Methodical development and evaluation of electromobility concepts for urban commercial vehicles

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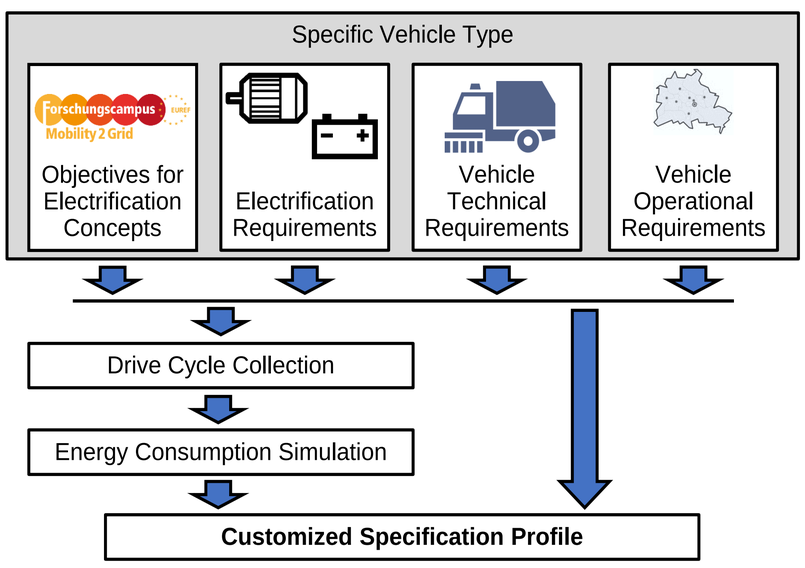
Introduction

Electromobility is a promising approach to the ecologically beneficial remodeling of urban mobility. Accordingly, German OEMs introduced a significant number of new electrified passenger car models most recently. Commercial traffic can account for up to 40 % of the overall urban traffic and thus contributes significantly to local emissions. However, only a very limited number of electric and hybrid commercial vehicle models are available despite the increasing efficiency goals, stricter fleet emission limits and potential future low or zero-emission zones. Additionally, the developed prototypes and pre-series vehicles often don't match the specific user requirements.

Compilation of Specification Profiles

Accordingly, a specification analysis is conducted to develop specific concepts for urban commercial vehicles. The specification profile is the result of an in-depth analysis and consists of targets for electrification concepts, technical and vehicle operation requirements.

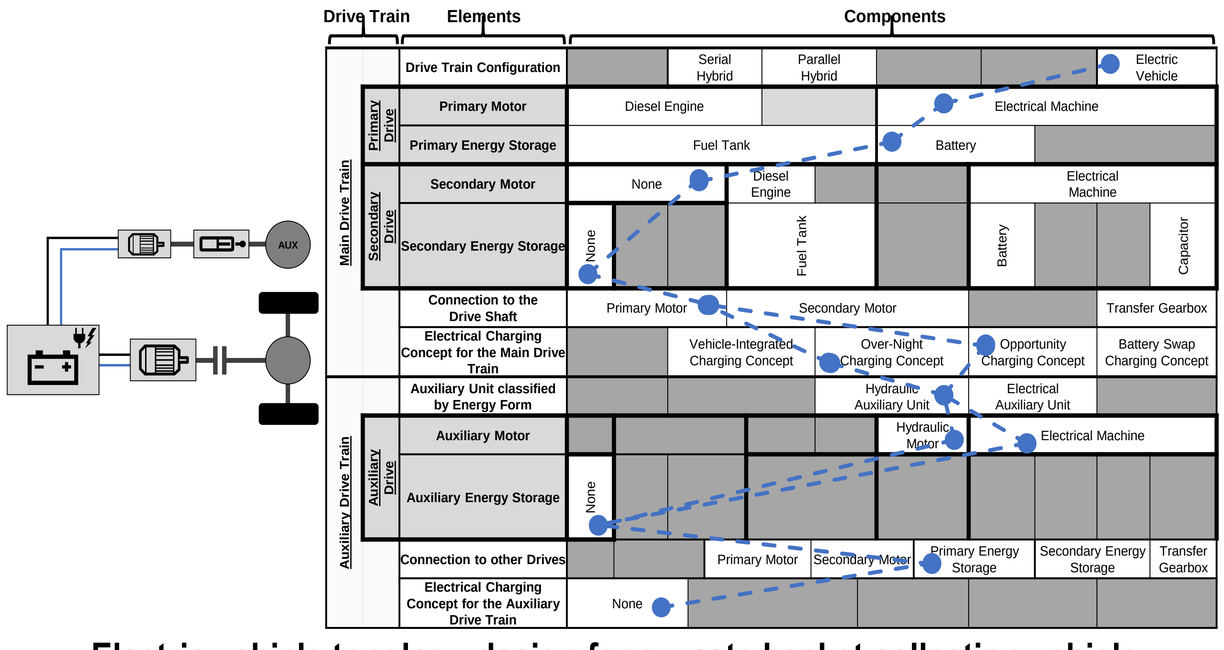


Process of specification profile compilation

For the vehicles, representative drive cycles are obtained and subsequently used in simulations to identify the vehicle energy consumption. The specification profiles contain only explicit and mandatory requirements for each vehicle type to ensure an accurate design in the early concept phase

