

MOBILITY INDUSTRY INSIGHTS

Researched and written by Michael L. Sena

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In Mobility Industry Insights we will investigate and debate the issues that affect how people and goods are transported, how governments attempt to enable and restrict transport, how consumers decide which transport options they will use, and the methods being used to make mobility safer, more convenient, and more affordable for all. We will discuss and debate the issues, presenting multiple perspectives, and will solicit views from a variety of sources.

Addressing the Opposition to Driverless Riding

"Innovation is hard. It really is. Because most people don't get it. Remember, the automobile, the airplane, the telephone, these were all considered toys at their introduction because they had no constituency. They were too new."

Nolan Bushnell, founder of Atari, Inc. and the Chuck E. Cheese's Pizza Time

ABRIDGEMENT

As you read through the beginning of this MII and begin to wonder what a discussion about ethical theories and moral philosophy have to do with deciding whether driverless cars are good or bad (i.e., why there are advocates and why there are adversaries), you might ponder these facts: Amish people don't drive cars at all; Orthodox Judaism prohibits its practitioners from turning on a light switch during the period of Shabbot, from approximately sundown on Friday until sundown on Saturday; it took until 2018 for Saudi Arabia to lift the ban on women driving cars, a prohibition that was based on the conservative interpretation of Islamic law requiring women to avoid mixing with men in public; Tesla Model Ss were not allowed into certain Chinese military zones because they are equipped with cameras, which are there to help the car stop if its driver is not paying adequate attention to his or her driving; Hummer H1s were banned in The Netherlands because they were deemed by the country's politicians to be too big and thereby dangerous for urban traffic and not suitable for their roads (although they were deemed suitable for roads in most other countries, and even though Dutch men and women are the tallest in the world. Was it maybe because Dutch politicians are short?)

At some point, societies will decide whether to allow vehicles to be driven around on their public highways and byways without a human driver behind the wheel because those who decide what is allowed in their countries will conclude that this is a good and just and right decision for their country and the country's people. Or they will decide that robot-driven vehicles are the antithesis of good and just and right and ban them, like they are currently banned in most places in all countries. The decision-makers' rationale of what is good and just and right for the people in their countries will depend on the foundations for their own existential realities, and that is why I have included a discussion of ethical theories and moral philosophy in this Insight.

We may forget that societies make decisions based on their ethical values, and it may also surprise us that most countries specify their ethical values in a written and official constitution. (The UK is an exception.) The United Nations believes that the building and operation of automobiles and other motorized vehicles are so important that it has created special agreements governing them and has devoted considerable resources to developing standards related to them. The UN still says every vehicle shall have a driver.



“Our biggest invention was the inventor, and all of our inventions have been aimed at one goal: making it possible to do more work with fewer human hands. The side effects have been to be able to do many things at the same time, and to do them faster.”

Michael Sena and Alain Korhauser
in

The Real Case for
Driverless Mobility

Maximize utility, produce benefits, and prevent harm

THERE ARE FORCES on both sides of the driverless vehicle development topic: those who are in favor and those who are opposed. Those who are in favor focus principally on safety benefits which may be derived from eliminating human follies, foibles, and faults. They point to the potential advantages of riding in a personal mobility vehicle while having the ability to do in a car what is possible on mass transit modes or as a passenger in a car, not as a driver. Although there has been very little discussion of the cost-saving potential for ride delivery resulting from removing the main cost of human-driven ride delivery solutions (i.e., the driver), this is most likely the strongest argument in favor of driverless vehicles.¹

Opposition to driverless vehicles exists for various reasons. They include concern over the safety issues presented by vehicles being driven by robots, fear that it is one more step in the process of marginalizing humans, resentment over the loss of jobs that would result from replacing humans with robots, unease over competition with public transport alternatives, or simply bewilderment over why the world needs robot-driven vehicles when human drivers are perfectly capable of doing what they have done for the past one hundred-and-twenty-five years.

Supporters of and investors in driverless vehicle development solutions have received a more prominent place in the public media, and, as a result, there is a perception of inevitability that driverless vehicles will be available for sale to consumers within a relatively short period of time. This perception is reinforced by the operational tests being performed in a number of U.S. and Chinese cities by Waymo, Tesla, Zoox and Baidu. Having companies which have some of the highest market capitalization values financing these tests, including Alphabet for Waymo, Amazon for Zoox, Tesla, and Baidu, lends a great deal of credibility to the belief that we will all soon be riders, not drivers.

Although perception is not reality, perception has a potent influence on how we look at reality.² People may believe that driverless vehicles work flawlessly because they have read articles or seen videos praising their performance, but before these vehicles are going to be allowed on public roads they are going to have to prove that they do operate flawlessly. All of the concerns about driverless vehicles must be addressed in one way or another if driverless vehicles have a future. Either there need to be solutions found to meet the reasons for the opposition and allay fears, or there need to be arguments presented for why the driverless option, on balance, provides greater benefits than human-driven vehicles to a larger number of people. Luckily, there are ways of going about this task that our ancestors started practicing a few thousand years ago.

How do you argue in favor of using a machine to do a task that is done by a human, a human that obtains both personal satisfaction

¹ Korhauser, A., Sena, M. The Real Case for Driverless Mobility. Elsevier. (2024).

² Taylor, J. Perception Is Not Reality. Psychology Today. (August 5, 2019)

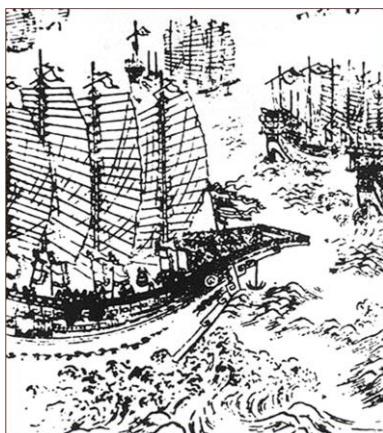
and material rewards from performing the task, a human who is expected to act according to moral and ethical standards and who can be held liable if these standards are regulated by law and they are not followed? Humans have faced this question throughout their history. They have never achieved unanimity in their decisions, but eventually, have reached consensus.

