Group 10-35 (Smart Cars) - Written Report

Introduction

A. **4th Industrial Revolution Impacts**
B. **Background on Smart Cars**
C. **Problem with Smart Cars**

Firstly, Smart Cars would not be possible if not for the 4th major revolution. It is characterized by a fusion of technologies that is blurring the lines between the physical, digital and biological spheres, collectively referred to as cyber-physical systems. Examples of it include emerging technology breakthroughs in a number of fields, including robotics, artificial intelligence, nanotechnology, quantum computing, biotechnology, the Internet of Things, the Industrial Internet of Things (IIoT), decentralized consensus, fifth-generation wireless technologies (5G), additive manufacturing/3D printing and fully autonomous vehicles.

Advances in automotive safety through Fourth Industrial Revolution technologies can reduce road fatalities and insurance costs, and carbon emissions. Autonomous vehicles can reshape the living spaces of cities, architecture, and roads themselves, and free up space for more social and human-centered spaces. Digital technology can liberate workers from automatable tasks, freeing them to concentrate on addressing more complex business issues and giving them more autonomy. It can also provide workers with radically new tools and insights to design more creative solutions to previously insurmountable problems.

However, while the Fourth Industrial Revolution has the power to change the world positively, we have to be aware that the technologies can have negative results if we do not think about how they can change us. People have a deep relationship with technologies. They are how we create our world, and we have to develop them with care. More than ever, it's important that we begin right.

Smart Cars have a total of 5 different levels to show their abilities and functions, level 1, level 2, level 3, level 4 and level 5. The SAE, the Society of Automotive Engineers, has created a lexicon of autonomy. To date, the highest level a Smart Car has reached is level 2+, which is on the cusp of Level 3.

Level 1 autonomous cars: a single aspect is automated

Level 1, the most basic type, is where one element of the driving process is taken over in isolation, using data from sensors and cameras, but the driver is very much still in charge. This started in the late 1990s at Mercedes-Benz, with its pioneering radar-managed cruise control,

while Honda introduced lane-keep assist on the 2008 Legend. These were the first steps towards removing the driver's duties behind the wheel.

Level 2 driverless cars: chips control two or more elements

Level 2 autonomy is where we're at today: computers take over multiple functions from the driver – and are intelligent enough to weave speed and steering systems together using multiple data sources. Mercedes says it's been doing this for four years. The latest Mercedes S-Class is in between level 2 and level 3. It takes over directional, throttle and brake functions for one of the most advanced cruise control systems yet seen – using detailed sat-nav data to brake automatically for corners ahead, keeping a set distance from the car in front and setting off again when jams clear, with the driver idle.

Level 2+ autonomous cars: somewhere in between

Nestled in between Level 2 and Level 3, Level 2+ is more where most car makers hope to be by the end of this year. It's a level that's been coined by Nvidia, and although not quite the driverless Level 3 below, it's a little more than Level 2. With Level 2+ the driver is still alert and in control, but the vehicle is also well aware of its surroundings – and make adjustments if necessary. As well as the outside, the car is more aware of the driver too, and will monitor things like tiredness.

Level 3 autonomous cars: the car can boss safety-critical functions

Highly automated vehicles are not far off. The SAE calls Level 3 'conditional automation' – a specific – mode which lets all aspects of driving be done for you, but crucially the driver must be on hand to respond to a request to intervene. Audi calls its new A8 a Level 3 ready autonomous car – meaning the car has the potential to drive itself in certain circumstances, where it will assume control of all safety-critical functions, by refining maps, radar and sensors and fusing this environmental data with ever-wiser and faster processors and logic. Today's assumption of a two-second comms lag will soon look very slow.

Level 4 driverless cars: fully autonomous in controlled areas

Early next decade cars will fully drive themselves in geofenced metropolitan areas, as HD mapping, more timely data, car-to-car comms and off-site call centres (to deal with unusual hazards) improve accuracy. `You won't really need the driver in Level 4,' says Mercedes Benz's autonomous guru Christoph von Hugo. 'The likelihood is you will just be renting a car, rather than owning it. You won't take this car on vacation to Florida but you'll take it on an urban

journey around New York, say. It is easier to have ultra-detailed mapping for carefully defined areas.' Twenty car makers say they'll sell autonomous cars in the US by 2022.

