ENG3004 – Individual Assignment (Part B)

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Are electric vehicles (EVs) paving the way to a greener future?

The development of electric vehicles has actually gone all the way back to the 1830s in Scotland, United Kingdom. Robert Anderson developed motorized carriages which were then powered by non-rechargeable batteries composed of galvanic cells [1]. However, in 1859, rechargeable batteries mainly composed of lead-acid cells were developed by a physicist named Gaston Planté from France [2]. Fast forward to the 21st century, some Japanese manufacturers including Nissan, and Mitsubishi have developed a number of EVs over the years with the first models being available in the market from 2009. The Nissan Leaf and Mitsubishi i-MiEV – both utilizing lithium-ion powered batteries, were one of the first models sold in the automotive market. Prior to the Japanese models, Tesla developed its first EV – the Tesla Roadster in 2008 [4]. This model was actually renowned for being sent to outer space in 2018 throughout Elon Musk's SpaceX Program. Having said that, the global market share of EVs have since grown from 2009 to 2022. Particularly, EVs have accounted for 14% of automotive sales in 2022 when compared to values in 2021, which was 5% lower than 2022 numbers [5]. These values are clearly indicative of the upcoming trends of the EV market share. Whilst EV are said to be known for its sustainable advantages, the use of Lithium-ion batteries as an alternative to fossil fuels can come with its downsides. This can be further analyzed with different perspectives such as Professional, Economic, Environmental, Health and Safety, as well as Legal dimensions.

The Professional Dimension

Professionally speaking, it is the obligation of a professional individual to carry out his or her tasks/projects in an ethical manner. In that sense, one has a responsibility to bring positive impact to society. Taking Tesla's Corporate Social Responsibilities (CSRs) as an example to this dimension, their EVs are aimed at prioritizing its social impacts to the community, customers, employers, investors/shareholders, and governments, in order of priority [5]. In terms of community, Tesla aims to focus on the environmental benefits it can bring to society. Pricing of their products as well as maintaining its quality is a highlight of Tesla's CSR towards

its customers. Employees on the other hand would benefit through reasonable compensation, benefits, and career opportunities. Long-term planning for EV market domination and continuous development of existing patented technologies of Tesla is a way for the company to demonstrate its responsibility to its investors or shareholders. Lastly, governments would benefit through economic growth as well as reduction of carbon emissions as Tesla vehicles do not utilize gasoline-dependent engines. It also emphasizes that all of its products including its sourced materials are in compliance with all government regulations. When taking this example into analysis, there is no clear violation of social responsibilities with regards to Tesla's sale and development of its automotive products. Lithium-ion batteries are not only used in electric vehicles, but also consumer devices such as iPhones and iPads. When comparing Tesla's CSR against Apple's, Apple guarantees that all components of their devices are manufactured in a way where the safety of every person involved in the supply chain is valued, respected, and safe [6]. In this way, it can be inferred that both companies who largely use lithium-ion batteries claim that their products put no individual at harm – relatively contrary to the statement of the question in this subject's assessment where child labor is involved when mining cobalt for battery production.

The Economic Dimension

Major components of economics from an engineering point of view include development and growth in a country as well as appropriate usage of resources and high production. We know that the supply of fossil fuels is on a continuous decline globally speaking. Data shows that by 2060, the supply of fossil fuels would be depleted if its usage continue at 2019 rates [6]. As such, continuous research & development of EVs and its increasing market share in a number of countries is showing promising results with regards to reducing the use of fossil fuels to conserve global supplies. Moreover, the larger beneficiaries of using electric vehicles lie within the low to middle-income countries. For instance, electric vehicles have a relatively simpler architecture which would lead to easier manufacturing. This means that EV manufacturing could be done locally (e.g., Congo, Kenya, Philippines, etc.) which would bring economic benefits to these nations. More importantly, lower costs due to local manufacturing would increase market shares of EVs in these countries. Higher number of EVs would in turn improve the nation's air quality due to lower carbon emissions.

Now taking the economic point of view to the child labor issue on cobalt mining, this issue would have no direct violation or impact to the economic dimension of electric vehicles.

However, the recycling process of lithium-ion batteries would have an impact of the global supply chain. According to Chemical and Engineering News, only a small portion of lithium-ion batteries ending up in landfills are collected for recycling [7]. Recycling these batteries would involve the process of extracting raw material used in manufacturing these batteries such as cobalt and nickel – two of the most expensive materials in lithium-ion batteries. Prices of these materials have continuously fluctuated in the market. Therefore, recycling batteries could improve the global supply chain and reduce the costs of manufacturing lithium-ion batteries – benefitting the society due to lower costs of products utilizing such batteries.

