Circular economy as a strategy in European automotive industries to achieve Sustainable Development: A qualitative study

Monica Del Angel Hernandez and Venkat Bakthavatchaalam (University of the West of England, UK)

Abstract

The automotive industry is reported as being one of the main contributors to the global environmental crisis, thus requiring a radical shift in the way they perform business-as-usual (UNFCCC, 2018). The UN and a growing number of studies hail Circular Economy as a holistic economic model that is expected to minimise human's impact on the environment and the resources (UN, 2021; Desing et al., 2021). This study aims to develop a model and to provide a set of recommendations for the automotive supply-chain and policy-makers to enable their transition, acceleration and to boost the adoption of CE. Interviews were conducted with stakeholders and content analysis used to group factors and form a model. The analysis revealed a range of internal and external roadblocks for the adoption of CE. These include differences in the generational mindset, measuring circularity, complex logistics and the lack of innovative solutions. Furthermore, interestingly, the results pointed to a need for redefinition of concepts such as value, design and luxury in order to boost and accelerate the adoption of CE in the automotive sector. This research addresses SDG 8, 9 and 12.

Background

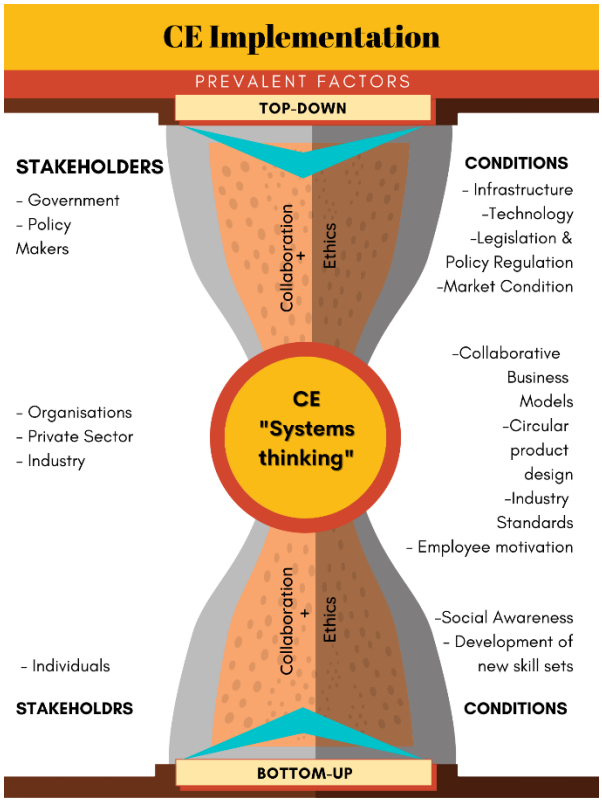
During The automotive industry is critical to any country's economic development; however, current practices in the automotive sector are shown to have a negative impact at the social and environmental dimensions (ACEA, 2019, 2020). Looking at Europe, whilst the reduction of greenhouse gas emissions is under the lenses of the European Commission (EC, 2022) there are other factors that are equally important to address. These include the reckless exploitation and of extraction of minerals, pollution and biodiversity loss etc., which are directly and indirectly related with automotive sector (Mamalis, Spentzas and Mamali, 2013). As a solution, several studies including Bocken et al. (2016), EMF (2015), Bauer et al. (2020), Desing, Braun and Hischier (2021) etc. suggest Circular Economy (CE) as an alternative to the environmental damage caused by the current model which follows a linear approach - which extracts, uses, and disposes products rather than reintegrating them into the economic system (Prieto-Sandoval, Jaca and Ormazabal, 2018). A widely accepted definition of CE is that it is "an industrial system that is restorative or regenerative by intention and design" (EMF, 2013). They further assert that the three core principles of CE are to eliminate waste and pollution, circulate products and materials and to regenerate nature.

The majority of automotive businesses and operations follow a linear approach, meaning that once a vehicle reaches its end-of-life, many of the components of the car will end up in landfills. With Eurostat (2021) reporting that the end-of-life vehicle (ELV) weight had reached 5.2 million tonnes by the end of 2015 just in the European Union alone (Eurostat, 2021). This number has only increased to 6.9 million in 2019. Even though the 'Directive on End-of-life Vehicles'(2020) set targets for the reuse, recycling and recovery of the ELV materials, more than 260,000 tonnes of automotive components were disposed and sent to landfills without any further processing (Mehlhart, Möck and Goldmann, 2018). If such large amounts of material continue to be disposed as waste, rather than being reintegrated into the economy, it would result in huge loss of minerals and resources, economy and adverse environmental damage (EC, 2022). OECD (2018) predicts that if we continue with the same trend of mining and using metal, minerals and energy, then by 2060, we would require double the amount of resources to meet the global needs. But with the amount of planetary resources being limited, it becomes essential to identify and practice new methods to keep the value of products and materials. Circular Economy has emerged as a holistic approach addressing the environmental crisis at a micro, macro, meso levels. However, there are several challenges that have been slowing down the proper implementation of CE, with the automotive sector being no exception.

