So, you think you have an AI strategy? Think again.

Authors:
Luciano C. Oviedo
Researcher
Warwick Business School, University of Warwick
luciano.oviedo.16@mail.wbs.ac.uk

Sotirios Paroutis
Professor
Warwick Business School, University of Warwick
Sotirios.Paroutis@wbs.ac.uk

Michael A. Smith
Director
American Association for the Advancement of Science - Lemelson Invention Ambassador Program

INTRODUCTION

Popular press, media and even companies tend to portray the future of AI from one of two dominant world views. From a utopian point of view, where AI brings humanity new ways of achieving exponential benefits to economies of scale, productivity and safety, so the implied strategy is "build it and they will come." From a dystopian point of view, though, AI will make irreversible immoral decisions for mission critical situations, so the implied strategy is "stop it before it takes over the world." The fragmented thinking regarding plausible systemic risks and benefits for companies, consumers and everybody involved has resulted in AI becoming a controversial topic. Furthermore, the rapid evolution of AI and its convergence with other technology platform ecosystems such as 5G, Blockchain, AR/VR, IOT, Fog and Cloud are driving and shaping new ways for people to live. This next evolution is often referred to as Ambient intelligence or the 4th Industrial Revolution and has resulted in many open questions, such as:

- **What is the social impact of AI, really?**
- **How might we characterize the plausible systemic risks and benefits of AI before, not after, it is deployed into a community?**
- **To what extent does an organization's AI strategy comprehend plausible futures where the adoption of AI technologies, products and services are conditioned on factors, such as impact to environment and society?**
- **In what ways might an AI strategy be adapted to be resilient or to thrive under these conditions?**

In this short overview, we argue organizations will increase the expected value of their investments in AI technologies, products and services by adapting their technology strategy to include the social impact of AI. More specifically, we assert an AI strategy should not just be about technology, but it should also be about integrating open strategy and design thinking processes and practices. These activities should proactively include citizens' perspectives and participation to gain direct insights and feedback on the plausible systemic risks and benefits of AI technologies before, and not after, they are deployed into their respective community. Secondly, we argue organizations should adopt new analytical methods and techniques deliberately designed to characterize the social impact of AI. These approaches should characterize the impact of AI to factors such as environment, energy and society (ethics, economics, gender, culture, language). Regardless of whether an organization is making mobile apps or autonomous vehicles (AV), we assert they stand to gain more from their AI strategy by expanding it to include the social impact of AI.

First, we provide a brief background on our motivations, the opportunity space, and a sampling of existing initiatives exploring social impact of AI. Next, we walk through an example of "Social Impact Factor Analysis"

(SIFA) by applying it to an AV use case; where mission- and non-mission-critical workloads occur in public and private spaces. AVs also relate well to adjacent smart transportation use cases such as autonomous planes, boats, buses or trains. Applying SIFA to the AV use case shows a relatively low cost and quick-turn way for organizations to integrate open strategy and design thinking processes and practices into their technology strategy activities.

MOTIVATION

The United Nations estimates that the world's population will reach 10.2B by 2060, and 68% of those people will reside in cities.[1] In order to cope with this emerging crisis, city leaders and decision makers will need to adapt their strategy for serving existing citizens as well as future ones through the adoption of AI technologies, products and services. They will face at least two challenges. First, AI products and services are capable of sensing, collecting, storing and predicting highly sensitive data and information about citizens. City leaders and decision makers will need to figure out how to balance evaluating these technologies to meet security requirements with satisfying business policies aligned to social values such as privacy and ethics.

There is a lack of standardization for how city leaders and decision makers can perform this evaluation. For example, the International Organization for Standardization (ISO)[2] approved ISO 37120 standard on "Indicators for City Services and Quality of Life" and ISO 37122 standard on "Indicators for Smart Cities." Unfortunately, ISO 37122 has 18 factors and 32 indicators, and only two relate to AI. One indicator addresses "Percentage of vehicles registered in the city that are autonomous vehicles" and the other addresses "Percentage of roads compliant with autonomous driving systems."

Building on advancements over the past few decades, the promise of AI to change the nature of work has become more plausible, mainly due to the computational advancements in recent years and the ability to collect, store and analyze more data than was the case only a few years ago. These mean new possibilities from manufacturing, construction, health-care, transportation, agriculture to smart cities.

Despite these advancements and their promise to bring a seismic change to the way machines and humans interact, the exact evolution of AI remains unclear. For example, DARPA asserts AI will evolve in three waves.[3] In the third wave, they expect

[1] https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html

[2] https://www.iso.org/

[3] https://www.darpa.mil/about-us/darpa-perspective-on-ai

fully autonomous systems to emerge; when and how this evolution may occur is unknown. Given this uncertainty, there is a growing momentum towards increasing the understanding of the social impact of AI. Therefore, we seek to help organizations effectively and affordably characterize the plausible systemic risks and benefits of AI before they are deployed into a community in order to mitigate risks such as growing fear of AVs,[4] as well as to identify novel opportunities such as features that balance privacy and security. SIFA can be performed using publicly available data and independent of whether an organization has the resources to sponsor or participate in university research, standards or consortia.

OPPORTUNITY SPACE

There is a growing spectrum of initiatives aimed at characterizing the impact of AI from different perspectives. We will briefly share an overview of three different types of organizations:

- **Berkeley Center for Human-Compatible AI** - university research center
- **Partnership on AI** - independent consortia
- **IEEE Ethics on Autonomous Systems** - standards association

Berkeley Center for Human-Compatible AI

The Berkeley Center for Human-Compatible AI is a university research center founded in 2016. It brings researchers together from UC-Berkeley and university partnerships.

Berkeley Center for Human-Compatible AI [5]	
Mission	• To develop the conceptual and technical wherewithal to reorient the general thrust of AI research towards provably beneficial systems;
Structure	• University research center;
Access	• Internal research topic generation and development process;
Members	• Sponsors, Faculty, Staff, Faculty Affiliates, Students

Deliverables	• Perform research; publish journal articles, blogs and social media; present at conferences, seminars and workshops;
	• Research themes include:
	  ○ Value alignment and inverse reinforcement learning
	  ○ Long-term risks of AI
	  ○ Human-robot cooperation
	  ○ Theories of (bounded) rationality

Table 1: Berkeley Center for Human-Compatible AI

[4] https://www.smartcitiesdive.com/news/aaa-poll-autonomous-vehicles-fear/550766/

Partnership on AI

The Partnership on AI was initially launched by a group of AI researchers representing six technology companies: Apple, Amazon, DeepMind and Google, Facebook, IBM and Microsoft. It is a multi-stakeholder organization that brings together academics, researchers, civil society organizations, companies building and utilizing AI technology and other groups working to better understand AI's impacts. The Partnership was established to study and formulate best practices on AI technologies, to advance the public's understanding of AI and to serve as an open platform for discussion and engagement about AI and its influences on people and society.

