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AUTOMOTIVE & INDUSTRIAL

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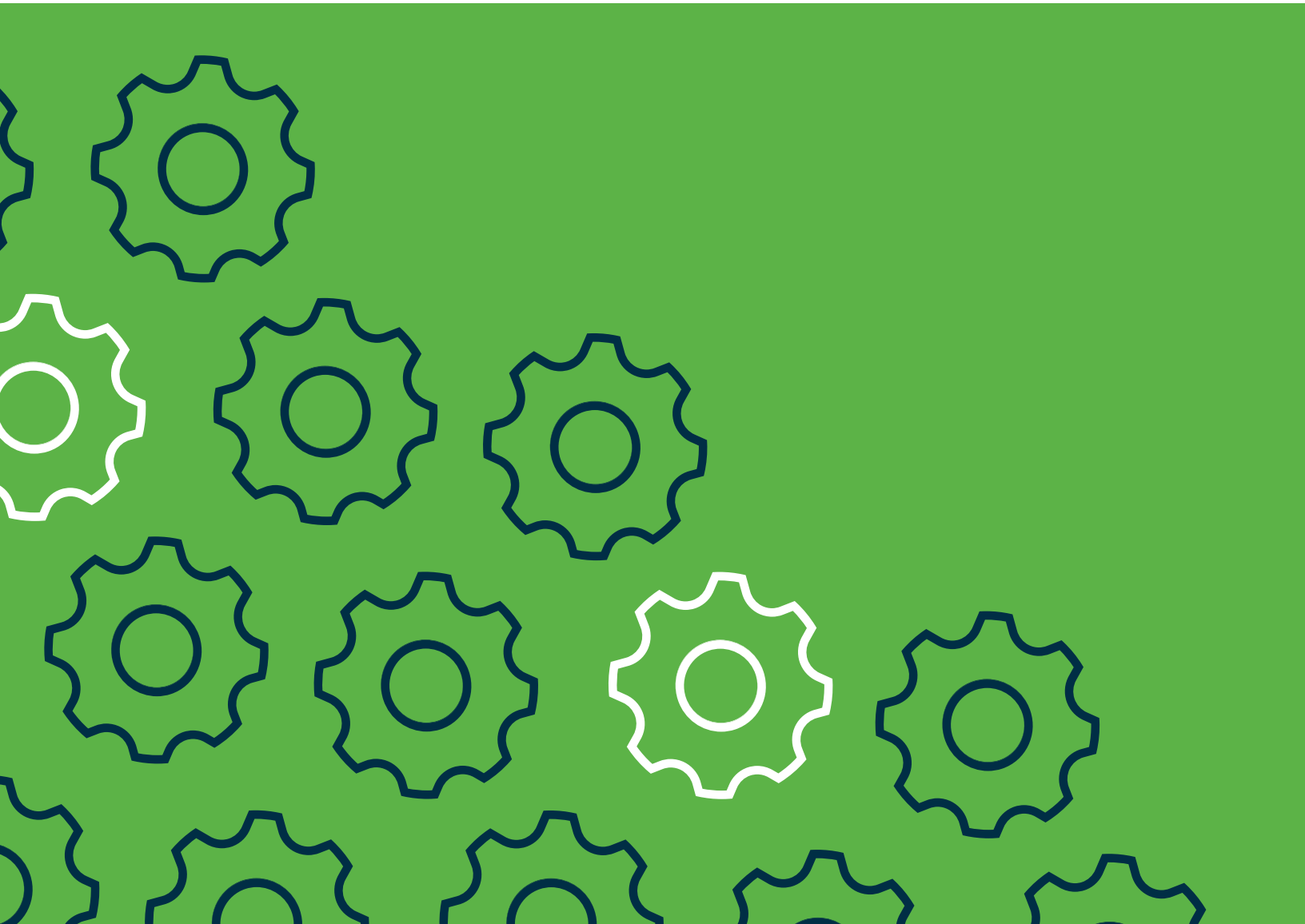
How automakers can take control of their software development – with lessons for others



At A Glance

1

Spotlight on new technologies and software integration

- A wave of new models and technologies have triggered complex R&D challenges for automakers, specifically on aligning with software development.
- Despite efforts to innovate, their R&D productivity and efficiency have worsened.
- Meanwhile, new trends like connectivity, autonomous driving, shared mobility, and electrification (CASE) are already applying pressure.