Looking at the EU, it has consistently progressed towards a circular mindset, which can be seen from their CE Action Plan (2015, 2020). Narrowing down the focus to the EU automotive sector, the main automotive brands in this region are performing several actions with the purpose to transition to a CE, which are presented in Appendix 1. It is imperative to notice that many of these actions are targeting recycling, reuse and remanufacturing as a mean to achieve circularity. However, CE is a much more complex system. With Kumar et.al. (2019) asserting that not only the lack of proper awareness, but also the lack of understanding of

CE principles is a major barrier to its' implementation. Figure 1 presents the most common factors found in the literature; however, they are not targeting EU automotive industry context, which is the studied sector in this report.

Figure 1. CE Implementation common factors



Source: Author, based on Coenen et al., (2020), Cantú Garza, Aguiñaga and Scheel (2021) and Desing et.al., (2021)

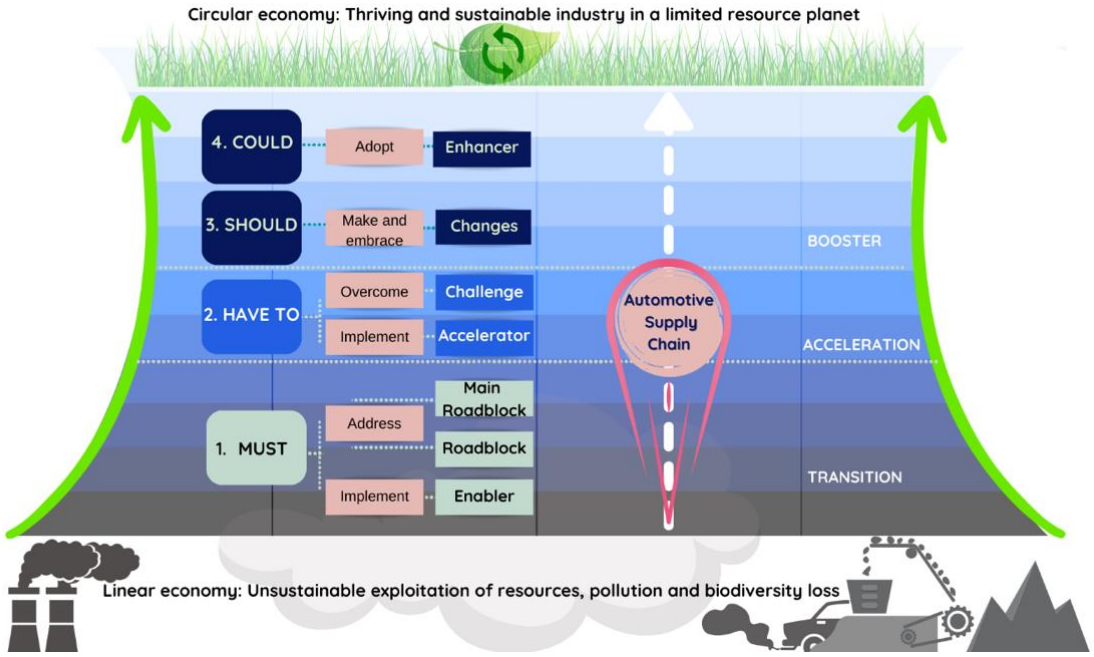
Methodology

This being a new area, a qualitative method was selected. Data was collected through 12 semi-structured interviews with stakeholders from the automotive and sustainability sector to understand the context of potentially unexplored factors affecting the automotive Supply Chain (SC). The target population included managerial roles in the automotive SC or persons with relevant studies or positions in sustainability or CE. Content analysis was used to form themes and to identify patterns emerging from the data (Neuendorf, 2017). The results revealed a set of 8 relevant categories for the creation of an acceleration model (See figure 2.)

Results and discussion

Figure 2 represents the results pictorially. It revealed three phases for the automotive SC to speed up the adoption of CE. These include the transition, acceleration and the booster phases. The model also shows the various actions that (1) Must be done, (2) Have to be done, (3) Should be done and (4) Could be done in order to achieve a successful transition to CE in the automotive industry. The model goes further to identify the various barriers and enablers in each of the phases. This differentiation was considered important so as to decrease the complexity of the recommended actions towards the acceleration of CE in this sector compared to previous studies (Govindan and Hasanagic, 2018; Kumar et al., 2019) where the categorisation of the model in figure 2 has not been seen before.

Figure 2. CE Acceleration model



A detailed view of the phases and their sub-sections are discussed in Del Angel (2022 forthcoming). A concise discussion of the model stages is presented below.

