OLIVER WYMAN

ENGINEERING DIGITAL BREAKTHROUGHS

CHANGING THE PARADIGM OF DEFENSE INDUSTRY

THE DEFENSE SECTOR, AN INDUSTRY UNDERGOING A DEEP TRANSFORMATION

Until recently, the defense industry operated by its own set of rules: designated a national priority and a "protected area", it was intended to preserve sovereignty and leveraged as a tool for strategic alliances. Rather than being governed by the profits and losses statements as a measure of value, the sector emphasized performance without the constraints of budget and cost and was characterized by long product cycles (lasting up to 50 years) and long-term partnerships between the military establishment and selected companies. The competitive landscape of the defense sector was comprised of established and stable nation-based champions, with enduring relationships with the military administration.

That paradigm, however, is changing. Driving the transformation has been a new set of factors: the end of the Cold War has de-emphasized the need for large standing armies, placing greater pressure on defense budgets in Western Europe; military operations have grown increasingly complex, with the rise of new battlespaces, such as cyber warfare; the growing digitalization of the battlefield has changed warfare; and the rise of asymmetric threats has changed the nature of conflict, calling in turn for new strategies and capabilities.

One consequence of these new trends is that the defense industry no longer enjoys the same protection from competition as it once did, with new players and disruptive startups entering the market thanks to lower costs and/or advanced digital technologies. Another consequence, armies are more and more willing to use off-the-shelf products, to reduce development costs.

This market evolution has had a broad impact, pressuring in particular traditional development cycles and engineering practices, which are the focus of these articles. Incumbent players have begun to adapt and are progressively upgrading their development and innovation processes in order to master and turn disruption into a competitive advantage.

Defense firms are in a position to leverage various breakthroughs in engineering processes and approaches so as to shorten development cycles, reduce non-recurring costs, and increase client satisfaction. To benchmark and map these breakthroughs and assess their maturity and impact, Oliver Wyman surveyed engineering directors at leading defense and non-defense players.

5 MAJOR TRENDS ARE SHAKING THE DEFENSE SECTOR

INCREASING NUMBER AND DIVERSITY OF STAKEHOLDERS AND THUS RULES

SWITCH OF VALUE FROM EQUIPMENT TO INTEGRATED SYSTEMS

SWITCH OF VALUE FROM PRODUCTS TO SERVICES AS A NEW GROWTH DRIVER

CIVILIAN DIGITAL PLAYERS
Using their technological lead as competitive advantage

CIVILIAN NEW ENTRANTS
Using lower costs as competitive advantage

Market trend

Competitive trend

INCREASING NUMBER AND DIVERSITY OF STAKEHOLDERS AND THUS RULES

The Europe of Defense initiative has increased the number of allies and defense players must deal with:

- **Defense agencies:** the defense department of each country involved in the specific project
- **Ministry of Defense and end-users:** the armed forces and/or equipment operators
- **Partners and Tier-1 and Tier-2 suppliers** working on the project

The growing number and diversity of players challenges the traditional engineering sequential development process and profitability:

- **Defense players must serve different armed forces** with different operational tactics and specifications that can evolve over the course of the development process
- **The volatility of the quantities** ordered by the various defense agencies put at risk defense player profitability, as development costs are amortized by volume of product
- **Defense players must share engineering information** with different domestic partners, meaning engineering tools must be compatible with open ecosystems while guaranteeing cybersecurity

CASE STUDY

Lessons learned from a European multi-country aircraft program

In 2003, the EU launched a multi-country program to build a new European, four-engine turboprop military transport aircraft, resulting in €10 bn over costs and 4-year delay for the 1st delivery.

Looking forward, Defense players will have to anticipate and tackle 3 key challenges related to increasingly collaborative and complex programs: misalignment of countries' priorities (e.g. price vs delays) and operational concepts, over-complexity of OEM and supplier involvement, risk of inefficiency of collaborative frameworks diluting decision making and responsibilities.

