

Mastering Engineering Service Outsourcing in the automotive industry

Market study

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1. Executive summary

The Engineering Service Outsourcing (ESO) market is growing steadily and offers flexibility and cost-saving potential for Original Equipment Manufacturers (OEMs) and Original Equipment Suppliers (OESs). While certain domains (e.g. body/interior) will not see major growth rates, powertrain and electronics/electric (E/E) are the fastest-growing segments for outsourcing.

Both vehicle manufacturers and suppliers are facing increasing pressure on development costs and must leverage engineering outsourcing to benefit from gains in flexibility and efficiency. Emerging market players, in particular, provide the right assets, in terms of both a low-cost engineering workforce and the mastery of low-budget vehicle design concepts.

Due to a steep learning curve, they are now increasingly advancing into the high-end segment, and also urging established market players to engage in low-cost engineering. We at Roland Berger have examined with a market survey amongst leading automotive managers major trends and successful business practices in engineering outsourcing.

Based on our findings we have formulated comprehensive insights and recommendations for both, the OEM/OES as well as the Engineering Service Provider side.

2. Automotive R&D spend in light of the market downturn

A. The market downturn is heavily impacting automotive R&D spend

In response to the significant decline in global vehicle demand, automotive players are looking to adjust their installed capacities and cut costs throughout their organizations. Among the victims of this belt-tightening are typically R&D budgets, as end customers do not easily notice such cutbacks in the short-term. Shrinking R&D budgets mean that companies are scaling down their new project pipelines, reducing complexity and/or entering into development collaborations, and further increasing R&D efficiency through outsourcing. Concrete examples of these actions can be found across the spectrum of major automotive players. For instance, Daimler's "Go For 10" program exemplifies a lean R&D approach to improve efficiency. Also GM and Ford are discussing joint engine development, while Honda has decided to cancel ten models for the Japanese market due to R&D budget constraints.

This picture is not expected to change anytime soon: although overall R&D spend in the automotive industry suffered an approximately 10% slump over the previous year in 2009, it is not projected to reach 2008 levels before 2012. The absolute value of R&D spend in the automotive industry is expected to stagnate between 2008 and 2013 (+0.4% p.a.). This is due to the fact that relative R&D spend weighted by company revenue (R&D share) is expected to decline because of increasing low-cost design and R&D efficiency gains (from 4.0% in 2008 to 3.7% in 2013 on average).

To cope with the declining market demand, OEMs and suppliers are even insourcing development projects to better utilize captive R&D capacities. The question remains whether cost cutting and efficiency improvements will be sufficient to overcome current crisis and what additional market trends must be taken into account.

B. Key regulatory and technological challenges ahead for the automotive industry

Efforts made to tighten budget control and improve R&D efficiency will be countered to some extent by the key challenges that lie ahead for the automotive industry. Intense pressure from multiple directions means that automotive R&D will have to deliver more for less.

Stricter regulations on emissions and efficiency mean that new and innovative powertrain technologies are needed for cleaner and more energy efficient vehicles. As a result, manufacturers no longer can focus on their core technology e.g. combustion engines but also have to develop alternative powertrain technologies in parallel. Requirements for passenger safety are becoming tougher and small cars are being required to meet similar active and passive safety standards as larger cars. At the same time, OEMs are competing on a global scale with a decreasing number of vehicle platforms but increasing numbers of niche models and derivatives. Increasing model variants and derivatives expose the industry to shorter vehicle lifecycles, requiring even more R&D efforts. At the same time, customers are clamoring more than ever for greater value for money. The demand for low-budget car concepts is rising, while buyers of premium cars are looking for more features and convenience, both resulting in increasing R&D costs.

Overall, this means that moderate growth is expected in the next few years for automotive R&D spend, with a particular focus on low-cost development competence and specific domain expertise. Even though OEMs have been trying to insource some of their R&D in response to the market downturn, they will need external engineering competence and resources to cope with an increasing number of models and derivatives and handle the complexity involved in new technologies. There is no doubt that OEMs will increasingly have to agree on tighter market cooperation and industry standards when it comes to basic technologies in order to cope with excessive development costs. This is where engineering outsourcing emerges as one lever to manage excessive R&D spend.

C. Engineering outsourcing offers flexibility and cost savings

Compared to outsourcing IT and other business processes, engineering outsourcing on a global scale is a relatively recent trend in the automotive industry. ESO is nowadays considered by industry practitioners as a means of increasing flexibility, reducing fixed R&D capacity costs and compensating for short-term engineering bottlenecks while generating significant efficiency gains through specialization and scale effects.

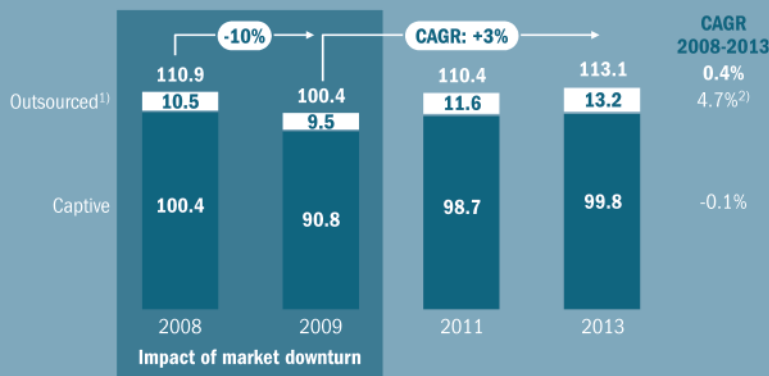
However, unlike other business processes subject to outsourcing, product engineering is considered a key differentiating factor and therefore a core activity of OEMs and their respective component suppliers. OEMs and suppliers are nervous about transferring this key strategic and heavily intellectual-property-based process to external parties. They have thus adopted a generally more cautious approach toward engineering outsourcing.

Automotive producers are still not pushing outsourcing to as great an extent as in aerospace, for example (see snapshot below). One example for this is the E/E domain, where case-based evidence argues for the merits of entrusting external engineers with regional adaptations and derivatives for vehicle variants. However, many OEMs emphasize the importance of having their own captive R&D centers, and started to install themselves in low-cost location, instead of outsourcing to an external party. Generally speaking, external Engineering Service Providers are frequently considered only as extended workbenches that occasionally compensate for inhouse capacity and capability bottlenecks rather than fully recognized and entrusted development partners.

Overall, in 2008, the automotive engineering service outsourcing market accounted for only a relatively small share of slightly below 10% of total automotive R&D spend. Given the pressures on the automotive industry, it will rise slowly but steadily to about 12% by 2013, thus growing at 4-5% p.a., well above the captive R&D spend (slightly declining at -0.1% p.a.). A strong decline in the captive R&D spend level is not expected, as major adjustments are rather difficult due to running contracts of R&D staff and the need to keep core know-how and technology in house.