2

Five levers to improve software development

- An automotive OEM's first priority should be to gain more control over software development.
- We examine five levers automotive OEMs can move to gain more control over software and prepare for what's next: SW/HW development decoupling, advanced SW development tool integration, top talent acquisition, subcontractors partnerships, and digitization.

3

A roadmap for other industries

- Technological challenges are hardly limited to automakers.
- Machinery, powersports, home appliances, agriculture, and heavy equipment may feel the heat too.
- Taking stock of what's happening to automakers can help them face future challenges.

Technological innovations are rocking the automotive industry, and so far, the industry seems to have risen to the challenge. It has innovated through vehicle platforms and experimented with new software development methodologies.

It has also explored decoupling hardware and software development cycles, it has revamped software recruiting efforts, and it has found many other solutions to issues that arise in the fast-changing marketplace. These are good signs because automakers will likely face even tougher challenges down the road, as connectivity, autonomous driving, shared mobility, and electrification (CASE) continue to apply pressure.

After a close study of the industry, we highlight in this paper five levers that many automotive original equipment manufacturers (OEMs) move in order to gain better control over product development and software integration as the marketplace evolves. Business leaders across a wide span of industrial sectors should take note because these levers don't apply only to OEMs. What's happening now in the automotive industry can also serve as a roadmap of what lies in store for other industries as well, such as industrial goods, railway or heavy vehicle manufacturing, powersports, aerospace, and consumer goods. Lessons learned by automotive OEMs can help other business leaders anticipate upcoming market trends such as the Internet of Things and prepare for what's next.

R&D PRODUCTIVITY AND EFFICIENCY WORSENED DURING THE PAST DECADE

The automotive industry has had a busy decade. It faced certain complex R&D challenges brought by a wave of new models and technologies. It also had to satisfy multiple and strengthening regulatory requirements—especially ones regarding safety and emissions.

The industry has tried to cope with those challenges through global vehicle platforms. Companies bundled R&D efforts across multiple brands and models by way of increased standardization and modularization. They introduced new architecture that spanned multiple body styles and price segments, that shared the same technical basis, and that used a standard kit of interchangeable modules that met local customer requirements for cost and performance.

