

Analysis of Road Vehicles' Lifecycle Stages

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Abstract: The paper deals with the issue of lifecycle stages of motor vehicles. This topic is trending around sustainability issues, given the very unfavorable age structure, increasing import of used cars, which causes an increasing intensity of the number of waste vehicles. This situation creates problems with management of all kinds of waste. Optimal life of a motor vehicle is 10-15 years on average. Individual phases of lifecycle are indicated differently with multiple parameters. All phases are influenced by many factors, but this paper focuses on maturity and decline phases. Key findings suggest that different market, business and environment indicators define the key stages of the lifecycle-maturity and decline stages. Future research will expand the sample on other countries from the Balkans region.

Keywords: vehicle, lifecycle phase, transport.

INTRODUCTION

Motor vehicles function throughout their lifespan as the time of its use from the formation of the idea, design, and development of construction, production, placing the motor vehicle on the market - operation, its use, maintenance, obsolescence and until the very end of its use.

In [1] it is revealed that majority of research papers in top tier journals dealing with lifecycle of motor vehicles, have been published only in the last ten years, making this a topic of significant interest for any research dealing with sustainability. Papers are dealing mostly with environmental (or technology- i.e. related to engine technology) indicators influencing lifecycle phases of motor vehicles, but this research attempts to broaden the scope of indicators via empirical research. In [2] it reports that only one third of research papers includes a case study or empirical research.

Discussion about environmental issues concerning motor vehicles has been going on for 10 years in the EU Parliament. In 2000, the EU have adopted Directive 53, which provides a clear direction for all decision makers, to provide minimum amounts of reusable materials and vehicle parts, recycling and energy restored [3]).

It also included investigation of paradigm of sustainable growth as a consequence of recycling end of life vehicles, determining business decision, government

support, and volume (number) of end of life motor vehicles, as critical enablers of success.

MATERIAL RESULTS FROM LITERATURE REVIEW

Maturity phase deals with the specific period of lifecycle when the peak moment of operational capability of a motor vehicle approaches. Very often, drivers (in case of passenger cars) or decision makers (in case of fleet management of commercial vehicles). Taking into account the fact that the market is already saturated with many kinds of new models of motor vehicles, which causes large pressure on further shortening of lifecycle of used cars.

Motor vehicle is declared obsolete by two means-market trends and technology/car manufacturing trends. Market trends are reflected through change in demand for a certain type of motor vehicle, and emerging trends are depicted through introduction of new types of engines, fuel technology, new functions and functionalities. Figure 1 displays key lifecycle stages in the case of motor vehicles.

