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Plug in for Growth: How Electrification Can Boost Profits Of Automotive Suppliers

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Summary

Electrification is becoming a reality for the entire automotive industry. The impact is significant: with OEMs investing heavily to build competences and keep pace, long-established value chains are being disrupted. With uncertainty being high, this provides with business opportunities for suppliers who set the stage now and plug in for growth. Out of four viable electrification plays for suppliers, only the positioning as component or system suppliers will enable boosting profits. Taking the example of an electric axle drive, this paper assesses winning growth paths for suppliers in an electrified future.

Keywords: business model, market development, strategy, EV, PHEV

1 Introduction

For the last 30 years, one of the key trends in the automotive industry has been automakers divesting their supply chain arms. Suppliers have seized this chance to broaden their product and service portfolios accordingly. However, the driving force during the past five years auf automotive history has been electrification. Largely driven by emissions regulation, but none the less fuelled by newcomer competition and increasing consumer interest, all incumbent original equipment manufacturers (OEMs) have ramped up their powertrain development to prepare for an uncertain time after the internal combustion engine (ICE). Alongside this process, OEMs are reconsidering their role in the automotive supply chain. This can be observed in the ongoing discussions of bringing more electrification competence in-house, e.g. with battery packs and electric motors.

Driven by electrification, new markets from component to system level are emerging while others linked to internal combustion engines decline. Still, the disruption caused by electrification creates considerable business opportunities for suppliers as established supplier relationships are opened, shared best practices are yet to be established and for several key components demand outnumbers supplies by a considerable margin. In turn, suppliers must set the stage now in order to benefit from accelerated disruption. Four questions need to be answered in order to prepare this:

1. Which market segment and application to target?
2. What electric drive system technology to develop, and when?
4. How to refund investments into early concept and engineering work?
3. How and when to change the internal organization for the new business?

2 Technology development and product-market-fit

It has taken incumbent OEMs years to enter competition with Tesla, one of the key disruptors in electrification of the automotive industry. However, after a starting phase large in hype but small in tangible offers and sales, the offering of electrified vehicles is growing as new models hit the market on an increasingly regular basis. With technology adoption taking its time, market acceptance and thus sales will ultimately ramp up as well (see Fig. 1). In the mid-term, this ramp-up will establish a new state of the art in propulsion technology. Until then, however, suppliers need to prepare the next strategic steps to gain a competitive edge on their competition.

2.1 xEV technology adoption

Market forecasts are the most frequently used means to answer the first two questions raised in this paper. In recent years, new market data for the electrified age has been circulated - with in several cases drastic differences. The model developed by Strategy Engineers predicts a continued increase in electric vehicles (EVs) from 2019 onwards, growing xEV powertrain share to 100% of total production volume in 2030 for Europe and 85% in China (see Fig. 1). Driven by tight emissions legislation, the strongest growth in market penetration is expected until 2025. By that time, almost all OEMs will have their first or second generation of xEVs on the market.

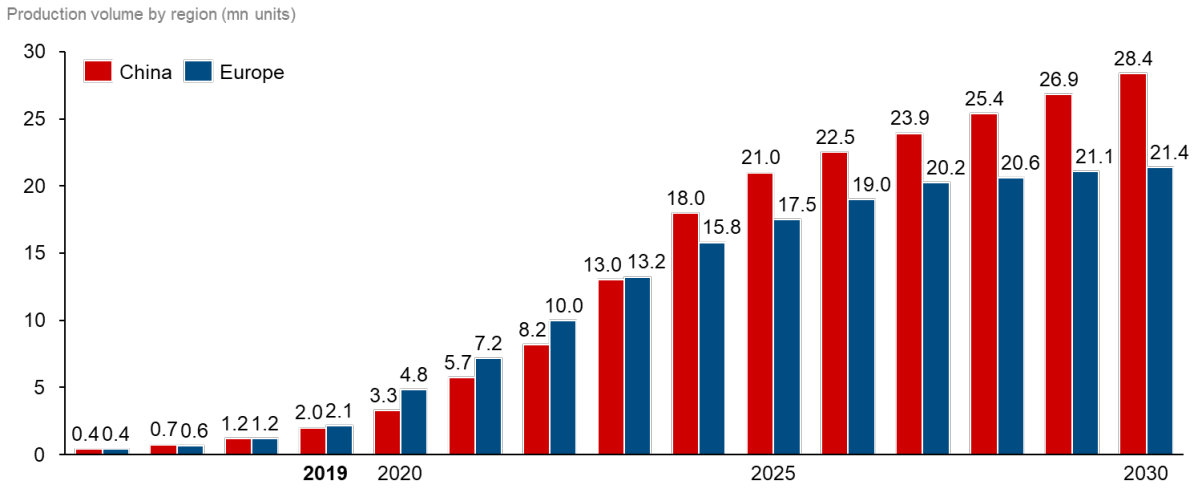

Fig. 1: xEV penetration rate. Strategy Engineers forecast.
xEVs include MHEVs, PHEVs, BEVs and FCEVs.