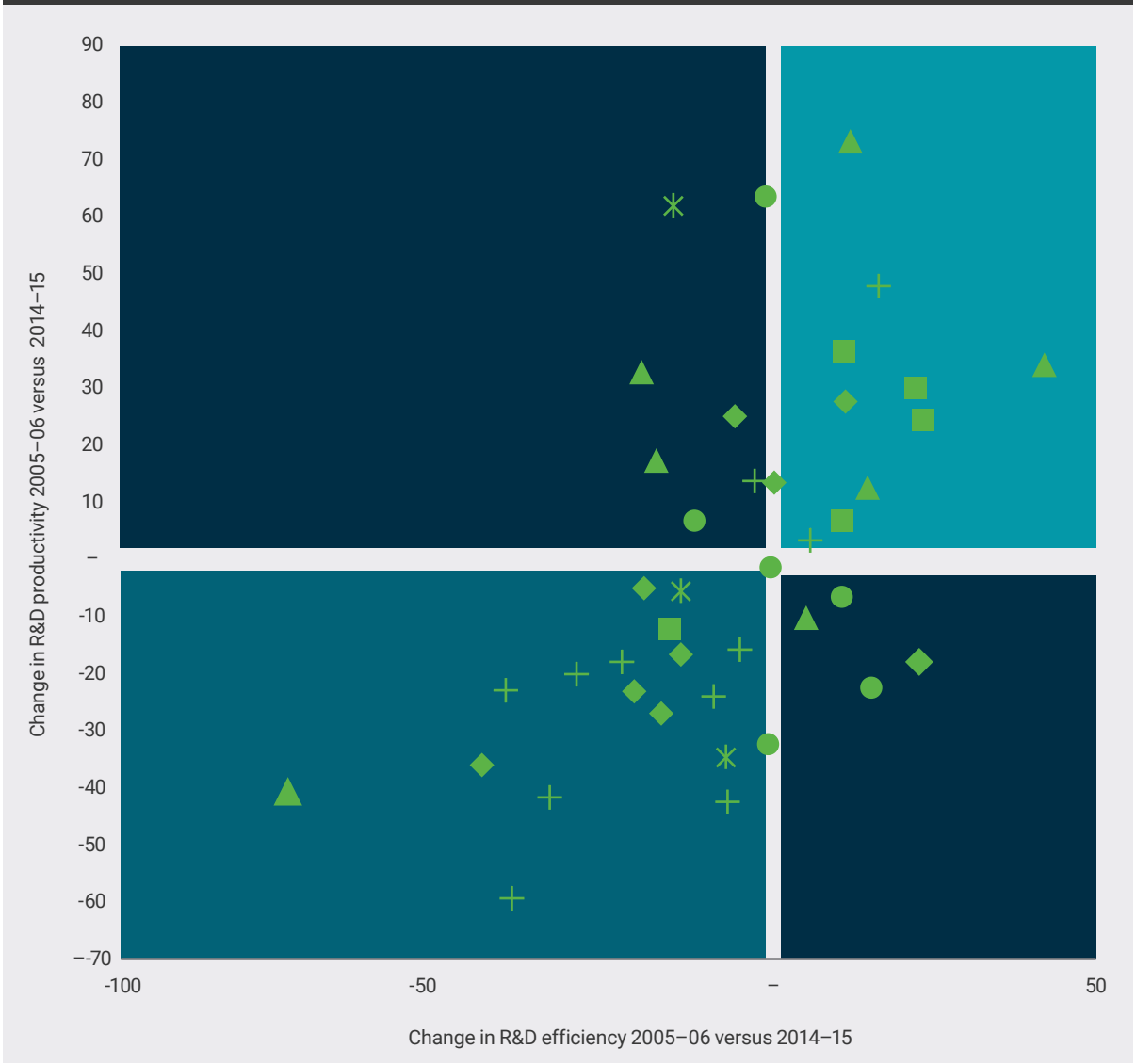
Since 2007, the automotive industry's growth has come entirely from vehicles built of these platforms, and that trend is expected to continue in the coming years. In 2007, 17 million vehicles were built on platforms with an average scale of more than 1 million units per platform. In 2016, that number more than doubled to 37 million vehicles, and the forecast for 2020 is more than 50 million vehicles, representing more than half of global vehicle production volumes.[1]

Our analysis shows that the doubling of vehicle platform volumes facilitates potential savings in the range of 6% on recurring product costs and about 15% on nonrecurring costs, 10% of which approximately relates to vehicle and powertrain engineering.

Despite that radical shift in automotive product development processes, R&D productivity and efficiency have worsened in the past 10 years. We conducted an analysis of public data covering R&D spend across the industry. We used the ratio of R&D spend to sales so we could measure for productivity, and we used the ratio of profitability (at EBITDA level) to R&D spend so we could measure R&D efficiency. To neutralize the impact of different accounting practices across the industry, we

[1] IHS, AlixPartners analysis.

FIGURE 1: R&D productivity and efficiency changes 2005–06 versus 2014–15



Key: OEM Chassis Electrical Electronics Interior Powertrain

Source: S&P Capital IQ, AlixPartners analysis

considered relative changes during only the past 10 years, from 2004–05 to 2015–16 (figure 1).[2]

R&D spend as a percentage of sales has increased, and the same R&D money spent today generates less profit than it did 10 years ago. The efficiency and productivity improvements expected from vehicle platform and module-based development did not seem to have offset the increased complexity caused by the introduction of new technologies. To balance that negative impact, OEMs seem to have significantly addressed gross margins (e.g., through product cost reduction and net sales optimization) and streamlined selling, general, and administrative expenses.