We forget that old ideas were once new

Our first reaction is often to reject and ban new inventions because we believe they are dangerous, economically upsetting, immoral, unwise, or simply too unknown for our own good. For example, the Amish prohibit the use of automobiles, viewing them as symbols of individualism and materialism. Instead of motorized cars, trucks, and tractors, they use horse-drawn vehicles for work and transportation. Another example is Orthodox Jews not being allowed to use electrical devices on Shabbat, including not being allowed to turn on a light switch. This ban is based on the Biblical prohibition against igniting a fire—or performing any other type of work—on the Shabbat.³ When electric lighting was first introduced, Orthodox Jewish leaders made the fire comparison and followers of its laws suffer the consequences. One of Michael’s college roommates living in a suite of eight students was an Orthodox Jew, and the seven of us had to promise to never leave the dorm room on Friday evening without making sure the lights were turned on.

In some cases, new technologies are seen as a threat to those holding power. Guns, bows, and swords were not allowed in Japan during the Tokugawa shogunate, between 1603 and 1868. This was a period of peace and stability that followed four hundred years of civil war, anarchy, foreign missionary activities, and the proliferation of firearms that arrived from both China and Korea as well as from Europe. The Tokugawa chose to follow a path of isolationism, expelling or killing all foreigners, and strictly enforcing the ban on possession of weapons by the commoners. Of course, the rulers used the banned weapons to enforce their ban.

During the Ming Dynasty in China, exploration sailing ships were outlawed by the court following the seven voyages to the west by the Chinese fleet commanded by Admiral Zheng during the Yongle period (1403-1424). The entire Chinese fleet was destroyed by 1525, and no new ships were built as a result of what was called the Ming Ban. Why? To stop piracy along the country’s coast. Court officials believed that if there were no ships carrying goods in or out of the country, there would be nothing for the pirates to steal, and since there was no need to be close to the coasts to ship goods, those living along the coast would move further inland, out of reach of pirates. The logic of this thinking must have been compelling at the time the Ming Ban was put into place. It didn’t work. The pirates found ways to get to the goods, and because the Chinese had no ships, they could not effectively defend themselves.



Zeng He’s ships shown in a 17th century illustration in the *Wubei Zhi*, a military book on Chinese history. It was compiled in 1621 and contains 240 volumes, 10,405 pages, and more than 200,000 Chinese characters.

³ In the Torah (the Jewish bible), Yahweh (the Hebrew word for God) tells His people (the Jews): “You shall kindle no fire throughout your dwellings on the Sabbath day.” (Exodus 35:3)

The only ones who suffered were the coastal inhabitants who lost their ability to earn an income.

Some examples of opposition to technological progress⁴

Luddites

Luddism in the early 19th century is the go-to example of workers reacting to their labor being replaced by machines. It was primarily artisans and craftsmen in the textile industry who found that their skills could be automated and their ability to earn a living erased. They destroyed the machines and the mills that housed them in revenge for their loss of income. The name comes from the apocryphal weaver Ned Ludd who supposedly expressed his dissatisfaction with his employer after being criticized for how he was using his new tools and destroyed the machines he was supposed to be using. The Luddites' acts of revenge simply accelerated the Industrial Revolution rather than stopping it, and there was little if any retribution paid to the displaced workers.

Anarcho-primitivism

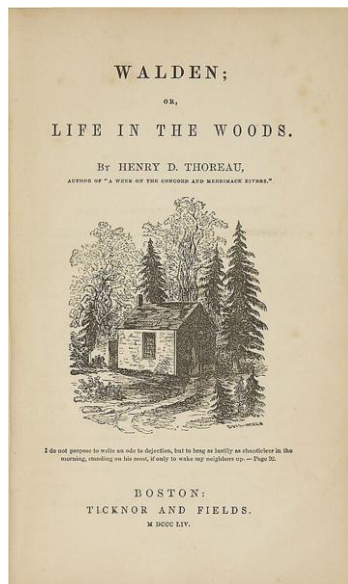
Henry David Thoreau is the poster child for the political ideology that advocates a return to a life before industrialization and the abolition of specialization and division of labor promoted by Adam Smith in his 1776 treatise, The Wealth of Nations. Anarcho-primitivists argue that "the shift from hunter-gatherer to agricultural subsistence during the Neolithic Revolution gave rise to coercion and social stratification".⁵ They want the world to return to a time when people lived in small, nomadic groups when the availability of food was tied to different places according to the seasons and the exigencies of the climate. We may get there one day, but most probably not by choice.

Degrowth movement

Anti-capitalist at its very foundation, its acolytes "advocate for societies that prioritize social and ecological well-being instead of corporate profits, over-production, and excess consumption". Ivan Illich, Catholic priest, author, and philosopher, is its prophet. Concerning technology, they believe that we should be oriented toward sufficiency instead of making technological changes simply because such changes are possible. Degrowthers make the distinction, described by Illich, between 'counterproductive technologies' and 'convivial technologies'. As Illich described it, 'conviviality is considered to be individual freedom realized in personal interdependence and, as such, an intrinsic ethical value'. Degrothers do not believe in green growth' or 'eco-modernism'.

Anti-GMO

Genetically modified organisms (GMO) have been around officially since 1973, but we have been selecting plants and animals for their traits and developing new breeds for almost ten thousand years. Anti-GMOs want everyone to stop eating foods, both plants and animals, which are genetically modified because they believe



During the six years that my wife and I lived in the central Massachusetts Town of Bolton, I passed by Walden pond on my way into Boston. It is a much better place today than when Thoreau was camping out on his friend Ralph Waldo Emerson's land. It was hardly an experiment in survival in the wilderness.

⁴ <https://www.lesswrong.com/posts/6aRANeq89z4n7Kxz4/historical-examples-of-opposition-to-technological-progress>

⁵ Ibid.



that by modifying what we eat we modify ourselves, and not for the better. If you are what you eat, can you become what you eat, a banana, for instance?

No farm mechanization



The Horse Association of America has been using the power of positive thinking since its founding in 1919 to convince farmers that farm animals have major advantages over machines. For example: “A mule is the only fool-proof tractor ever built,” or “Horses can reproduce themselves, whereas tractors depreciate.” Both valid points, but the movement has not gained much traction outside of the Amish communities.