SWITCH OF VALUE FROM EQUIPMENT TO INTEGRATED SYSTEMS

The complexity of the battlefield and operations is growing, combining multiple types of players and equipment and involving an increasing amount of data analytics and intelligence. For example, during an operation today, the command center must be able to provide information to ground forces, coordinate different generations of equipment operated by different nations, gather and analyze real-time data captured via satellite.

Consequently, rather than stand-alone equipment, defense firms shift towards fully integrated solutions, capable of connecting with external systems, regardless of whether these systems are state-of-the-art or not. Additionally, the data exchange between these different systems must be secure and resilient.

Defense companies cannot rely solely on their internal innovation and R&D investments, but need instead to build ecosystems of partners and suppliers to propose comprehensive, connected, and collaborative solutions. Major military programs, such as FCAS (Future Combat Air System), are in line with this new trend.

CASE STUDY

Complexification of battlefield and equipment – Future Combat Air System

FCAS is a network of different interconnected and interoperable platforms that includes a new generation fighter, satellites, drones, airborne sensors, etc.

Given specific constraints of battlefields (narrow and unstable bandwidth, multiplicity of data sources, etc.), such system requires state-of-the-art functionalities (e.g. real-time tracking) and systems integration.

The project is led by a German, French and Spanish consortium, with multiple players who expressed their interests to take part in. All these players will have to learn how to work together to build this disruptive system by 2040.

SWITCH OF VALUE FROM PRODUCTS TO SERVICES AS A NEW GROWTH DRIVER

Armed forces in Western countries have been supported for several years by equipment original manufacturers for repair support and In-service Support programs. With digitalization and the explosion of data volume, value is moving away from developing equipment to providing sustaining and scalability support for them over their lifecycle. And value is also moving toward the development of data-driven services.

Defense players have to take into account these services value pools in their products design and development, mainly by facilitating:

- **Design-to-services** that aims at integrating Services features as soon as concept and product development phase by collaborating with support and services teams
- **Updates and retrofits** during product life time, based on additional development
- **Sustaining and scalability,** such as performance upgrades, cybersecurity or new software releases
- **Data collection and analysis** that can be leveraged for predictive maintenance, improved equipment availability, or even remote supervision

CASE STUDY

Defense incumbent offering comprehensive digital maintenance services

In mid-2019, the French entity in charge of aircraft maintenance (Direction of Aero Maintenance) signed with the manufacturer of its jet fighters a €3.5 bn maintenance contract, which includes:

- Maintenance for operational readiness, and logistic support
- Big Data analytics of the fighters' performance and predictive maintenance
- Active industry monitoring

Such services bring a two-fold benefit for the manufacturer:

- New, long-lasting additional revenue source
- Higher barrier-to-entry against intermediation by specialized players

CIVILIAN DIGITAL PLAYERS
Using their technological lead as competitive advantage

Civilian digital players are taking advantage of the ongoing digitalization of military systems and the shift of value towards data-oriented approaches to leverage their technological leadership, therefore positioning themselves on critical military projects and challenging incumbent defense players.

As civilian digital players pioneer and master latest battlefield computing technologies, they are driving innovation cycles: in software development the former paradigm of two- to three-year innovation cycles followed by five years of development has been reduced to six-month cycles followed by several months of agile development with incremental releases.

This new development approach, together with the growing use of COTS (commercial off-the-shelf) solutions to reduce development costs, has accelerated technology obsolescence and reduced product lifecycles.

CASE STUDY

Civilian tech company outperforming incumbents on intelligence systems

In March 2019, the US Army selected for the first time a civilian company for a Defense program of record 1 to develop the battlefield intelligence system DCGS (Distributed Common Ground System) for combat in remote and harsh environments.

This tech company leveraged its technological lead and UX know-how to surpass historic contractors: the solution it offers displays better performances yet remains cheaper, and it is backed by American soldiers who praise a better usability versus current system.