Automotive suppliers appear to have fared somewhat better than OEMs, though significant differences seem to exist across commodities: interior suppliers improved the most; electronic ones deteriorated the most.

[2] Our analysis neutralizes the impact of different accounting practices related to R&D capitalization across the industry, but it might still be impacted by accounting practice changes within the same company between 2004 and 2016.

INDUSTRY MACROTRENDS INDICATE EVEN MORE COMPLEX R&D CHALLENGES IN THE NEXT DECADE

Looking ahead to the next decade, research and development challenges do not appear to diminish. A sharper focus on closer-to-end product development (industrial development versus fundamental research) and the integration of new technology and features will increasingly become key market differentiators for OEMs. Most innovations across vehicle functions will come from electronics suppliers and will involve extensive software and mechatronics integration. This is particularly true for four major trends that are affecting the industry.

- Connectivity, with 70% global market penetration, through both tethered device integration and embedded technologies, is expected to provide a full value-added services offering by 2021.[3]
- Fast-paced adoption of advanced driver assistance systems, with 40% of new vehicle coverage by 2020, will progressively extend to fully autonomous driving.[4]
- OEMs are increasingly having to interact with new software-savvy players as the new shared mobility business models gain traction.
- Mass-market adoption of electrification is expected beyond 2020 because battery technology and its industrialization will push costs below the threshold of $200 per kilowatt-hour—to begin to be competitive with internal combustion engines.[5]

The increasing electrification and dominance of software coupled with what's perceived as a weak response by traditional OEMs have encouraged technology companies to enter the market with their own offerings. This directly challenges the traditional integrator role of OEMs.

HOW AUTOMOTIVE OEMS CAN GAIN BETTER CONTROL OVER THEIR PRODUCTIVITY AND HANDLE INCREASING SOFTWARE COMPLEXITY

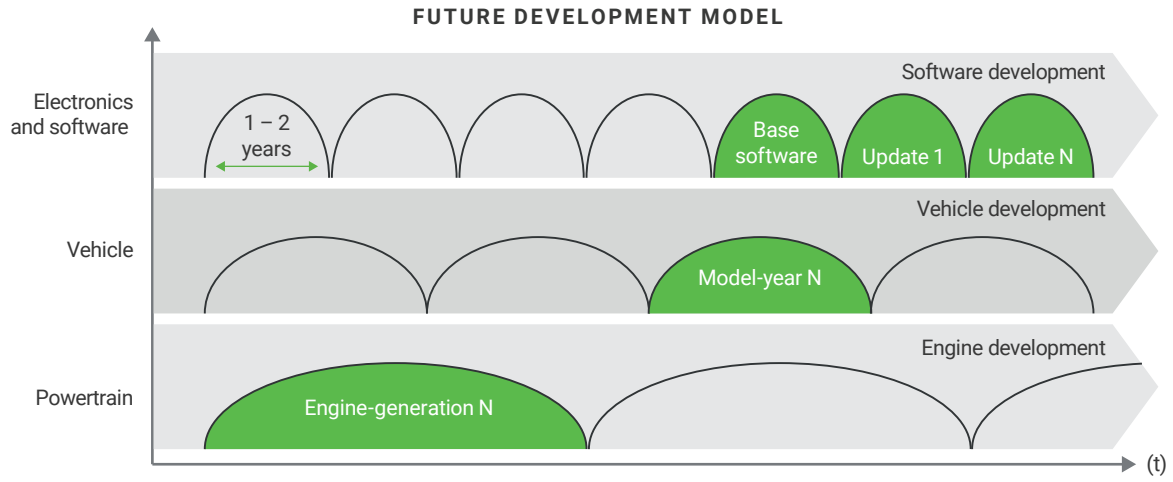
OEMs cannot afford to have their productivity deteriorate further. Their first priority should be to gain control of software development while addressing three specific areas: product development process, internal competencies, and relationships with software subcontractors.