Within xEV powertrain technology, the shares for the different hybrid and electric topologies develops continuously. Reflecting the transition of the industry towards electrified mobility, we forecast MHEVs to be the largest segment in 2025. By that time, BEVs will outnumber plug-in hybrid electric vehicles – fuel cell and full hybrid electric vehicles are expected to play only a minor role in the powertrain split. Speaking in production numbers, the European market will be driven by continued substitution until 2030. That is, xEV models replace conventional powertrains in a slowly growing market (see Fig. 2). In China, the overall market is forecast to grow continuously during the same period. Therefore, electrification takes place with almost equal speed but slower substitution and overall higher volumes. China is and remains the leading market for electrified vehicles.

To assess the validity of such market forecasts, it is important to recognise their limitations. Regardless of the xEV powertrain split forecast for 2030 or beyond, most market forecasts model the number of electrified vehicles needed to avoid paying penalties to regulatory bodies. The ratio is that investment in R&D is always more valuable than spending money for non-compliance with legislation. What most electrification scenarios neglect is that customers might eventually like EVs. Strategy Engineers has not built this into its forecast model, since we are sceptical about product attractiveness in the near term. Lacking charging infrastructure

and concerns about the well-to-wheel sustainability are only two reasons for this in addition to high sales prices. Still, it is our hypothesis that in the longer term, EVs will be available which are affordable and practical but also exciting to drive and look at. This in turn would raise the question whether OEMs and their supply chain are ready to accept higher-than-expected demand for the new energy vehicles they have been so tentative to develop.

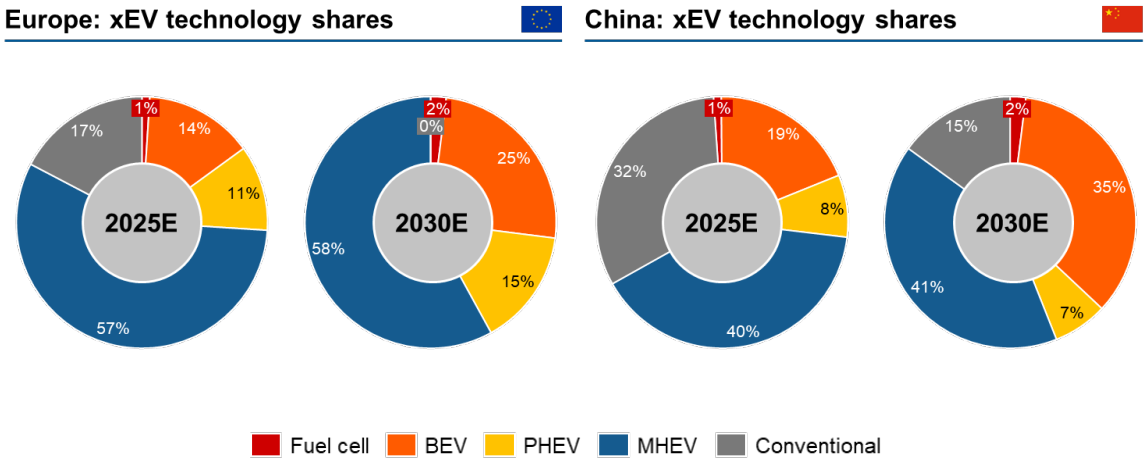

Fig. 2: xEV production forecast Europe and China. Strategy Engineers forecast.

Suppliers should prepare to deal with any of the given scenarios - be it simple legislation compliance or increasing sales volumes driven by attractive e-cars and customers' demand. At the end of the day, the question is not if electrification will come but rather when and for which application.

2.2 Market segmentation and target applications

For passenger cars, we propose a segmentation into six distinct OEM segments (see Fig. 3). This segmentation is made based on an assessment of make-or-buy strategies which consider the business opportunities for Tier-1 system suppliers.