Development of Electrification Concepts

In a structured process, drive train topologies of electric and hybrid commercial vehicles with energy intensive auxiliaries are developed. The input variables are the aforementioned specification profiles and a morphological box which presents the overall solution space of possible drive train configurations for commercial vehicles. After a systematic process to use case specifically reduce the design space, vehicle concepts are compiled as shown in the following figure.



Electric vehicle topology design for a waste basket collection vehicle

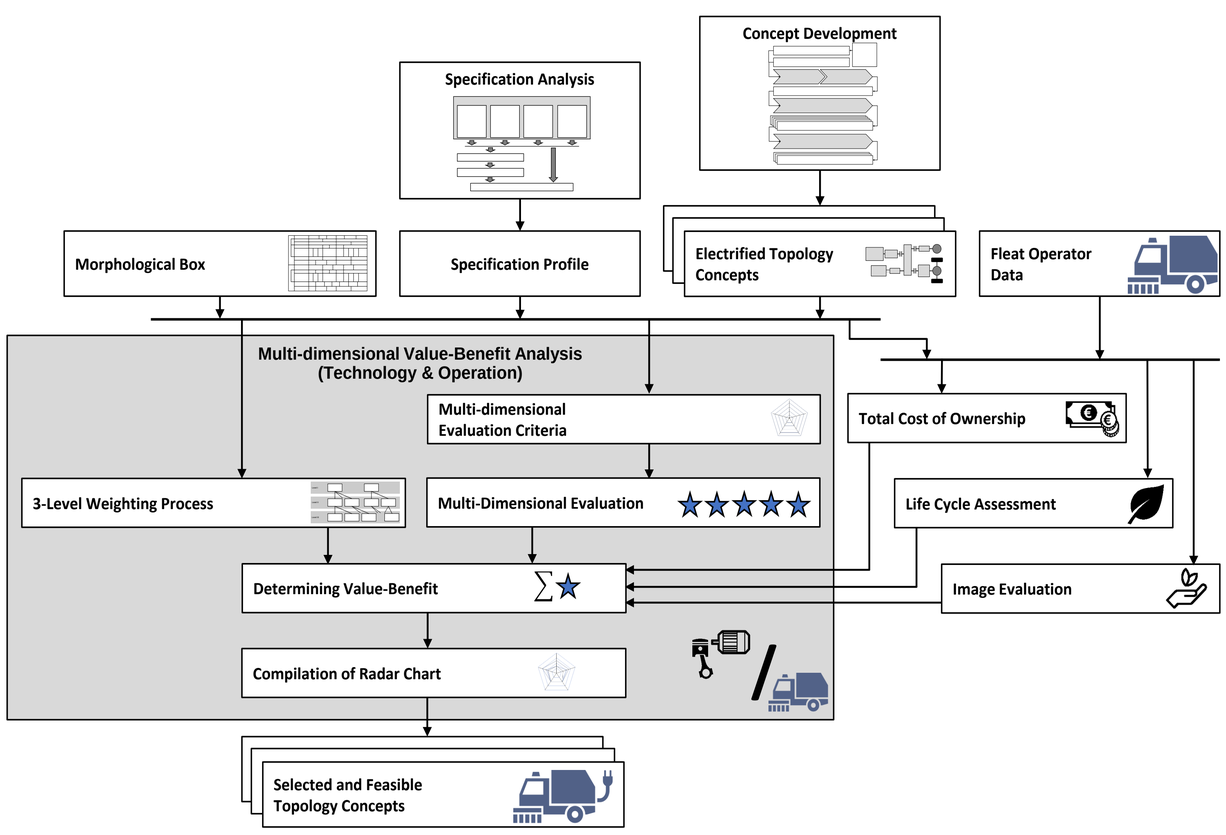
For the specific example of a waste basket collection vehicle, 60 technically feasible concepts could be identified including electric and hybrid drivetrains.

