

Mid-Term Essay
Engineers rule the world
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Introduction

Our modern world necessitates many essential goods, services, and infrastructure on a daily basis. Therefore, technically, any profession that is involved in the production or supply of these essential goods, services, and infrastructure could be construed as "ruling the world".

The reality is that this is an illustration of a false dichotomy: when one claims something "rules the world", it implies that a single entity rules the world while everyone else does not. The truth is that the economy and resource chains are intricate things and involve a large number of entities. No single group of people single-handedly "rules" over the world so much as everybody contributes to it.

The world is run by those who enjoy telling others what to do and do it properly. The ones good at manipulating people and navigating hierarchies. A leader might be an engineer, but that's just incidental. They might be wearing a hat, or they might be blonde, but we wouldn't say that hat-wearers or blondes rule the world either. There can be some thoughts like what if an engineer force other to do something. It seems the engineer is acting as an extension of somebody else. Perhaps a regulator on behalf of some politicians (who are rarely engineers, at least in the US!) or perhaps someone senior at work on behalf of management—but rarely an engineer acting as an engineer on their own (*I*).

After all, who rules our world? The CEO of the company, management, politicians, whatever, some sort of social leader. It has nothing to do with being an engineer. It's just a quick thinking how few engineers there are in Congress or at the head of large corporations. And even the leaders who have been engineers in the past usually aren't any more, having given it all up in favor of leadership above all (*I*).

On another note, engineers not only do the job at hand but know how to work across needs. They understand software and hardware must work together and serve a common goal. They understand that what they do today will impact tomorrow and calculate what's next before it arrives. Moreover, engineers have seen their budgets shrink year after year, yet somehow, they keep creating amazing designs on a dime. Meanwhile, our leaders spend major money trying to get companies to create a back door to smartphones.

Machines: Creation of Engineers

Player Piano tells the story of a man named Paul Proteus. He lives sometime in the not-too-distant future in the United States, in the aftermath of a grand world war which has given birth to a massive mechanization of the entire country. His father pioneered the birth of the society and he is following in his father's footsteps as a major manager of a plant in Ilium: futuristic New York. He becomes more and more dissatisfied with what turns out to be their very unfair and unfulfilling new way of life, and finally drops his former life as a plant manager to take part in a revolution against the authority. He is swept along with the events of their rebellion entirely out of his control, and at the end of the novel, they appear to be successful in dishelming the machines- but with the dreary reminder that they will always eventually return, and history will come full circle once more.

The lessons from this novel can be described from different perspective. Ingenious automated systems were developed, which rid factories and other work forces of human labor completely. Now, ten years after the war, machines have replaced everyone's jobs. Thus, it depicts the dystopia of automation in the near future, and the detriment this causes to quality of life. Significant themes are mechanization, class struggles, dystopian fiction, technology, and the uses of irony and sentimentality.

Humans, Machines and the Future

A future with intelligent machines is a wonderful thing: we won't have to work and can instead engage in meaningful leisure activities. The problem with this is that it requires a huge economic adjustment — and

such an adjustment can take a long time. Societies took at least 200 years to fully adapt to the industrial revolution (3). It started in the 17th century, but full adaptation only came with the development of the modern social-democratic state with its social-safety network, which didn't appear until after WWII. Economically adapting to the new changes within a few decades is a huge challenge.

Beyond the economic issues there is also a philosophical question: what is the good life? Is a world without work, without meaningful employment, really going to make us happy? Or is it going to make us dissatisfied, restless and even dangerous, as happens on Theodor Herzl's 1904 play *Solon in Lydia* (4). In the play the ancient Greek Eukosmos develops a way of making flour without growing wheat, eradicating most people's need for work. The effect on society proves disastrous and Eukosmos eventually drinks a chalice of poisoned wine to make sure he and his dangerous method perish forever (3).

The industrial revolution took off on the discovery of fossil fuels: a source of energy that doesn't depend on human or animal labour. Fossil fuels liberated us from labour in an unprecedented way. But we're now paying the price of climate change. Getting off the fossil fuel train is proving incredibly hard. Maybe this is the time to think before it happens, not after. To quote Nigel Cameron, leader of the Center for Policy on Emerging Technologies (C-PET), "Will a world without work be heaven or hell? Now is the time to think it through." (5)

Autonomous Vehicle and The Future

Current Scenario

Currently, Human error accounts for more than 90% of car crashes. More than 37,000 people died in U.S. roads in 2016 -- the vast majority because of human error. Additionally, American drivers spend about 293 hours on average behind the wheel annually, whereas, 17 hours a year searching for parking spots (*US Today*). After the automation of the vehicle, it could reduce traffic fatalities by 90% once fully deployed (*US Today*).