Figure 1: Automotive engineering demand will not exceed 2008 levels until 2012 – Outsourced R&D share steadily increasing

Global automotive R&D spend by source of delivery, 2008-2013 [USD bn]



1) Including both onsite/onshore and offshore R&D, excluding captive offshore R&D

2) Being a major lever to reduce costs, outsourcing is expected to increase in a declining/cost restrictive engineering demand market

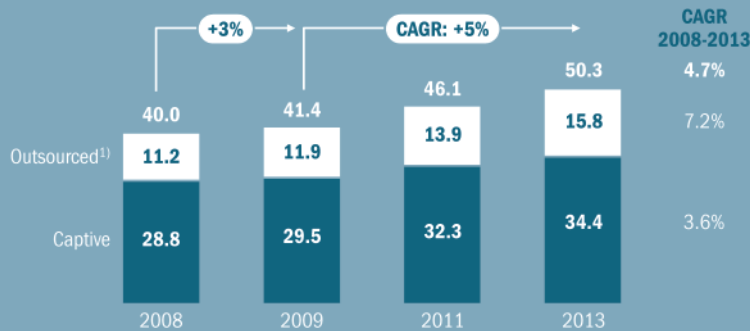
Source: Company information; Thomson Financials; market interviews; Roland Berger

Snapshot of aerospace R&D outsourcing

Compared with the automotive industry, engineering outsourcing is much more commonly practiced in the aerospace and defense industry today, where it accounts for slightly below 30% of total R&D spend. Offset obligations¹⁾ are the major driver for outsourcing and offshoring to emerging markets. Annual growth of 7.2% for aerospace engineering outsourcing spending is fueled by long-term increases in air traffic in light of stricter regulations (including offset requirements) that demand new airplane concepts, higher flexibility, the use of new technologies/materials and modularization approaches. Due to the long-term nature of R&D projects in aerospace, overall revenue-weighted spending levels in aerospace engineering remain relatively constant compared with those in the automotive industry. Individual projects may generally be postponed for a couple of months, but the overall spend level must be more or less maintained throughout the project phase.

Figure 2: Aerospace engineering demand will continue to grow – Even stronger growth in outsourced engineering

Global aerospace R&D spend by source of delivery, 2008-2013 [USD bn]



1) Including both onsite/onshore and offshore R&D, excluding captive offshore R&D
 Source: Company information; Thomson Financials; market interviews; Roland Berger

1) Offset ratio is a concept whereby companies that win projects for commercial aviation and defense orders are required by the government to invest a certain portion of the amount spent in the country that awarded the contract.

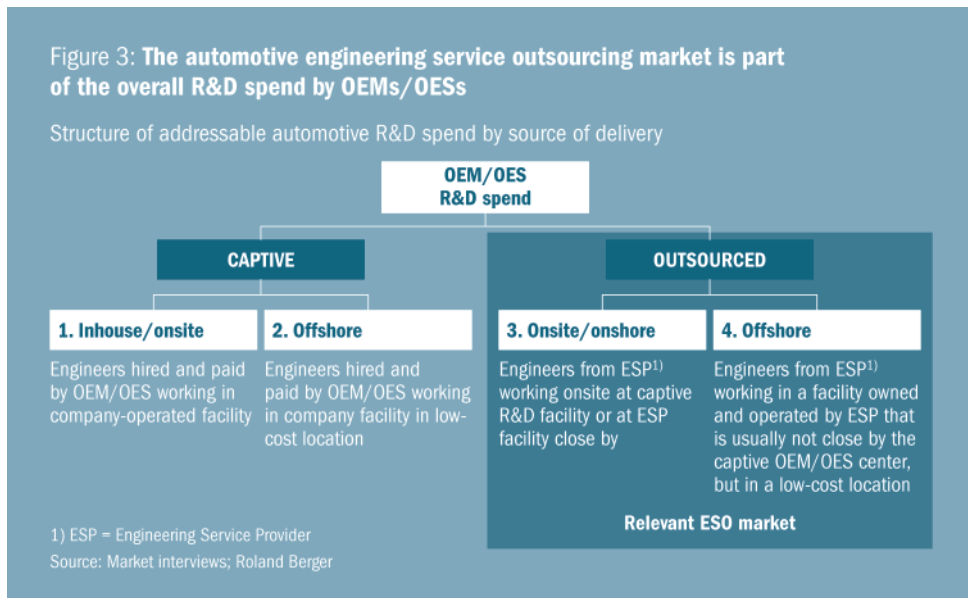
3. Engineering outsourcing in the automotive industry

A. Engineering outsourcing is competing against captive R&D

The R&D spend of an OEM/OES can be broken down into two major categories: captive R&D and outsourced R&D delivered by external third parties. The "captive" share refers to those engineers who are directly employed by the OEM/OES and work in company-operated facilities, either in an inhouse/onsite facility in an established market, or in an "offshore" facility in a remote low-cost location (meaning a facility not close to the company's own main R&D center).

By contrast, "outsourced" R&D refers to engineers employed by an external Engineering Service Provider (ESP). The latter group can be further broken down into two types: onsite/onshore and offshore. "Onsite/onshore" refers to engineers employed by an ESP to work onsite at an R&D facility owned and operated by the OEM/OES or at an ESP-owned facility in established markets. "Offshore" refers to those ESP-employed engineers who work offshore in a low-cost facility owned and operated by an ESP.

The majority of automotive R&D spend is still concentrated on the "captive" side worth approximately USD 100 billion in 2008. On the "outsourced" side, the entire ESO market for automotive is worth approximately USD 10 billion.



This category of R&D spend is further broken down into spending on activities delivered in different locations, with the lion's share going to onshore (~90%) and the remainder (~10%) to offshore activities. Due to the ongoing relocation of engineering activities to low-cost countries, ESO delivered offshore is expected to grow significantly above services delivered onshore.

B. Distinct benefits and risks associated with engineering outsourcing

Engineering outsourcing is not the "silver bullet" that will solve the challenges automotive industry is currently facing. There are some clear advantages for those practicing engineering outsourcing, but clients are also well aware of the downsides. Even so, depending on what the specific outsourced tasks are and how the ESO provider is integrated into the existing R&D network, outsourcing can be of vital help to the automotive industry. Based on our market survey of senior management at leading automotive companies, we have identified the commonly achieved benefits as well as the associated downsides of engineering outsourcing and offshoring to low-cost countries.

There are three main benefits of engineering outsourcing: cost reductions, increased flexibility and access to complementary competencies.

1. In the short-term, **cost reductions** are perceived as the most important advantage of engineering outsourcing. Cooperation with an ESO provider enables clients to reduce their own R&D workforce as some – typically less complex – tasks are completed by external engineers who usually work for lower salaries. If the ESO staff is based in a country like India, engineering wage savings compared to US and Europe can reach beyond 50-60%. Adding associated process and coordination costs, **total savings for well implemented R&D offshoring can reach up to 25-35%** of comparable inhouse costs. Nevertheless, the engineers freed from tasks through outsourcing often do not necessarily leave the company. Instead, these resources can be shifted to other projects that are deemed to be of high importance or to require highly qualified, inhouse engineering.
2. This reflects the second major benefit of engineering outsourcing: **flexibility**. It provides companies with access to a large pool of engineering resources and enables them to quickly build up, reduce or refocus their resources. In times when a large number of vehicle programs need to be completed, external engineers can be hired for specific projects.

Once the peak demand is over, the engineering resource level can be reduced again by simply dissolving or not renewing the contract with the ESO provider. Creating this kind of flexibility in resource levels in industrial countries without the help of external partners is nearly impossible due to labor laws and legal restrictions.