Anti-vaccine

Polio, smallpox, and other diseases have killed and maimed children for millennia. Vaccines have been developed that have saved billions of lives, both those who received them and those who were born to those who were vaccinated. In 1998, a person by the name of Andrew Wakefield published a study which linked the measles vaccine (MMR) to autism. If you do not receive the MMR vaccines, you are likely to contract chickenpox, diphtheria, hepatitis B, rubella, or meningococcal. Wakefield’s study was declared fraudulent and was retracted. No evidence has been found in countless studies since its publication to link vaccinations to autism or any other affliction. Nevertheless, the health authorities in one of the largest and wealthiest countries in the world are building their health policies around Wakefield’s unsubstantiated claims. Since most people have been vaccinated, one would think that everyone would be suffering from autism. Maybe we are.

Anti-nuclear movement

The anti-nuclear energy movement began in earnest in the 1960s, although questions about using nuclear technology in weapons began as soon as they were used for the first time in 1945. ‘No Nukes’ coincided with the environmental movement that used Rachel Carlson’s 1962 book, Silent Spring, as its springboard. Although there were and continue to be unquestionable advantages of nuclear energy over fossil fuel-based, hydro-based, and solar/wind-based technologies for generating prodigious amounts of electricity, objections to nuclear technology have continued based on its potential for catastrophic destruction, either as a component of warfare or terrorism or as a result of a mishap, like the ones at Three Mile Island in 1979 or Chernobyl in 1986. Countries like Germany and Sweden have closed their perfectly serviceable nuclear reactors as a political gift to the anti-nuclear lobby, and have ended up fueling Russia’s world domination efforts through purchase of its natural gas (Germany, Hungary, etc.) and oil (China, India, etc.), or found themselves purchasing electricity from coal-burning neighbors to keep their industries running and their homes heated.

Philosophy – A tree with many branches

Metaphysics – Nature of reality
Epistemology – Study of knowledge
Ethics – Moral principles
Logic – Reasoning structure
Axiology- Theory of value
Political philosophy – Governance principles
Aesthetics – Beauty and art
Philosophedia - <https://philosophedia.org/about/>

Ethics: Normative, Theoretical, and Applied


A strong leader or a group with a monopoly on thinking, backed by force to execute and enforce their decisions, like a Chinese emperor or a Shogun, or the Catholic Church in Europe up until the Reformation, can decide unilaterally what is right or wrong, what should be banned or what should or should not be allowed. Nevertheless, force has taken the effectiveness of banning just so far. We have always found a way to smuggle in the forbidden fruits. A strong story has proven to be a much more effective means for convincing people to change behavior or directing them to the tools they should use to do the jobs that need getting done. This is where ethics comes into play. Ethics, or moral philosophy, is the branch of philosophy that involves “systematizing, defending, and recommending concepts of right and wrong moral behavior, moral concepts (such as justice, virtue, duty), and moral language”.⁶ Ethical theories attempt to answer the question “What is the greatest good?” by defining a set of proper behaviors for individuals and groups.

The Greeks did not invent morality, but they are credited with inventing ethical philosophy. Socrates is acknowledged as the first Western moral philosopher. He attempted to define justice, and he projected the ability to achieve a just society by comparing five hypothetical forms of government. He argued that a society based on an aristocracy would be best, and one based on democracy would be the worst. “The desires of the inferior many should be controlled by the wisdom and desires of the superior few,” he opined. In his opinion, philosophers were the superior of the superior. So, we can thank Socrates for providing the outline of the narrative used by despots down through the ages. His student, Plato, further systematized his teacher’s thinking, especially with the concept of the philosopher king.

Aristotle thought Socrates was missing the ‘happiness’ (*eudaimonia*) concept and built his theories around a ‘great-souled’ citizen who, by living well and doing well, ‘flourishes’. He concluded that there was no universal good, but that virtues should be based on finding the proper balance between extremes. If the individual flourishes, society flourishes, and society flourishes if it cultivates virtue in its citizens, posited Aristotle. That is the main purpose of societies, to promote the development of character and virtue, said Aristotle. He was a practical person, eschewing idealized concepts of societies and explaining why states should balance the interests of all of their citizens and make compromises to ensure stability. He is revered in those countries where the rule of law and the natural evolution of the state have become and remain the foundation for their political thinking.

By the time we reach the Medieval period, between 500 and 1500 A.D., the world had grown smaller and groups that had existed in isolation of one another were now trading with or invading each

⁶ MacIntyre, Alasdair (1998). *A Short History of Ethics*. London: Macmillan. ISBN 0-415-04027-2. (https://en.wikipedia.org/wiki/History_of_ethics#CITEREFMacIntyre1998)



other. It seems that invade and trade became interdependent. Latin and Byzantine philosophies were joined by Jewish, Arabic, and oriental philosophies. The principal areas of philosophical concern during this period were the eternity of the world, divine omniscience and human freedom, and the soul and immortality. The second of these, human freedom, was of the most practical utility. If God knows everything, as it was assumed He did, and He knows exactly what is going to happen, how can man be free? If my choices are already made for me, what is the point of worrying over a choice since whatever I choose is predetermined? Answering this question was important for what would follow the Medieval period, the Reformation and Industrialization, and it was ethical philosophy that provided the basis for deciding how best to live and organize societies.

Ethical philosophy

There are three different forms of ethical philosophy: normative, theoretical, and applied. Within each form there are different families.

Normative ethical philosophy

A 'norm' is something that is usual, typical, or standard.⁷ Normative ethics is concerned with the criteria of what is morally right and wrong. At the time the United States Declaration of Independence was signed in 1776, slavery was legal in all thirteen colonies. In the following years, up to the secession of the southern states, nine of the original thirteen states had abolished slavery. They decided that there was no moral basis for enslavement. The four remaining states, Virginia, North Carolina, South Carolina, and Georgia, retained slavery and became the core of the eleven states that seceded from the Union. Massachusetts abolished slavery in 1783 when the Chief Justice of the Massachusetts Supreme Court ruled that "slavery was incompatible with the Commonwealth's new Constitution, which stated that "all men are born free and equal; and that every subject is entitled to liberty, and to have it guarded by the laws as well as his life and property". Once the norm was established (all men are born free), the justification for the decision was obvious.