Level 5 driverless cars: fully autonomous, can travel anywhere. Driver is optional…

The difference between Level 4 and 5 is simple: the last step towards full automation doesn't require the car to be in the so-called 'operational design domain'. Rather than working in a carefully managed (usually urban) environment with lots of dedicated lane markings or infrastructure, it'll be able to self-drive anywhere. Because the frequency and volume of data, and the sophistication of the computers crunching it, will mean the cars are sentient. It's a brave new world – and one that Google's Waymo car is gunning for, leapfrogging traditional manufacturers' efforts. The disruption will be huge: analysts forecast 21 million autonomous vehicles globally by 2035.

Next, is the potential problems Smart Cars could face. Firstly, accountability. This is not a technical issue but an ethical issue. When smart cars are released, there will be instances in which they crash, and accidents altogether are inevitable. But now, comes the question of accountability. Who is accountable for the injuries sustained, or maybe even the death of the passenger. The smart car cannot be held responsible, because after all, it is only a machine, a product of the company that manufactured it. Then, how about the company? The smart car is a product of the company, so should the company be the one to take responsibility of the situation? However, some may argue that the driver should have paid more attention to the road and should have hit the emergency brakes when he foresaw an accident. Therefore, there are many perspectives to see the accident from and it would not have a fixed solution.

The problem of criminal hacking and system malfunction exists with every piece of technology. Like all computer systems, autonomous cars would be programmed to run a certain way, but with all automated systems there is always a risk of the computer being hacked or crashing due to a glitch or error. No system is infallible and if a hacker was able to get into the car's software, they could potentially reprogram the car to do any number of things. It could be reprogrammed to create distress amongst members of the public. Researchers from the University of Michigan have also warned that it is impossible to track the various threats a computerised system faces. Researchers Andre Weimerskirch and Derrick Dominic concluded that cybersecurity is an overlooked area of research in the development of driverless vehicles. More threats are also likely to emerge with technology progressing to higher levels. This is a cause for concern

because if such powerful technologies like the smart car falls into the wrong hands, it could cause lots of issues.

Our third problem is the reliability issue. ‘Smart Cars’ are imagined to be efficient, powerful, dynamic, convenient and life-changing, but the fact is smart cars haven’t reach that stage of development and they are still struggling to fit in society. Companies might have tried to implement ‘Smart Cars’, and make models of them, yet they are dangerous, unreliable and no one wants or dares to use them yet. For example, Smart Fortwo, a Smart Car has been receiving consumers’ complaints, with one user claiming that their engine broke down three times in two months. Another user has said their 2010 model has been recalled eight times. They have also noted that the service and the cost of the repairs haven’t been great when the car has gone wrong.

After much thought we decided that accountability would be the biggest threat. All the other issues stated are all technical. Although we may not have the technology available now, since our resources are limited as mentioned earlier in this presentation, it will still be solvable as that just requires scientific advancements. However, accountability had many different possible ways of looking at it. Everyone is different, and each of us have different opinions. When a smart car accident case file goes to court, many people would have different views to the judge’s final verdict at the end of the hearing. Bringing in the example of Uber test driving accident. The court decided to let Uber get away scot-free and it raised many questions. Many felt it was the wrong call as Uber should have been fined. However, on the other hand, there were also those that stood with the verdict, saying the system was not developed enough to have detected the pedestrian. The same problem would continue even as scientific breakthroughs are made, as this cannot be easily solved with technology.

I think that reliability is the main technical issue we face in society today. Examples include:

- Unreliable Systems
- Problematic Parts
- High Maintenance Fee

Reliability issues are frequent and present in Smart Cars.