Partnership on AI [6]	
Mission	• To develop and share methods and practices in the research, development, testing, and fielding of AI technologies; • To advance public understanding of AI across varied constituencies, including core technologies, benefits, and costs; • To provide an open and inclusive platform for discussion and engagement on the future of AI, • To ensure that key stakeholders have the knowledge, resources, and capacity to participate in these important conversations; and • To identify and foster aspirational efforts in AI for socially benevolent applications.
Structure	• Industry led consortia;
Access	• Policy agreement, membership fee, working groups;
Members	• Staff, member companies, member universities, member other, research fellows;
Deliverables	Undetermined, although thematic pillars include: • Safety-critical AI • Fair, transparent and accountable AI • AI, Labor, and Economy • Collaborations between People and AI Systems • Social and Societal Influences of AI • AI and Social Good

Table 2: Partnership on AI

Global Initiative on Ethics of Autonomous and Intelligent Systems

The Global Initiative on Ethics of Autonomous and Intelligent Systems was launched by IEEE Standards Organization to serve as a platform for standardization across a few fronts.

IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems [7]	
Mission	• To ensure every stakeholder involved in the design and development of autonomous and intelligent systems is educated, trained, and empowered to prioritize ethical considerations so that these technologies are advanced for the benefit of humanity;
Structure	• Global standards organization;
Access	• IPR agreement, membership fee (based on revenue);
Members	• Staff, companies, universities;
Deliverables	• Videos, webinars, conferences • Glossary - First edition; • Publications: Ethically Aligned Design, Edition v1 & v2; • Standards: P7000, P 7001, P7002, P7003, P7004, P7005, P7006, P7007, P7008, P7009, P7010, P7011, P7012, P7013 • Certifications;

Table 3: IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems

There are many pros and cons associated with these different organizational structures. Collectively though, work products can usually be categorized into one of two camps – 1) university research aimed at creating new knowledge or ways of thinking about social impact of AI; 2) standards and consortia aimed at creating agreement in perspectives and tools about social impact of AI.

SOCIAL IMPACT FACTOR ANALYSIS (SIFA)

We will now introduce one version of "Social Impact Factor Analysis" (SIFA) – a method and technique for evaluating the plausible systemic risks and benefits of emerging AI technologies, products and services to a community. This strategy tool [5] was developed from experience performing open and closed strategy workshops as part

[5] Wright, R., Paroutis, S. & Blettner, D. (2013) How Useful are the Strategic Tools We Teach in Business Schools? Journal of Management Studies, 50(1): 92-125.

of new product and strategy development processes and practices at a Fortune 50 multi-national technology corporation headquartered in Silicon Valley, California. More than 30 one or two-day workshops were held where more than 500 internal and external stakeholders participated to tackle a diverse mix of strategic discussions and activities.

Strategy tools are under constant development and evolution.[6] For example, in 1979, Michael Porter introduced the now classical Porter's Five Forces (P5F)[7] which were designed to be used by individuals to characterize the drivers of profitability of an existing market structure. Nowadays, this tool is severely insufficient due to a variety of reasons; the most important being that social factors were bolted onto the original P5F design at a later stage by extending it to include non-traditional "forces" of Society, Technology, Environment and Politics (PEST). As a result, social factors are secondary and not the primary basis for analysis. Furthermore, they are framed in terms of how they impact profitability of a market structure and other related competitive "forces."

In contrast, SIFA, like most modern strategy tools,[8] is designed for both individual and group processes and practices. SIFA is designed to focus only on characterizing the impact and implications of an emerging technology, in this case AI, to at least eight social factors as the core basis for analysis. Yet similar to when performing a P5F analysis where one aims to characterize the dynamics and interplay between different forces to give insights on drivers of profitability and competitiveness, SIFA also aims to characterize the dynamics and interplay between difference social factors to give insights on drivers of plausible systemic risks and benefits for a particular emerging technology.

[6] Knight, E., Paroutis, S. & Heracleous, L. (2018) The Power of PowerPoint: A Visual Perspective on Meaning Making in Strategy. Strategic Management Journal, 39(3): 894–921.

[7] https://www.isc.hbs.edu/strategy/business-strategy/Pages/the-five-forces.aspx

[8] Paroutis S., Franco A. & Papadopoulos T. (2015) Visual Interactions with Strategy Tools: Producing Strategic Knowledge in Workshops. British Journal of Management. 26: S48-S66.

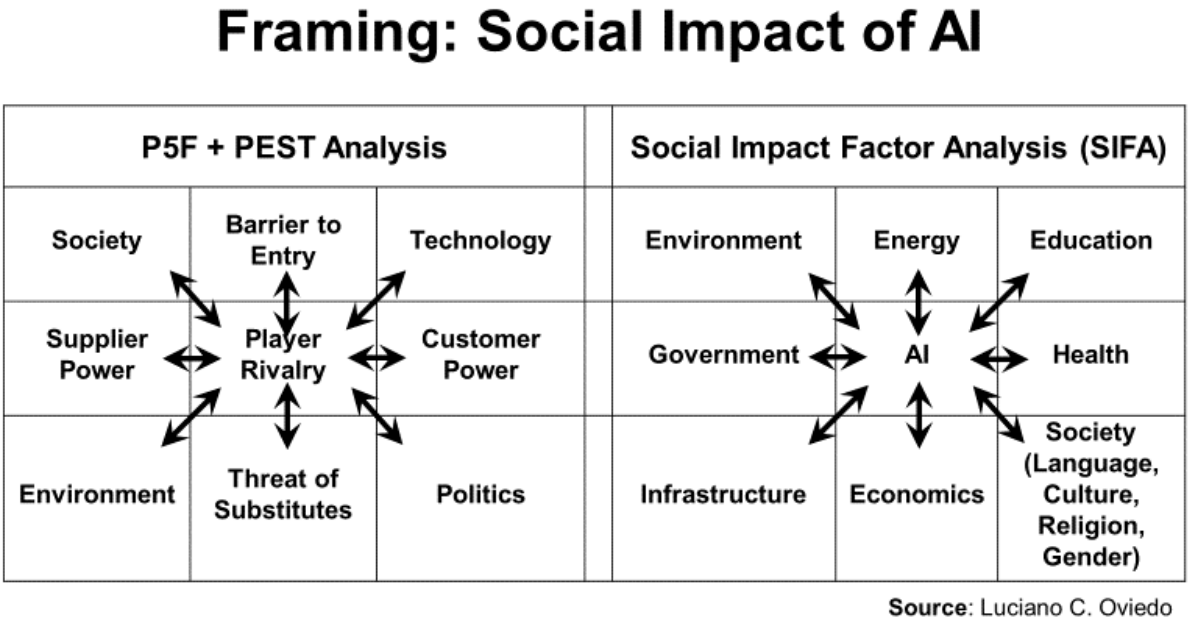

Figure 1: Visual Comparison of P5F and SIFA

We will now walk through a high-level step-by-step characterization on the impact of AI to society by using SIFA on a popular use case, autonomous vehicles (AV). Figure 2 represents how an organization can start to score risks and benefits.