Utilitarianism

Utilitarianism is a normative ethical theory that is based on the principle of utility, which evaluates actions based on their ability to promote happiness and well-being among those people who are affected by the action.⁸ In other words, utilitarian ideas encourage actions that lead to the greatest good for the greatest number, and that the moral quality of an action or policy is entirely a function of its consequences, or the value produced by the action or policy. Jeremy Bentham, the founder of utilitarianism, described utility as "the capacity of actions or objects to produce benefits, such as pleasure, happiness, and good, or to prevent harm, such as pain

⁷ Merriam-Webster

⁸ Driver, Julia, "The History of Utilitarianism", The Stanford Encyclopedia of Philosophy (Fall 2025 Edition), Edward N. Zalta & Uri Nodelman (eds.), URL = <<https://plato.stanford.edu/archives/fall2025/entries/utilitarianism-history/>>.

Deontology vs. Utilitarianism

Attribute	Deontology	Utilitarianism
Focus	Emphasizes duty and moral rules	Emphasizes overall happiness and consequences
Principle	Act according to moral rules and duties	Act to maximize overall happiness
Decision-making	Based on moral obligations and rules	Based on the greatest good for the greatest number
Intentions	Emphasizes good intentions over outcomes	Emphasizes outcomes over intentions
Individual Rights	Respects individual rights and autonomy	May sacrifice individual rights for the greater good
Universalizability	Focuses on universal moral principles	Focuses on maximizing overall happiness for all
Justice	Emphasizes fairness and treating people as ends	Emphasizes overall utility and treating people as means
Consequences	Does not solely focus on consequences	Emphasizes consequences as the primary factor

and unhappiness, to those affected". Bentham asked, "What use is it?", and that was the only yardstick for measuring value.

Deontology

Immanuel Kant is the principal proponent of the normative ethical theory known as 'deontology'. The word is derived from the Greek *deon* (duty) and *logos* (science). It is defined as the theory or study of moral obligation and says that morality is determined by the act itself, regardless of the consequences. It is typically placed in opposition to Utilitarianism, which says that morality is determined by the consequences of an action and the amount of pleasure or pain it produces. From the deontological perspective, pulling the switch to divert the trolley which kills one person instead of five is morally wrong because you have actively involved yourself in the killing of one person, while you were not involved in putting the five people in danger. From the utilitarian perspective, saving five people is better than not killing one. Dropping two nuclear bombs on Japan was not justifiable from a deontological point of view no matter how many lives were saved as a consequence.

Theoretical/Meta Ethical Philosophy

Theoretical ethics is "concerned with understanding the nature of ethics, ethical language, and ethical reasoning".⁹

Applied Ethical Philosophy

Applied ethics is the practical aspect of moral considerations. It is ethics with respect to real-world actions and their moral considerations in private and public life, the professions, health, technology, law, and leadership.¹⁰ For example, bioethics is concerned with identifying the best approach to moral issues in the life sciences, such as euthanasia, the allocation of scarce health resources, or the use of human embryos in research. Environmental ethics is concerned with ecological issues such as the responsibility of government and corporations to clean up pollution. Business ethics includes the duties of whistleblowers to the public and to their employers. It can best be described as a combination of utilitarianism and deontology with a 20th century twist. It grew out of The Belmont Report, a report issued by the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. It is based on four ethical principles: respect for self-determination; an obligation to act for the benefit of others; refrainment from causing deliberate harm; and maximizing efforts to ensure that costs and benefits are fairly distributed.

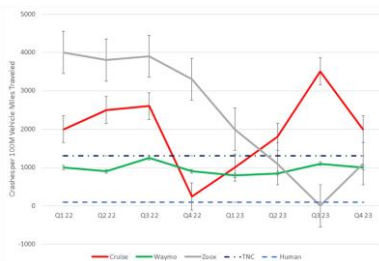
Developing and adopting technologies are forms of behavior, whether it is a weapon of mass destruction, a way to turn ocean wave energy into electricity, or maneuvering automobiles on public roadways without the involvement of a human driver. Stem cell research is a case in point. Stem cells are cells that have the ability to divide and produce more stem cells and specialized cells that make up the tissues and organs of animals and plants. The two

⁹ University of Wisconsin-Madison. Center for Journalism Ethics. Ethics in a Nutshell.

¹⁰ <https://en.wikipedia.org/wiki/Principlism>

The concept of “sanctity of life” or “moral status” is a shared ethical concern, though interpreted differently. For some, this applies from conception, making embryonic stem cell research problematic due to the destruction of an embryo for cell derivation. Others believe the potential to alleviate suffering outweighs these concerns, or they focus on the moral imperative to use scientific knowledge for the greater good.

Biology Insights



Testing and Deployment crashes per 100 million vehicle miles traveled for Cruise, Waymo and Zoox for December 2021 – November 2023. TNC and Human Driver Data are provided for comparison. One standard error is shown. (Source: M.L. Cummings and Ben Bauchwitz in Identifying Research Gaps through Self-Driving Car Data Analysis)

types of stem cells are embryonic stem cells and adult stem cells. The former can become any type of cell, while the latter are more limited in how they can develop. They play a critical role in how plants and animals grow, develop, and repair their tissues. In the mid-19th century, scientists began to make major discoveries in the field of cellular biology. In 1998, researchers were able to isolate embryonic stem cells, and the possibilities for using this discovery for regenerative medicine seemed endless. But there was a problem: where do those embryonic stem cells come from.


Early in his first term in 2001, President George W. Bush stopped federal funding for stem cell research that would “deliberately destroy human embryos”. In 2005 and 2007, the U.S. Congress passed a bill that would allow federal funding for embryonic stem cells. Bush vetoed them both, and there were not enough votes to override his vetoes. Pro-Life groups and the Catholic Church were in favor of the ban. Barack Obama became president in 2008 and lifted the ban on federal funding for embryonic stem cell research in 2009. He said at the time: “Today, we will bring the change that so many scientists and researchers, doctors and innovators, patients and loved ones have hoped for, and fought for, these past eight years.” One man’s moral wrong is another man’s moral cause.

The (il)logic behind the reasons for banning driverless vehicles

Let’s put the reasons for opposing a driverless vehicle future under the ethical microscope. I have compiled a list of reasons that individuals and groups have given for being opposed to driverless vehicles. Do they have merit from a future-of-humanity perspective, either from a deontological or utilitarian viewpoint, or are they attempts to rationalize a fear of beneficial change?