1 Electric Vehicle (6 Variations)	+	4 Serial-Hybrids (18 Variations)	+	4 Parallel-Hybrids (36 Variations)	=	**60 Concepts**

Developed vehicle system architectures for waste basket collection vehicles

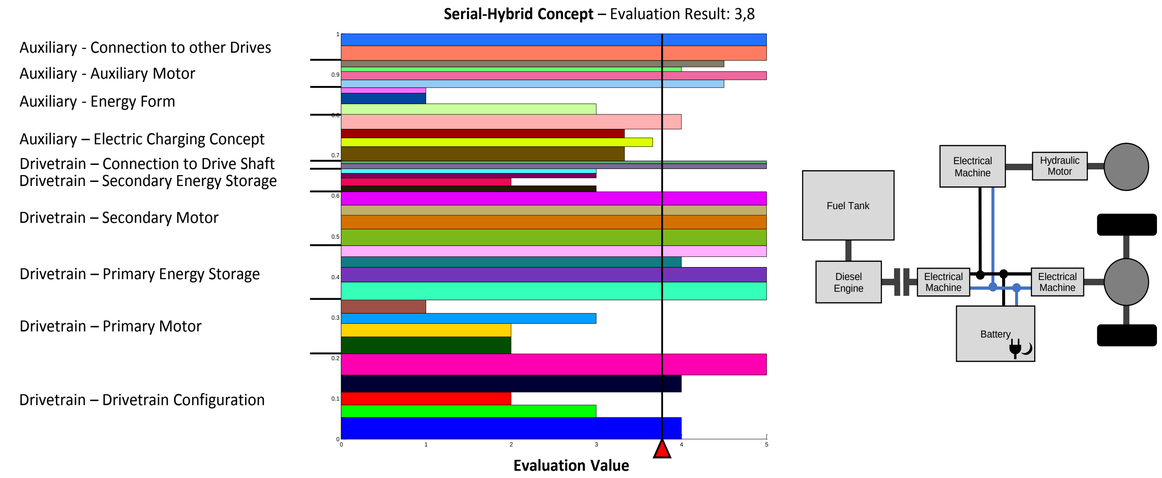
Concept Evaluation Process

The established concepts are evaluated in a multi-dimensional approach, including factors such as economic feasibility, environmental impact, technological benefits, operational effects and relevance to a company's reputation. The assessment incorporates individual vehicle components as well as drivetrain system structures.



Drive train topology evaluation process overview

The multi-dimensional value-benefit analysis breaks down topology concepts into their individual drive train components, which are then assessed individually and finally compiled in a 3-level weighting system. The inter-disciplinary process proved to significantly support the comprehension and to reduce the uncertainty of all involved parties in the development process.

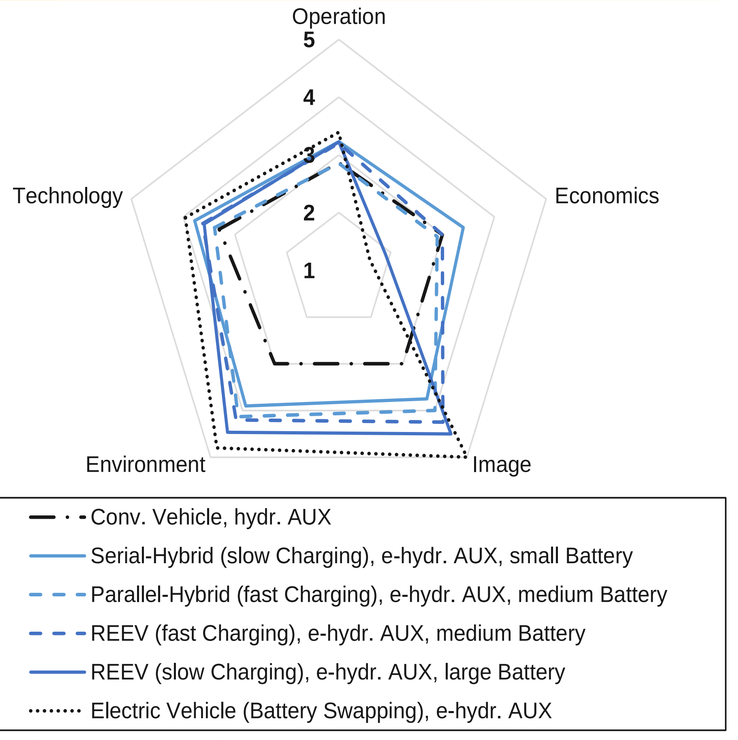


Technical evaluation result for a serial hybrid vehicle concept

The individual evaluation results are subsequently consolidated in a radar diagram for further analysis and holistic assessments.

Conclusions

The methodology is an effective tool to identify applicable and feasible concepts for electro-mobility in commercial vehicle fleets, especially when working in inter-disciplinary teams. The results can support fleet operators formulating in-house implementation strategies and OEMs developing application-oriented electric and hybrid vehicle systems.



Radar chart for vehicle concept evaluation

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