Many consumers have been saying that their cars:

1. Breakdown Easily
2. Run out of Fuel and can't travel long distances
3. Needs High Maintenance costs

This can be seen through many critics negative comments like:

"she complained about was extremely expensive tires for a small car"- High Maintenance Costs

".

freeway driving is dangerous, lacks durability and versatility"- Breakdown Easily

Consumer reports have also been really really low, and many are regretting their decisions, as it doesn't add up economically and it really just adds up to the amount of trouble and frustration the driver has. Driving is already very stressful as a driver should always keep his eyes focused on the road. Smart Cars were introduced to help reduce the energy required for the driver, yet based on these negative reviews, it seems that not only do Smart Cars not function for their desired purpose, they are actually even worse than the current cars.

Based on all of the above examples, we felt that reliability was a huge part in the introduction of Smart Cars, hence we felt it was necessary to enquire A* about their expert opinion on this issue.

We started off the interview, by questioning the huge problem Smart Cars are facing, in current society. The fact that the Cars have been facing increasing criticism due to problems consumers face, like not being able to drive long distances without the breaking down of cars, unable to make right decisions or failing to recover their system.

We asked, how exactly A* and Smart Car Companies plan to solve the issue?
They told us that the concept of Smart Cars was one that was maturing and needed time to do so. They also said that they themselves and other companies have already invested huge amounts of money in R&D and that they are preparing these cars to go out in public and operate smoothly.

We then asked about an even larger problem that has angered the public for long. The fact that Smart cars have had times where their systems failed and caused accidents that brought to us detrimental outcomes, such as death or injuries to the victims.

However, they were right in saying that this was not a problem of the industry, as it happens with normal cars, as well and have many factors. They also explained to us why these factors mean, that this was not an inherent problem and factors like, negligence or pure accident leads to it, mostly.

The 3rd question we asked was on how many articles claim smart cars have lower fuel costs and require less repairs, with other benefits along with it. However, there are those who also disagree, so we asked how their extensive research on smart cars, made smart cars a more environmentally friendly or fuel efficient choice than conventional cars?

Smart cars are NOT designed to have less repairs or have lower fuel costs. Repairs is inevitable and it depends on the manufacturers. Generally, the more parts there are, the higher the chances that a fault occurs. They explained to us, why and how these Smart Cars do not have the ability or responsibility to be fuel efficient and that they believed that the public had to be aware that such powers were not to be associated with the name of smart cars.

However, they accepted that few companies did include fuel saving plans and for low fuel consumption, they understood it as something referring to “petrol” which is car using fossil fuel versus electric car or “green car”. Comparing an AV to a normal car, an AV has sensors and computers on board – and thus, it will consume more energy.

They made it clear that the main benefit of AV is that it does not require a driver and in a scenario where all cars are autonomous, the chances of an accident is much less and the traffic congestion due to intelligent routing etc. Under such a scenario, there is a benefit in having lower energy consumption due to such traffic congestion. In addition, AVs can be tasked to do more things instead of having the car parked somewhere after the driver reaches his/her destination. This makes it more friendly to the environment, in a way, as less number of vehicles is needed to cater to the demand.

The 4th question was on the fact that researchers, Andre Weimerskirch and Derrick Dominic, from the University of Michigan, concluded in a report that cybersecurity is an overlooked area of research in the development of driverless vehicles and more threats are likely to emerge with (advances in technology). How do you think Smart Cars are liable to Hackers or Computer

Viruses, and are there any systems in place to protect the Smart Cars from them?

Their response was that they acknowledged it as an inherent problem and that cyber security is an important aspect of AV. Researchers are aware and as mentioned, AV research is only beginning. They told us that even though the priority is to achieve such a function and as such, there is less mention about the cyber security aspect. But, it is still an active area of research. Like other smart devices, cyber security requires frequent upgrade since the method of attacks keep getting more sophisticated. On the liability aspect, again, this is not a technical question and thus depends on scenario and the terms and conditions of the agreement reached when the AV is used/purchased etc.

Underlying Problem

“When Smart Cars get into accidents, who is accountable for it?”

Possible Solutions

1. **Reliability**
2. **Accountability**

In today’s world, despite us being in the fourth industrial revolution, on the verge of great technology and automation, there are still many problems in our society. The smart cars, which are more advanced than their older counterparts, still have not caught on in our society due to a few reasons. And the main reason, is the fact that it is difficult to hold the accountability in the case of smart cars. Basically, who is accountable during an accident? Smart Car Manufacturer? Driver? However, we have a few solutions that we think might aid in the solution of this kee problem.