1. Believe that driverless vehicles will never be as safe as human drivers. That removing the human driver from the driving equation will remove the principal cause of accidents is the main peg on which driverless vehicle advocates hang their hat. No distractions, no drinks or drugs, no sleeping at the wheel, never losing control. Waymo churns out papers telling anyone who will listen that its cars, built by others but driven by its hardware and software, have far fewer accidents than all cars driven by humans. The fact is that there is simply too little data on the Waymo cars to make a reasonable comparison. Waymo drives in limited areas on limited types of roads that the company has meticulously mapped, but accidents still occur. And if you compare the rate of accidents experienced by Waymo to total vehicle miles driven by all cars, Waymo’s accident rate is much higher (see sidebar). Tesla has been driving on all types of roads without detailed maps, and their cars do remarkably well in its Full Self-Driving mode, but interventions are still needed.

The main problem with the proposition that driverless vehicles will never be as safe as human drivers is that it is based on a flawed yardstick. There is no such thing as a standard human driver. It is important to differentiate between driver performance (what the



driver can do) and driver behavior (what the driver does).¹¹ Driver performance relates to the driver's knowledge, skill, perceptual and cognitive abilities. Driver behavior is what the driver chooses to do with these attributes. Some individuals are simply better drivers than others, just like some individuals are better musicians, mathematicians, or magicians than others. There are individuals who are 'naturals' or prodigies, who can pick up a violin and start playing Paganini's Caprice No. 24, but most of us require years of practice before we can even hit the right notes. It's the same with driving. Experience is not only the best teacher; it is the only teacher. Experience isn't programmable, it is learned, and when it comes to driving, it is very much related to the goals of the driver. A race car driver turns out to be a fairly lousy everyday driver because he or she wins the race (the main goal) by taking risks. Risk-taking is a bad trait for a regular driver.

Stating that robots will always be better drivers than humans takes as its starting point that humans cannot improve and that robots are unerring. Stating that humans will always be better drivers than robots ignores the factors that make some humans act in ways that result directly in accidents. Because humans are intelligent, they are able to make both good and bad decisions. We cannot program humans to always make good driving decisions, but programming a robot driver to always follow the rules of the road will not ensure that the robot-driven vehicle will never have an accident.


Bottom line: Driverless vehicles may be safer drivers than some humans some of the time, but not all humans all of the time. It is the utilitarians who are pushing driverless technology with promises of safer travel. There needs to be more emphasis on how this technology can be used to improve the lives of individuals, and an honest recognition that significant efforts will have to be made to make the technology safe.

2. Believe that driverless vehicles cannot make ethical decisions

Humans are the only species that drive cars. Marc Hauser, director of the cognitive evolution lab at Harvard University in a 2009 article in *Scientific American* states "mounting evidence indicates that, in contrast to Darwin's theory of a continuity of mind between humans and other species, a profound gap separates our intellect from the animal kind."¹² These abilities, which Hauser believes are the essence of our "humaniqueness" are: 1) Generative computation—humans can take a learned rule and create new expressions and mix different learned elements and create a new concept; 2) Promiscuous combination of ideas—mingle different domains of knowledge and generate new laws, technologies, social relationships; 3) Mental symbols—encode our sensory experiences and share them with others; and, 4) Abstract thought—the contemplation of things beyond what we can sense.

¹¹ Evans, Leonard. *Traffic Safety*. (2004).

¹² Hauser, Marc. *The Origin of the Mind*. *Scientific American* (September 2009).



Theories of driver behavior are based on the idea that human behavior is determined by how humans process information, that is, cognitive processes. This is why it is difficult to separate theories concerning how humans obtain and apply complex skills and theories concerning risks and motives. Driving has been described as a hierarchical decision-making system in which motivational aspects (why we do certain things, like drive too fast) and cognitive aspects (how we view certain situations, like overestimating our ability to maneuver in a dangerous curve) of driver behavior are combined. Driving is a complex cognitive task that requires the ability to accomplish complex and often conflicting goals. This is very close to the definition of ‘intelligence’, which according to Merriam-Webster is “the ability to learn or understand or to deal with new or trying situations”.

If driving requires intelligence, then in order to for a robot to master the driving task, it must be able to accomplish complex and conflicting goals. This is a step (maybe several) above the one-goal-at-a-time artificial intelligence tools that are being used today. This requires artificial general intelligence (AGI), and this is where the question of ethics comes in. How do we make sure that the AGI devices’ goals are consistent with our human goals?¹³ An organization called the Future of Life Institute, founded by MIT professor Max Tegmark, with financial support from Elon Musk, Larry Page, and, before his death, Steven Hawking, says, “there is no guarantee that AGI will be good for humans, nor can it be guaranteed that humans as a species will survive if the ‘super intelligents’ believe that the goals they have either been given or arrive at themselves can be better achieved without humans around”. Tegmark states that he is in favor of developing AGI, but that humans must control it, otherwise, what’s the point. He quotes Dostoyevsky in *The Brothers Karamazov*: “The mystery of human existence lies not in just staying alive, but in finding something to live for.” Most of us don’t live to drive; some of us drive to live. Let’s make sure we know who is ultimately steering and deciding where we are going before we let AGIs drive our vehicles.¹⁴

So, maybe driverless vehicles can at some point in the future make decisions that align with humanity’s goals, but we are not sure they ever will. If we start to open all the roads to driverless cars before we are absolutely certain that the AGI robots can’t game the ‘kill switch’, keep testing, open useful services that provide affordable rides in defined and restricted areas, and develop the standards that will ensure that driverless cars perform predictably.

3. Believe that developers of driverless vehicles will never accept responsibility or be held liable for the actions of the vehicles

I typed the following sentence in my search engine: Waymo admits its car was at fault. In addition to a number of articles produced by Waymo apologists who explain that it’s all the humans on the

¹³ Tegmark, Max. *Life 3.0: Being Human in the Age of Artificial Intelligence*. Allen Lane (2017).