Driven by the urge to develop internal know-how and capture a growing share of value creation to compensate for losses in conventional powertrains, chances on system level with the OEM segments of technology and volume leaders as well as electrification followers around the world are limited. Those OEMs who have picked up speed in electrification already and need to cope with the described urges have made their technology decisions to large extends and are looking for suppliers of components and sub-assemblies for their first and second product generations.

In contrast, Niche OEMs and Chinese xEV followers, but also product and service newcomers are currently looking for strong partners in making their electrification plans tangible. Considering the different OEMs represented in these segments it is apparent that there is not one single application to target: while service newcomers might be interested in a light-weight 48 V powertrain for a people mover, a Niche OEM might be interested in a high-performance hybrid. This variety of applications and degrees of maturity with the OEMs' electrification initiatives opens the potential for suppliers on different steps of the electrification value chain.

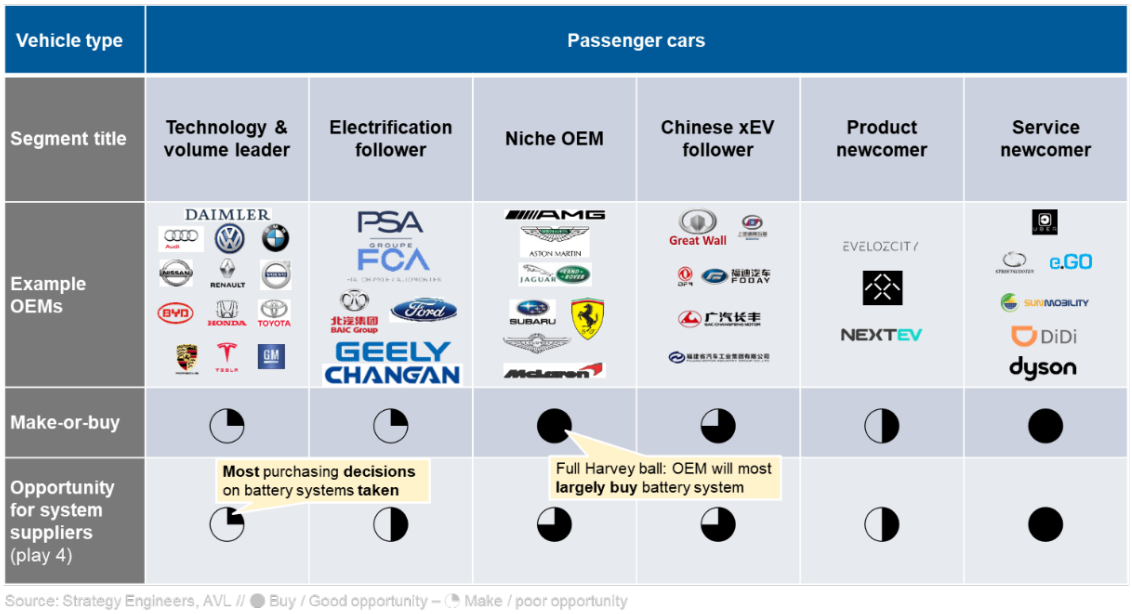

Fig. 3: OEM segmentation in Europe and China – the six identified OEM segments differ regarding opportunity for system suppliers.

3 Electrifying growth strategies for suppliers

To describe and evaluate the basic strategic options a supplier has in positioning with regards to this market structure, a four-level framework of supplier integration is applied. Each of the four viable supplier plays represents a certain degree of integration along the value chain and holds unique potential for value creation and the establishment of competitive advantages. For illustrating purposes, this paper uses an electrified axle (e-axle) to highlight the different implications each play has on suppliers.

3.1 Supplier plays and strategic market positioning

The four possible supplier plays follow the idea of system integration from component to system level (Fig. 4). To illustrate the differences between the four plays, an electric axle is considered. On a high level, an electric axle comprises of five central elements: an electric motor, power electronics, transmission, a cooling system and structural components like the housing.

On the lowest level of integration, a supplier following the component play will develop and manufacture single parts. On an electric axle, this can be gears, shafts or cables, for example. In a sub-assembly play, the supplier offers basic assembly steps for the components, e.g. fitting gears to a shaft. In case multiple assembly steps are performed on multiple components, the delivered good is considered a sub-system. Taking reference to the e-axle, one example for this supplier level is a finished electric motor. The fourth level of the model is the system play. In this play, a supplier provides a fully integrated e-axle including development, testing and manufacturing.

