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Thoughts on the [Second] Revolution

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Elaine Herzberg, a 50 year old woman was killed by a driverless test automobile in March of 2018 in Tempe, Arizona. At the moment of the accident, Elaine was pushing a bicycle with groceries against traffic. She was wearing dark clothes and tested positive for meth and marijuana per National Transportation Safety Board (NTSB) investigation.

As it turns out, the sensors in the semi-autonomous car did not detect the presence of Elaine in the roadway and the car failed to brake. The safety driver, sitting in the back seat, was responsible to take control if necessary and she responded late. Ms. Herzberg died as the result of her injuries. Elaine Herzberg's death has punctuated the debate about the second revolution of the automobile, namely automation in trucks and cars. What do we make of all this?

The first revolution was the invention and development of the automobile. "The machine that changed the world." Production vehicles began appearing in 1887, 133 years ago, when Karl Benz developed a gasoline-powered automobile. Recent automobile production is marked by the Ford Model T, created in 1908, which became the first automobile to be mass-produced.

Today, we are in the midst of a second revolution in the world of automobiles and trucks. After decades of development, we are closer to the goal of fully autonomous vehicles. In the same manner as the development of the automobile, the new paradigm - driverless vehicles - is gaining momentum as numerous companies such as Google, General Motors and Tesla are in late stages of development.

The timeline of various automotive technologies dating back to the mid-twentieth century includes the standardization of cruise control, seat belts, and brake lights. Today we have tire pressure sensors, rear facing cameras, keyless ignition switches, and so on.

In certain respects, the future is now. The development of autonomous vehicles has advanced to the late stages. The question is how fast will we adopt the new technology and how receptive will consumers be to the new paradigm, driverless cars.

There are six levels of driver assistance according to the Society of Automotive Engineers (SAE). Many of us today drive cars that are at level zero- that is no automation. Some of us have automobiles at level two such as adaptive cruise control, the cruise automatically adjusting speed depending on the distance from the vehicle in front. Other autonomous features you may recognize are blind spot detection, collision warning, and lane warnings. Test vehicles in California and Arizona are testing at level five in defined boundaries; these semi-autonomous cars are already on the road including the Volvo involved in the fatal accident in Arizona.

You probably have already ridden in a driverless vehicle. If you are familiar with the Minneapolis airport, there is a train shuttle that moves passengers between concourses A, B and C to the main terminal. These shuttles are driverless. We have similar driverless trains in Atlanta, Denver and other major airports.

Disney World in Orlando has the driverless “people-mover” that circles the park. In the same manner, the National Highway Transportation Safety Administration reports that driverless vehicles are currently being used in restricted operations such as mining, farming, factories and warehouses.

Other semi-autonomous trends include Volvo’s “Pilot Assist” with steering guidance functionality. Cadillac promotes “Super Cruise” for hands-free driving, providing you have a subscription, working electrical system, cell reception and GPS signal.

Restricted operations such as mining is one thing; but what about driving in our highways, next to other drivers? Driverless cars and trucks on our highways is a big idea. In a sense, automation is “coming out.” What are the benefits? According to the National Highway Transportation Safety Administration, 94 percent of serious crashes are due to human error. In the same manner, DuPont, a leading safety authority in the workplace, calculates that approximately 96 percent of workplace injuries are attributed to unsafe behaviors of employees. In short, people make mistakes. Will autonomous cars make less mistakes?

McKinsey, a global management consulting firm, predicts that with automaton, accident rates will be reduced 90 percent. Keep in mind that robots don't drink or fall asleep. Robots aren't distracted by a text message for instance. McKinsey further reports that 1.2 million people a year are killed in car accidents and predicts that automation could save one million lives a year. Emissions could be cut by up to 60 percent according to McKinsey. What's not to like?

Detractors cite safety as a primary concern. We learned about the dangers of automation failure with the story of the woman who was killed in Arizona. And big questions remain. Ethical questions on the programming decisions; regulatory questions; and cyber security. When is safe "safe-enough". Robots may not drive impaired; but a hacker with control of an autonomous vehicle would be obviously problematic.

Some detractors warn that driverless should not mean human-less. Why would we trust anyone to develop a safe-enough vehicle when we struggle to paint the lines in our roads. They predict the technological change is more of an evolution rather than a revolution. Furthermore, detractors predict that there will be a mix of driverless and driver-controlled vehicles until the infrastructure, currently designed for human driving, is fit for autonomous purposes.

Mark Kulansky, in his highly readable book *Paper: Paging Through History* describes the technological fallacy that technology changes society. Kurlansky argues, convincingly in my view, that it is "society [that] develops technology to address the changes that are taking place within it."

One example of how society influences technology, the example Kurlansky cites in his book, is the invention of the camel hair paint brush in China in 250 BCE. Apparently, the camel hair paint brush was a significant technological breakthrough in art. However, people did not start to paint because of the paint brush, rather the paint brush provided a device that provided better quality than previous tools. The change had already taken place.