Summary: Social Impact of AI

Use Case: AI-enabled Transport – Autonomous Driving		
date-stamp/participants	Risks	Benefits
Environment	?	?
Government	?	?
Infrastructure	?	?
Energy	?	?
Economics	?	?
Education	?	?
Health	?	?
Society (i.e., Language, Culture, Religion, Gender)	?	?

Source: Luciano C. Oviedo

Figure 2: Simple Scoring Tool for Tracking Risks vs. Benefits across Factors

Step 1 – What is the setup?

There are four basic parts to the setup – 1) participation; 2) prioritization; 3) use case; and 4) content. SIFA can be performed as an individual or group process; therefore, the organization should determine who will contribute towards participating in the analysis. Options are start off with internal and individual participants, then scale up to external stakeholder to collaborate in groups. Next, the social factors should be prioritized. If using a group format, then ideally the group uses a convergence process to select the use case and to verify or refute an area of highest concern or opportunity. In this article, we highlight eight social factors for consideration: 1) Environment; 2) Energy; 3) Society; 4) Health; 5) Education; 6) Economics; 7) Government; 8) Infrastructure. To clarify, the idea is to characterize the impact of AI to these factors and vice versa. Therefore, we recommend selecting factors which provoke exploration of two-way, rather than one-way dynamics. The important element to this part is on developing the right level of specificity in the use case and the factors. For example, if seeking a detailed understanding on the impact of an AI feature, then develop a use case description that compares and contrasts across features or feature-sets. On the other hand, if seeking to understand the impact of an AI technology portfolio, then develop a use case description that compares and contrasts across portfolios. Finally, content should be gathered on the use case and social factors. In this AV example, we are using publicly available content.

Step 2 - What does the platform ecosystem look like?

Once the setup is complete, the first step is to contextualize "where are we" by establishing a converged mental model of the existing platform ecosystem. In Figure 3, Comet Labs published a "future of transportation stack" [9] where the various hardware and software technologies span 7 layers and 33 different categories.

[9] https://www.wired.com/2017/05/mapped-top-263-companies-racing-toward-autonomous-cars/

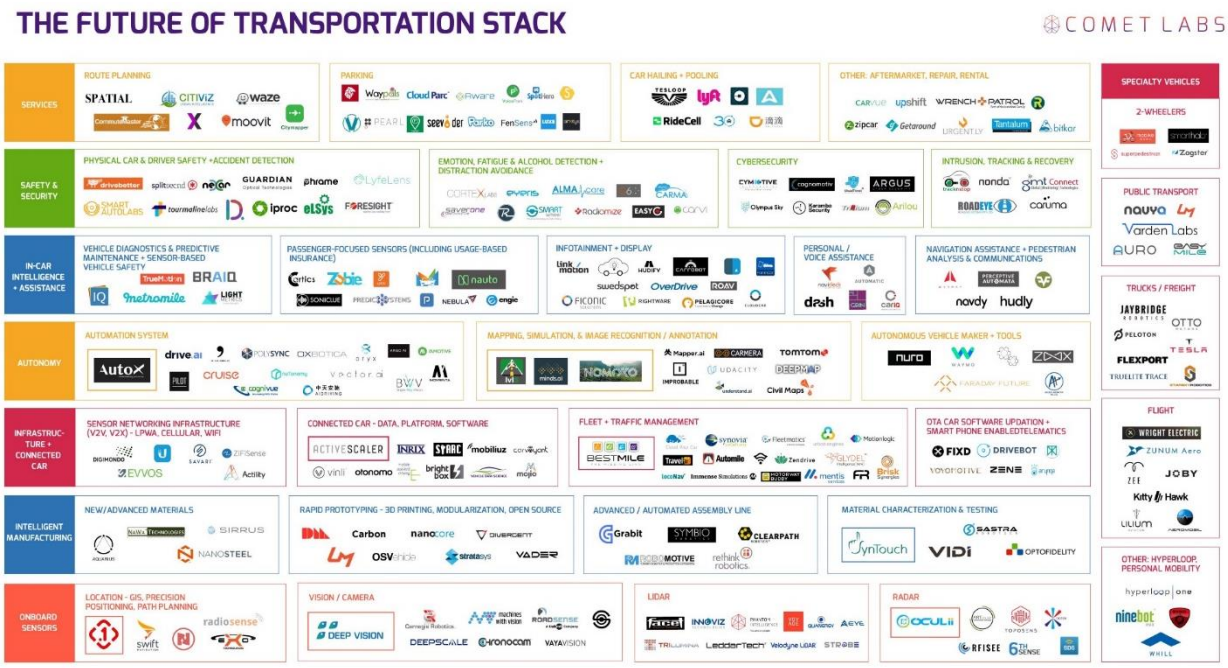

Figure 3: The Future of Transportation Stack

The layers and categories are:

- Services
- Safety & security
- In-car intelligence assistance
- Autonomy
- Infrastructure & Connected car
- Intelligence manufacturing
- On-board sensors
- Specialty Vehicles

This highly complex and rapidly evolving platform ecosystem of software and hardware technologies implies high uncertainty. Therefore, organizations should expect that the fragmentation will continue into the foreseeable future. The point of this step is to integrate diverse perspectives and converge on a common mental model around "where are we." To mitigate this level of uncertainty, an organization may choose to anchor on a specific layer or category.

Step 3 - How might the platform ecosystem evolve?

The next step is to address "where can we go next" by evaluating the plausible evolution of the AD platform ecosystem. We explore this along two dimensions: 1) the type of contract between the rider and the vehicle and 2) the type of control used to drive the vehicle.

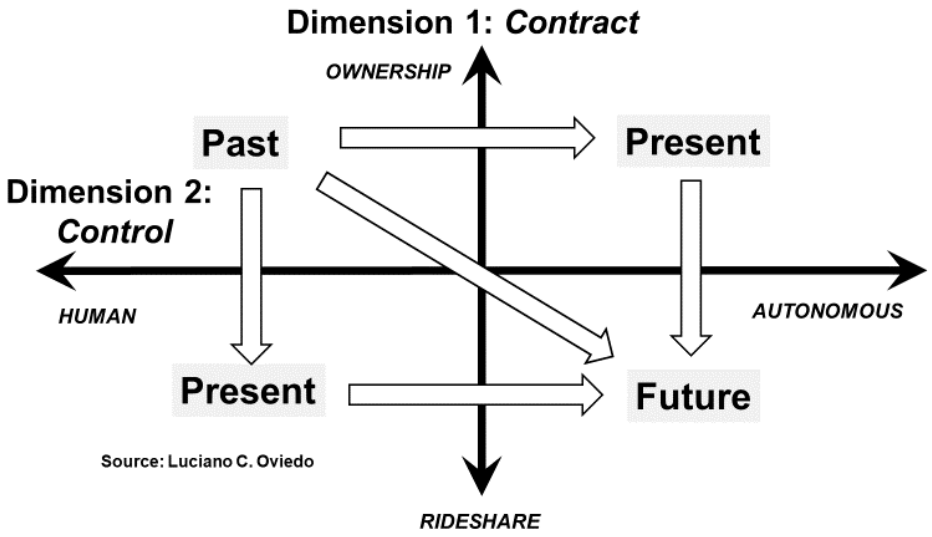

Figure 4: Evolution from Human Control/Ownership to Autonomous Rideshare

- **Dimension 1 – Type of Contract**: This represents the type of contract that exists between the rider/driver and the vehicle; i.e., person is being transported by a vehicle they own or in one that is being used for ridesharing;
- **Dimension 2 – Type of Control**: This represents the type of control for driving the vehicle; i.e., a human is in control of driving the vehicle or an autonomous system is in control of driving the vehicle;

As context, for the past 100 years, the typical business model for automobile manufacturers assumed people sought to own and control their vehicles. More recently, this dynamic has changed through the adoption of ridesharing. Uber and Lyft are current examples of rideshare companies investing in making ridesharing a mainstream mode of transportation. In Figure 5, a study by UC-Davis and Bloomberg[10] described the rapid adoption of rideshare is displacing other means of public and private transportation.