Observing the sourcing and localisation decisions taken by automotive OEMs, a short-term pattern can be observed: To develop and protect advantages in technology, incumbent OEMs develop the required competences internally and thus tend to source on component level. On the other hand, Newcomers as well as Niche and Chinese xEV followers seek integrated and ready-to-apply solutions to pick up speed and gain access to established technology and quality. This divergence in purchasing behaviour creates room for supplier innovation. At the same time, it threatens those who cannot meet the OEM's product roadmaps.

In preparing their offerings, suppliers need to make informed decisions on which play to bet for both value chain positioning and margin potentials. Corporate data analysed by Strategy Engineers suggest that components make more money than systems - despite the usual exceptions. For the suppliers analysed in the

EU, China and the US, component suppliers achieve higher profitability than module suppliers as additional assembly services are less profitable than manufacturing tasks performed earlier in the value chain. In addition, companies covering fewer steps of the value chain achieve higher profitability than companies with a broader focus. One explanation is that focussed companies have better chances to build unique capabilities and expert know-how to outperform competition. In conclusion, suppliers should focus on the extremes of the four plays: Either compete as component supplier or go all in and engage in the system play.

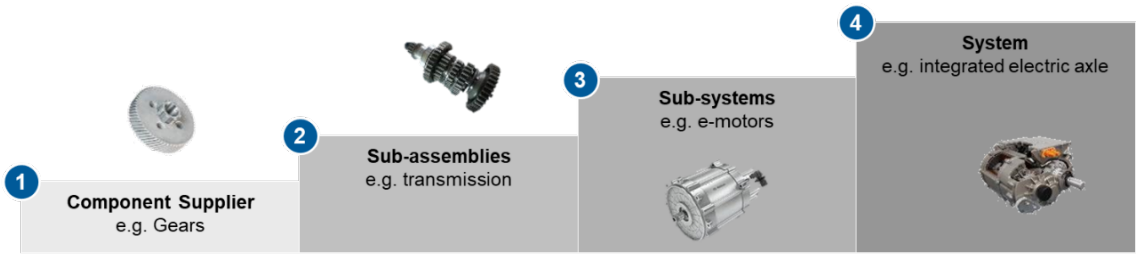

Fig. 4: Framework of supplier roles for e-axles.

To maximise margin potential, a technology-focused analysis of the electric drive system is required. At the example of an electric axle, the inverter (as part of the power electronics) and e-motor account for more than 50% of total value, followed by the transmission, housing and thermal system. For each of these sub-systems, typical margins can be analysed to assess the value-based margin contribution of the complete system. Combining value share and typical margin potential assessed from the analysis of more than 50 key suppliers, the inverter accounts for approximately one third of an e-axle's margin. EV transmission and electric motor account for the another ~25% each, leaving the thermal system, housing as well as the contribution of integration and assembly far behind. In total, an EBIT margin potential of 7.2% is assessed for an e-axle with an annual production volume of 250k units.

Combining these insights with the results of the market segmentation and application focus developed earlier on, a first recommendation for suppliers to position their offerings can be derived. Given the size of the market segments presented, the short-term focus of a component supplier needs to lie on both the technology & volume leaders as well as the electrification followers. To win volumes with these OEMs, a supplier needs to be able to supply high volume components meeting the requirements of the newly established electrification platforms. Meeting this requirement, competences on system level are an asset. Looking at the current market environment, it is most likely that such system expertise is to be built on either a low-cost product for Service newcomers or Chinese xEV followers or a high-performance electric drive system for Niche OEMs and Product newcomers. In any case, the understanding is that any supplier needs to acquire a certain level of system know how to successfully participate in electrification.

3.2 System integration, value creation and unique selling propositions

How can suppliers strategically make use of system integration to increase value creation and claim unique selling propositions? For an electric axle, two different integration steps can be distinguished depending on their starting points (see Fig. 5). It is most likely, that suppliers considering any of the viable plays introduced, will have different starting points in electrification based on their existing competences and skills.

At the first step of integration, a supplier with know-how in electric motors could develop an integrated e-motor with inverter. This offers optimisation potential regarding the interplay of e-motor and inverter which is an opportunity for supplier value creation since it has a major impact on system efficiency. Another entrance point could be a transmission supplier integrating an e-motor into its transmission to optimise on package and NVH. The sub-assemblies / sub-systems created in doing so might however be a "stuck-in-the-middle" position as analysed beforehand.