The first solution, is basically to help prevention of such a problem. It consists of issuing licenses for smart cars. To obtain the license, one would be required to attend a compulsory teaching course to understand the smart cars abilities and operating ways, with the necessity of obtaining the license before being allowed to purchase a smart car. After the course, they are required to be examined, and after getting a passing mark, then would they be able to obtain a license.

Annually, a driver is required to attend a refresher course to update him on future updates to smart cars, or also to refresh his mind on the functions of smart cars. Failure to do so would result in the license being revoked. As such, there is also a virtual reality simulator for drivers to allow them to be more learned on this matter.

Thus, the first solution aims to ensure that all drivers are more educated on smart cars, decreasing the chances of the drivers faulting, and basically easing the process of finding the culprit.

The second solution, is more on justification, on how we can better solve the problem via finding out who is truly accountable. When we review the accident, it would be more enhanced if we could understand more about the real scene scenario. Thus we would be installing some sensors in the car, to ensure with its statistics that the car had not malfunctioned, and that it was maintaining in correct order. There will also be other forms of sensors to show the conditions outside as well, such as whether it is very rainy in which the driver cannot see clearly outside. All conditions would be considered before final judgement on whose accountability it is. This will also partially help prevent such scenarios, by allowing servicing to be conducted immediately after a problem with the car is spotted.

The case will also be judged professionally on a case to case basis, allowing for more flexibility in terms of the judgement. As such, the judge will also not jump to conclusions and allow the pedestrian to get the right of way immediately.

Thus, the second solution aims to justify the accountability of the accident by providing as much evidence as possible to enhance the case.

Our third solution is both prevention and justification. What our last solution entails is prevention against tampering. This would include blockchain technology which would help us attain true statistics and records without tampering, to ensure that even companies are not allowed to change recordings in their favour.

Thus, the third solution aims to prevent change of footage, and to justify and find the culprit reliable of the accident.

Moving on, is our fourth solution, which is to create a platform for witnesses to report any abnormalities or submit relevant evidence. This will help aid the process of justification during the court case. We will develop the website to make it more convenient for witnesses.

Lastly, is the solution on maintaining the quality of the car. This will ensure that less cases of road accidents are caused due to malfunctions, and also to decrease the possibility of accidents. Ultimately, it will benefit both the driver's safety, and the reputation of the respective companies. Routine checkups would be held to ensure the cars are in perfect shape, and manufactured using decent materials to maintain the durability of the car. There will also be rigorous tests on the cars, and random spot checks involved. We will also hire experts to find

the weaknesses, and suggest how to improve them, ultimately making the car better and of higher quality.

3. **Technical Problems (Hacking/Glitches)**

Criteria

Even though we had five solutions, the three that we thought was the best and most adequate were the first three, on issuing licenses for smart cars, reviewing the accident through expert methods, and also preventing the change of footage.

Here is our decision making matrix, used to decide which solutions we felt were the best.

In the table, 1 means the worst, whilst 5 is the best.
After the scores are tabulated, the scores which are the highest are deemed the best solutions.

	Cost	Effectiveness	Sustainability	Feasibility	Total
Criteria Rating	1	4	2	3	
Solution 1	3	4	4	4	39
Weighted Rating	3	16	8	12	
Solution 2	5	4	4	4	41
Weighted Rating	5	16	8	12	
Solution 3	4	4	5	3	39
Weighted Rating	4	16	10	9	
Solution 4	4	3	2	5	35
Weighted Rating	4	12	4	15	
Solution 5	2	4	3	3	33
Weighted Rating	2	16	6	9	

Recognized Problem

It may be difficult to find out who is accountable for the damages caused in the situation that an accident takes place.

Final Solution

Our final solution is reviewing the accident, and judging each case on a case by case basis, via evidence brought up to simulate the real-life scenario of the incident, so as to ensure the fairness of each court case.