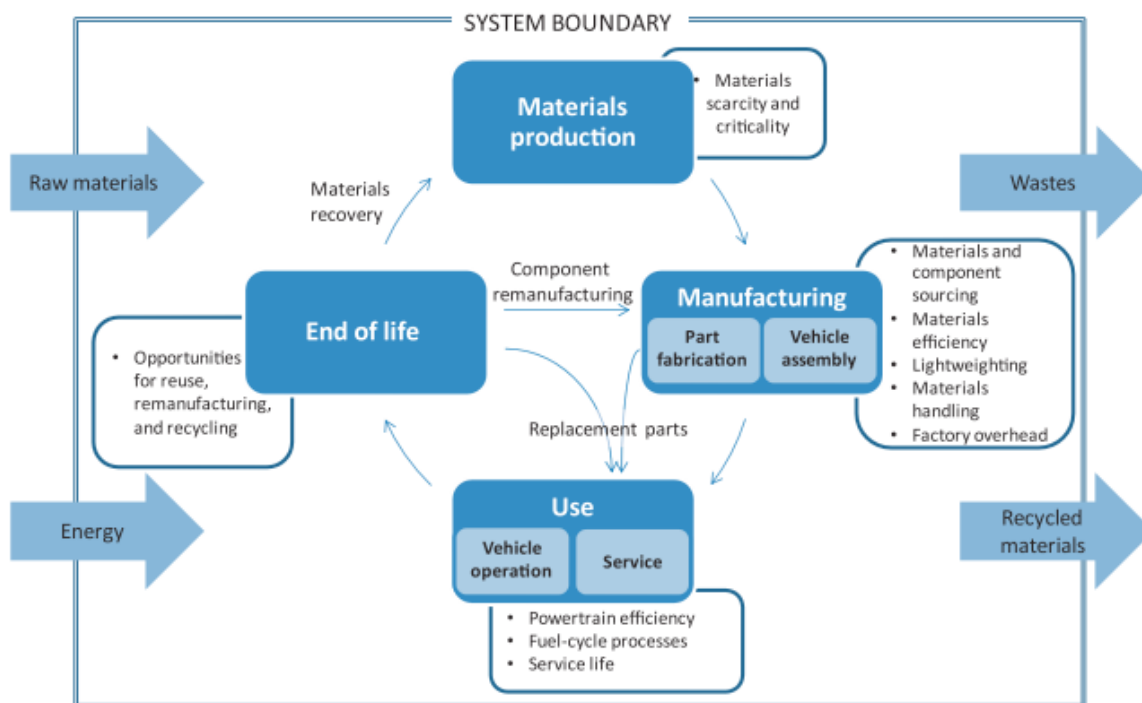


Figure 1. Lifecycle framework for a motor vehicle with reflection to environmental impact [4]

It can be concluded that decision about motor vehicle replacement represent a trade off between different impacts, which supports previous, older study performed [5].

Maturity phase is followed by decline phase, where all motor vehicles eventually become obsolete (otherwise called end of life phase), creating 1% of all waste in Europe [6], investigated decline phase of lifecycle in the case of commercial trucks and found that light duty trucks enter the decline phase when emissions of greenhouse gases drastically increase (compared to average emissions during the whole lifecycle).

Now follows a display of potential key indicators for distinguishing between lifecycle stages in Table 1.

Table 1. Analysis of key indicators defining lifecycle stages of a motor vehicle

Indicator defining lifecycle stages	Previously researched in
Emergence of new engine technology	[7]
Innovation of vehicle manufacturing	[8]
Market trends regarding demand and supply	[9]
Eco friendly technologies connected with vehicle manufacturing and recycling	[10], [11]

In [12] there is analyzed transport sector incentives for purchase of electric vehicles, through the decarbonization initiative, so it can be concluded that external incentives can also influence the retirement of existing vehicles.

Depending on passenger car size and emissions connected with fuel engines, major EU markets, China, USA and Japan recorded a significant shift in the last decade, switching from petrol to electric vehicles in the segment of larger cars (SUVs etc).

In the case of medium and heavy-duty trucks, entering the last stage of the lifecycle occurs when total cost of ownership increases drastically (as previously investigated also in [13] because the likelihood of sudden end of life a motor vehicle increases drastically).

Apart from environmental (emissions) and economic dimensions, such as the research conducted in [14], there it was analyzed interdependency of fuel technology and maintenance costs of engines, as the main distinguishing factor.

CONCLUSION

This research enabled introduction to different factors influencing maturity and decline phase of motor vehicles' lifecycle. Since the characteristics of both lifecycle phases were developed through theoretical analysis, it is important to discuss the results with potential previous papers by other authors.

Apart from taking into consideration the most obvious indicator (age of motor vehicle), it is possible to conclude the following:

- regarding maturity phase of lifecycle - since maintenance costs are optimal with number of kilometers travelled is as high as 200.000 kilometers, this phase is also characterized with low to

medium external costs,

- GHG emissions, market appeal is still more important than technology, and the potential for recycling is medium to very high- during this phase majority of resources can be reused;
- regarding decline phase of lifecycle - in this phase, maintenance costs are no longer sustainable after passing the 200.000km mark, external costs are higher than ever, GHG emissions are higher than ever and influence of brand loyalty is dropping significantly. Lastly, potential for reuse of resources is minimal and end of life is approaching where the vehicle shall be put out of order through waste management.

In [15] it is analyzed the life cycle sustainability by taking into account corporate, social and eco-friendly parameters/indicators. This paper expands on it by introducing market trends and some environmental indicators. Also, this study presents a preliminary effort to distinguish between key lifecycle stages of a motor vehicle.

This study can be a useful addition to previous studies which analyzed life cycle of motor vehicles through input-output analysis, where appropriate analysis enabled initial definition of boundaries between the key lifecycle phases.

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