CIVILIAN NEW ENTRANTS
Using lower costs as competitive advantage

New competitors from the civilian sphere have begun to position themselves on specific military sub-systems, offering aggressive pricing and reduced time-to-market that is placing pressure on incumbents. These new entrants have used their position and strength in domestic civilian markets, allowing them to:

Experiment with disruptive and lean cost structures that rely on high volume and low variability of output

Amortize investment costs, given higher volumes, thus offering lower cost of ownership to clients

Build their skill set on less complex civilian equipment, which typically carries lesser security specifications

Additionally, defense agencies and armament OEMs (original equipment manufacturers) have opened the market to civilian players by structuring RFPs (requests for proposal) differently, separating out the military aspects of the proposal from nonmilitary provisions to reduce costs. Having entered defense markets, civilian players are able to further develop their technologies and hone their skills, improving their credibility and understanding—and anticipating—clients' expectations. Plus, developing a "combat-proven" solution is a springboard for export.

CASE STUDY

Civilian high-tech start-up capturing market share from incumbents

A French high-tech company that develops Inertial Navigation System (INS) succeeded in winning defense contracts over incumbent manufacturers of naval sub-systems.

Capitalizing on its experience in civil leading-edge fields such as ocean exploration equipment, this company has been equipping French navy frigates with its INS since 2012.

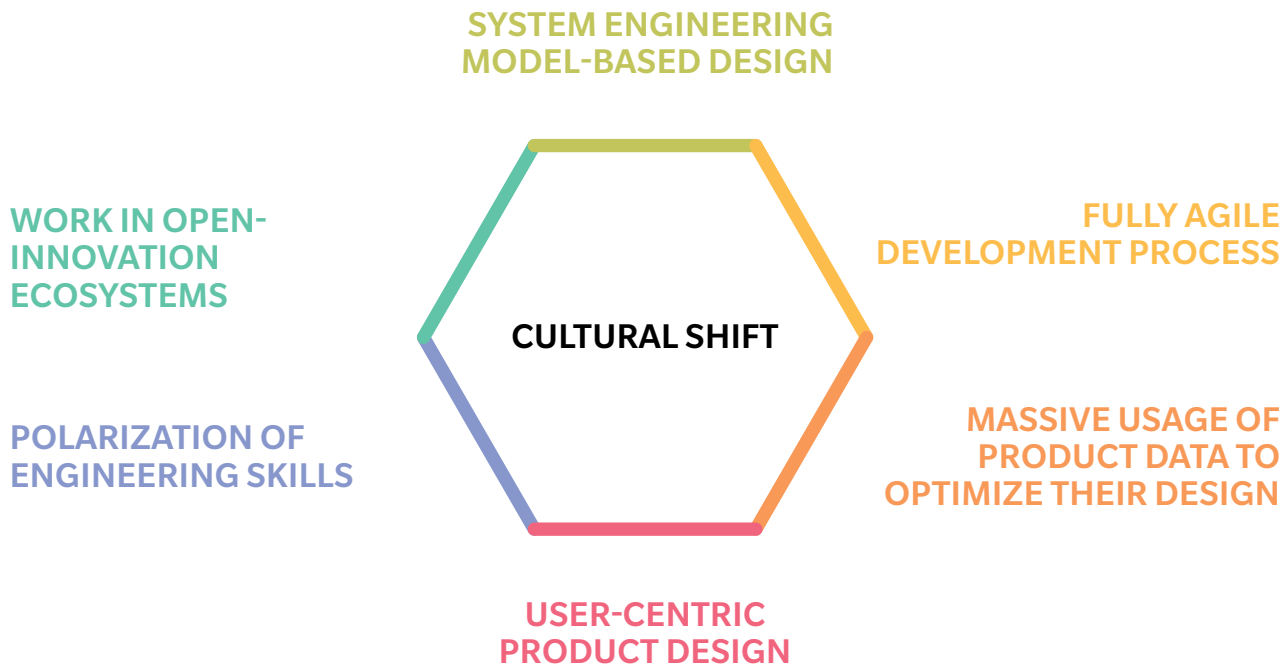
The French Frigate reference opened export naval markets (UK, Germany) and perspectives on adjacent markets, as the company is preparing an expansion to the land Defense industry.