[10] https://www.bloomberg.com/news/articles/2018-02-13/self-driving-cars-will-kill-things-you-love-and-a-few-you-hate

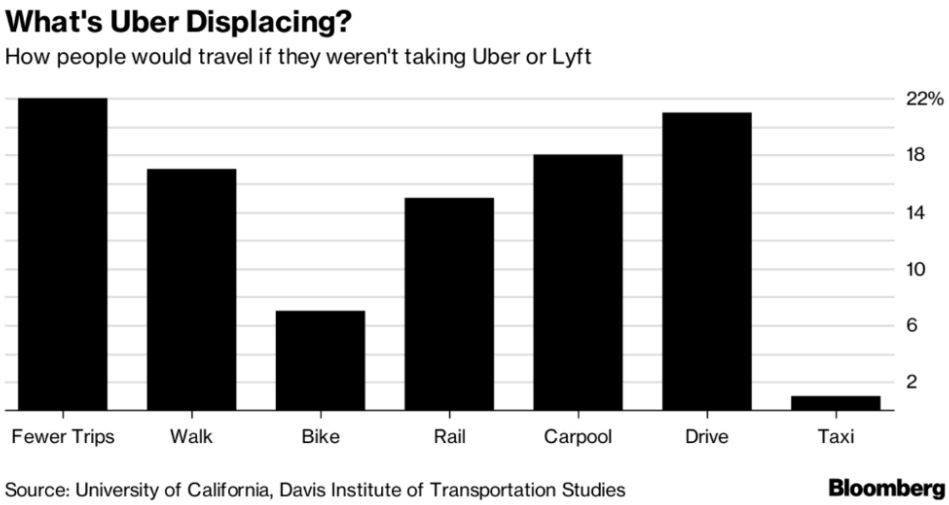

Figure 5: Impact of Rideshare to Public Transport

The Evolution from Citizen Ownership to Rideshare

According to internal analysis in Figure 6, the cost of owning a vehicle is already higher than ridesharing; more specifically, year-on-year savings from using rideshare can reach up to approximately $11K savings over 7 years. This cost savings suggests an inevitable shift from ownership to ridesharing.

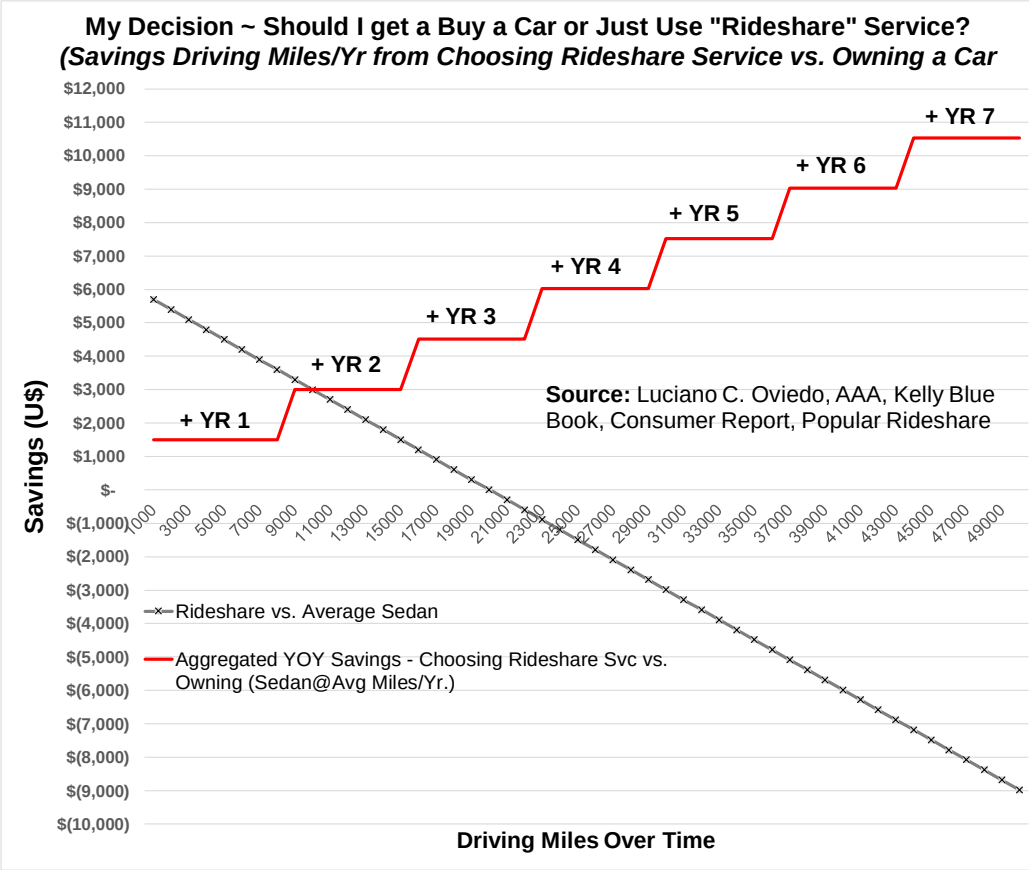

Figure 6: Savings from Using Rideshare vs. Owning a Vehicle

The Evolution from Human to Autonomous Control

According to BIS research, [11] "the global autonomous vehicle market was valued at 6.6 million units in 2017 and is expected to reach 67.5 million units by 2028, registering a CAGR of 20.78% between 2018 and 2028." Rideshare companies continue to invest in AV. For example, Bloomberg reported[12] that Uber plans to purchase 24,000 driverless cars from Volvo. Similarly, the NYT reported [13] that Lyft had signed an agreement with Magma International to be its supplier for AVs as well as contribute $200M to its latest fundraising round. Most recently, Uber's Autonomous Driving Unit (Advanced Technologies Group) received a

[11] https://bisresearch.com/industry-report/autonomous-vehicle-market.html

[12] https://www.bloomberg.com/news/articles/2017-11-20/uber-steps-up-driverless-cars-push-with-deal-for-24-000-volvos

[13] https://www.nytimes.com/2018/03/14/technology/lyft-magna-driverless-cars.html

$1B investment from Toyota, Denso and Softbank.[14]

Step 4 – What are the growth prospects?