3. Similarly, cooperating with an ESO company can provide clients with **access to additional competencies**. The current trend toward powertrain electrification is an excellent example. Powertrain electrification is a major challenge for automotive companies and requires them to build up significant additional engineering resources. They must accomplish their "regular" workload of program development and handle the additional R&D for electrification. Cooperation with an ESO provider can solve this challenge. Some ESO companies specialize in certain R&D domains where they are able to provide automotive companies with cutting-edge know-how almost instantly. In this way, OEMs/OESs are able to quickly enter new fields at relatively low "fixed costs" instead of building up inhouse research and development.
4. In cases where outsourcing is combined with offshoring, additional benefits can be realized. One such benefit is access to a **large pool of talented engineers**. In their home countries, many technology-dependent companies are facing difficulties in recruiting enough qualified engineers, as fewer and fewer students are looking for careers in traditional industrial R&D. In other countries – most notably India – the situation is completely different. A large number of qualified, English-speaking engineers graduate from universities every year and ESO providers in those countries use this large talent pool to offer qualified services to clients from Western countries.

Despite proven advantages, clients also see a number of downsides that must be managed in order to achieve significant benefits from engineering outsourcing.

1. Among the mentioned downsides of outsourcing, the potential **loss of know-how and intellectual property** is the most prevalent. Clients are aware that the know-how stored in the heads of their engineers is one of the most valuable resources they possess. As long as these engineers work directly for their companies, this know-how is readily available and relatively safe from competitors. But as industrial companies begin to bring into their R&D organizations external engineers who will leave once a project is finished, the accompanying know-how will also leave the organization if no preventive measures are taken.

2. Additionally, the cost reduction benefits of ESO providers are partially neutralized by a **time- and cost-intensive ramp-up phase**. The day-to-day cooperation between internal and external engineers can create **additional "hidden costs"** (e.g. for travelling, IT systems, communication) that further diminish the achievable cost reductions. Companies that engage in outsourcing and offshoring must first be able to formulate clear and autonomous work packages that can be delivered externally or offshore to avoid duplicating R&D efforts.
3. The **challenge involved in streamlining the current engineering organization** is often underestimated. A general issue with outsourcing corporate functions is interference from workers unions and sometimes politicians. This is typically due to fear that jobs, once outsourced, will be dissolved even more easily, especially when capacities are offshored to countries with lower labor costs.
4. Being able to conduct advanced research is a major competitive advantage for a country, and it is likely that there will be significant **public opposition to any perceived trend of large-scale offshoring of research functions**.

To achieve successful outsourcing and offshoring of R&D activities, companies must carefully calibrate their individual approach. Most importantly, companies must determine the best answer to the questions of what to outsource, where to outsource to, which provider to cooperate with and what the timeframe for realizing tangible benefits should be.

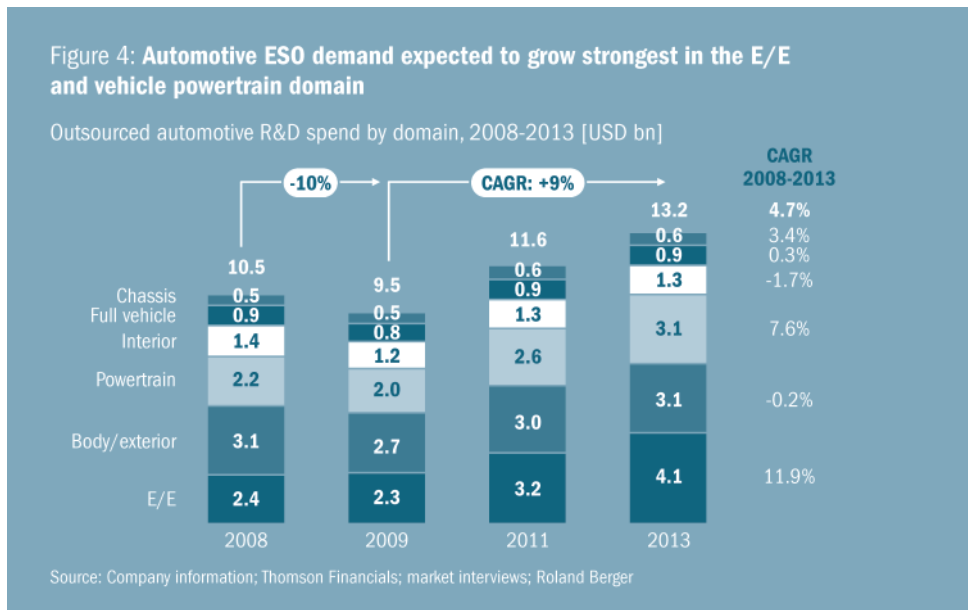
C. Automotive engineering outsourcing demand varies across domains

More commoditized components such as interior and exterior components are already sourced from specialized Tier 1 suppliers that provide combined engineering and manufacturing capabilities. The most prominent vehicle components in each of these domains are wiring harnesses (E/E), roof systems (body), engine control, and exhaust systems (powertrain).

The current degree of and expected growth potential for engineering outsourcing greatly depends on the automotive domain under consideration. Currently, electronics/electric (E/E), body/exterior and powertrain account for the largest share of engineering outsourcing, with a combined share of about 70% of total ESO demand.

While E/E components such as on-board communication and vehicle telematic systems are communicating via well-defined interfaces and protocols, they are more and more connected to other vehicle functions. The resulting system complexity at increasing standardization of interfaces make it very attractive for an OEM to engage with capable system development partners. This helps counterbalance the growing complexity and ongoing integration of such systems, which are driven mostly by market trends in safety and driver comfort.

The strong demand for outsourcing powertrain development reflects the pressure automotive OEMs and suppliers are under to adopt new concepts and technologies in tackling the ubiquitous challenge of emission reduction and fuel efficiency. A growing number of alternative fuel concepts for conventional combustion engines, hybridification of entire vehicle programs and the rise of pure electric vehicles have pushed all major OEMs out of their comfort zones of conventional fuel combustion engines. Given the lack of appropriate know-how, coupled with the vast scope of new engineering fields to be covered (generation, refueling, storage and ideally emission-neutral disposal of various energy carriers), outsourcing will happen here even more frequently in the near future.



4. OEM/OES approaches to engineering outsourcing and offshoring

A. Engineering outsourcing is driven by key market trends

The automotive industry has shifted from highly vertically integrated OEMs conducting design, manufacturing and assembly of most vehicle components inhouse to a buyer-vendor base approach with a multi-tier supplier structure. As a result, automotive suppliers now account for up to 55-60% of the entire vehicle value creation in terms of OEM net revenues.

This shift was driven in part by the fact that only a specific subset of vehicle components actually provide a distinct competitive advantage for OEMs. The remaining standard components barely register in end-customer perception, or don't even matter at all. OEMs are thus better off outsourcing these components or sub-modules to specialized suppliers. Prominent examples of this include the heating, ventilation, and air conditioning (HVAC) modules, vehicle braking systems and front-end modules. Nowadays, these are designed and provided entirely by recognized Tier 1 suppliers.

Increasing system complexity and tighter R&D budgets have spurred a similar shift in engineering tasks across all domains where OEMs must habitually make the trade-off decision between internal development and external contracting of third parties. The current market downturn only adds to the need for more flexible R&D structures that allow quick reaction to market developments.

The further globalization of vehicle sales and production has also increased demand for globally delivered R&D, while continuous cost pressure again emphasizes the role of low-cost engineering. The rising demand of emerging markets for automotive products (e.g. BRIC) is further pushing the transition of engineering tasks to these emerging markets. For example, China is now the largest single market for the Volkswagen Group. New models and variants are ideally developed and customized locally to meet specific local requirements and allow companies to capitalize on lower labor costs.