To unlock full value creation potential and benefit from superior margins in return, suppliers can take the second integration step and offer an integrated e-axle. This promises large optimisation potential as the main challenges regarding mechanical, electrical and thermal integration can be addressed on system level. Moreover, a system supplier can also excel in terms of cost as the full system can be optimised from component selection to assembly and logistics concept.

Analysing the market for electric axles, we have identified different growth paths for system suppliers. For example, a supplier with core competences in controls and software or power electronics can add competences in e-motors and clutches through M&A activities. These could entail setting up a joint venture, partnering with another supplier or acquiring a specialised company. Another of the growth paths is a transmission supplier with core competences in differentials, transmissions and clutches who adds e-motor competences to enable an integrated offering. Today, there are several other growth paths depending on a supplier's starting point leading to a highly dynamic market environment and the entrance of new competitors. Ultimately, fortune will be with those being able to provide a scalable, cost-competitive yet efficient solution.

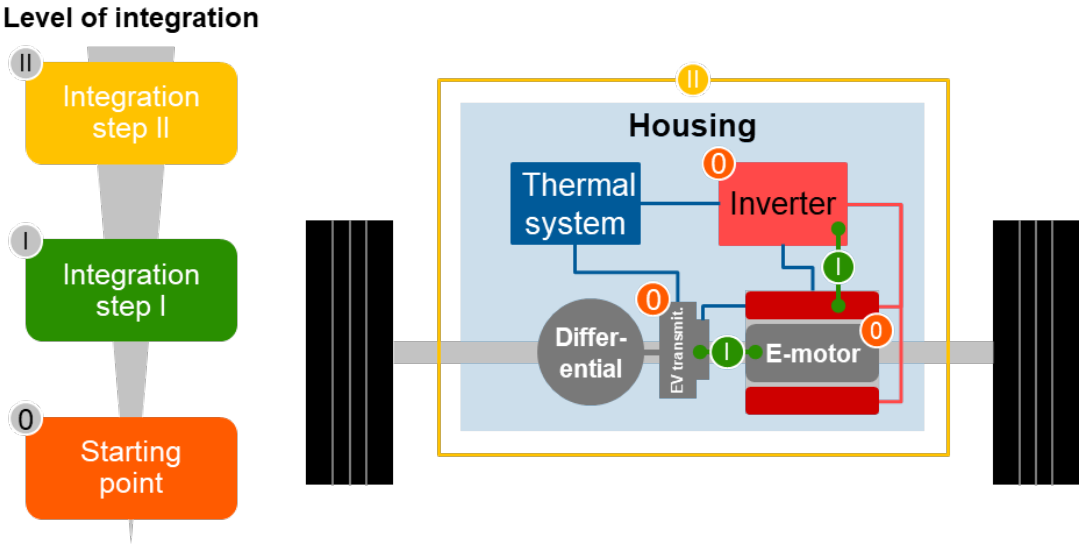

Fig. 5: Illustrative integration paths for e-axles.

In turn, suppliers need to assess their competitiveness regarding value creation potentials to derive a final decision on their offering. Cost, value and time are the three basic, yet interlinked ways suppliers must build competitive advantages. For suppliers, it is about striking the perfect balance between opposing targets and taking deliberate decisions when making compromises. To support this process a framework evaluating value-creation potentials in the key engineering challenges of a given product is applied.

With electric axles, there are eight main challenges which reflect value-creation potentials along four dimensions: (1) mechanical integration, (2) electrical integration, (3) thermal integration, and (4) cost as depicted in Tab. 1. For example, value-creation potentials originating from superior mechanical integration can be leveraged with package and installation of the e-axle into the vehicle, NVH of gear set and electric components, or the integration of e-motor into axle. In contrast, know-how in thermal integration is best used to create a superior offering in terms of combinations of axle and power electronics, and the cooling system for electrical components.

Based on superior value-creation potentials identified along the main challenges, a supplier can decide on choosing between component or system play.

Tab. 1: Value creation potential for suppliers based on main engineering challenges of electric axles.