The Environmental Dimension

This dimension puts emphasis on sustainable development which would be inclusive of economic growth, conservation of natural resources, and social development. The rise of electric vehicles is strongly indicative of sustainable development due to new job opportunities, benefits in the global supply chain, conservation of fossil fuels, as well as new opportunities for recycling lithium-ion batteries. According to Recurrent Auto, demand for electric vehicles is continuously rising and that in 2021, 21,961 new job opportunities was generated in the US due to rising EV demands [8]. Clearly, the increase in EV usage would exponentially decrease the number of fossil fuel vehicle owners due to supply and demand driven factors affecting the lower costs of EVs. Additionally, as EV is relatively new to the market in most countries, this would generate new job opportunities in the manufacturing sector of EVs as well as its components. As mentioned in the economic dimension as well, the call for recycling lithium-ion batteries not just from EVs but also from consumer electronics would improve the global supply chain of nickel and cobalt – making its use more economical. Taking the ongoing issue of cobalt mine workers into account, there is no direct violation of this dimension in this particular issue.

The Health and Safety Dimension

The health and safety of engineers and workers involved are emphasized in this particular dimension. Specifically, health and safety considerations must be included when planning the project or activity. According to the Occupational Safety and Health Ordinance, it is the obligation of employers to ensure that the working environment shall not endanger the safety and health of its employees. Analyzing the issue of cobalt mine workers in Congo, reports from news companies such as The Verge have reported underpaid and underfed cobalt miners in Congo [9]. Moreover, workers in Congo have reported of extreme or harsh environmental

conditions in the mining site where fresh water is inaccessible leaving them thirsty at most times. Moreover, over 40,000 Congolese children have been reported to be working in cobalt mine sites where the working environment leads to high exposure to chemicals which could in turn lead to long-term health damage. Some children working in the mining site have also reported being constantly ill and working substantially long hours [10]. This is very much indicative of multiple violations stipulated in the health and safety dimension. Although it can be said to be a violation, practices of cobalt mining sites often lie within trade practices of the mining site's country. In this case, Congo, who is renowned for poor trade practices. While many companies utilizing lithium-ion batteries often claim that no human rights violations are involved in the supply chain of their raw materials (e.g., Apple, Tesla), there seems to be continuous reports of poor workplace environment and abusive labor in mining sites of cobalt. As such, an article from Amnesty International stipulates the need for organizations to call for transparency from their lithium-ion battery suppliers [10]. While the rise of EVs have strong advantages towards its consumers, it can be said that the process behind EV manufacturing continue to violate and hamper the health and safety of workers involved in the supply chain of lithium-ion batteries.

The Legal Dimension

This dimension aims to guide engineers to ensure that every action or step in the process of a project or task should be in compliance with regulatory requirements or else legal impactions could be faced by an organization. According to Amnesty International, Congo has often been criticized for its poor management of its miners' labor rights. While the country has made initiatives to eliminate child labor by 2020, no action to date has been implemented by Congo [11]. The Ministry of Labor of Congo who is also responsible for the enforcing the proper practices for the Health and Safety of mining workers have substantial shortage of workers responsible for oversight of mining operations. Analyzing the labor practices and regulations in Congo, the lack of regulatory requirements for companies to transparently report their cobalt mining processes including the type of labor involved in such operations is a primary cause for child labor involvement in Congo's cobalt mining. Moreover, no regulations in Congo protect enforce its mining companies to comply with policies stipulated in the International Due Diligence Standards which protect its labor force from abuse of human rights. Violation of human rights would also include the harsh working environment and water supply issues encountered by its miners as mentioned in the Health and Safety dimension.

In addition to the human rights violations, recycling of lithium-ion batteries would be another perspective to the dimensional analysis of this issue. According to AZO Materials, there is no existing law that requires any businesses to recycle lithium-ion batteries. Rather, there are laws in the United States, United Kingdom, and European Union which stipulate different standards with regards to how certain chemicals from batteries should be handled as well as how hazardous and non-hazardous materials should be properly disposed of [12]. Considering the exponential growth of lithium-ion battery usage not just in EVs but also consumer electronics, governments should consider drafting regulatory requirements to recycle lithium-ion batteries which could ultimately slow down the depletion of natural minerals used to manufacture such batteries as well as improve its global supply chain. Existing laws in handling hazardous chemicals and certain types of batteries could be used as a framework to develop legal requirements and standards in recycling lithium-ion batteries.

Conclusion

While EVs can certainly pave the way for a greener future mainly due to the elimination of fossil fuel use, the process involved in manufacturing EVs is considered questionable. For instance, child labor and human rights violations in cobalt mining in Congo, while not directly affecting the consumers of electric vehicles, remains a violation of the legal and health & safety dimensions. It would be inevitable to eliminate EV manufacturing as well as uses of lithium-ion batteries as this is indeed the future direction of batteries and the automotive industry. However, policies to promote transparency and adequate workforce to oversee and ensure that no person's rights are violated would be a necessity not just in EV manufacturing, but also other industries.

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