Learning Points

Throughout our research and studies, we have learnt that the cybersecurity plays a huge role in maintaining the safety of every individual in a more advanced society, in which many roles are taken on by technology. In the case of smart cars, we found out that many smart car researchers are aware and research is always active for cybersecurity, since methods of hacking keep getting more and more complex, and that we have to be ready in any case of hacking.

Next, looking from the point of view for accountability, it still depends on the situation and the terms and conditions when the smart car was purchased

Survey results

A survey form, created using Google forms, was distributed electronically to 110 respondents. Although for some questions (if not all), the percentage adds up to more than 100% as the questions were checkboxes, as we felt that this would best represent the Public's Opinions and Understanding of Smart Cars.
The objectives of the survey were to find out more about the:

1. Public's Opinions on Smart Cars
2. Public's Understanding on Smart Cars

The link to the form can be found here.

For the **first question**, 78.7% (of the respondents) felt that Smart Cars mainly revolved around the ability to navigate around efficiently. 66.7% believed that Smart Cars were predominantly about their responsive accident prevention systems, and 74.1% trusted that Smart Cars were about their highly intelligent sensors.
The results can be summarised into the table below:

Option	Percentage of respondents	Number of respondents
Ability to Navigate Efficiently	78.7%	85
Responsive Accident Prevention Systems	66.7%	72
Highly Intelligent sensors	74.1%	80
Other	9%	10

For the **second question**, 45.5% (of the respondents) did not understand Smart Cars as the systems were too complicated. 25.7% did not understand Smart Cars due to a lack of good reviews, and 59% did not understand Smart Cars as they were not regularly updated on their development.
The results can be summarised into the table below:

Option	Percentage of respondents	Number of respondents
Systems were too complicated	45.5%	46
Lack of good reviews	25.7%	56
Were not regularly updated on their development	59%	29
Other	8%	8

For the **third question**, 31.8% (of respondents) felt that Smart Cars would frequently break down and cause traffic jams. 74.8% felt that Smart Cars would be susceptible to Hackers and would make the roads more dangerous.
The results can be summarised in the table below:

Option	Percentage of respondents	Number of respondents
Frequent breakdowns and traffic jams	31.8%	34
More dangerous roads due to hacking	74.8%	80
Other	15.3%	17

For the **fourth question**, 65.1% (of respondents) felt that Smart Cars would make their lives more convenient. 33% felt that Smart Cars would make Singapore's roads safer, 71.6% felt that Smart Cars would allow for easier navigation on roads, and 32.1% felt that Smart Cars would be more reliable than conventional cars.
The results can be summarised in the table below:

Option	Percentage of respondents	Number of respondents
Convenience	65.1%	71
Safer Roads	33%	36
Easier Navigation	71.6%	78
Reliability of Cars	32.1%	35

Other	5.4%	6

For the **fifth question**, 19.4% (of respondents) felt that Smart Cars would be almost the same as Conventional cars.
The results can once again be summarised in the table below:

Scale from 1 to 10, how efficient Smart cars are as compared to Conventional cars	1	2	3	4	5	6	7	8	9	10
Percentage of respondents	3.7%	0%	0.9%	7.4%	19.4%	14.8%	18.5%	17.6%	8.3%	9.3%
Number of Respondents	4	0	1	8	21	16	20	19	9	10

For the **sixth question**, 66.7% (of respondents) felt that Smart Cars would be more convenient for their families. 34.3% felt that Smart Cars would be safer for their families, and 63.9% felt that Smart Cars would allow easier navigation on roads for their families.
The results can be summarised in the table below:

Option	Percentage of respondents	Number of respondents
Convenience	66.7%	72
Safer Roads	34.3%	37
Easier Navigation	63.9%	69
Other	3.6%	4

Citations:

1. Understand the impact of the Fourth Industrial Revolution on Society and Individuals. Retrieved July 28, 2019, from https://trailhead.salesforce.com/en/content/learn/modules/impacts-of-the-fourth-industrial-revolution/understand-the-impact-of-the-fourth-industrial-revolution-on-society-and-individuals