Value-creation potential	Main e-axle challenges							
	Package and **installation** of e-axle into vehicle	**NVH** of gear set and electric components	**Integration** of **e-motor** into axle	Combination of **axle** and **power electronics**	**Cooling system** electrical components	**Lubrication** of gears and bearings	Component and system **optimisation**	**Testing** and calibration
Mechanical integration	●	●	●	◑	◔	◕	●	◑
Electrical integration	◑	◕	◔	◕	●	○	●	◕
Thermal integration	◑	◔	◑	●	●	◑	●	◕
Cost	◕	◕	◕	◕	◑	◑	●	◔

3.3 Plug in for growth

So how can suppliers make use of these insights, plug in for growth and boost profitability? The analysis presented suggests that especially the leading and large OEMs are ramping up internal resources to build system know-how. In the short-term, this favours suppliers on component level. However, in the long-term, these OEM segments are expected to shift their focus back to inhouse integration as electric axles are commoditised – purchasing focus is than shifting back to higher integration levels. This is a pattern which has been observed with other technology change as well. Those OEM segments presented which need to rely on system suppliers to shorten time-to-market and access suitable know-how which is not available in-house are the short-term target segment for system suppliers. Hence, it is the business case originating from product integration level, product specification and targeted OEM segment which defines the right or wrong in the electric axle business. Fig. 6 shows the relationship between performance on the vertical axis and volume on the horizontal axis.

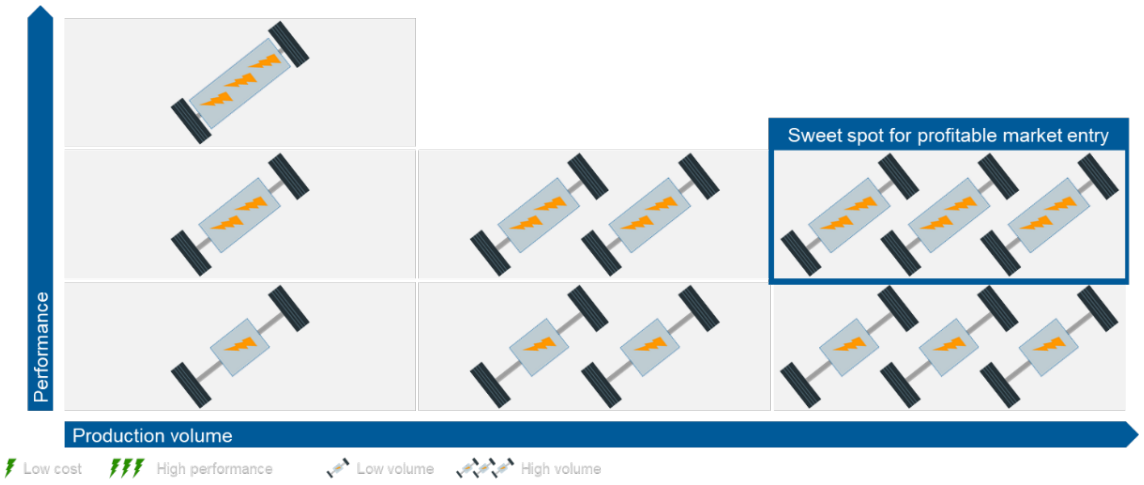

Fig. 6: Market potential regarding production volume and performance level.

A low performance offering sees reduced product cost as requirements on all sub-systems are reduced. While there is the potential to go for high volumes with low performance axles (~35 kW at 48 V), no such combination is possible for high performance axles (>225 kW at up to 800 V) which will only be demanded

by a small market segment, e.g. high-performance Niche OEMs. There is however a high margin potential on this high-performance axle as advanced requirements need to be fulfilled. In addition, small volumes make OEMs shy away from in-house production. This creates a window of opportunity for specialised system suppliers. Between these two extremes, there are mainstream e-axles (50-175 kW at 300 - 450 V) which can be used in both pure electric vehicles or as a parallel hybrid module (P4 architecture).

For single series production orders, the business cases for the upfront outlays for initial e-axle projects do not differ much by either performance or scale over the estimated development time of three years. It is thus the sales revenues which are critical in recovering the outlays based on production scale and margin. Along the product life cycle and including efficiencies requested by the OEMs, only the high volume, medium margin e-axle as reflected in the mainstream application yields enough revenue to compensate the outlays.

Both a high volume but low cost and therefore low margin e-axle as well as a small volume high margin e-axle do not accumulate enough revenues to do so. At least not for a single project – in case multiple projects are considered and scales are achieved on a highly standardised and modular product offering, positive business cases are also possible in these niche applications. Successfully running multiple customer projects is thus a question of the right in-house resources and capabilities.