AVs - Transformation in the Economy

Increased productivity will come in many forms. Driverless cars will improve traffic flow and reduce accidents, that means less time commuting to work and less time in court for traffic tickets. One can even work while in the driverless car since doesn't have to pay attention to the road. Driverless vehicle will cause gradual displacement in jobs. However, people may find other things to do. The AVs will cut the labor cost and make a reduction in process of goods. Parking lots can be used for other purposes and more spaces will be available (6).

Autonomous Vehicles - Who will be affected

There's no doubt driverless cars will make our lives easier, save drivers time and provide significant user convenience. They will improve passenger safety and make our commutes to work more predictable. They will deliver the ability for people to do other things while traveling, freeing time for much-needed sleep or remote work and collaboration. However, the following thing will happen with automated cars, with many industries feeling the impact:

- **Parking**

Driverless cars will drop passengers off at their destination and go find parking elsewhere (or remain on the road if they are part of a ride-sharing program). The U.S. has about 144 billion square feet of total parking, which represents up to one-third of the total real estate in some large cities. Reports estimate self-driving vehicles have the potential to reduce parking space by about 61 billion square feet, which is about the size of Connecticut and Vermont combined. A reduction in the demand for parking can result in reclaiming this valuable real estate for more beneficial social and

economic purposes. However, it also means significantly less money for cities through parking tickets. In 2012 alone, Washington, D.C. collected \$92.6 million in parking ticket revenue (7).

- **Real Estate**

While freeing up parking space may present an opportunity, real estate agents should be worried. Faster and easier commutes will shift residential value from properties in urban centers to those in suburban areas. In commercial real estate, spaces currently predicated on human drivers will be converted to other uses. For instance, PARTNER Engineering CEO, Joe Derhake, has suggested there will no longer be a need for gas stations on busy street corners to attract people's attention (7).

- **Law Enforcement**

In 2014, Washington, D.C. issued an average of 773 tickets per day from cameras used to identify speeding cars — adding up to roughly \$37.5 million worth of fines, according to the latest figures from AAA Mid-Atlantic. Self-driving cars will significantly reduce the number of speeding tickets. In addition to the decline in these tickets, we can also expect to see less drunk driving and other traffic violations, which may lead to a decrease in the size of police forces or shift people and resources to more important areas of serving and protecting the public (7).

- **Insurance**

About 90 percent of car accidents are caused by human error. In the world of autonomous vehicles, we can expect to see a major reduction in the number of accidents, which will significantly change the insurance revenue model. As the risk of accidents drops, demand for insurance will take a sharp dive as well. In anticipation of this shift, some insurers are rolling out usage-based insurance policies (UBIs), which charge consumers based on how many miles they drive and the safety of their driving habits (7).

- **Legal Professionals**

Personal injury lawyers will see a significant decrease in demand for their services. Vehicle collisions, which accounted for 35 percent of all civil trials in 2005, will be all but eliminated with automated vehicles. While this may seem like a niche of professionals, around 76,000 attorneys in the U.S. specialize in personal injury and make up approximately 6 percent of the country's population of lawyers (7).

- **Hotels**

The need for lodging will drop as people sleep in their cars during overnight road trips. Utilizing cars as a moving motel is much more cost-efficient and convenient than purchasing a hotel room. Audi's vice president of brand strategy and digital business, Sven Schuwirth, has predicted that car interiors will eventually be able to morph between driving mode and sleeping mode, presenting a major obstacle for the hotel industry (7).

- **Media, Entertainment and Online Retail**

Experts predict there will be more media consumption as autonomous cars transform into rolling living rooms. A report by McKinsey and Company finds each additional minute occupants spend on the Internet could generate \$5.6 billion annually, totaling \$140 billion if, for example, half of the time of a 44-minute average round-trip commute is spent online (7).

- **Package and Food Delivery**

For delivery services, there will be enormous economic gains: McKinsey estimates between \$100 to \$500 billion per year by 2025 from driverless vehicles in the U.S. trucking industry. However,

the bulk of this windfall will come from the elimination of truck drivers and their wages. We're already witnessing the digitization of package delivery systems with drones and UberEats, but the effects will become more devastating for drivers when autonomous cars are the norm (7).

- **Auto Repair**

With multiple sensors, no distractions and no drunk driving, self-driving cars will largely eliminate car crashes, so collision repair shops will lose a huge portion of their business. Indirectly, the decreased demand for new auto parts will hurt steel producers and part manufacturers. In 2010, 24 million vehicles were damaged in accidents, which had an economic cost of \$76 billion in property damages, according to the U.S. Department of Transportation. The loss of this revenue will put a strain on these manufacturers (7).

