tech giants eventually end up writing their own laws, policing themselves
Environmental	<ul style="list-style-type: none"> • L.A. is recognized around the world for being the most sustainable city • Autonomous cars, busses and trains are highly dependent on solar energy or are fully electric which comes to great health benefits for its citizens and for the environment • Sustainable development of L.A. expands to other areas besides its transit system • Eco-friendly approaches to transportation are credited with being the reason congestion has improved in L.A.

Narrative 4:

Daenerys is almost done with her work day, she grabs her mobile device to make sure that her vehicle is not fully charged, otherwise she risks being charged a fee for driving a fully charged vehicle on the road. Tech giants have developed most of the infrastructure in L.A. and they have implemented regulations such as making sure your vehicle needs charging when you decide to drive or risk a fee, they state that if your vehicle is fully charged then you must seek alternative methods of transportation such as the bus or metro. Daenerys prefers to set her route on her driver-less vehicle because it is more comfortable, but she is not bothered if she has to take public transportation home, after all, bus and metro services have come a long way in L.A., they are almost always on time and experience few delays.

Angelenos have experienced a long reign of prosperity after Los Angeles partnered with tech giants to address climate change in their transit systems, urban planning, and for addressing congestion in a strategical manner. Most people in L.A., like Daenerys, spend less on a transportation, live in a city where risks to health as a result of poor environmental conditions are at incredibly low levels and have seen an increase in their wages. These results have been credited to the success private companies have had in addressing congestion issues via innovations produced in their industry. Moreover, these companies or tech giants, usually refrain from taking all the credit on their successes, they usually shift the spotlight towards the government of Los Angeles.

Despite the current state of Los Angeles, which 10 years ago seemed like pure fantasy, Daenerys and some of her colleagues know there is an issue which is shadowed or overlooked as a result of the fruits L.A. has harvested when partnering with private

companies or tech giants to combat congestion. Big data and privacy, Daenerys has to sign off all her data in terms of services in agreements which are drafted by tech companies, additionally, these tech companies usually write their own regulations which city officials simply sign off on. Every once in a while, Daenerys hears, via the media that a fee has been issued against certain companies for violating privacy laws, but the fees are generally small and not enough to encourage any changes in said company's behavior.

Daenerys is an attorney who specializes in protecting client's private data along with consumer rights, she is well aware of the practices carried out by tech companies which have become the norm. Unfortunately, this is an issue which politicians are afraid to touch, especially since voters are more concerned in keeping congestion low, even if companies sell and do as they see fit with data that is collected on them. Data privacy activist continue to fight for more protections and Daenerys has anonymously joined the fight, she fights incognito because she is worried about any repercussions if her name were to be affiliated with such a cause.

9 CONCLUSION

It has become apparent after my research that while Los Angeles has made many attempts to combat traffic and congestion issues there seems to be minor advances in the way the issue is addressed. There have been some strategic approaches such as "carma-geddon" and sustainable approaches which have only helped alleviate congestion in a temporary manner, temporary in the form that the issues simply reset and go back to the status quo after 12 months. Technological approaches have also been minor, while systems which as synchronized traffic lights have helped they have also proven to be one thing, a massive expensive on the city which is often funded via tax payer dollar. Moreover, there are other issues such as poor public transit ridership levels and inefficient urban planning which, in my opinion, needs to be developed in a more precise manner in order for city officials to address congestion in general. Furthermore, while the automobile industry is making promises of autonomous vehicles, the city of Los Angeles is far from being adequately prepared for such concepts implementation.