The next step is "why should we go there." According to analysis[15] by Strategy Analytics in Figure 7, sponsored by Intel, the total economic impact of AV will be on the order of $7T for consumer and business products and services. As the Verge[16] noted, "Intel's study offers a few interesting predictions for autonomous vehicles and how a combination of mobile connectivity, population density in cities, traffic congestion and subsequent regulation, and the rise of on-demand ride-hailing and car-sharing services will be the catalysts in this new economic era."

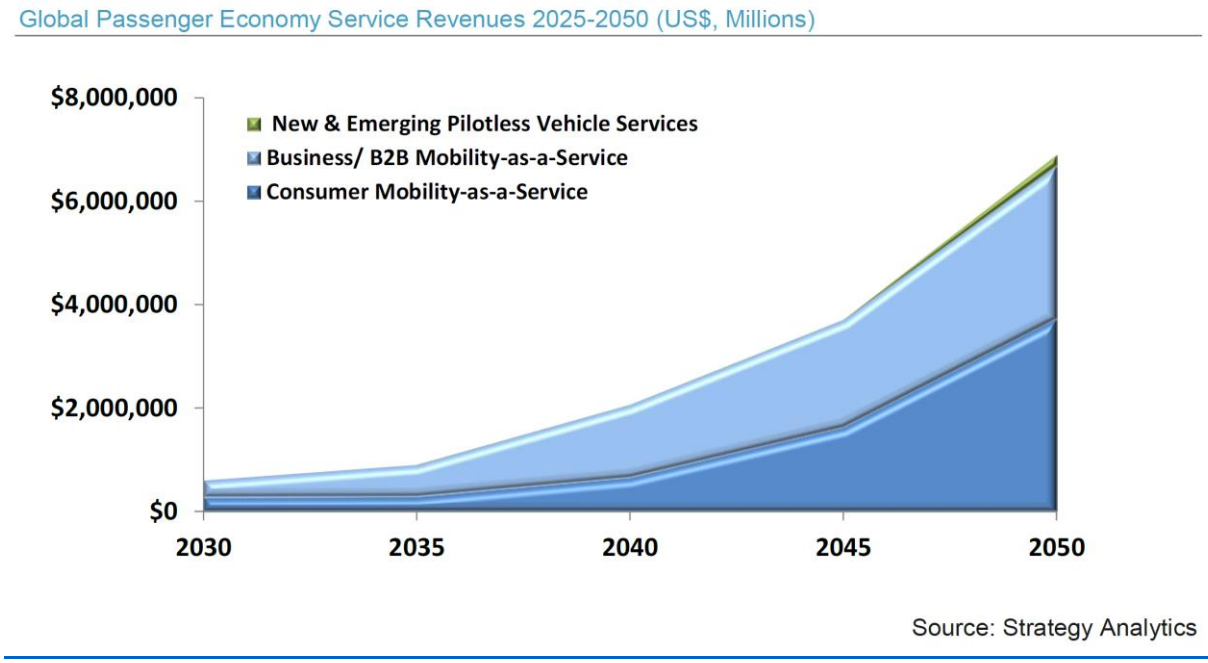

Figure 7: Market Opportunity for AV Related Products and Services

Due to market and technology complexity, we expect key drivers for mass adoption of AVs to be through ridesharing. We also expect them to take longer than it took for mass adoption of Cloud computing (i.e., 15-20 years).

[14] https://arstechnica.com/cars/2019/04/toyota-leads-1b-investment-in-ubers-self-driving-tech/

[15] https://newsroom.intel.com/newsroom/wp-content/uploads/sites/11/2017/05/passenger-economy.pdf?cid=em-elq-26916&utm_source=elq&utm_medium=email&utm_campaign=26916&elq_cid=1494219

[16] https://www.theverge.com/2017/6/1/15725516/intel-7-trillion-dollar-self-driving-autonomous-cars

Step 5 - What is the impact of AV to environment and energy?

Given the converged view of the ecosystem, how it may evolve and growth prospects, we can now look at the impact of AVs to a variety of social factors, starting with environment and energy. We will now look at internal combustion engine powered vehicles (ICE-AVs) and electric or battery powered vehicles (EV-AVs).

A study[17] by the University of Michigan and Ford indicates a 9% net reduction in energy usage and Green House Gas (GHG) emissions for the base case from an ICE-AV. As DMV.org implies in their analysis, [18] inefficiencies are due to the limited integration of technologies and the high-power consumption from computing required to process the sensing and navigation. As these technologies decrease in costs from economies of scale then the GHG should decrease even more for ICE - AVs.

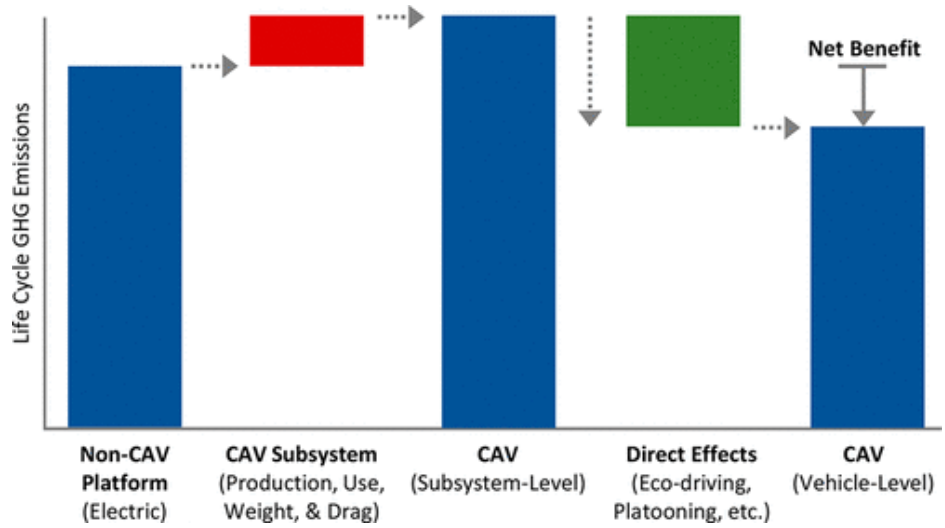

Figure 8: Net Benefits of an ICE - AV

Another study [19] by UC-Berkeley finds the cost of service provided by a fleet of EV-AVs will be $0.29-$0.61 per revenue mile, an order of magnitude lower than the cost of service of present-day Manhattan taxis. EV-AVs will also be $0.05−$0.08/mi lower than

[17] https://pubs.acs.org/doi/10.1021/acs.est.7b04576

[18] https://www.dmv.org/articles/environmental-effect-of-self-driving-cars

[19] https://pubs.acs.org/doi/abs/10.1021/acs.est.7b04732

a fleet of hybrid or ICE-AVs. They estimate that a fleet of EV-AVs drawing power from the current NYC power grid would reduce GHG emissions by 73% and energy consumption by 58% compared to a fleet of ICE-AVs. These analyses indicate that although ICE-AVs do help the environment more than standard ICE vehicles, EV-AVs stand to make the highest positive impact.