- **Auto Manufacturing**

By 2030, PwC predicts electronics will account for 50 percent of automobile manufacturing costs, up from one-third today. With Intel buying Mobileye for \$15.3 billion, we're already seeing a shift in value from traditional auto manufacturers to software and electronics companies, which will form the core of all automotive systems. Traditional parts manufacturers will face competition from more technology-focused companies like Nvidia, which has already been tapped by automakers to help build the computers needed for driverless cars (7).

Economic Effects of AVs

When autonomous driving becomes a reality, what effects will it have on our economy and society? Some people say it will bring fundamental changes. In the US, a series of organizations in both business and academic spheres have estimated the economic effects of autonomous vehicles.

According to an estimate by Intel Corporation and Strategy Analytics, announced in June 2017, the economic effects of autonomous vehicles will total \$7 trillion in 2050 (Figure 1). The dollar amount represents a newly created value or a new 'passenger economy', calculated based on the assumption that fully automated Level 5 vehicles will be on the roads by 2050 (8).

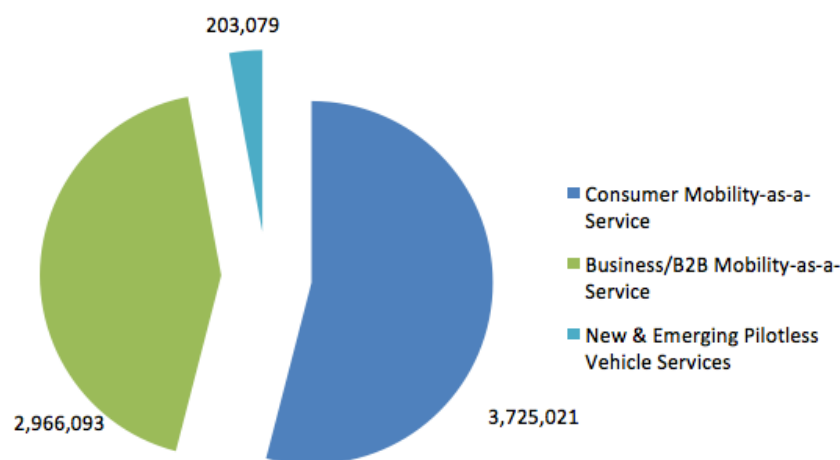


Figure 1: Global service revenue generated by autonomous driving in 2050 (US\$ millions)

**Source: Strategy Analytics (2017).*

They also assumed that consumers and businesses will use Mobility-as-a-Service (MaaS) offerings instead of owning cars, and those who had been commuting to work by car will become passengers and spend the commuting time doing something else. Furthermore, transportation companies suffering from a serious

labor shortage – such as long-haul truck operators and home delivery service providers – will introduce autonomous driving services, thereby enabling them to change their business models drastically. As such, the estimate reflects a very broad range of potential effects, which also include a wide variety of new commercial services such as onboard dining and retailing (8).

Positive Aspects on Economy

Albeit private ownership of cars reduces dramatically, the overall automotive market will likely expand as the vehicle distance travelled (VDT). The trucking and freight industry improves transport efficiency. Moreover, it will enable trucking companies to transport larger quantities of freight at lower costs, resulting in an increase in economic benefits. Besides, there will be a decrease in congestion pricing. Approximately \$488 billion of cost will be saved through a reduction in injuries and deaths caused by car collisions. The overall economic effects of autonomous vehicles, which combine both industry-specific and economy-wide effects, amount to more than \$1.2 trillion, or \$3,800 per capita (8).

Summary of Economic Effects (Industry- and Economy-Wide)

Researchers in the sphere of academia have also conducted a series of detailed studies. Clements and Kockelman (2017) estimated the economic effects of fully autonomous vehicles in the US, measured in terms of net economic benefits to society, to provide a comprehensive view by integrating findings from multiple studies and, using additional data, to generate estimates of industry-wide effects (Table 1).