One step further down the value creation chain, Tier 1 suppliers who are awarded the supply contract for a component or even an entire vehicle subsystem make similar trade-off decisions when conducting R&D for contracted vehicle systems.

It can even happen that tight cost-to-target requirements imposed by OEMs force downstream suppliers to engage intensely in engineering outsourcing and offshoring for the very same reasons as OEMs. This can take place even if not explicitly stated by the OEM, as this is the case for most commodity purchase parts.

For this reason, engineering outsourcing is not specific to one single step of the vehicle value chain, but is rather a recurring decision point along the entire value chain.

In our experience, a tier-based prime/sub-contracting model has even emerged among Engineering Service Providers. In such a constellation, a primary ESO provider is contracted to assume full responsibility for the engineering project while subcontracting specific engineering tasks to a smaller or more specialized market player (especially to compensate for gaps in its own domain expertise).

B. Automotive OEMs and suppliers practice different approaches to outsourcing and offshoring

Most passenger car OEMs show a relatively higher than average, but fairly similar level of R&D spend (the industry average is about 5% of total revenue). This reflects the growing convergence between OEMs following the industry consolidation in recent years. As the market challenges that OEMs face are similar for all players, their respective R&D spend level is largely consistent. A few outliers exist, but their diverging R&D spend can be explained by company-specific factors (e.g. Porsche's high-end product portfolio and the company's relatively low-volume vehicle sales). The main differences between car OEMs lie in their approach to a global R&D base. Some OEMs, like VW and GM, created a truly global R&D organization that has technology centers in almost all major markets. These centers not only monitor market developments to report new trends back to the R&D headquarters, but they also play an active role in developing vehicle concepts for their specific market environment, and possess complete vehicle development competencies. Other OEMs, e.g. Toyota, pursue a more centralized R&D organization. They have established smaller R&D units in important markets, where they are mostly active in monitoring key trends and distinctive customer requirements, but the main vehicle development activity is conducted at a genuine R&D headquarters in the OEM's home country.

For those OEMs that do support a globalized R&D infrastructure, the advantages of offshoring – mostly the lower cost base – are frequently secondary decision factors. The main driver of their approach is the perceived need to develop vehicles close to end customer markets. In addition, they might operate independent brands in major markets (like GM's Opel in Germany) which focus on widely different vehicles than those developed at the home-country R&D headquarters.

Automotive companies at the forefront of R&D offshoring are actually the largest suppliers. Companies like Bosch and Hella have established global R&D networks that cover all major markets. One reason for this is the same as for OEMs: suppliers must produce market-specific products that can best be developed at the respective location. But the other, and probably more important, reason is the cost pressure that OESs face. Searching for cost potentials in their R&D infrastructure, large OESs realized early on that offshoring R&D activities to low-cost countries can provide them with crucial competitive advantages. Therefore, OESs today show a higher level of R&D offshoring than OEMs. At the same time, their R&D spend levels are also higher than those of car OEMs. This is driven mainly by current industry dynamics: OEMs are increasingly reliant on suppliers to take over large parts of development efforts. The revenue-weighted R&D spend is therefore proportionally higher for suppliers than for OEMs.

The approach toward outsourcing is more difficult to generalize across industrial groups. To what degree Engineering Service Providers are used to complement or replace their own engineering capacity seems to be driven more by the historic relationship with specific providers than by a clear strategic consideration. Some OEMs are heavily involved with ESO companies (e.g. MB tech is a subsidiary of Daimler, and VW owns a large share in IAV's equity), while others are not known to utilize ESO providers significantly, or only for limited project volumes. Large automotive suppliers as Continental and Bosch support their own Engineering Service Providers and use them to balance fluctuating capacity needs. There is thus no identifiable general trend for either car OEMs or suppliers in this respect.

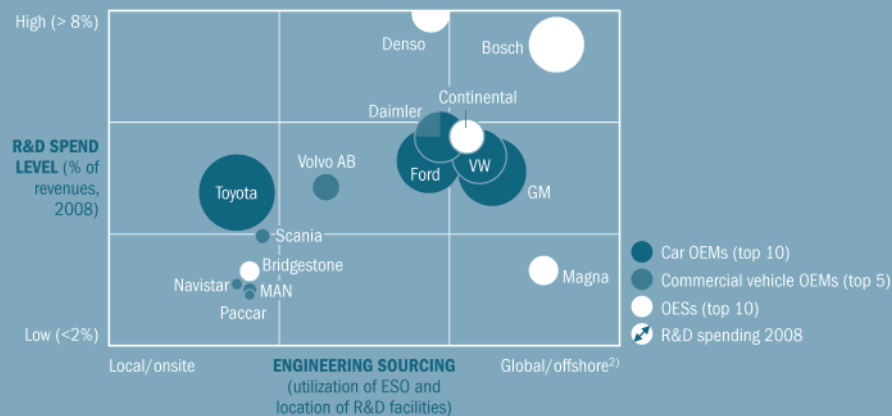
In contrast to passenger car OEMs and OESs, commercial vehicle OEMs pursue a somewhat different R&D strategy. Their R&D facilities are largely concentrated close to their headquarters. This is driven by the fact that most commercial vehicle OEMs have traditionally followed such a highly market-tailored vehicle strategy compared with car OEMs to meet different regional customer requirements. Therefore, establishing research facilities in emerging markets, e.g. in Asia, was not as necessary as it is for car OEMs entering a market with a highly localized product.

Due to differences in the business model, the R&D spend of commercial vehicle manufacturers is generally lower than that of car manufacturers. Instead of developing a large number of different models (as is the case for car OEMs), they focus on a limited number of products. For example, MAN production is based on just four different truck platforms. Additional customization of trucks is not done by OEMs but by specialized body-manufacturers, thus further reducing the development costs of truck OEMs. Volvo AB is the noticeable exception to this trend, with an R&D ratio well above those of its competitors. This reflects the broad product portfolio that Volvo AB must support (a total of 8 different truck models and a broad variety of construction equipment machinery).

To visually differentiate the various approaches, major automotive players can be ranked according to their relative outsourcing and offshoring activity level using a scoring model based on a 5-point scale (see figure 5). On this scale, 1 represents a very locally focused and internally conducted engineering approach, and 5 indicates the highest level of outsourcing and offshoring, well over 50% of total engineering. By using the R&D spend weighted by total revenue as the vertical axis, automotive players can be plotted on a matrix to visually represent the individual approaches taken. One factor that inhibits broader use of engineering outsourcing by OEMs/OESs, and especially offshoring R&D to ESPs, is the fear of knowledge spillovers.