On the other hand, although there is lack of data on the extent that AVs will drive EV[20] sales or vice versa, Tesla serves as a good example of how EV-AVs sales might evolve. Back in October 2016, Tesla reported[21] that all their cars will include hardware necessary for full self-driving capabilities. Then, by August 2018, Musk announced that Autopilot Version 9 includes software features for full self-driving capabilities, where customers can pay $5K for Autopilot lane-keeping and lane-changing capabilities or an additional $3K for full self-driving capability. [22] According to Statistica, [23] the number of Tesla vehicles delivered worldwide since they started including hardware necessary for full self-driving went from ~22K vehicles delivered in Q4/2016 to ~41K vehicles delivered in Q2/2018 resulting in a total of ~196K vehicles with the ability to be fully self-driving. Tesla recently reaffirmed its guidance of reaching 360K-400K vehicles to be delivered in 2019.[24] As the growth of EV-AVs continues, so will the demand increase for raw materials, manufacturing and disposal of AV batteries. The mining of battery ingredients can be detrimental to the environment and humans who perform the mining.

Lithium: The extraction of lithium can impact the environment through water pollution and depletion as well as through the toxic chemicals that are used to extract and process it. Based on analysis[25] by Friends of Earth Europe, "the amount of Li-ion batteries collected in the EU in 2010 was estimated at 1,289 tons along with 297 tons of lithium primary batteries. This is only about 5% of the Li-ion batteries put on the market," according to the Belgian recyclers, Umicore. In terms of harvesting, natural environments and underdeveloped countries stand to face the challenge of delivering on Lithium. For example, according to the Democracy Center, "Large quantities of toxic chemicals will be needed to process the predicted 30,000 to 40,000

[20] https://www.greencarcongress.com/2018/07/20180720-hayden.html

[21] https://www.tesla.com/blog/all-tesla-cars-being-produced-now-have-full-self-driving-hardware%20

[22] https://www.zdnet.com/article/elon-musk-tesla-autopilot-gets-full-self-driving-features-in-august-update/

[23] https://www.statista.com/statistics/502208/tesla-quarterly-vehicle-deliveries/

[24] https://ir.tesla.com/news-releases/news-release-details/tesla-q1-2019-vehicle-production-deliveries

[25] http://www.foeeurope.org/sites/default/files/publications/13_factsheet-lithium-gb.pdf

tons of lithium per year that the project expects to mine. The escape of such chemicals via leaching, spills or air emissions is a danger that threatens the communities and the ecosystem as a whole."[26]

Cobalt: According to the CDC,[27] the mining of cobalt can cause serious health effects. For example, "chronic exposure to cobalt-containing hard metal (dust or fume) can result in a serious lung disease called 'hard metal lung disease'" – a kind of pneumoconiosis, meaning a lung disease caused by inhaling dust particles. Inhalation of cobalt particles can cause respiratory sensitization, asthma, decreased pulmonary function and shortness of breath."[28]

Nickel: Back in 2016, Philippines' Environment and Natural Resources (DENR) Secretary Regina Lopez "ordered the closure … of 23 mines, mainly nickel producers that account for about half of output in the world's top nickel ore supplier, in a government campaign to fight environmental degradation by the industry." [29] This was due to a series of audits that found environmental damage from mining.

According to Wired,[30] the annual demand for nickel, cobalt and lithium are expected to increase from a total of 200K metric tons to a total of 1.1M metric tons in order to meet the demand for battery-powered EVs. The sources of these ingredients stand to face many challenges. Figure 9 describes the expected growth with demand for lithium, cobalt and nickel.

[26] https://democracyctr.org/dc_2017/wp-content/uploads/2017/01/DClithiumfullreportenglish.pdf

[27] https://www.cdc.gov/niosh/topics/cobalt/

[28] https://www.cbsnews.com/news/the-toll-of-the-cobalt-mining-industry-congo/

[29] https://www.reuters.com/article/us-philippines-mining/philippines-to-shut-half-of-mines-mostly-nickel-in-environmental-clampdown-idUSKBN15H0BQ

[30] https://www.wired.com/story/the-potential-pitfalls-of-electric-cars-in-5-charts/

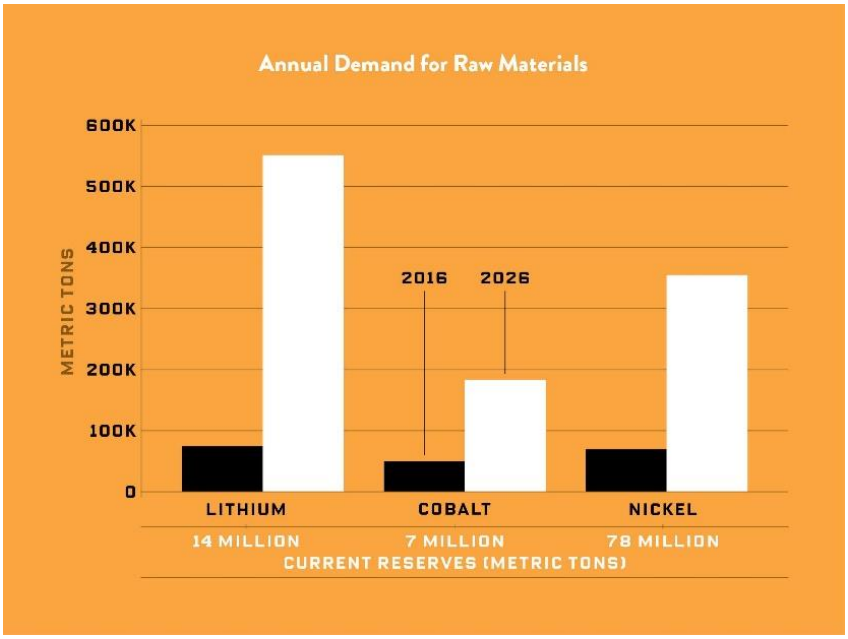

Figure 9: Expected Demand for EV Battery Ingredients

Another challenge is how to properly recycle or dispose of EV batteries. "However, in the EU as few as 5% of lithium-ion batteries are recycled. This has an environmental cost. Not only do the batteries carry a risk of giving off toxic gases if damaged, but core ingredients such as lithium and cobalt are finite and extraction can lead to water pollution and depletion among other environmental consequences."[31]

Step 6 - What is the impact of AV to quality of life and economics?

AV stands to drastically improve productivity. For example, according to AAA [32], the time wasted from driving or waiting in car lines is approximately 300 hours per person per year. In the USA alone, this adds up to 4B hours per year of wasted time going from point A to point B. Similarly, as described in Figure 10, the British Parking Association and Visa estimate the average British driver spends 91 hours looking for parking and 18 hours in lines for a total of 109 hours per year per person. By reducing or eliminating this waste of time, AVs stands to increase the productivity of citizens across geographies where traffic and congestion are issues.