Table 1: Summary of economic effects (industry- and economy-wide)

Industry	Size of Industry (\$ billions)	Dollar Change in Industry (\$ billions)	Percent Change in Industry (%)	\$/Capita (\$)
Insurance	180	-108	-60%	339
Freight Transportation	604	+100	+17%	313
Land Development	931	+45	+5%	142
Automotive	570	+42	+7%	132
Personal Transportation	86	-27	-31%	83
Electronics & Software	203	+26	+13%	83
Auto Repair	58	-15	-26%	47
Digital Media	42	+14	+33%	44
Oil & Gas	284	+14	+5%	44
Medical	1067	-12	-1%	36
Construction & Infrastruc	169	-8	-4%	24
Traffic Police	10	-5	-50%	16
Legal Profession	277	-3	-1%	10
Industry-specific Total	4480	418	9%	1312
Economy-wide Total		Dollar Change in Industry (\$ billions)	\$/Capita (\$)	
Productivity		448	1404	
Collisions (*)		488	1530	
Economy-wide Total		936	2934	
Collision Value Overlap (*)		-138	-432	
Overall Total		1217	3814	

The most affected is the automotive industry. The authors estimate that although the penetration of car-sharing services may reduce private car ownership dramatically, the overall automotive market will likely expand as the vehicle distance travelled (VDT) increases in a broad scope of users – elderly people, persons with disabilities, and so on – who are enabled by autonomous driving to enjoy the convenience of automobiles without physically driving them. The trucking and freight industry will be among the earliest adopters of automotive driving as companies seek to improve transport efficiency. Autonomous driving systems will free drivers from the task of driving, and eventually many driver jobs will be eliminated when such systems become a reality (9). This will enable trucking companies to transport larger quantities of freight at lower costs, resulting in an increase in economic benefits.

The realization of autonomous driving will dramatically reduce the number of car crashes caused by human error, which is responsible for over 90% of car accidents, eliminating the need for auto insurance policies. Demand for car repair services, medical services, and traffic police will decrease, too.

As for economy-wide effects, the number of car accidents – which account for 25% of traffic congestion – will decrease significantly when autonomous driving becomes the norm. Improved efficiency in the use of roadways translates into increased roadway capacity, and it is estimated that this would result in approximately \$488 billion of cost savings through a reduction in injuries and deaths caused by car collisions. The penetration of autonomous vehicles would reduce unproductive hours Americans spend driving to work by 2.7 billion hours, enabling them to use the freed-up time working or doing other activities, thereby boosting overall driver productivity by \$448 billion. The overall economic effects of autonomous vehicles, which combine both industry-specific and economy-wide effects, amount to more than \$1.2 trillion, or \$3,800 per capita (8).

With AVs, Public Health, Safety and Society

As previously mentioned, AVs will reduce accidents from human error. It will work to liberate elders and the disabled. It will also eliminate the need for auto insurance policies, demand for car repair services, medical services. Traffic police will be decreased as well. More space for the community can be managed having less noise with better environment.

Interaction of AVs with The Transportation System

Relevant government agencies have been taking various steps toward the realization of autonomous driving. The Public-Private Intelligent Transport Systems (ITS) Initiative/Roadmaps 2017, a government-wide programme adopted by the Strategic Headquarters for the Advance Information and Telecommunications Network Society (IT Strategic Headquarters), has set the explicit goal of realizing Level 3 or higher autonomous driving on highways from 2020 onward and calls for developing necessary rules, regulations, and policies toward achieving that end (10). Concerned parties from both the public and private sectors are also joining forces to test autonomous vehicles, such as the large-scale highway testing of autonomous vehicles and the testing of remote-controllable pilotless vehicles on public roads within designated areas.

The implementation of Autonomous Vehicle may affect the transportation system in a several ways. It is going to decrease road accidents and congestion, which results in improved efficiency. Essentially, improved efficiency in the use of roadways translates into increased roadway capacity. It requires less space than conventional cars and no signs or signals required. Subsequently, it may cause a reduction in the need for car parking spaces. As a result, people will be able to use car-sharing services whenever necessary.

Conclusion and Thoughts

Autonomous vehicles are going to be noteworthy creation of the Engineers which will interact our society, safety, economy as well as the transportation system. Unmanned vehicles will be evolving industry, with implications not just in various job sectors, but the public's everyday life. Each year we grow closer to fully automated vehicles, with companies vying for an early foothold in the new market front, releasing ever increasingly sophisticated and polished models to fight it out in the automotive arena. Most projections put full saturation of the market at 2070, and therefore we can expect that around **50%** of vehicle sales and **30%** of all vehicles in use would be fully autonomous by 2040, the impact of which will be profound (11). However, before it is fully deployed, some questions should be kept on mind to make ourselves better prepared for the upcoming future. What sort of transportation system should we build when fully automated vehicles become the norm? How should we change urban landscape including land use and how should we redesign the economic and social systems? What will be the road infrastructure? And, how people will be

made comfortable about the new changes? If these questions can be addressed, then, things can be planned in a proper way before the situation get worst due to unprecedented malfunctions.

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