Has the change already taken place in our society to adopt driverless vehicles? Are we demanding driverless cars and trucks? James Womak, in his book *The Machine that Changed the World*, namely the automobile, describes the benefits of new technology. Womark reports that the benefits of technology, and presumably the automobile, include more choices for the consumer; changing and [improving] the nature of work; and changing the fortunes of companies. In my view, we could say the same about the second revolution- autonomous vehicles.

Automation certainly changes the nature of work. Mark Cuban, entrepreneur and television personality, in a recent promotion for the robotic industry promoted automation to replace jobs that were dull, dangerous, and dirty. Some of the many jobs that automation will replace may be dull, dirty or dangerous, but they are relatively good paying jobs. Like job losses in coal mining; robotic factories; and farms; driverless vehicles will contribute to a loss of delivery drivers, truckers, cab drivers, and so on.

This cumulative job loss has contributed to the unrest we have experienced over time and increasingly in the past decade, the stress of job loss accentuated in the recent election. Gerald Seib, in a Wall Street Journal article argues that these jobs are the traditional path to middle class for many Americans; “these workers feel that they are losing control of their economic future.”

Which reminds us of the story of the Luddites, the textile workers who revolted when machines took over their craft jobs in England in the 19^{th}-century. These workers believed that machines would replace them- these workers were right. The machines did replace the workers. Economists remind us that the Luddites acted rationally from an economic point of view. They were losing their jobs. In the same manner, and in my view, people losing their jobs today such as truck drivers and delivery drivers will likely oppose this change in technology.

On the other hand, other benefits are reported savings of millions of hours of driving time; less parking space needed; less cost of accidents; with significant reduction in vehicles injuries and deaths. We could work in the car; play games in the car; and other possibilities.

What is Next? The proponents of automation in vehicles predict that we are close to acceptance and use, most likely in parcel delivery, trucking, and low speed shuttles such as bus transportation. People may stop buying cars as car sharing services become cheaper. Car sharing is predicted to reduce car ownership; the driverless vehicles simply driving all the time- rarely parked.

Truckers will be likely first to feel the impact. Long over-the-road trips will likely be automated as the industry accelerates its hub-and-spoke strategy. Specifically, McKinsey projects that 33 percent of trucks will operate autonomously by 2025. Keep in mind that future trucks will be more productive as there will be no requirement for scheduled rest periods. Significantly, the Department of Transportation is developing standards including cyber-security; manufacturer claims and future infrastructure.

In any event, driverless vehicles on our roadways is a matter of time. The supply chain will benefit by reduced labor costs, “the gift that keeps on giving” providing for lower cost goods and services. After all, robots do not call out sick and do not require wages or benefits. Robots also do not take time off to watch the Super Bowl, or recover the day after.

For those interested in the engineering, Tesla, one of the leading companies in this field, has a technological engineering approach by utilizing cameras. Other manufacturers are relying on a technology called LIDAR, a combination of lasers and sensors to map the roads. Conceptually, driverless trucks will not need an accelerator, seats or windshield. A driverless truck may not need doors. Driverless cars will be programmed to drive the speed limit and the European Union is considering mandating speed limiters in cars and truck.

A list of companies currently working on autonomous vehicles includes Tesla, General Motors, Ford and many others. Tesla has a big advantage since autonomous cars all talk to each other- accelerating the knowledge, Tesla is building data from its one-million cars on the roads today, comparing what the computers would do and what the driver actually does- in other words, machine learning. Ford, for instance has committed seven billion dollars for development through 2025, one example of the big bet on technology.

There are numerous other companies investing in this technology. The investment in autonomous driving is significant and anticipation is growing. The technological risks include the lack of centralized standards and an infrastructure currently designed for human driving. On the other hand, we should be able to leverage findings from other industries such as mining and aviation. As I mentioned earlier, the burning question is when is safe "safe-enough." How will our regulators act and how fast?

The allure of driverless vehicles will remain. Blind and disabled people will have more independence. Companies will adopt the new technology, which will certainly displace people in the industry. The technology is disruptive and in the end, society will have more choices.

Elaine Herzbergs' story brings to mind the story of Bridgett Driscoll. In 1896, Bridgett was reportedly the first pedestrian killed by an automobile. Bridgett, a 44-year-old mother from the United Kingdom was killed in an automobile accident, a demonstration car driving probably no more than ten miles an hour. The local coroner reportedly said that "he hopes it will never happen again."

In summary, fully autonomous vehicles are fast approaching because, despite the challenges and the detractors, in the long run, the new paradigm becomes the norm. In short, and as Kurlansky reports in his book, "Luddittes never win."

Notes:

Regarding the Tempe accident. Rafaela Vasquez was the safety driver and her job was to take control of the vehicle in certain situations. In this case, and by most accounts including the NTSB, she was late on her response to stop the car. The NTSB investigation found that her smart phone was streaming "The Voice" television program at the time of the accident.
Interesting, the local district attorney recused his office in the investigation because his office had earlier supported driverless car testing as a potential benefit to reduce impaired driving. Vasquez was indited by a Grand jury for negligent homicide and upcoming trial is expected in 2021.

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