

INTELLIGENT INDUSTRY Engineering the Next

for Automotive, Aerospace & Defense

OVERVIEW

How business models, operations, and culture should adapt to a constrained, collaborative, connected and intelligent world.

EXECUTIVE SUMMARY

The threat of climate change, finite natural resources, and threats to biodiversity, means that large, engineered products – such as cars, planes, and satellites - need to be radically reinvented to run on clean energy, and use sustainable or recycled materials.

And, in doing so, they need to improve the user experience, or these sustainable innovations will not be accepted. That means ensuring smooth, efficient, safe, and cost-effective transportation, with increasing automation and embedded intelligence.

Engineering is being called upon to save the world. Those who step up to the challenge will provide differentiators that secure their legacy, sovereignty, and revenues for years to come. But to get this right, the role of engineering will need to transform.

ENGINEERING MUST MOVE FROM A PLENTIFUL WORLD TO A CONSTRAINED WORLD, WHERE PRODUCT DESIGN NEEDS TO CONSIDER MATERIALS AND SKILLS THAT ARE IN LIMITED SUPPLY.

It will move from a world of physical components to a world of intelligence and autonomy, where products become driven by software, data, and embedded AI, including autonomous decisions about trajectory, route, how to respond to the unexpected, and user comfort – all of which will help transform physical products into digital services. The Generative AI development will radically change the human-machine-interaction and how software is developed in the future of software engineering.

Consumers love Generative AI and more than 73% trust the content generated by AI. Thus, AI systems bring new changes and challenges in safety-critical industry and subject to ethical principles. AI and especially the rising stars of foundation models will help by prompt engineering, fine-tuning, and modelling new sustainable designs and developing simulated test scenarios for validation.

BASELINE FOR THAT IS THE MOVE FROM A SILOED WORLD TO A WORLD OF COLLABORATIVE DATA ECOSYSTEMS. ENGINEERING COMPANIES HAVE TO ACCESS AND INTEGRATE NEW SKILLS AND DATA DRIVEN TECHNOLOGIES – FROM ADVANCED COMPUTING TO NEW MATERIALS. THAT MEANS COLLABORATING WITH A WIDE RANGE OF SUPPLIERS, PARTNERS AND START-UPS IS A KEY PREREQUISITE.

It means multi-skilled engineering teams - physical and digital, in-house, and outsourced - will join their forces and work together on increasingly complex products.

It means close collaboration between engineering, manufacturing and aftersales to cover end-to-end the product and service life cycles. All this leads to new organizational structures and digital engineering technologies to enable secure collaboration, information sharing and real-time feedback. Today across the industry 96% of the boardrooms have Generative AI on TOP of their agenda, because they believe it is redefining product design and customer experience.

THIS IS NOT A SINGLE HANDOVER FROM THE OLD WORLD TO THE NEW. IT IS A TRANSFORMATION JOURNEY YOU WILL NOT WIN IN A SPRINT, NOR IN A MARATHON – IT IS MORE ABOUT A TRIATHLON. IT WILL REQUIRE ORGANIZATIONS TO CHANGE THEIR BUSINESS MODELS TO DELIVER INTELLIGENCE AND SUSTAINABILITY, AND RESHAPE THEIR OPERATIONAL MODEL TO BE AGILE, COLLABORATIVE AND RESPONSIVE.

To achieve that, they will need to transform skills, culture, leadership, and the use of data driven technologies. It is a journey that will take time, commitment, and creativity. If you haven't started already, you must start today to be and stay competitive.

5 MEGA TRENDS

The future of engineering is shaped by global megatrends, which place new constraints on supply and demand, but also new opportunities from innovative technologies. These dictate the products and services that businesses and consumers want or need, which defines how they should be made.

We see five megatrends shaping the future of engineering, which places huge disruptive pressure on the engineering function, with important impacts within and across industries.

1 THE ENVIRONMENTAL EMERGENCY

While connectivity is the transformational shift in how industrial businesses sell to and engage with customers, business models are also being reshaped by the other big customer demand: sustainability.

People, businesses, and governments are increasingly concerned about the impact of human activity on the climate, biodiversity, and health. Companies with engineering at their heart are under immense consumer and regulatory pressure to change to low and zero environmental impact products. Businesses will increasingly sell on their sustainability credentials; for example, Renault already sells cars that are 90% recyclable and 30% recycled. That in turn will create new markets for reusable used parts, selling them as replacements, or for whole new applications, which will mean new business lines and customer bases.