¹⁴ Sena, Michael. *No Humanless-Drive Without AGI*. *THE DISPATCHER*. February 2018.

roads who are causing Waymo vehicles to crash,¹⁵ there is the official Waymo site called *Waymo Safety Impact*. Here is what Waymo says about itself:

The trust and safety of the communities where we operate is paramount to us. That's why we're voluntarily sharing our safety data. The data to date indicates the Waymo Driver is already making roads safer in the places where we currently operate. Specifically, the data below demonstrates that the Waymo Driver is better than humans at avoiding crashes that result in injuries – both of any severity and specifically serious ones – as well as those that lead to airbag deployments.

This hub compares the Waymo Driver's Rider-Only (RO) (i.e., there is no human driver behind the wheel) crash rates to human crash benchmarks for surface streets. It leverages best practices in safety impact analysis and builds upon dozens of Waymo's safety publications, providing an unprecedented level of transparency within the autonomous driving industry. By sharing our data and methodologies, we also invite you to join us as we push for advancements in measuring safety impact. The data displayed on this webpage undergoes consistent updates aligned with NHTSA's Standing General Order (SGO) reporting timelines.

In the FAQ section, there is the question: Why don't you share fault information for these collisions? Waymo answers: "This analysis included all collisions, regardless of the party at fault and Waymo's responsibility. Moreover, the question of fault in causing or contributing to a collision is a legal determination. That said, the recent peer reviewed study led by Swiss Re showed that over 3.8 million miles, the Waymo Driver reduced the frequency of property damage insurance claims by 76% and completely eliminated bodily injury claims compared to human drivers."

The first two sentences in Waymo's response say that Waymo does not care about fault, and the last sentence is unrelated to the question. The apologists say that most of the accidents in which Waymo cars are involved are rear-end collisions with the Waymo being rear-ended. Has it possibly occurred to Waymo that there is something their cars are doing that result in an inordinate number of rear-end collisions. Saying "It's not our fault that someone runs into us" begs the question. The five common causes of rear-end collisions are distracted driving, tailgating, speeding, sudden stops, and weather conditions. The second and third are owned by the car doing the rear-ending. The first, distracted driving, is shared because the car ahead must be aware of the location of the car behind. Sudden stops is also a shared responsibility because the car behind them may judge the driving situation as one in which sudden stops are not expected. NHTSA says that 29% of all accidents can be classified as rear-end collisions, and that they are most common on highly congested roadways and intersections. Its

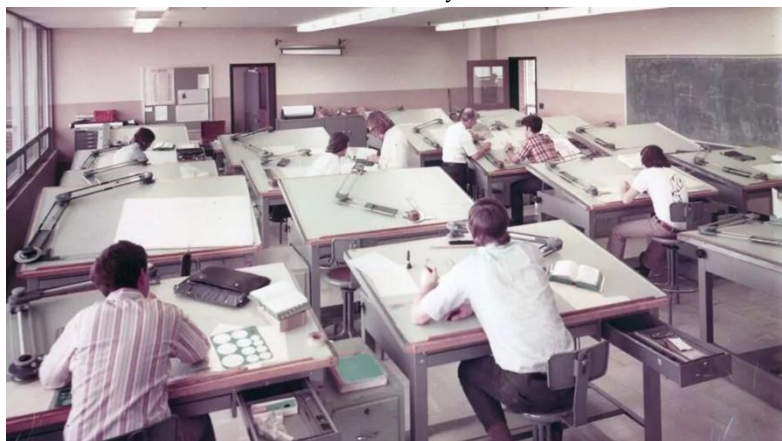
¹⁵ To list a few: Williams, Kai. Understanding AI blog – Very few of Waymo's most serious crashes were Waymo's fault. (September 17, 2025); King, Ryan Erik. Jalopnik. Waymo's Crashes Are Largely The Fault of Us Mere Humans. (March 28, 2025)

tips to avoid rear-end collisions apply both to the car that is hit and the car doing the hitting.

Waymo's boasting about how safe their cars are compared to mere humans, and their implicit transfer of blame to human drivers for actions in which their cars share culpability, are providing fuel to the argument that developers of driverless vehicles will shirk responsibility when their vehicles malfunction. They will blame humans as long as there are humans driving on the roads, and then they will blame other external factors, like power outages (recently experienced in San Francisco which caused Waymo vehicles to stop dead at non-functioning traffic lights). It is difficult to see any level of acceptance of ethical responsibility in Waymo's actions, which I will attribute to its total lack of transparency about what its ultimate goals are, to be a driverless ride delivery company or a driverless drive delivery company.

4. Believe that driverless vehicles are just a way of eliminating jobs

Waymo lists four “core mission objectives” as its reason for doing what it is doing: enhance safety and reduce traffic fatalities; provide inclusive and accessible mobility; transform urban transportation and reduce environmental impacts; and advance technological innovation.¹⁶ It does not say it wants to eliminate the livelihoods of the 400,000 taxi drivers in the U.S., or the 2 million transportation network company (TNC) drivers gigging for Uber and Lyft in the U.S. (2024), or the 5.4 million TNC drivers in the world (2025). Nevertheless, if you follow the logic of what it is promoting, driverless driving, then the people driving the cars carrying the people the taxis and TNC vehicles carry will be the first cherries to be picked. By eliminating the major cost of providing rides, which is the driver, ride provision can be more inclusive and mobility more accessible to a larger number of people. Oddly, Waymo is not charging less for the rides it is delivering today without a driver. Its rides are generally more expensive than both taxi and TNC rides. It still loses mountains of money, but that is another issue.



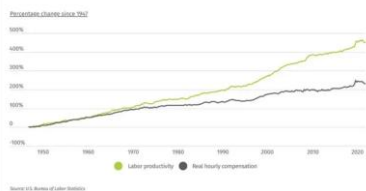
Technology has been eliminating jobs for millennia. The goal of human invention is to do more with fewer hands. Computer-aided

¹⁶ I have said that Waymo is a driverless driving delivery business, not a driverless ride delivery business (see The Dispatcher February 2025). It says so on its own web site (“Our mission is to be the world’s most trusted driver”), but everyone who writes about Waymo describes it as a ‘ride hailing’ company, as if its objective was to become the taxi company for the world, and to deliver all rides with vehicles that it operates, and with no driver in the driver’s seat.



design and drafting (CADD) not only eliminated the jobs of drafters sitting at drafting tables like in the photo above, but wiped out entire industries producing drafting tables, drafting chairs (good riddance), templates, drafting machines (the tool used to make straight lines), mechanical pencils, and much more.¹⁷ In 1920, there were 18,185 architects in the U.S., and 52,865 drafters. That ratio, 1-to-3, was about the same as when I started my architectural career in 1972. In 2025, there were 116,000 architects and 59,761 drafters, approximately two architects for every drafter.¹⁸ Three hundred thousand jobs were replaced by a combination of desktop computers with associated software (e.g., AutoCAD) and the substitution of an architect doing part of what a drafter had done. The same thing happened with the typist occupation. In 2000, there were 280,000 full-time typists employed in the U.S. In 2024, there were 40,000.