Next, I proceed to elaborate on the answering of my research questions. The first question, how will automation and machine learning effect congestion and transportation within cities? I answer this question by referring to on-going technical innovation within the automobile industry, innovations such as autonomous driving or driverless vehicles will have a huge impact on congestion and transportation. I believe this is the case because of developing systems such as Industry 4.0 which has the potential to communicate with data from the physical world and create an analysis for autonomous systems to interpret and then act accordingly. Moreover, the primary impact which automation and machine learning will have on transportation within urban areas is that it will remove

human behavior which may contribute to traffic and congestion, such as going back to driving the same routes once they have noticed traffic has slowed down in their usual routes. It is not unreasonable to conclude that these automated systems will not make such mistakes as their behavior will be driven by analyzed data.

My second research question, what type of effects have the solutions pursued by Los Angeles had on traffic and congestion? This question is answered in my research by referring to concepts such as sustainability which has been a theme that has been aggressively pursued by Los Angeles mayoral candidates, temporary reduction in congestion levels, the realization for the need of smart technology in the city's traffic grid, etc. However, there have been other effects which I conclude have been in the negative spectrum of the matter. One negative effect is the continued pursue of road expansion which does not help, researchers and all kinds of experts have continuously expressed that the expansion of roads is not the solution, yet it seems their statements are ignored. Housing issues have also been ignored via these solutions and strategies, my research has demonstrated that Angelenos move towards the outskirts of the city in order to be able to afford a home, this creates massive transport movement at the same time into and out of the city, officials know, yet this is not something urban or city planners seem to prioritize.

Research question number three, will private companies play a significant role in the development of city planning in the future? This question is answered in part but not entirely, one cannot state the future and I do not claim to know what the future shall be; however, you can engage in foresight and make an educated projection based on research. My research demonstrates that automobile companies, which tend to be private, have the possibility of naturally looking to play significant role in city planning due to their autonomous vehicles. Also, companies who are already acknowledging the industry 4.0 system are looking to play a major role in strategical development, while it may not be an element that is specific to urban planning or transit systems it will work very well on tackling the issues in such systems are challenged with. Furthermore, if my fourth Scenario "The Techformation of Los Angeles Transit Systems" is actualized then the question can be directly answered by addressing the situation at the time (the scenario). This scenario is one where private companies essentially run the entire city grid of Los Angeles, it helps address congestion to a point where citizens are willing to allow access to their private data in order to ensure that congestion remains controlled, this leads to bigger issues such as privacy and security concerns.

Next, I move on to discuss the societal impact in the content of my research and writing. Researching traffic and congestion does not have to be specific to Los Angeles, most developed countries already have populations which are amassed in urban areas, under developed countries are also following this trend and this is not something which we will slow down, perhaps not even in our life time. Congestion in Los Angeles has been addressed by applying temporary fixes, the issue has grown so large that it has

prompted experts to include themes such as pollution and health matters and also the cost of housing as having an influence on the matter. My research and writing also places influence on the massive impact technical innovations will have in our mobility, especially in transit systems. These innovations will have the opportunity to work in interconnected systems by communicating with each other in order to yield favorable results. How these results are used, sold, handled is something that will challenge the world as we continue to move forward, and technology continues to make rapid advances. Furthermore, automobile companies and other companies which will make use of industry 4.0 for profits will wield enormous power in the future, it is important that such power is not used in a misguided manner.

In terms of a scientific impact I would like to point out that my research and writing implores city planners to use futures tools when attempting to solve urban issues such as traffic and congestion. Tools such as PESTLE and scenario making would provide urban planners with an adequate view of what congestion may look like in Los Angeles in the future. Moreover, from said views they will be able to make more concrete decisions, especially because via foresight because you also consider elements which are traditionally outside of the real of the phenomena you may be studying or attempting to create a strategic approach to. The innovation within related industries is also something which can be studied as society progresses, the impact these innovations will have on decision making, laws and regulations is something that should continue to be researched now, especially since most experts have noted that Los Angeles does not have the available infrastructure in order to meet such innovations, but this is something that can change in the future. There are other areas of congestion, automation and machine learning which are not covered in my thesis due to having to how large these concepts are, especially congestion. These areas that I did not cover can be identified and further researched in the future.

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