Figure 5: Engineering sourcing approaches vary greatly between OEMs and OESs – Suppliers lead in terms of R&D spend

Engineering sourcing approaches of major automotive companies¹⁾



1) Based on revenue ranking 2) Incl. captive R&D facilities

Source: Company information; Thomson Financials; market interviews; Roland Berger

Cooperation with external engineering suppliers means sharing confidential information that should not be available to other players in the industry. By working with ESPs that are active for more than one OEM/OES, clients are rightfully afraid that their know-how might end up in the hands of competitors. A large number of OEMs/OESs therefore developed a more expensive, but simultaneously more controllable way of tapping into the potential of a globalized, low-cost engineering base: they operate captive engineering centers in low-cost locations. Figure 6 demonstrates that most major automotive companies are already present in the prime engineering outsourcing locations with their own R&D facilities. To some extent, these facilities are responsible for developing products for the respective market. But to a varying degree, they are also used as a low-cost engineering base that takes over design responsibilities from established R&D locations in more expensive locations. Establishing a captive R&D center in a low-cost location is a major decision for automotive companies that only makes sense as part of a broader strategy. R&D centers incur high fixed costs, take a relatively long time to become fully operational and require highly qualified personnel that must be trained to fulfill industry and company standards. To go down this path, OEMs/OESs must be convinced that there is long-term value in supporting engineers e.g. in India. Figure 6 shows a selected number of R&D facilities, indicating that a growing number of automotive companies recognize that value. Nearly all larger OEMs and suppliers are among the companies that have R&D facilities in low-cost locations.

Figure 6: Major automotive players have already set up captive R&D facilities in low-cost locations such as India and China

Offshore/low-cost R&D facilities of automotive OEMs/OESs



Source: Company information; press research; Roland Berger

Automotive companies have several reasons to offshore engineering besides lower wages abroad. Offshoring allows them to make better use of their own inhouse staff and speed up development cycles to respond to the industry trend toward shorter time-to-market. At the same time, they can benefit from the global competence network of specialized service providers around the globe. Existing global R&D facilities of automotive companies shown in figure 6 demonstrate the two different kinds of offshoring that currently exist. If established in countries like Brazil and China, R&D facilities are mostly utilized to adapt products for local markets. The share of engineering taking place that is part of a truly global R&D initiative (e.g. new vehicle development) is relatively small. India, on the other hand, was able to establish itself as the primary R&D offshoring country. The R&D facilities located in India also conduct research for local and global product development. However, the relatively cheap, well-educated engineers take also part in other, more demanding global R&D projects. Currently, India can thus be considered the true engineering offshoring hub of the world.

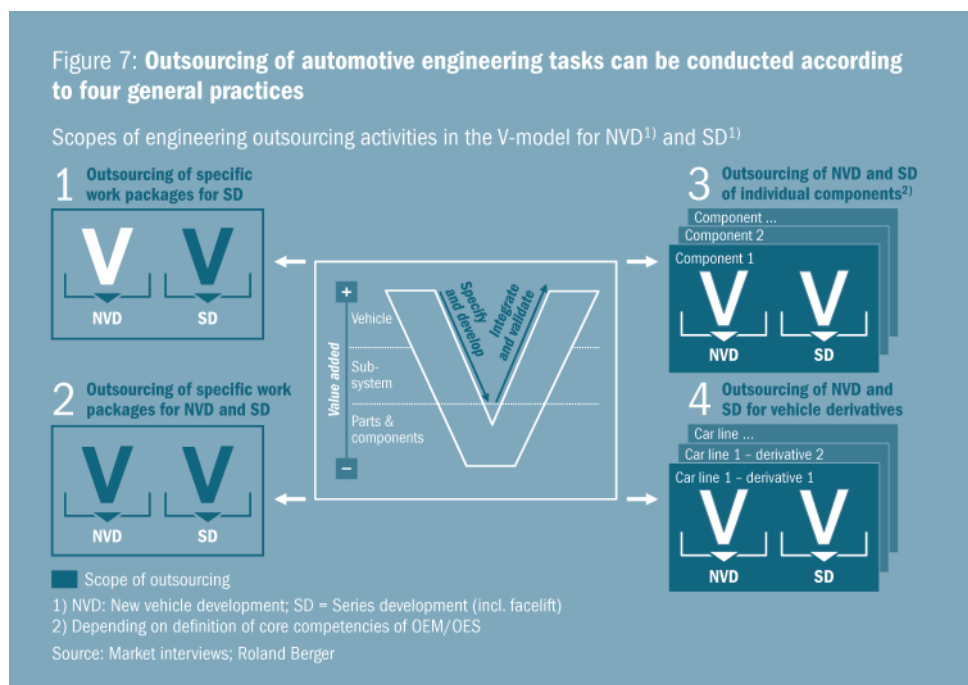
C. Different scopes in the engineering V-model are considered for outsourcing

When it comes to the scope of "outsourcable" engineering activities, four general types of outsourcing practices can be distinguished along the system engineering V-model of vehicle development (see figure 7). Distinctions can be made, on the one hand, between the outsourcing of a specific R&D work package for vehicle series development (SD) only or the extended responsibility comprising also new vehicle development (NVD). On the other hand, outsourcing can apply to an entire family of components (for both NVD and SD) or even an entire vehicle derivative comprising both NVD and SD. In industry practice, all four types are common, but each type of outsourcing scope is generally linked to a specific type of ESO provider.

Large, established ESO providers like Karmann and Magna are mostly utilized to develop (and to some extent also produce) entire vehicle lines by themselves, and OEMs are willing to engage in these projects to even out their own development and production capacities. Instead of developing a vehicle variant, such as a cabriolet version of an existing car, thus tying up valuable engineering resources, OEMs frequently contract ESO providers to complete the development and focus their captive R&D resources on their core development programs. Similarly, instead of building a new factory for a new niche model, it is more efficient for OEMs to ask an external provider to take over production of such a model at an existing plant. On the other end of the spectrum, ESO providers can be contracted to fulfill very limited tasks, e.g. analyzing a body panel for a specific model variant or designing a certain component.

There is virtually no limit to what specialized ESO providers can do to support OEMs/OESs.

However, our market survey of top managers at leading automotive companies showed a relatively strong reluctance to outsource or even offshore very complex, high-value-added engineering tasks. Despite well-established development and communications tools, the close collaboration required for such tasks prevents companies from outsourcing complex tasks to a greater extent. Further amplified by concerns regarding capabilities to deliver complex development tasks, the bulk of engineering work currently out-sourced consists of completing clearly defined tasks and work packages for certain components instead of handling entire vehicle programs.

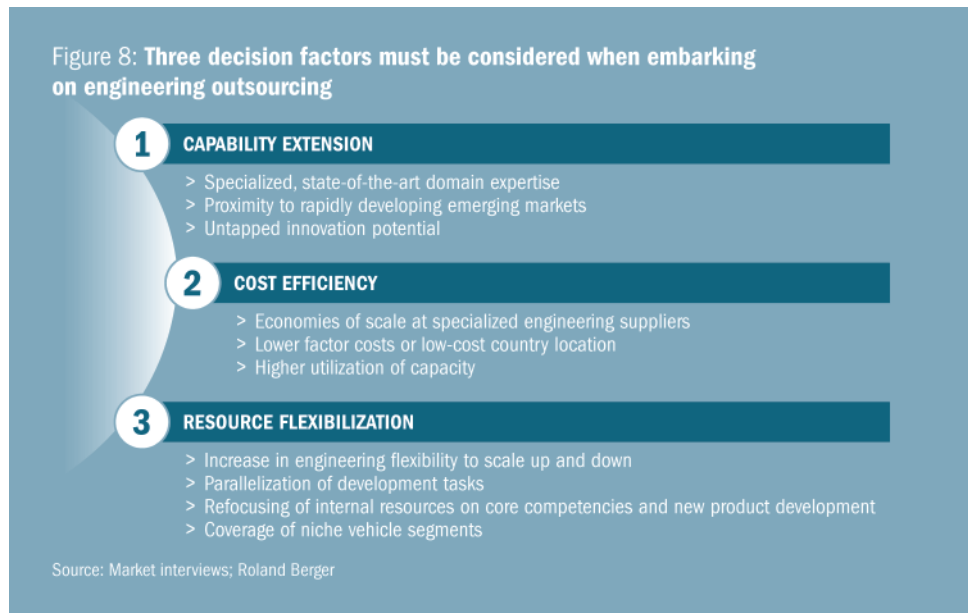


D. Three key criteria apply when selecting an engineering service provider

A sustainable automotive R&D strategy certainly can't be built around outsourcing the entire engineering workload to third parties and concentrating solely on the integration of modules and components. It is more about a smart trade-off between make-or-buy along a given set of key decision criteria for individual research and engineering tasks throughout the entire the value chain.