3.4 Change process and the internal organization

Ultimately, suppliers need to develop the selected product offering. Consequently, a suitable internal organisation needs to be put in place to deliver the development in time, cost and quality. Coming from a rich knowledge-base in ICEs and originating from 30+ years of consolidation and continued refinement, electrification presents a major change to supplier organisations. Again, the degree of change is directly related to the supplier play selected. From the perspective of resources and capabilities, choosing higher levels of system responsibility requires growing the set of competences regarding a supplier's organisation and processes, research and development as well as manufacturing.

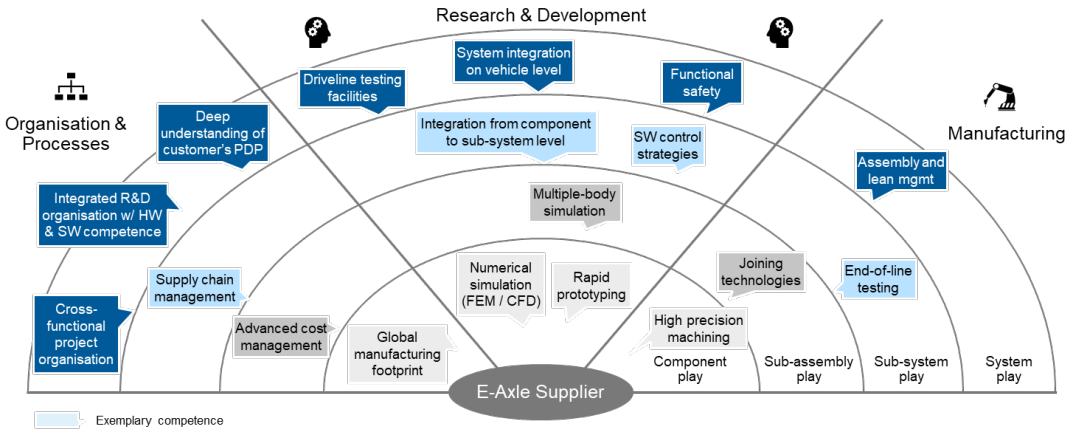

Fig. 7: Required competences based on supplier play.

Building on the model of supplier plays, Fig. 7 indicates how the required competences increase from component to system play. All items listed are additive, leaving the system supplier with the most comprehensive set of competences. While the component supplier can focus on core competences in, for example, highly specialised manufacturing processes for its components, a system supplier needs to run large scale assembly plants and has a sophisticated cross-functional project organisation.

To meet OEM requirements, this supplier needs to master competences in vehicle integration. Building on this example of a system play supplier, typical electric axle organisations start as projects bundling R&D and all other competences under a centralised project management. The key challenge for such a project inside an existing organisation is to establish processes and milestone plans. These are required to align all key functions supporting the project that are not directly controlled by the project. However, this setup holds

pitfalls regarding decision rights and responsibilities (e.g. budget). It should thus not be considered a permanent solution but a means to pull resources together and gather critical mass in the organisation.

As the offering gains traction on the market and multiple projects need to be handled, an electric drive division should be targeted as final state of organisational development. This can be set up as a profit centre, integrating all required functions as well as components, and has a dedicated manufacturing footprint for electric axles (see Fig. 8).

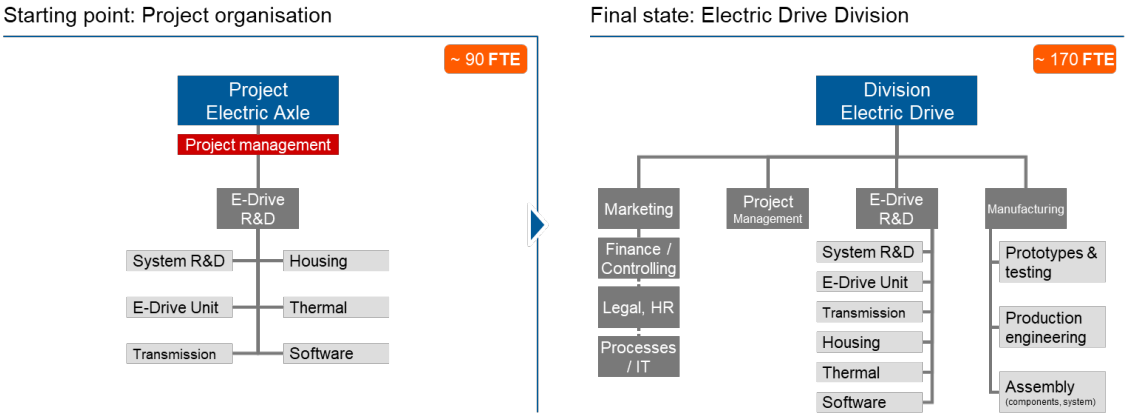

Fig. 8: Organisation setup for e-axle project and electric drive division.

