



Challenges that we Face at this Non-Automotive Market for the Electrification of Commercial Vehicles and off-Highway Applications

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Introduction

When electrification is discussed publicly in the field of mobility, the discussions often relate to car manufacturing, the charging infrastructure on highways or the availability of new cars. This is understandable in view of the huge volume market that has made significant progress with electrification worldwide and is definitely important as a driver of the technology. At least important milestones have been achieved thanks to the enormous development resources of the automotive OEMs. Some vehicle manufacturers have launched fully electric cars on the market in the 5th generation, brought a wide variety of electrification solutions to series production and built on their experience. There are now a variety of low-cost volume models from small passenger cars to super sports cars and even fully electric delivery vans. Where do things stand with light commercial vehicles and off-highway applications?

Challenges for Vehicle Manufacturers of Light Commercial Vehicles and off-Highway Applications

As all derivatives from the automotive sector have been technically electrified, the electrification of large trucks is currently in full progress. The manufacturers of large trucks have to face the challenges of

- a) Very long ranges,
- b) more intensive use in the logistics sector and
- c) the need for a more powerful charging infrastructure.

The leading companies in the industry have already developed large electric trucks and are in the pilot phase or at the beginning of series deliveries to selected customers. However, this discussion about the electrification of vehicles usually ends the discussion and with it public attention. In this discussion, we want to focus on the challenges facing a number of so-called "hidden champions". Some of these companies are world market leaders with their products and in important markets that are also in the public interest. These include:

- a) Agricultural vehicles,
- b) Construction equipment,
- c) Mining
- d) Busses

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Copyright@ Ing Marcus Kaatz, This article is distributed under the terms of the Creative Commons Attribution 4.0 International License, which permits unrestricted use and redistribution provided that the original author and source are credited. e) Light commercial vehicles

f) Maritime applications

and numerous other special vehicles that are used in everyday society today. These vehicle manufacturers are under the same pressure to meet the requirements from the fields in "1-Electrification challenges" (Figure 1). The environmental regulations differ in detail both regionally and in terms of vehicle classification - but in principle, (partial) electrification is expected in almost all mobile commercial vehicles by achieving CO2 savings during operation. Areas in which the electrification of mobile machinery is unlikely in the medium term are outlined and discussed in the paper [1]. Social pressure refers to the change and acceptance of private individuals who use their private experience with e-mobility in their respective roles as decision-makers in the procurement of mobile machinery. The phase of "early adopters" in the automotive industry is long gone - experience in handling and using electric vehicles has been positively evaluated and is available in broad sections of the industrialized nations. This has had an influence on e.g. public tenders for mobile machinery, but also indirectly through e.g. emission-free construction sites in large cities. Electrification, regardless of the actual benefits, is being sought by public opinion as a solution.



Figure 1: Electrification challenges.

The formation of public opinion leads us to the consideration of customer USPs. This refers to the aspect that technical innovations bring added value to the purchasing decision across all products. Even if no environmental regulations force the vehicle manufacturer to go electric, in a direct comparison between combustion engines and electric drives, the vehicle manufacturer with the electric drive receives more media attention and therefore has a better chance of increasing its market share. Conversely, companies will only be able to increase their market share through innovation, even if they currently still have a large market share. A cross-brand electrification strategy is important for this.

Transition for Electrifying the Product Range of Hidden Champions

In order to be able to switch to electric drives, it is important to understand that there is still no clear trend from the automotive industry in terms of technical implementation. A great deal of development work has been done on battery technology, but it is important to note that this is strongly tailored to the needs of the respective companies. This means that there are trends for high volume & low cost vehicles in terms of nominal voltage, for example - however, there is no clear trend for battery cells in detail or in further detailing. This means that the "smallest component" in electrification with batteries - the battery cells - does not currently have a standard.

Often, hidden champions are now trying to develop batteries out of nothing. This undertaking is not only extremely costlyit also usually has nothing to do with the hidden champions' unique selling proposition or their special features on the market. Especially when it comes to the details of electronic components, an enormous engineering effort is necessary - just to ensure series development of already developed components. The phase-out of electronic memory chips, for example, requires a new development with the necessary testing. All these issues are a challenge for the much smaller personnel resources of hidden champions. It is much more important for hidden champions to understand their own application and to focus on their core business. The aim must be to use a battery solution that can cover a broad portfolio of vehicles.

The Solution

One approach could be to use modular battery systems, like [2]. The modular battery container has been developed for this purpose. This industry standard is robustly designed, modularly expandable without additional electronics or master structures and can also be expanded with additional battery containers after commissioning. This gives vehicle manufacturers the opportunity to equip smaller vehicles with just one battery as well as larger vehicles in their portfolio with several batteries without additional master structures (Figure 2). The vehicles can also offered with different pricing models. For example, a low-cost entry-level variant with one battery, in the "basic" or "standard range", so to speak. For customers with a more intensive use, several batteries can be installed in the same vehicle "Performance" or "Long Range" as an equipment line.

Parameter	NMC Modular Main & Sub 644	NMC Modular Main 644	NMC Modular Main 322	Unit
Capacity	100,0	50,0	100,0	Ah
Cont. Charge Current	100,0	50,0	100,0	Α
Cont. Discharge Current	100,0	50,0	100,0	А
Energy Density	140,6	144,0	144,0	Wh/kg
Weight	458	230	230	kg
Dimensions	827 x 736 x 500	827 x 736 x 245	827 x 736 x 245	mm
Energy	64,4	32,2	32,2	kWh
Connection (Cells)	11s2p	22s1p	11s2p	
Connection (Modules)	16s1p	8s1p	8s1p	
Connection (Container)	2s1p	-	-	
Voltage	644,16	644,16	322,08	v
General Properties				
Heating/Cooling	Externally Liquid-cooled/heated			
Certifications	ISO26262/UN38.3/ ECE R100/ECE R10	UN38.3/ ECE R100/ECE R10	UN38.3/ ECE R100/ECE R10	
Protection	ІР6К9К			
Multiplication	Up to 12 batteries (Main & Sub)			
C-Rate (continuous/10 s peak)	1/2			

Figure 2:	NMC-Modular-Container.
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This gives hidden champions the opportunity to:

- a) Offer competitive entry-level prices for their vehicles and to
- b) Respond flexibly to tougher customer applications
- c) Focus their development resources on their main applications and
- d) Qualify only one battery for a large product portfolio.

Conclusion

The transition of light commercial vehicles and specialized off-highway vehicles to electric powertrains involves overcoming unique challenges and leveraging innovative solutions. This shift is driven by environmental regulations, societal pressure for sustainable practices, and market trends favoring electrification. Key strategies include adopting modular battery systems for flexibility and cost-effectiveness, focusing on core competencies, and utilizing industry-standard, robust battery designs. These approaches enable a successful transition while maintaining competitive pricing and meeting diverse customer needs in this specialized sector.

References

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