Once the decision to outsource specific engineering tasks has been made, the selection of an adequate ESP is based on three basic decision factors:

- > Which provider can contribute the most up-to-date **technological know-how, domain skills and expertise or local market expertise**?
- > Which ESP can provide the most **cost-efficient** solution?
- > Which ESP can contribute **suitable and flexible resources** to support internal development?



The trade-offs among these three dimensions must be weighed against each other, as they have a significant impact on the selection of an outsourcing service provider. These factors are strongly linked to the content of the engineering task to be outsourced.

For more cost-driven approaches, predominantly less complex and more standardized work packages are suitable for generating scale effects for the supplier while avoiding incurring further process management and transaction costs (e.g. 2D/3D CAD conversions, FEA meshing).

When it comes to more complex tasks or tasks related to core competencies, the question of extending capabilities or making resources more flexible is only a temporary one. OEMs and suppliers will have to decide whether or not to foster such competencies inhouse by enabling their own engineers, even incorporating new, experienced engineers (which will require a dedicated know-how transfer process to be in place), or relying on external resources to appropriate the know-how generated.

E. Engineering outsourcing is conducted according to different operating models

Two typical types of engineering service contracts can be distinguished:

- a) Contracting of "time and material" ("body leasing"): the engineering workforce is put at the OEM's/supplier's disposal to support/conduct an internally coordinated and developed project
- b) Contracting of services: the entire development process and responsibility for defined work packages is handed over to the ESP, which does the engineering mostly autonomously

Currently, the majority of ESO contracts are based on "time and material", meaning that providers are not remunerated based on the results they deliver, but rather on the cost they incurred during the development phase. This is a double-edged sword: while ESO providers don't bear the risk if the development of a product takes longer than expected, they also don't profit if they are able to deliver results faster than anticipated.

As a result of this situation, the entire ESO industry is seeing a shift from a predominantly work- and labor-oriented approach to service contracting, increasingly transferring cost and result responsibility to service providers. This is also supported by OEMs/OESs, who are becoming more and more willing to hand over responsibility for complex work packages or entire component development to their ESO providers. This shift is expected to continue in the future as providers become even more experienced in specific domains and general project management.

In terms of operating models, ESO providers can be clustered into three different approaches (see figure 9). As a reaction to the differentiated demand of their clients, ESO providers developed distinct operating models:

- a) Pure-play **labor contracting**
- b) Outsourced or offshored **work package contracting**
- c) Outsourced **operation of a captive development center** for OEM/OES

The first operating model type, "labor contracting", embodies the beginning of the engineering outsourcing industry. Since its establishment and very much until today, lending engineers to clients who are in need of short-term R&D capacity expansion has been the backbone of the entire ESO industry. Clients get access to a vast engineering workforce that can be integrated just as well as actual employees. The crucial advantage is the fact that the "leased engineers" do not represent fixed costs (as own employees would), but can be more easily hired or reduced as R&D capacity needs require. This extra flexibility is a major selling point for ESO companies.

The second operating model type, "work package contracting", is an enhancement of labor contracting. Instead of merely supplying engineers to OEMs/OESs, why shouldn't the ESO provider be able to deliver entire projects by itself? In this model, the ESO provider essentially takes on the role of a "classical supplier". The client specifies exactly what result is expected by when and at what price, and the ESO provider is responsible for delivering this result. How many resources are used to complete the project is up to the provider. As mentioned before, this gives the ESO company the opportunity to realize higher profits while the client is able to delegate responsibility for certain projects and focus on the few issues that matter most to him.

Most ESPs offer a mixture of above mentioned operating models, but there are still some typical examples where a certain operating model is especially well suited for a particular assignment. For example, clients might want to have dedicated personnel working in an offshore location to prevent knowledge spillovers and general IP protection problems, or because they don't believe that the level of experience of external personnel is high enough. At the same time, the client might be aware of the difficult working conditions in the chosen country and want to avoid organizational difficulties in establishing the R&D center.

Using an ESO provider as a "facility operator" would thus be a suitable operating model. The ESO company can provide the office and laboratory space and help overcome administrative hurdles by taking over HR management. The client is able to reap two-fold benefits: the R&D center is run smoothly but does not require excessive management capacity by the client. On the other hand he can be certain that only his own, contracted personnel works in this center. Such an operating model is exemplified by KPIT Cummins operating an engineering facility for Continental in Bangalore, India. Cooperations of this kind usually take as much as one and a half to two years before reaching full operational performance.

Figure 9: Three general approaches to operating an ESO business have been identified – Individual success factors to be considered

Typical operating models for ESO

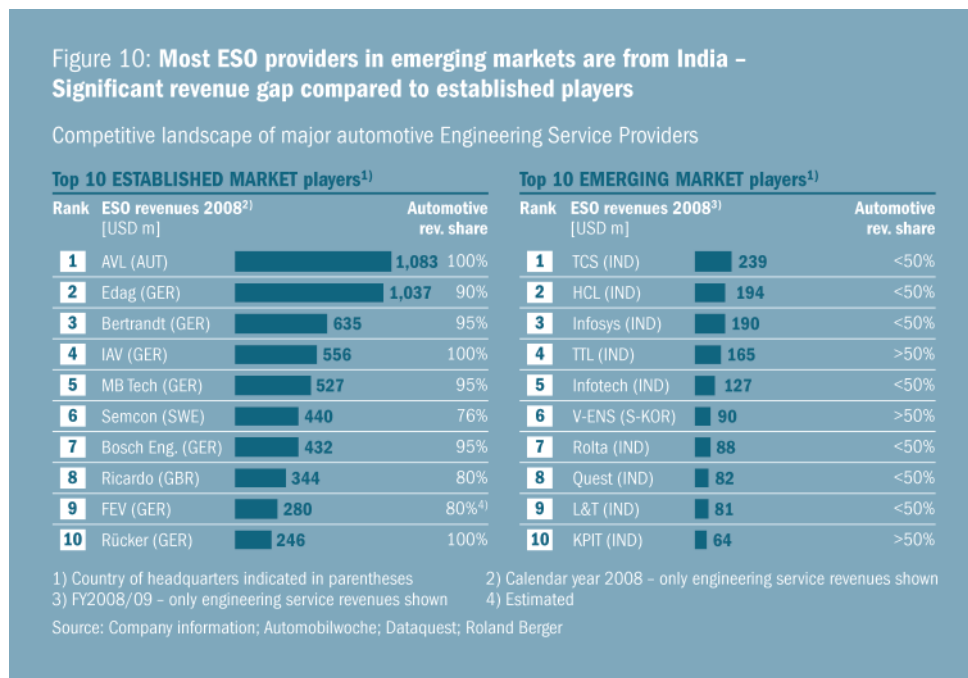
	Labor contracting ONSITE/ONSHORE	Work package contracting NEARSHORE OR OFFSHORE	Facility operator for OEM/OES OFFSHORE
Description	<ul style="list-style-type: none"> > ESO provider sends personnel to work for OEM/OES at OEM/OES facility > After completion of project, personnel leaves if no longer required > Allows temporary expansion of resources for OEM 	<ul style="list-style-type: none"> > Completion of defined work packages according to given specifications > Regular status review with client, but no constant contact/monitoring > Work is completed in ESO provider's facility by ESO personnel 	<ul style="list-style-type: none"> > Local provider operates R&D facility at offshore location as service for OEM/OES > HR management > Involvement in actual engineering or only body leasing
	Low	ESP RESPONSIBILITY	High
Success factors	<ul style="list-style-type: none"> > Locally available personnel (no language/cultural barrier) > Efficient cost structure > Appropriate skill level 	<ul style="list-style-type: none"> > Know-how and facilities to handle defined work packages > Excellent client relationship through sales force in OEM/OES proximity > Strong compliance policy to protect intellectual property 	<ul style="list-style-type: none"> > Ability and experience to provide necessary tools/materials/logistics services to enable smooth operation > Strict compliance policy > Financial/organizational stability