[31] https://www.theguardian.com/sustainable-business/2017/aug/10/electric-cars-big-battery-waste-problem-lithium-recycling

[32] https://newsroom.aaa.com/2016/09/americans-spend-average-17600-minutes-driving-year/

Figure 10: Opportunity for AV to Increase Productivity by Reducing Time Wasted

AVs also stand to increase quality of life of citizens by increasing access to transportation, health care and education.

For example, AVs could provide increased access to transportation in general to 15M-20M seniors who struggle to get it.[33] This figure will likely increase as the population who are 65 or older grows to more than 78 million by 2035.[34]

In terms of health care, AVs could provide increased access to transportation for health care across all demographics. For example, a study on comparing the distance and mode of transportation to radiotherapy and chemotherapy and perceptions of transportation as a barrier to care among white, black and Hispanic cancer patients found that 55% of African American and 60% of Hispanic respondents reported transportation being a major barrier to treatment, compared to 38% of white respondents.[35]

In terms of education, AVs could provide increased access to educational choices. For example, although "more than 25 million

[33] https://www.aarp.org/content/dam/aarp/livable-communities/old-learn/transportation/aging-in-place-stuck-without-options-transportation-for-america-report-2011.pdf

[34] https://www.census.gov/newsroom/press-releases/2018/cb18-41-population-projections.html

[35] https://www.ncbi.nlm.nih.gov/pubmed/9397704

children (over 55% of U.S. public K-12 students) climb aboard school buses each day," [36] data suggests that parents would have chosen a different school for their children if transportation was not an issue.[37]

Finally, in Figure 11, according to Bloomberg, AVs stand to save 350K lives over a 10-year span.[38]

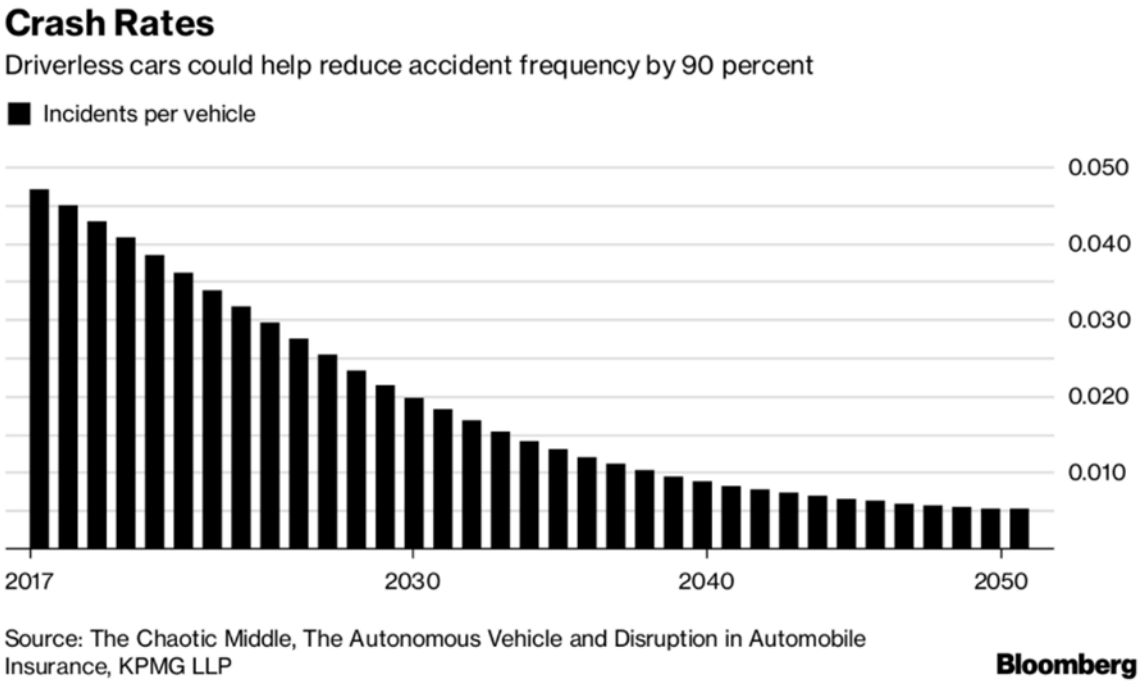

Figure 11: Expected Decrease in Crash Rates due to AVs

On the other hand, analysis by the Casualty Actuarial Society Automated Vehicles Task Force (CAS AVTF) found that "49% of accidents contain at least one limiting factor that could disable the [AV] technology or reduce its effectiveness."[39]

Furthermore, open questions remain on liability, insurance rates, lost driver jobs and privacy. For example, when there is an inevitable accident, who or what is liable is still unresolved. In fact, Figure 12 highlights

[36] https://www.forbes.com/sites/gailcornwall/2018/05/01/why-tech-is-prepping-to-overhaul-school-transportation/#64ac218b588a

[37] https://www.crpe.org/sites/default/files/pub_dscr_teske_jul09_0.pdf

[38] https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf

[39] https://www.casact.org/pubs/forum/14fforum/CAS%20AVTF_Restated_NMVCCS.pdf

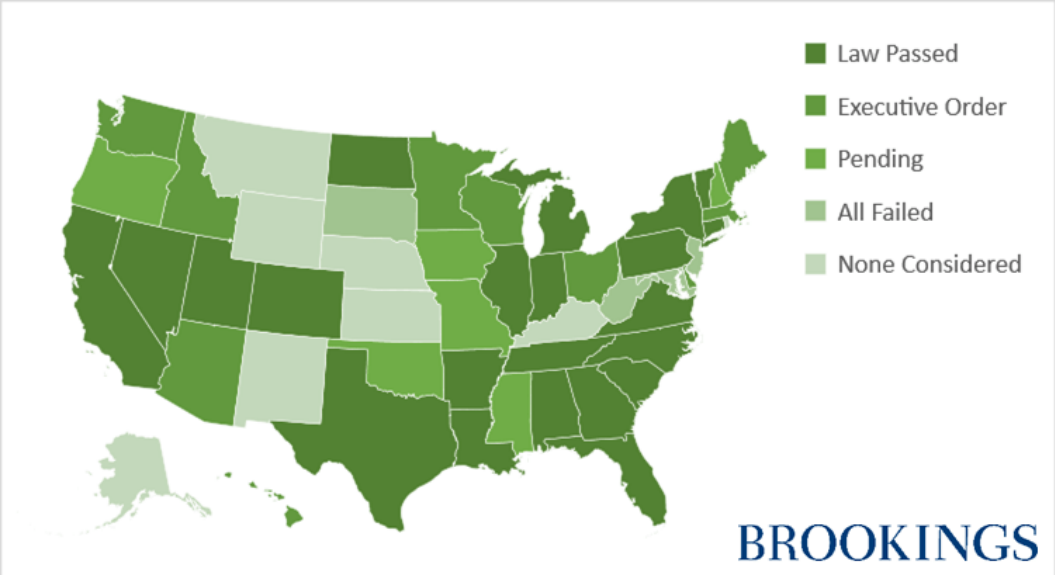

Figure 12: Status of AV Legislation across the United States

the lack of standardized federal or state laws around AVs. In terms of insurance rates, the CAS AVTF published research[40] around the lack of standards for AV insurance premiums, liability systems and assessing risks.[41] "There is no standard, and every manufacturer is going about this in a different way, so to try to normalize all these data sets from all these manufacturers is going to be of extreme importance," says Ash Hassib, senior vice president and general manager of auto and home insurance for LexisNexis.