DECOUPLE HARDWARE AND SOFTWARE DEVELOPMENT CYCLES

To facilitate a faster innovation cycle in electronics, OEMs could decouple software and electronic developments from hardware. Current electronic vehicle architectures are static in both form and function during a vehicle's life cycle. But the vehicle of the future should be updated several times during its life cycle by means of adjustment of software contents to provide new, state-of-the-art services and features.

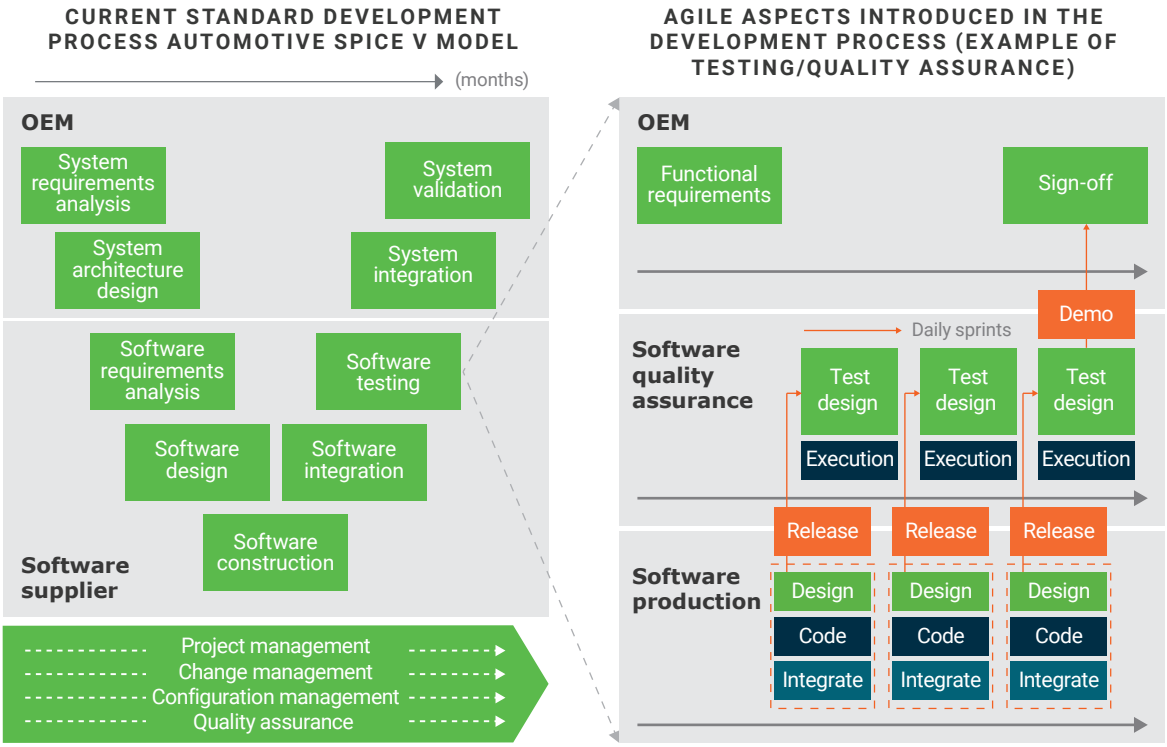
In the same way that powertrain product development process and organization are already decoupled from the vehicle so as to facilitate a longer usage cycle, the development of new technology will have to be decoupled from the development of hardware and made continuously upgradable—for example over the air, like mobile devices (figure 2).

FIGURE 2: Differentiated future development for electronics and software, vehicle, and powertrain



[3] Automotive OEMs, Volkswagen, ABI Research, AlixPartners analysis.
[4] Automotive OEMs, AlixPartners analysis.
[5] USABC, AlixPartners analysis.

FIGURE 3: Agile aspects introduced in the development process



SELECTIVELY INTEGRATE MAINSTREAM SOFTWARE DEVELOPMENT PROCESSES WITHIN THE PRODUCT DEVELOPMENT CYCLE

In automotive, current software development follows the hardware development process, which is driving overall testing processes. The response to changes in requirements is rather slow.