Source: Market interviews; Roland Berger

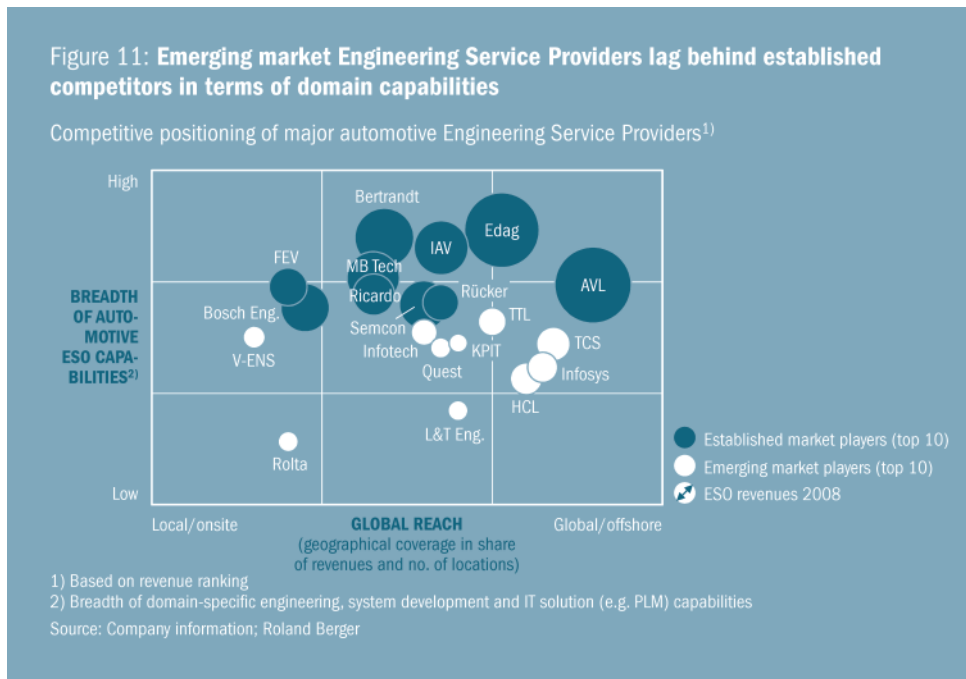
5. Engineering Service Provider landscape

Two groups of Engineering Service Providers dominate the market. One comprises the established players of mostly European origin that have been active in this field for decades. The other group consists of new competitors from emerging markets – the vast majority of which are based in India – that have only recently been established. The differences between the two groups today are remarkable in terms of engineering know-how, industry focus and revenues. Established market players maintain a strong lead over their new competitors from emerging markets in most categories. Nevertheless, ESPs from emerging markets have continued to grow quickly and are prepared to attack established competitors in their home markets.

Figure 10 provides an overview of the major players in the automotive ESO industry for both categories. It is worth noting that even the largest emerging market ESO provider (TCS) generated fewer revenues from ESO than the tenth-largest established company (Rücker).



To further demonstrate the differences between the two groups, figure 11 evaluates selected companies based on their domain experience and their global reach. The illustration provides an overview of how individual ESO providers are positioned to meet customer requirements in engineering outsourcing.



A. Established ESPs maintain the lead in terms of domain expertise

Figure 11 shows that European ESPs are still the dominant players in engineering outsourcing. They profit from their long-standing client relationships that enabled them to build up specific domain experience in relevant fields of automotive engineering. Some OEMs even own equity in ESPs – e.g. VW in IAV – making the working relationship even closer. To achieve a competitive advantage, several established ESPs are highly specialized in single domains or fields of engineering. A prominent example is AVL, who focuses exclusively on powertrain development. This enables ESPs to build defendable market positions and approach OEMs with a specific service offering instead of trying to sell a less domain focused "engineering service".

In terms of their global reach, established ESPs differ widely. While some are focused on a small geographic area (typically their home country), others have established a global footprint, following their clients into new markets and attracting new customers. Again, AVL is an example of a truly global ESP. The company operates nearly 50 technology centers and sales offices around the world, making it the most globalized established ESP.

Bertrandt represents the other extreme: a company that is highly focused on a specific geographic area. It operates only one facility outside of Europe (Detroit, USA). Nevertheless, most ESPs have felt pressure to become more global as several OEMs themselves have begun to build worldwide R&D networks, and as cost pressures have increased. To benefit from the same cost advantages as new competitors from developing countries, incumbent ESPs have established engineering offices close to new centers of the automotive industry (e.g. AVL in Pune, India). This strategy enables them to stay close to their main customers in Europe while leveraging the cost-effective engineering base in India.

B. Emerging market ESPs offer low-budget engineering and are steadily increasing their market share

Along with the general development of the automotive industry in emerging markets – driven both by domestic OEMs and local subsidiaries of global OEMs – new ESPs have emerged as well. The major stronghold of this new group of competitors is India. Despite a similarly low labor cost base in China, India has become the preferred location for the establishment of new ESPs. This is due to the fact, that India possesses of a relatively large base of well-educated engineers, a comparably low language barrier (English fluency is prevalent) and the country's positioning as the leading business process outsourcing location. However, in contrast to the European industry players, the scene in India is more diverse. Differences between players in terms of ESO approach, know-how and industry focus are much greater than between European companies.

Figure 11 demonstrates these differences. While the established ESPs are relatively homogeneous in terms of ESO capabilities and differ mostly in regional coverage, the emerging market players differ along both dimensions. This stems mostly from the fact that the Indian ESPs come from different backgrounds. One group of emerging ESO providers has come into existence as branches of major IT companies, e.g. Infosys and HCL. These companies are traditionally strong in IT services and related outsourcing. Over time, they were able to build ties with automotive companies through IT projects related to Product Lifecycle Management (PLM) and other engineering applications. They ultimately entered the scene by not only delivering software licenses for engineering tools, but by applying them for their clients.