Since the 1970s, productivity & wages have steadily diverged



Who benefitted from the loss of 240,000 typist jobs and 300,000 drafter jobs? According to the U.S. Bureau Labor Statistics, labor productivity has increased by 300% since 1980, while real hourly wage compensation has increased by 100%. That extra 200% has been fueling the rise in stock prices. In 1980, the Dow Jones Industrial average was 993. In December 2025, it was 48,731.

There is no question that driverless cars will, by definition, eliminate the jobs of drivers. What is in question is whether by eliminating those jobs and reducing the cost of providing a ride, significant benefits will accrue to the riders, and whether there are other jobs that will result directly from the implementation of driverless technologies that could be performed by the replaced drivers that would provide similar income, similar job satisfaction, and require similar qualifications? Or will they go the way of drafters and typists? This question appears in passing in articles as one of the examples of how AI will make humans obsolete. Give everyone a basic income (Universal Basic Income) so that they can consume the produces and services delivered by robots.

The ethical framework that has developed during the past two millennia was created for a world dominated by humans, not by robots. We have not yet answered the question of whether humans would be happiest if we did not have to feel fulfilled by earning our daily bread. If we do not answer that question before we have a world dominated by robots, there will be a price to pay.

5. Believe that driverless vehicles will be expensive and will only be affordable by the wealthy

On the one hand, companies developing hardware-heavy driverless technology, like Waymo, claim that the cost of the hardware will be lower when volumes increase, and offer proof with comparisons of LiDAR costs today versus ten years ago. Systems that

¹⁷ Except for the drafting table and drafting machine, I have saved all of my other drafting tools from my days as a practicing architect.

¹⁸ <https://www.coopercenter.org/research/occupation-change-1920-2010>

cost \$75,000 in 2015 now cost in range of \$500-1,500.¹⁹ On the other hand, companies like Tesla that are heavy on the data processing side, using large numbers of inexpensive cameras as their sensors, claim that they will be able to equip even the least expensive vehicles with the capability to perform in driverless mode. One thing is certain, and that is that cars have not become cheaper as a result of the equipment and design changes required by safety regulations and added by car OEMs to make them more interesting and safer to drive.

The question is whether the targeted buyer of driverless cars is the private consumer who will sleep on the commute to work, or it is ride delivery companies for whom the cost of the car is factored into the cost of the rides to customers. Taxi companies in Europe for years bought Mercedes diesel vehicles because they had the longest lives and the lowest operating costs. They did not buy gasoline-driven Volkswagen Beetles.

The moral issue is whether the cost of the ride for the rider is lower with a driverless vehicle than with one driven by a human. If it is not, then the driverless option is not only disadvantaging the driver, who has lost the means of feeding himself/herself and his or her family, but the potential rider who cannot afford a regular taxi service and is not served adequately by any other means.

6. Believe that driverless vehicles are just a way of eliminating public transport




Public transport systems in the form of the buses, trolleys, and subways/undergrounds, have attained the status of endangered species, like mountain gorillas and black rhinos. I enjoy taking the narrow-gauge steam train from a neighboring town to a small village where there is a dessert smörgåsbord, but it takes me four times as much time to reach this destination than if I drive there in my car. The trip on the train is the end, not the means. This is the reason it is called a “museum trip”.

As long as public transport options serve the purpose of providing affordable rides to all people who do not have other, better transport options, it should be supported financially on ethical grounds. If there are better options which are more flexible, more responsive, more comfortable, and less expensive, they should be encouraged – even if it means public transport wilts on the vine.

7. Believe it will be easier to steal personal data

99.97% of the people in the world do not have the slightest possibility of knowing what personal data is or is not collected, stored, or used by vehicles. Of the 0.03% of the total world population who work in the automobile industry, it is likely that less than 5% of them could answer the question definitively of whether the vehicles their employers sell to the public collect and use personal data.

¹⁹ Wolfe, Jeremy. Lidar costs for autonomous trucks are dropping fast. Fleet Owner (September 16, 2025). <https://www.fleetowner.com/technology/article/55316670/lidar-costs-for-autonomous-trucks-are-dropping-fast>



It will be no easier or more difficult for a company selling a driverless vehicle to collect personal data than a company selling a vehicle driven by a human.

8. Believe that driverless vehicles will become reliant on technology that could be both expensive, open to manipulation, and susceptible to becoming outdated, like positioning technology and onboard sensors

Before the lead pencil was invented in 1564, someone who wanted to jot down his or her thoughts about a journey they were taking, or passages for the book they were writing, needed to carry a pot of ink, a writing instrument, and expensive writing paper.²⁰ Pencil and paper were more flexible, especially when the pencil was equipped with an eraser after its invention in 1858 and cheap paper tablets were available. We gave up this flexibility when we moved our writing to typewriters, beginning in 1868, and especially when we moved to electric typewriters that required a connection to an electrical outlet. The IBM Electric Typewriter Model 01 appeared in 1935. We still had a direct connection between the writing and the result on paper. That was broken with the word processor, especially the Wang Laboratories system introduced in late 1970s, and then the desktop computer in the early 1980s. Today, we compose on our laptops, store our drafts on a remote data server located somewhere in the world, and print – if we ever print – on a device connected to our device by an Internet link. For many, if there is a power outage and they have not kept their battery loaded or have an extra battery handy, they are dead in the water.

So, yes, like the equipment we are using in our daily lives today, our phones, computers, TVs, and, increasingly, our cars, they will not last for fifty years and be drivable, as long as we keep the gears greased and the electric wires from being eaten by squirrels. It will be no different for driverless cars, except they will absolutely have to be continuously updated with the latest bug fixes.