OEMs are exploring mainstream software development methodologies but are hindered by a conservative culture, a hierarchical structure, domineering relationships with suppliers, lengthy validation cycles, and bureaucratic quality gate processes. OEMs should experiment with new methods wherein those factors can be embedded within their development processes.

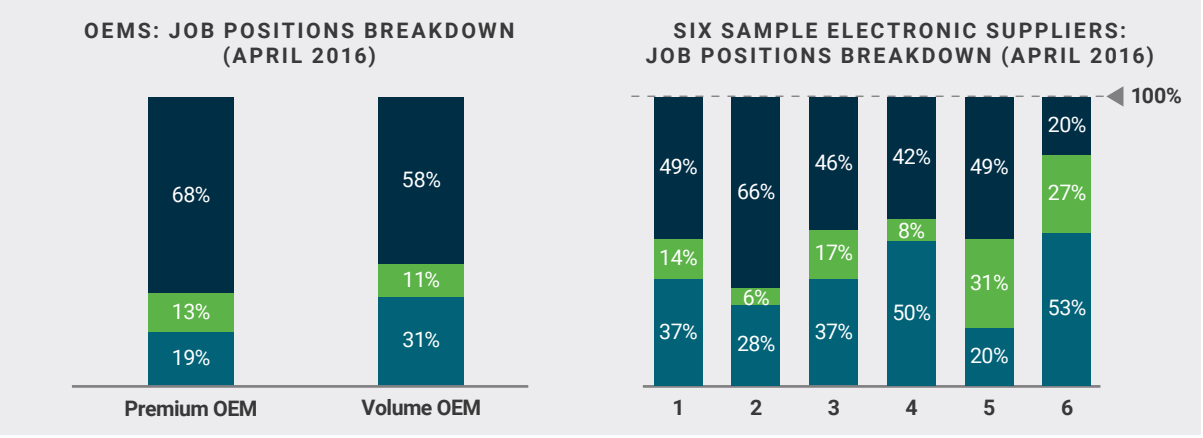
Selective use of mainstream software development processes such as agile methods could improve automotive software quality while still adhering to established process gate requirements. For example, OEMs could apply agile methodologies to daily automated test cycles by software suppliers in which they can actively participate. Such an approach could improve adherence to customer requirements and at the same time increase levels of defect detection (figure 3). Applying model-based and agile methods to software features would likely progressively spread to other mechatronics components.

RETHINK RECRUITING AND HUMAN RESOURCES POLICIES TO ATTRACT THE BEST SOFTWARE TALENT

OEMs and electronics suppliers should ramp up their in-house software development capabilities. But they could be facing a very tight job market.

An analysis of job postings in the second quarter of 2016 revealed that 31% of open positions at a volume OEM were related to the product development of software and electronics. For a premium OEM, that percentage was down at 19%, probably indicating that luxury OEMs had started building up their software competencies some time ago. The situation is even worse for electronics suppliers: across a panel of six major Tier-1 suppliers, 37% of open positions were related to software development (figure 4).

FIGURE 4: Job positions breakdown for product development at OEMs and electronics suppliers



Source: Company websites, AlixPartners analysis

For their software recruiting needs, companies may have to consider unconventional talent pools. They could consider recruiting from the movie or video gaming industries. And they could also shore up their presence in technology hubs like Silicon Valley and offer competitive salaries, which most OEMs have already done. But the war for software talent does not end with recruiting. Companies should adjust their human resources policies to attract and retain software talent, such as by offering enhanced benefits packages and integrating work/life-balance policies.

ADOPT NEW APPROACHES TO MANAGING SOFTWARE SUBCONTRACTORS

In addition to building internal software product development capabilities, leading OEMs may also have to develop solid competencies in the management of software suppliers by establishing longer-term technology partnerships in order to capture first-to-market innovations and to foster rapid co-development.

To control those relationships, OEMs can develop internal capabilities for setting functional and economic targets for electronics and software, thereby controlling time to market and costs. Adopting software sizing methodologies (figure 5) could provide many advantages such as improvement of scope definition and budgeting, contracting of external resources, reduction of requirement creep, increased transparency with suppliers, progress monitoring, performance analysis, and comparison of project teams.