2 GEOPOLITICAL INSTABILITY

After decades of globalization, the trend is shifting toward localization. Geopolitical instability and protectionism are constraining international trade and redrawing supply chains, but also creating new jobs and engineering business opportunities in Western countries. To master the transformation, companies must develop a breadth of new skills, and a collaborative culture to bring them all together, to deliver the agile engineering needed for sustainable, evolutive, and customer-centric products.

The World Economic Forum predicted in the latest Future of Job reports the reskilling need of 50% of our workforce within the next 5 years and ~69 new data and AI jobs.

That leads to a transformation in three areas: the new skills and mindset, the digital tools that underpin collaboration, and leadership to drive the cultural

All of this means engineers need to move beyond the domain of creating optimal products and start thinking about the way people will interact with their products long-term.

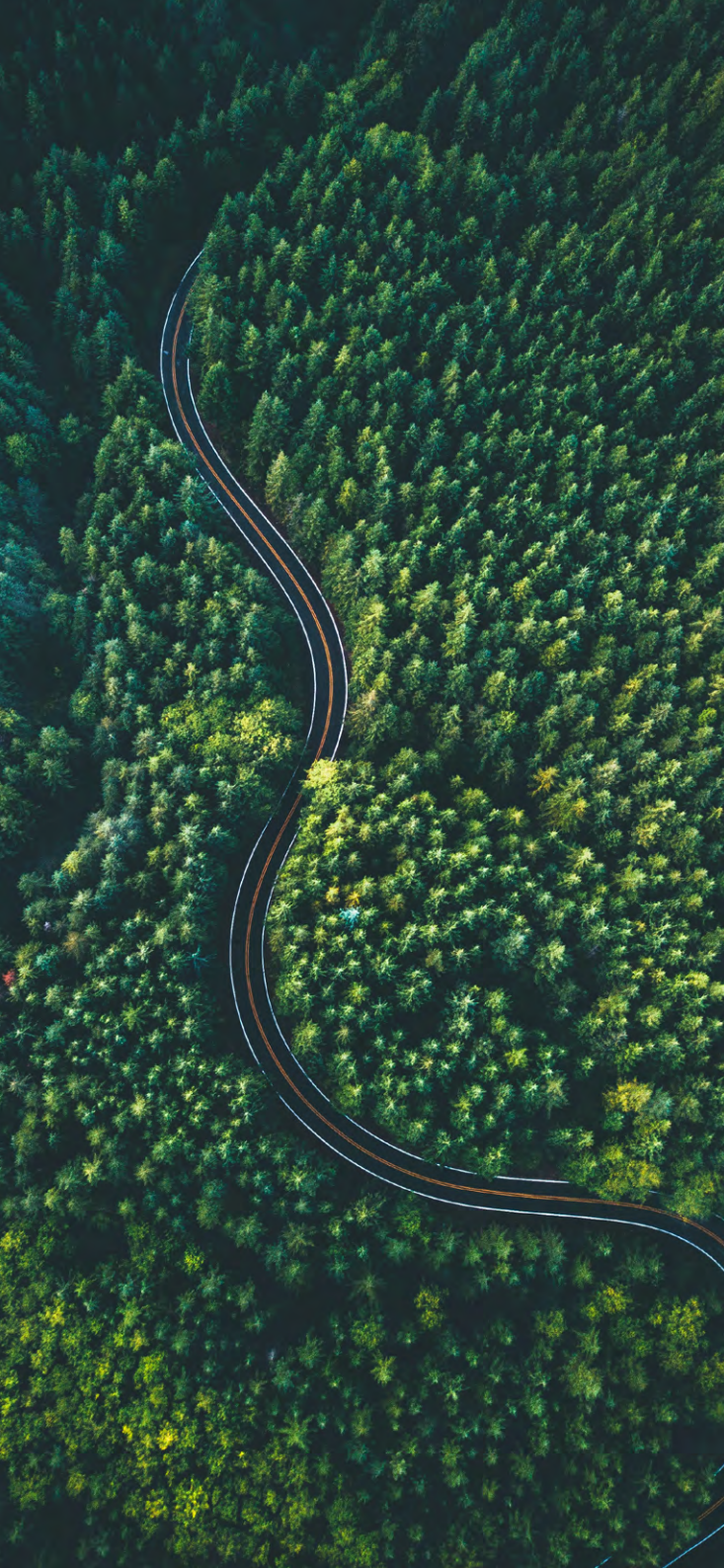
The space industry has long operated without a sustainability goal, like throwing away a car after the tank of fuel it was delivered with. There is now an exceptional field of possibilities in satellite services, specific launches, reusable launchers, maintenance and orbit corrections, extension of the life of equipment.