Transition phase

This is the first stage of the adoption of CE in the automotive industry where actions *must* be implemented and addressed for a proper transition to CE. The results are in line with the actions that a few of the companies are already adopting, these include: Acknowledging the importance of circular design, creation of innovative business models, availability of innovative sustainable solutions in the market, investment in time and technology, policy incentives and standardisation. On the other hand, the roadblocks in this phase are the waste culture and the lack of CE expertise and infrastructure. Finally, the main roadblocks highlighted by three or more interviewees include: complex logistics, constrained time, high implementation costs and lack of communication internally and across the entire SC. The automotive industry is yet to overcome many of these factors however, this study encourages the entire SC to address these with a sense of urgency to quickly progress to the next stage.

Acceleration phase

This stage includes factors that *have to* be implemented and overcome for a successful acceleration. The results revealed a gamut of factors in this phase as the automotive SC would need to pay special attention to them to ramp up their efforts towards CE acceleration. Some key aspects to implement include: Building expertise of CE, demand creation through collaboration, early engagement of CE practices and stakeholders, engagement of other sectors, implementation of CE targets and having a visionary leadership. On the other hand, the elements to overcome include: Adaptation of CE strategies based on social diversity, bureaucracy, company hierarchy, complex designs, company incentives, cross-functional team engagement, generational gap differences, measuring quantitatively and qualitatively the company's progress towards CE, product obsolescence and redefinition of requirements.

Boosting phase

The third stage includes actions that *should be* done to keep up the pace of the ongoing transition of CE and actions that *could be* adopted because they may represent a springboard towards CE. The first set includes the redefinition of business models and the concepts of design, value and luxury. This radical mindset shift requires an innovative strategy from the automotive sector to engage customers at a deeper level, showing that sustainable products have an inherent value of luxury and superiority due to the level of craftsmanship that they can achieve even after reprocessing or due to their smart designs. The last set includes: Challenging the current system, decentralise supply chain, improve processes efficiency, good planification and strategic thinking. As it can be seen, this last stage requires the development of competences that are already valued in the industry, but these need to be redirected towards a true vision of sustainability.

It is worth mentioning that all of these actions are driven by the '*why*' which in the model is presented by the problems that linear economy represents (bottom) and why circular economy is the right thing to do (top).

Recommendations for Automotive SC and Policy makers

From the results, it was clear that the move to becoming circular had a considerable economic significance to the company and their social responsibility. Several recommendations could be drawn for accelerating the adoption of CE from the results. A few of them include initially acknowledging the importance of understanding what CE is, what the principles are and to encourage the various stakeholders within the SC on CE adaptation. CE benefits are not perceived at a short-term, thus adopting a long-term vision for sustainability is key for a successful acceleration. Evaluate where the company is located within the presented model to elaborate a short and mid-term strategy to move up in the model from one phase to the next one. Also, companies' principal activities are highly dependent upon local and global legislations; however, these regulations need to address not only recyclability and reusability percentage but they need to encourage technological innovations and collaboration with academics and other industries through incentives.

A few of the functional recommendations include, assigning CE ambassadors in senior level management, to promote and explicitly embrace circularity within each department and overall in the company. Training the employees and the managers in CE, encouraging and celebrating circular practices rather than following a linear system. Creating novel data management technologies to trace materials and measure performance and to evaluate the adoption practice. Overall, the research recommends that the companies should prioritise upstream demand of CE over downstream push to the customer. This will increase demand for CE practices through competition and collaboration.

Lastly, it is important to highlight that companies are already looking for sustainable solutions to replace

their current use of materials and practices but the availability of this technology is still low, creating a huge opportunity area for both already established companies and start-ups to develop and provide the solutions that the industry is seeking for.

Limitations and future work

Critically looking, this being a qualitative work, even with data saturation, generalisability of the work should be done with caution. This research was conducted in the EU, and so might reflect the situation in Europe, but generalising it to other regions with. Future work could look at quantitatively testing the model developed and to iterate it. Similarly, the adoptability of the model to other manufacturing sectors should also be tested in the future.

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Appendix 1

Company name with the information source	Circular Economy approach
Renault (Automotive world, 2021)	Creation of 'Refactory', the first European factory dedicated to a circular economy mobility Target to become carbon neutral in Europe by 2040
Volkswagen (Volkswagen AG, 2020)	Closed material loop goals Become carbon neutral by 2050 Battery recycling pilot project Development of a sustainable waste management Circular Economy KPI's are under development
Jaguar Land Rover (Jaguar Land Rover Automotive PLC, no date)	Net zero carbon emissions across their supply chain, products and operations by 2039 Use of alternative materials such as plant-based textiles and recycled plastic Recovery of premium grade aluminium from scrapped vehicles to reduce the use of virgin aluminium
Daimler (Daimler AG, 2020)	In support of the Waste Management Hierarchy, they aim to avoid waste by re-using (with a focus on HV batteries), recycling, and re-manufacturing their materials.
Volvo (Volvo, 2021)	They want to become a circular business with circular products by 2040 Increased use of remanufactured parts
BMW (BMW Group, 2020)	Efficient use of raw materials and their reuse and recycling. Use of pilot digital tools that could enable them to trace critical raw materials to improve the flow of goods globally.