EMBRACE THE OPPORTUNITY TO DIGITIZE ALONG THE WHOLE VALUE CHAIN

A key challenge is to ensure end-to-end data continuity from design to manufacturing and in service life. OEMs have to apply configuration management throughout the whole cycle. They could achieve that end-to-end continuity by using product life cycle management tools and new technologies such as data lakes, which must be planned up front.

Product development could lead to a broad range of opportunities from digitization. It could:

1. Accelerate product development cycles

- Allow a late or even no design freeze for ongoing development and upgrades. This may prove much easier for software (via mouse click) than for hardware development (because of model years).
- Make changes possible whenever they are ready for implementation.
- Make sure that more than 90% virtual testing is done via simulation (e.g., based on big data) so that only hardware testing of a very limited magnitude and cost are required as final confirmation of the software test results.

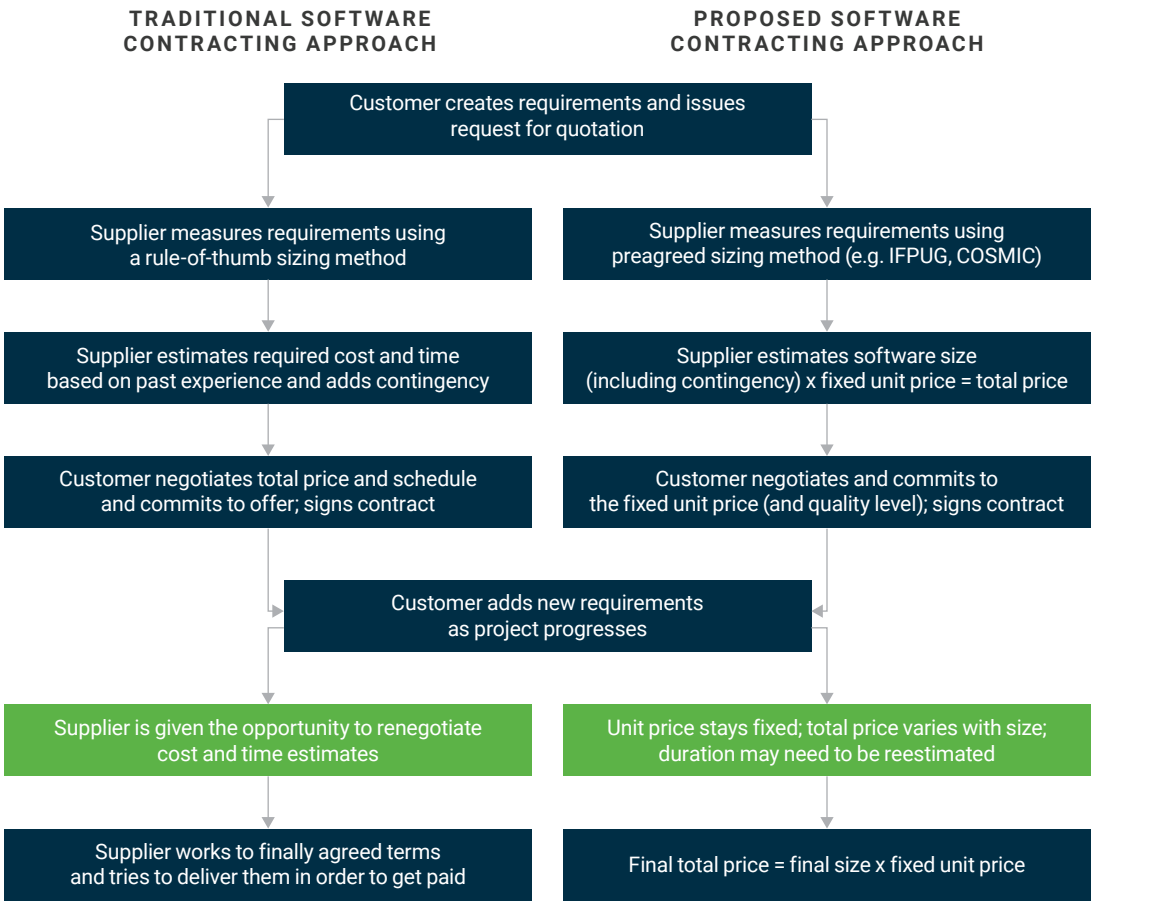
2. Introduce total flexibility in life cycle management