Jean-Luc Maria
Exotrail, CEO

transformation. The role of the engineering function is evolving quickly and becoming ever more transdisciplinary, as physical products are reinvented for sustainability and as digital services.

A transformation happens over several years. It is our responsibility to transform the engineering function to face new challenges. We take care of our employees by upskilling to new competences like software engineering, we collaborate with new agile and autonomous players. We work on mindset change to transform the job of engineer.

Pierre-Yves Datchet
Stellantis, HR Leader for West Europe Engineering



3 THE CONNECTED CUSTOMER AND HYPER-CONVENIENCE

Customers expect easy-to-use, secure, intelligent, and autonomous experiences—from ordering food and taxis to booking holidays. 66% of consumers would seek advice from a generative AI on personal interaction or relationships. Businesses, too, want rapid data-driven decisions about assets and customers. These digital services need to be built around ease of use, convenience, connectivity, privacy, and security.

Customers want intelligent and autonomous digital products that are seamlessly integrated in their everyday eco-system. The products provide safe and valuable services that save them time or help them in their lives, from assisted driving/flying and route optimization, to entertainment and remote maintenance (which will now include operations in space). For long term investments like cars, planes, or satellites, they want to upgrade over time, so their purchases are not obsolete in two years.

4 NEW PLAYERS, NEW COMPETITION

New players with new models are challenging the old way of doing things. Companies such as Tesla, SpaceX, or Vertical Aerospace, are building digital first organizations that allow rapid innovation, simulation, and testing on digital platforms, as well as ongoing digital relationships with the end user.

In the past, a car was designed in 4 to 10 years with a given configuration for a target life of 10 years. An aircraft was designed in 8 to 15 years and its operational life was 25–30 years, with a change/refresh of the cabin every 5–6 years. For the most part, the manufacturer had little to do with the product once it was sold. Now the target is to be in a permanent position to launch new intelligent functionalities that customers expect as technology evolves—from assisted driving/autopilot to in-flight VR—which can be added over the air or easily retrofitted.

For many years, the engineering function focused on products designed for performance (weight, speed, robustness, etc.), with an emphasis on ‘Design to Cost’. The new context requires, designing products around the customers need and their individual preferences. It also, by implication, means an ongoing relationship with customers, a move from ‘build and sell’, to ‘continuously engage’; from ‘long-lasting’ to ‘permanently evolving’. The current development of Generative AI will redefine the Human-Machine-Interaction and merge the data driven technologies in multimodal foundation models.

“End-customer orientation is key to our strategy, in that the notion of services is just as important as the engineering of our product. You could say that we are not working on a launcher but on a launch service.”

Yohann Leroy

MaiaSpace, CEO

Early this year, BMW sent 4.7 million remote iDrive software updates to 30 models, while a Tesla Model X reportedly gets 27 hardware and software changes a day. These improvements—often small, contribute to the enthusiasm that connected vehicle owners feel for their digital cars. This is not a launch and forget, but part of a continuous innovation loop by new players, who promote healthy competition.

“A deep cultural shift is required: we need to develop and promote the “Engineering judgment” from our engineers. With the digital, simulation tools, ALM and generative AI, our engineers will be increasingly empowered by new capabilities (even “assistants”) and their value will then rely on their capacity to use their judgment to challenge a requirement, a design, a process.”

Olivier Flous

Thales, SVP Head of Corporate Engineering & Digital Transformation


5 THE AVALANCHE OF TECHNOLOGY INNOVATION

New products and ideas—materials, sensors, Generative AI, and so on—are emerging from start-ups, universities, and corporate R&D daily. Many of which could transform engineered products, with an open and collaborative approach. Next to the tech giants, the start-ups and open-source communities are driving the technology development and publishing new Generative AI tools and features every day.

A CONNECTED DATA-ECOSYSTEM AND THE INTEGRATION OF GENERATIVE AI WILL ENSURE THE FUTURE VIABILITY OF ENGINEERING.

Nowadays everybody is discussing how to join the Chat-GPT hype. 96% of the boardrooms have Generative AI on TOP of their agenda, because it is redefining the product design **process** and customer experience **with AI empowered user interfaces and new assistance services**. At the same time, the hardware driven engineering industry is facing the challenge of how to enable their data infrastructure to ensure a sustainable and future-proof data ecosystem. 90% of the AI use is stuck in the PoC [Proof of Concept] phase and thus cannot provide any measurable data value.