The electric drive division also serves to break organisational silos and enable cross-functional support inside the supplier organisation. This requires rethinking organisational boundaries. While in the sub-assembly play, divisions with different components remain as independent businesses integrated by a project overlay, the sub-system and system plays require medium / high levels of transformation and re-organisational effort. On sub-system play, customer units and a programme layer are required to enable application engineering for specific and multiple OEM projects. Even in case the resources on component level remain in the existing businesses and are integrated by a virtual project organisation, this encompasses new roles and responsibilities. Greatest change is required going for the system play where the major challenge is acquiring competitive system development capabilities and upgrade the organisation to offer all the required competences.

4 Conclusion

Several of the largest incumbent OEMs have taken their time to get a grip on electrification. Right now, a new state of the art in automotive propulsion technology is being developed and it will provide tremendous business opportunities for supplier setting the stage now.

As this new state of the art emerges, electrification of the powertrain is characterised by a high level of uncertainty. While technology and volume leading OEMs are trying to develop the required resources internally, new entrants to the industry and Niche OEMs will seek highly integrated and ready-to-apply solutions. Supplier's product and technology offerings vary accordingly – opening considerable room for innovation but also the threat of following the wrong roadmap. In the turmoil that electrification is causing, it is not only technology that changes, but also long-established relationships and positions along the industry's value chain.

Comparing the four supplier plays in electrification with OEM purchasing behaviour, it shows that for reasons of scale, value-creation potential and internal competences, only component and system supply promise positive business cases. These two plays enable suppliers to most likely claim superior margins. This understanding builds on a detailed analysis of automotive suppliers in the EU, China and the USA. To adjust their roadmap correctly, suppliers need to identify which are the key elements regarding both value and value creation for the system under investigation and identify, how they can create competitive advantages. For an

electric axle for example, highest margin potential is in inverters, while inverter, e-motor and transmission dominate product cost. Still – and in contrast to battery systems – the electric axle is not dominated by one single component regarding its value structure. To unlock meaningful value creation potentials, suppliers must thus critically assess, which integration path is viable for them.

In addition to the different growth paths available to suppliers based on their existing core competences and strategic targets, it is important to consider the demand side in finding the right market positioning. Automotive OEMs - especially in the premium and large volume segments - currently may not allow suppliers to capture system business. However, this is expected to reverse with increasing maturity. Consequently, an e-axle's business case strongly depends on the target segment determining scale and margin potential.

Strategy Engineers business case analysis suggests that the winning combination is with a high-volume, mainstream application (50-175 kW at 300 - 450 V; BEV or P4 hybrid application). At least with single projects being considered for market entry. Further analysis provides that also multiple projects for a highly standardised and modular design allow positive business cases for other applications. However, these increase the pressure on developing a modular and scalable architecture for standardisation while setting up the required organisation regarding processes, resources and capabilities. Electric drive systems ultimately require rethinking organisational boundaries.

The next generation of vehicles will decide the winning path of technology for electric drives. Now is the time to seize the opportunities, electrification is creating for suppliers in the automotive industry.

Nomenclature

BEV	battery electric vehicle
CFD	computational fluid dynamics
E-axle	electrified axle
EBIT	earnings before interest and taxes
EBITDA	earnings before interest, taxes, depreciation and amortisation
EU	European Union
EV	electric vehicle
FCEV	fuel cell hybrid electric vehicle
FEM	finite element method
FHEV	full hybrid electric vehicle
HW	hardware
ICE	internal combustion engine
kW	kilo watt
MHEV	mild hybrid electric vehicle
M&A	merger and acquisitions
NVH	noise, vibration and harshness
OEM	original equipment manufacturer
PDP	product development process
PHEV	plug-in hybrid electric vehicle
R&D	research and development
RPM	revolutions per minute
SW	software
US	United States of America
V	Volt
xEV	abbreviation for all electric vehicle architectures, e.g. plug-in hybrid

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