- Operate a connected fleet with real-time data from vehicles in operation and an end-to-end cross-functional data pool for each product and over each life cycle.
- Install predictive maintenance. Equip vehicles with sensors that can produce and transmit data that, combined with other data through telematics capabilities, enable advanced real-time analytics to predict machine health.
- Reduce product recalls. Companies should bring only mature modules into production.
- Stay open to opportunities to create new business models. For example, the Navistar OnCommand Connection offers a single remote diagnostic portal that gathers data from truck fleets comprising different makes and models. This tool provides fleet managers with real-time mapping and monitoring of trucks, maintenance action plans, and alerts.

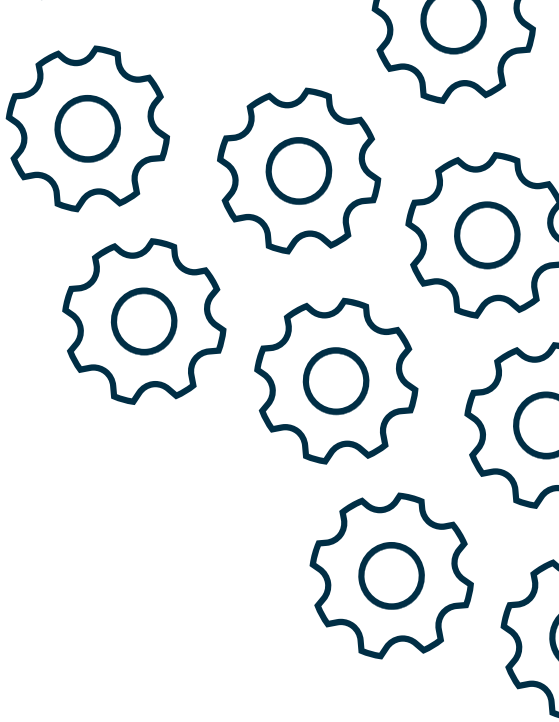
3. Ensure collaborative product development through open-source development platforms

- Digitization offers the opportunity to create a development platform whereby external developers, operating within a development cloud, can contribute and add functions to a product via standardized interfaces. Developers can then profit from shared revenues (development payback based on attractiveness to the market). For example, the "Remote S" app by Rego for Tesla uses an unofficial, but active Tesla application programming interface (API) to allow third-party access the vehicle controls.
- Foster collaboration, which reduces time and money spent on development efforts and could offer broader market access. Companies that collaborate can become more agile—and quicker to integrate new business ideas.
- Become independent from suppliers so as to avoid a supplier monopoly for the product life duration.

FIGURE 5: Traditional versus proposed software contracting approach



Source: cosmic-sizing.org, ISO 19761, AlixPartners analysis



LESSONS LEARNED FOR ALL INDUSTRIAL SECTORS: HOW TO PREPARE FOR INCREASING SOFTWARE COMPLEXITY

Automotive OEMs are at the forefront of a disruptive change triggered by the complexities of the software they need for engineering into their products. We have identified key levers they can move to successfully face off that challenge.

1. Decouple hardware and software life cycles and development cycles
2. Integrate typical software development tools (e.g., agile methods) within the structured hardware-based product development process
3. Fight for the best talent in the software industry to shore up internal development capabilities
4. Find new ways to increase transparency and build long-term relationships with strategic software subcontractors
5. Realize and master the opportunities of digitization

These technological challenges are hardly limited to the automotive industry. As trends like the Internet of Things begin to spread, industry sectors such as machinery, home appliances, agriculture, and heavy equipment will start to feel the heat too. Companies in those sectors should anticipate the challenges and start using what the automotive OEMs have done as a guide for introducing innovative and differentiating features in their product ranges. **A**

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