To ensure solid data value creation and knowledge transfer, silos must be broken down and we need to build a connected data-eco-system, which allows the access and use of the relevant data. The contextual data are the foundation to participate in Data Analytics, Artificial Intelligence, and the future of Generative AI.

 *Technical skills, or at least 'technical credibility', is a must for an engineering leader. They need capacity to make decisions and show solidarity with the engineering team so that decisions are respected and trusted.*

Jean-Michel Billig

Stellantis, Head of Hydrogen Engineering

WHILE THERE ARE NUANCES BETWEEN INDUSTRIES AND COMPANIES, THESE 5 TRENDS WILL HAVE A BROAD IMPACT ACROSS ENGINEERING. IT CREATES THREE OVERLAPPING FUTURES: CONSTRAINED, INTELLIGENT, AUTONOMOUS AND COLLABORATIVE.

The future will be constrained because sustainability requirements place limits (notably emissions limits) that constrain what can be produced. At the same time, engineering teams will need to compete for finite resources (e.g., lithium), or not sufficiently developed to have an adequate pipeline in the short term (e.g., chips and software engineers). The principles of circular economy will need to be embedded early in the design engineering phase.

The future will be intelligent and autonomous. Firstly, in use, because customers increasingly place a premium on physical products—including cars, planes, and satellites—that are connected, software-driven devices that deliver sophisticated digital and automated services. Secondly, in design, since new intelligent digital tools enable both physical and software innovations – including autonomous driving, novel satellites, hydrogen plane engines—to be designed in a data driven and AI-assisted digital environment and virtually simulated rapidly toward prototypes, and beyond, accelerating innovation and product cycles.

The future will be collaborative because the only possible way to deliver this level of transformation is to bring together many new technologies (e.g., AI and biomaterials) and skills (e.g., software and data). It means building ecosystems of new suppliers, processes to assess and onboard emerging technologies, and partnerships with start-ups, universities, other industries, and even competitors. And it means digital tools and industry-specific platforms that allow multiskilled distributed teams to collaborate on the same project.

FOR THE COMPANY OF THE FUTURE TO SUCCEED, IT MUST BE READY TO FACE THESE THREE OVERLAPPING FUTURES. TO DO SO, IT MUST MAKE DEEP AND PROFOUND CHANGES TO ITS BUSINESS MODEL, ITS OPERATING MODEL, ITS CULTURE, AND ITS DIGITAL ENABLERS.

CONCLUSION

An exciting future ahead...

Anticipating what the future will look like is always a complex exercise. This paper, developed with the help of 30 global executives from the automotive, aerospace and defense industries, brings some perspectives on what the future of engineering could be.

WE ARE UNDOUBTEDLY MOVING TOWARD A MORE CONSTRAINED WORLD, MEANING DECISION CRITERIA WILL INCREASINGLY DEMAND SUSTAINABILITY (USE OF RECYCLED RAW MATERIALS, ENERGY CONSUMPTION, LIFE CYCLE, ETC.) ON TOP OF THE TRADITIONAL CONSIDERATIONS OF QUALITY, COST AND PERFORMANCE. WE HAVE ALSO STARTED THE JOURNEY TOWARD INTELLIGENT PRODUCTS, WHERE EMBEDDED AI IS IMPROVING SAFETY AND BRINGING ADDITIONAL INSIGHTS TO DRIVERS, PILOTS AND OTHER USERS, TO HELP THEM MAKE THE BEST AND DATA-DRIVEN DECISIONS OR ADD VALUE TO THEIR EXPERIENCE.

It's only the beginning of that journey and we will move progressively to an era where data driven decisions and the use of Artificial Intelligence will be a key prerequisite to create a new data driven engineering space. New product and digital ecosystems will emerge to create new services driven by higher connectivity and data sharing, responding to changing expectations from customers.

Companies have no choice but to embrace that transformation path to stay in the game. This may sound like a challenge, but it is also an exciting opportunity for engineering to make the world a safer, more convenient place to live, and ultimately to solve the most pressing challenge of our time avoiding devastating climate change and saving the world.

THERE ARE HUGE CHALLENGES AHEAD, BUT ANY MEASURED CONSIDERATION OF THE FUTURE OF ENGINEERING SHOWS THAT IT IS ALSO ONE OF THE MOST EXCITING TIMES IN HISTORY TO BE IN THESE INDUSTRIES.

Capgemini 