According to the Bureau of Labor Statistics, there are 3.8M people who operate motor vehicles for their job[42]. Analysis by Goldman Sachs indicated these jobs are at risk, and job losses could result in 25K jobs lost per month or 300K jobs lost per year.[43]

Finally, AVs will sense, monitor and track not only internal but external movements of people and things. So who owns and controls the data? According to ECMAG,[44] "In 2017, the Safely Ensuring Lives Future Development and Research in Vehicle

[40] https://www.carriermanagement.com/features/2018/06/19/180750.htm

[41] https://www.casact.org/pubs/forum/18spforum/01_AVTF_2018_Report.pdf

[42] https://www.bls.gov/ooh/transportation-and-material-moving/

[43] https://www.cnbc.com/2017/05/22/goldman-sachs-analysis-of-autonomous-vehicle-job-loss.html

[44] https://www.ecnmag.com/article/2018/08/data-security-and-privacy-connected-car-age

Development (SELF DRIVE)[45] Act was passed. This bill requires automakers to develop a cybersecurity plan to regulate access to automated driving systems." Yet, in terms of privacy, "Currently, there are no specific laws in the United States that govern the use of our cars' data, and you may have given up your privacy rights when you signed the contract on your new car…We are in the gold rush of data right now — it's basically who can dig it up first," says tech expert Gray Scott. In 2017, two Democratic senators introduced the SPY Car Act[46] to establish federal standards to secure cars and protect drivers' privacy, but it hasn't yet gained traction."[47]

Step 7 – Grade and Aggregate Results into Scorecard

The final step is to aggregate results into a summary table. Figure 13 is an example of results from a corporate or business unit activity to grade the plausible systemic risks and benefits of AV by using SIFA. Of course, there will continue to be many open questions. After a few iterations though, convergence is possible and these types of artifacts can be shared and serve as a basis for discussion, debate or further analysis.

[45] https://energycommerce.house.gov/selfdrive

[46] https://www.markey.senate.gov/news/press-releases/senator-markey-and-blumenthal-reintroduce-legislation-to-improve-cybersecurity-of-vehicles-and-airplanes

[47] https://www.esurance.com/insights/connected-car-data-sharing-myths

Summary: Social Impact of AI/AV

Use Case: AI-enabled Transport – Autonomous Driving		
Factors	**Risks**	**Benefits**
Environment	-- / +	+ / + / +
Government	-- / -- / --	-- / +
Infrastructure	-- / +	-- / +
Energy	-- / +	+ / +
Economics	-- / -- / -- / --	-- / +
Education	-- / +	-- / +
Health	-- / +	+ / + / + / +
Society (i.e., Language, Culture, Religion, Gender)	-- / -- / -- / --	-- / +

Source: Luciano C. Oviedo

Figure 13: Example of Simple Scorecard for Characterizing Social Impact of AV

CONCLUSION & RECOMMENDATIONS

Integrating open strategy and design thinking processes and practices as well as utilizing SIFA to characterize the social impact of AI/AVs indicates that there are no easy answers on the social impact of AI. Despite this, benefits for an organization include: A) an opportunity for quantitative and qualitative analysis and synthesis on factors it views as most important; B) creating a common mental model for internal and external stakeholders on where and how a perspective or position was derived; C) inclusion of non-traditional stakeholders, such as citizens of a respective community, to create buy-in and support for the vision and opportunity as well as identifying blind-spots and ways to mitigate risks.

We recommend a two-part adaptation of an AI strategy. In part one, we recommend integrating open strategy and design thinking processes and practices into technology strategy activities aimed at characterizing the social impact of AI. Traditional or classical strategy includes internal representatives, is need-to-know, is closed off to external stakeholders and is sourced with senior managers and executives. In contrast, Figure 14 shows how open strategy is open and transparent to participation to internal and external representatives and can be sourced with front-line and mid-level staff.

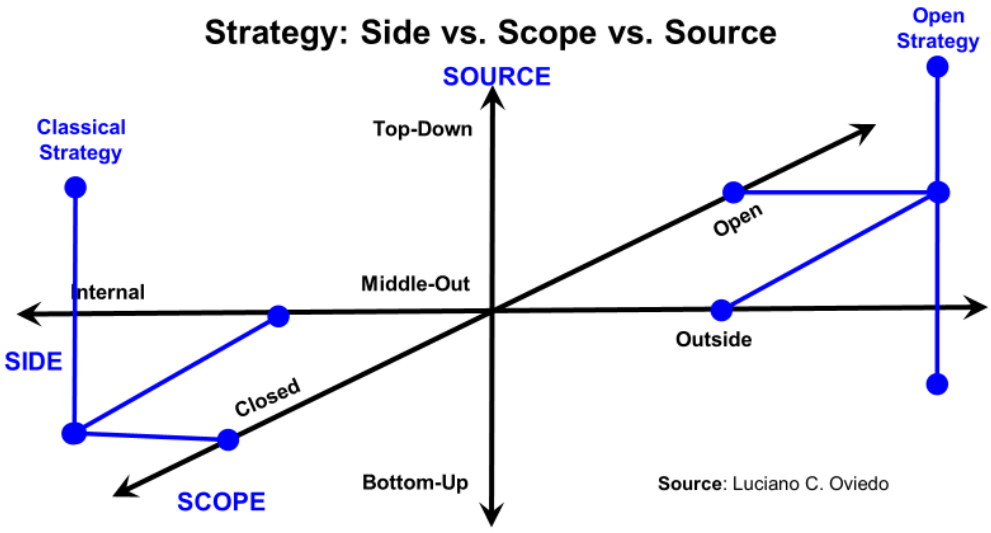

Figure 14: Open Strategy vs. Classical Strategy

In open strategy activities, we recommend corporate and/or business unit technology and business leaders "stress test" their existing or proposed AI strategy and plans against various types of plausible futures and adapt them appropriately.

In part two, we recommend utilizing new analytical methods and techniques that were designed to focus on the social impact of AI. By using methods like SIFA, an organization can standardize, grade and share results on the plausible systemic risks and benefits of AI to internal and external stakeholders. Internally, the results and insights can be used as filters in market and technology scanning activities or contribute towards go/no-go decisions on technology investments. Externally, the criteria, methods and results can be shared with customers, partners or suppliers to address topics such as reusability, disposability and recyclability.

In conclusion, characterizing the social impact of AI technologies, products and services remains an open challenge for organizations. Despite this, there are cost effective ways to proactively mitigate risks and promote benefits.

➢ Return to IIC Journal of Innovation landing page for more articles and past editions