I have friends who refuse to move to digital banking to pay bills, refuse to use credit cards for paying for goods and services in stores, and refuse to use personal computers and telephones with Internet connections. In some countries, like Sweden, their lives are difficult and complicated as a result. The act of riding will be more difficult and more complicated with driverless vehicles than with cars that are driven by humans. This is an issue that societies must address irrespective of vehicle technology.

9. Believe that driverless vehicles will consume more energy

They will if there are more of them and if they are driving around all the time, rather than sitting idle most of the time as are most cars. See #10. Otherwise, they won't.

10. Believe that driverless vehicles will generate more demand for cars, resulting in more traffic

²⁰ A large deposit of graphite was discovered on the approach to Grey Knotts from the hamlet of Seathwaite in Borrowdale parish, Cumbria, England. This particular deposit of graphite was extremely pure and solid, and it could easily be sawn into sticks.



They probably will. This objection is partly being borne out with the rise of transport network company taxi services. Uber, Lyft and other TNCs are not replacing taxis. They are adding to the demand for rides on demand because they are easier and more convenient than calling a taxi, and, for those who are not price-sensitive, like people living in expensive cities like London, San Francisco, and New York, they are a lot more convenient and comfortable than taking public transportation. The logic of this objection is that if rides are cheaper with driverless vehicles than with taxi services, then more people will use the service rather than owning their own car or taking public transport.

Traffic congestion is the result of people attempting to get to many different places that are dispersed over a large region and which are too far to reach by walking. Everything that politicians playing urban planners have done to reduce congestion by trying to reduce the number of cars on the roads has made it more difficult for those with limited resources to solve their own lives' puzzles. There is a latent demand for mobility that would be served by low-cost ride provision, and if this increases congestion, then cities should start thinking about dispersing, rather than concentrating, services facilities.

11. [Believe that driverless vehicles will lead to loss of human skills](#)


If people do not need to drive cars, they will never master the driving skill. I never learned how to shoe a horse or slaughter a pig. I learned how to set type when I was in high school, but I have never yet had to apply that skill. Is penmanship still taught in school classrooms? I learned to drive a car with manual transmission and never owned a car with an automatic transmission until 2014, when a back injury made it impossible for me to drive myself for three months. There is no moral dilemma with not knowing how to drive if we do not have to drive, but if we design vehicles that can be driven by a human if the robot driver fails, then not possessing driving skills will be a problem.

As I was writing this paragraph, my next-door neighbor knocked on my door and asked me if I could help to jump start his car, a twenty-year-old model. I have experience with jump starting cars, but I had never given it a thought with my Toyota RAV4 hybrid. I opened the hood and could not find the battery. The manual was of no help. He had to find another neighbor with an old car. I now have a mission to find out where my battery is located and how I can use it if I am ever called upon to jump start another car.

Human progress is a story of first acquiring the skills needed to survive, and then losing certain skills which are no longer needed while acquiring new ones. If cars do not need to be driven, we will not need to learn how to drive them.

12. [Believe that driverless vehicles will lead to loss of trust in humans if humans are banned from driving](#)

Did we trust humans any less when the elevator operators were replaced with automatic elevators? I don't believe we gave it much thought. Do we pay more for a rug woven by a machine than one



woven by craftspeople? We do not. When (if) driverless vehicles begin to outnumber human-driven vehicles, we may start to make comparisons that will favor robots over humans, but that will depend on who is funding the comparisons and how much money they are putting into the effort, and whether there is substantial evidence for or against allowing humans to continue to sit at the controls.

Yes, removing humans from the driving task is just one more example of replacing the work of humans with the work of robots. It is difficult to make exceptions for which tasks can be automated and which ones will be held sacred for humans. We might draw the line on replacing our priests or heads of state, but who can tell? Is the future for humans really one in which we augment our brains with superintelligence so we can carry on a conversation with an Alicia Vikander's android character in the movie *Ex Machina* or replace our limbs and organs as they age so we attain immortality.²¹

It is most probably the case that losing the right to drive will diminish the value of humans in the eyes of other humans during the period that people will remember that humans once drove.

The moral of the story

There are good reasons for objecting on ethical grounds to substituting robots for humans in general, and these apply to removing humans from the driving task. We are decoupling humans from the race, task by task, and if you aren't in the race, you cannot win. Death by a thousand cuts achieves the same result as one stab to the heart.

Hedonists don't care much about whether something is ethically justifiable. They are just in it for the pleasure and appreciate anything that offers more play for less work. They can do whatever they want, alone or with company, in the back seat of their very own driverless car. If you have enough money to buy one, you (or your heirs) probably will have enough money to pay a good lawyer to plead your case against the company that sold you your car if it hit a patch of black ice and wrapped itself around a tree while you were napping, or worse, plowed into another car and killed the occupants.

There are good reasons for supporting driverless riding, but these are not the ones spouted by Waymo apologists, such as: no one dies riding in a driverless car; traffic congestion will evaporate; and harmful emissions will disappear. The best – and perhaps the only – ethical reason for supporting driverless vehicles is that they spread the benefit of convenient mobility to a larger number of people by making rides more affordable.



²¹ Harari, Yuval Noah. [Homo Deus: A Brief History of Tomorrow](#). Harvill Secker (2015).

About Michael L. Sena

Through my writing, speaking and client work, I have attempted to bring clarity to an often-opaque world of highly automated and connected vehicles. I have not just studied the technologies and analyzed the services. I have developed and implemented them and have worked to shape visions and followed through to delivering them. What drives me – why do what I do – is my desire to move the industry forward: to see accident statistics fall because of safety improvements related to advanced driver assistance systems; to see congestion on all roads reduced because of better traffic information and improved route selection; to see global emissions from transport eliminated because of designing the most fuel-efficient vehicles; and to see everyone who needs a ride get one.

I try to put vehicles into their context. It is not just roads; it is communities, large and small. Vehicles are tools, and people use these tools to make their lives and the lives of their family members easier, more enjoyable, and safer. Businesses and services use these tools to deliver what people need. Transport is intertwined with the environment in which it operates, and the two must be developed in concert.



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