As this side of the business grew, activities were merged into specialized ESO branches that focus exclusively on engineering outsourcing. Nevertheless, the main activities of these ESO companies are still related to information technology and are less focused on actual engineering. As their service offering is not tied to any specific business area, they cover a broad range of industries, from aerospace, over automotive to consumer goods.

Companies in the other group, like TTL, Quest and KPIT, were founded and operate with a clear focus on actual engineering design services. They typically offer selected R&D-related IT services, as well (mostly Product Lifecycle Management support), but are trying to distinguish themselves from the competition through superior automotive expertise. Their currently strong operational focus on India is reflected in their positioning in the matrix in figure 11.

To make up for their technological shortfalls and to create a network of facilities close to global OEMs, Indian ESPs have typically pursued an aggressive growth and acquisition strategy. Over the course of the last few years, they have acquired ESO providers in Europe and the US to establish a foothold in the most prominent automotive markets. For example, TTL acquired INCAT in late 2005, doubling its revenues and enabling TTL to gain access to important customers like Honda and Chrysler. The company also built up a network of sales offices in the US, Europe and Japan to better access customers in these regions.

In the long-term, the differences in know-how and engineering capabilities between established ESO providers and competitors from emerging markets are likely to level out. As global OEMs continue to build R&D facilities in emerging markets, thus transferring knowledge, Indian ESPs will increasingly catch up to the dominant players. However, the competitive pressure will continue to build up for both groups. Currently, Indian ESPs are in the most advantageous position, as they benefit from a lower cost base. This makes them attractive partners for OEMs trying to reduce their fixed cost base in the aftermath of the market downturn. Nevertheless, over the next few years, established ESO providers are likely to also step up their efforts to become more cost competitive and will probably continue to build up capacities in low-cost countries. Once they complete this task, Indian companies will find it more difficult to compete as their cost advantage deteriorates. If they are not able to expand their domain expertise fast enough, there will be little reason for OEMs and suppliers to cooperate with them instead of European companies who would then be technologically more advanced at a similar cost level.

6. Concluding perspectives on how to successfully master engineering outsourcing

A. OEMs and suppliers must define their individual strategic approach to ESO

1. Vehicle manufacturers and suppliers must first develop a **clear and future-oriented R&D strategy** before thinking about outsourcing larger shares of the engineering workload. This strategy must clearly **define current and future core and non-core competencies** for their companies. Engineering of non-core development tasks should be prime candidates for outsourcing. Therefore, the use of engineering outsourcing must be defined based on a clear make-or-buy decision-making process.
2. The second important step is to **define and implement a global R&D footprint** once the strategy has been developed. Building on a captive R&D center in an offshore location is a viable option. The best approach to choose can vary significantly among companies. Depending on company culture, organization form and engineering scope, we have found successful and efficient practices ranging from small, focused offshore facilities to large-scale, centrally coordinated development hubs.
3. As an prerequisite for successful engineering outsourcing, **internal R&D processes need to be streamlined and clearly defined first**, before engaging with a third party and increasing complexity even further.
4. The fourth important step is for automotive OEMs and suppliers to **gain a clear understanding of their current deployment of internal R&D resources** and the extent of external engineering services employed. The current situation can be used as a basis for identifying and formulating change requirements to reach the defined R&D strategy targets.
5. For companies approaching significant R&D outsourcing it is important to **weigh the pros and cons of captive R&D**. At the same time, they should consider leveraging **vendor-based Engineering Service Providers** as a valuable extension of their own global engineering networks.

6. We have found that one proven approach is to have **a set of preferred ESO suppliers** that specialize in selected domains and services. However, excessively restricting independent choice among suppliers prevents players from leveraging the skills and know-how provided most efficiently by using a best-of-breed choice.
7. Companies thus need to define the **goal of individual outsourcing work packages and identify the key requirements** and specifications to be met. Once specifications and development goals are set, the market can be screened for the most appropriate Engineering Service Providers.
8. In addition, a **goal-/fact-based outsourcing decision-making process** must be established to identify, request and contract the right engineering service provider from the vast pool of potential candidates (there are at least 200 to 250 relevant and predominantly automotive-oriented ESPs in the market).
9. Especially for Tier 1 suppliers, but also for OEMs, cost-driven outsourcing or offshoring must be conducted along a **well-defined set of rules and processes based on Key Performance Indicators (KPIs)**. This will help prevent any disruption along the value chain, for example if a subcontractor suffers from quality issues or financial distress. For these cases, a strong governance model and tight management control (e.g. by acquiring a controlling stake in an ESP) should be evaluated to ensure that the engineering tasks assigned are carried out without impairing overall product development.
10. Finally, to benefit from the learning curve and to harmonize engineering contractor sourcing, companies must set up a **standardized contract award procedure**, defining the right performance metrics scheme up front and putting an effective monitoring system in place to ensure transparency with respect to individual engineering sourcing projects.

B. Engineering Service Providers should continuously expand their domain expertise

1. The increasing standardization of non-core components and basic technologies opens a huge window of opportunity for ESPs to support automotive manufacturers in mastering the challenges resulting from increasing complexity and the multitude of vehicle variants. They can establish a clear competitive advantage over other market players by fostering **cutting-edge technological know-how generation** in dedicated domains requested by OEMs.
2. Furthermore, ESPs need to define a **clear and comprehensive value proposition** for automotive OEMs/suppliers and a **go-to-market strategy based on proven domain expertise**. Just claiming end-to-end vehicle competency with no clear domain specialization is not perceived as compelling by most OEMs – in fact, they tend to regard it with suspicion. A proven track record in a specific automotive domain is key for winning long-term business contracts for outsourced engineering.
3. By offering OEMs competencies in a **comprehensive and standardized business model**, Engineering Service Providers can offer existing and future customers an easy-to-use service platform. The aim should always be to reduce customers' control and governance efforts by providing easy-to-use and transparent management interfaces for key performance metrics (costs, timing, resources).
4. As well as their clients, ESPs have to **define their own global R&D footprint** to best serve the increasingly global demand for engineering services.
5. According to our market survey, both OEMs and OESs stress the role of an accessible and responsive **front office in close proximity to OEMs** as a prerequisite for engaging in long-term business relations.
6. To address the intrinsic fear of intellectual property misuse and piracy, all Engineering Service Providers must **establish and demonstrate a solid compliance policy**. This policy must be applicable to everyday business and should incorporate high confidentiality and proprietary customer know-how.

7. Once running business relations are established with key automotive customers, ESO providers should develop a clear and sustainable **cooperation model for subcontracting** themselves with downstream service suppliers. The smooth integration of low-cost/offshore engineering facilities within their own value generation process will play a key role for their future competitiveness.
8. To acquire a significant share of business from major automotive companies, **emerging market players** in particular still need to **develop a spotless track record and domain-specific competence**. Our market study revealed that a successful approach to becoming a recognized engineering service outsourcing provider is to establish a specialization in selected domains and processes by taking over series development tasks and later on expand into related areas.
9. Especially important for emerging market ESPs but valid also for established market players it to **get a grip on excessive engineer attrition levels**, to avoid loss of well trained resources and overall company productivity.
10. Finally, **consolidation within the ESO provider market** is imminent, with tightening business opportunities due to the market downturn. ESPs need to come up with appropriate inorganic growth opportunities in order to successfully overcome the market downturn and benefit from the incorporation of needed domain expertise.

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