MAIN ENGINEERING BREAKTHROUGHS

To create a competitive advantage, incumbent defense companies must transform their engineering processes, which are a key driver of their competitiveness and value proposition. Based on its comprehensive benchmark of aerospace, automotive, digital, and military players, Oliver Wyman has identified six major clusters of engineering breakthroughs that will become game-changers for the defense industry.

Selecting and deploying the trends in engineering processes that are most relevant to your company and business capabilities and needs will be key to implementing the engineering transformation.

MAIN BREAKTHROUGH CLUSTERS



Source: Oliver Wyman

SYSTEM ENGINEERING MODEL-BASED DESIGN

Enhancing engineering processes with digital tools is a key lever for strong efficiency gains. Besides accelerating development and integration processes due to simulated behaviors and testing, model-based design drastically reduces rework by enabling quick modeling of alternative systems architectures, which lead to a better and quicker understanding of the needs and value for clients, including end-user's operational usage.

System engineering model-based design is the foundation for a consistent product policy, because it enables information sharing across teams or services and therefore allows the leveraging of reference architectures used as the building blocks for several solutions.

IMPACTS

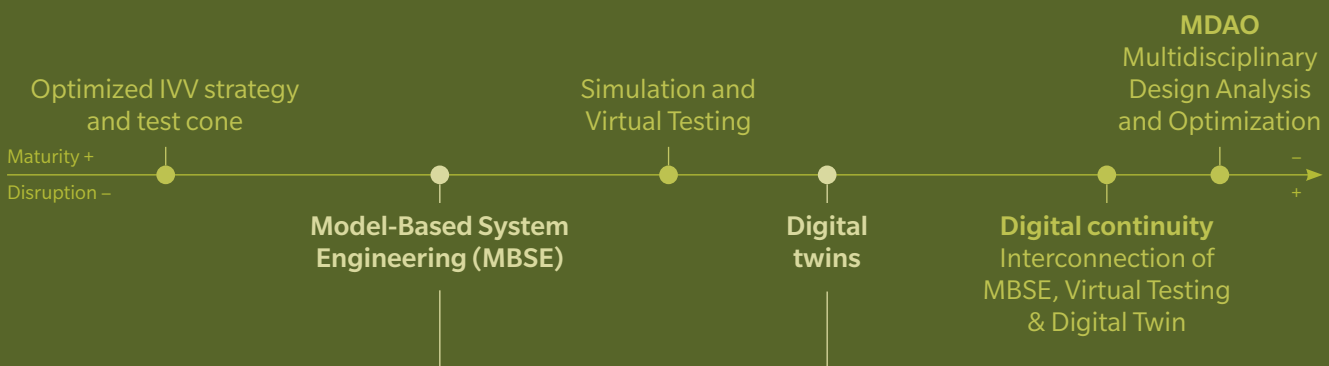
Limitation of rework and elimination of physical tests reduce non recurring costs

~30%

Improvement of design-to-manufacturing and design-to-services process increase productivity by

~10%

UNDERLYING BREAKTHROUGHS WITH ASSOCIATED MATURITY AND DISRUPTION LEVELS



Case Study: Aerospace manufacturer and space transportation services provider
Implementation of Siemens' FibersimTM software to automate the design of composite parts and *reduce design-to-manufacturing time by over 70% configurations of the aircraft*

Case Study: Leading aircraft manufacturer
Company delivered its 1st aircraft completely designed with 3D DMU (Digital Mock-Up) in 2015; digital model allowed for *+30.000 potential configurations* of the aircraft

Source: Oliver Wyman

FULLY AGILE DEVELOPMENT PROCESS

While most companies have already implemented agile software development, scaling this approach to the system level can help disrupt both development processes and business models. Besides increasing reactivity and flexibility of development processes, agile development is central to an end-to-end automated DevOps approach.

By allowing concurrent engineering development of a solution and successive releases of incremental, viable iterations, DevOps is transforming business models from definitive solutions with long life cycles to an ever-expanding services portfolio as a solution, best-suited to clients' needs and anticipating the evolution of those needs.

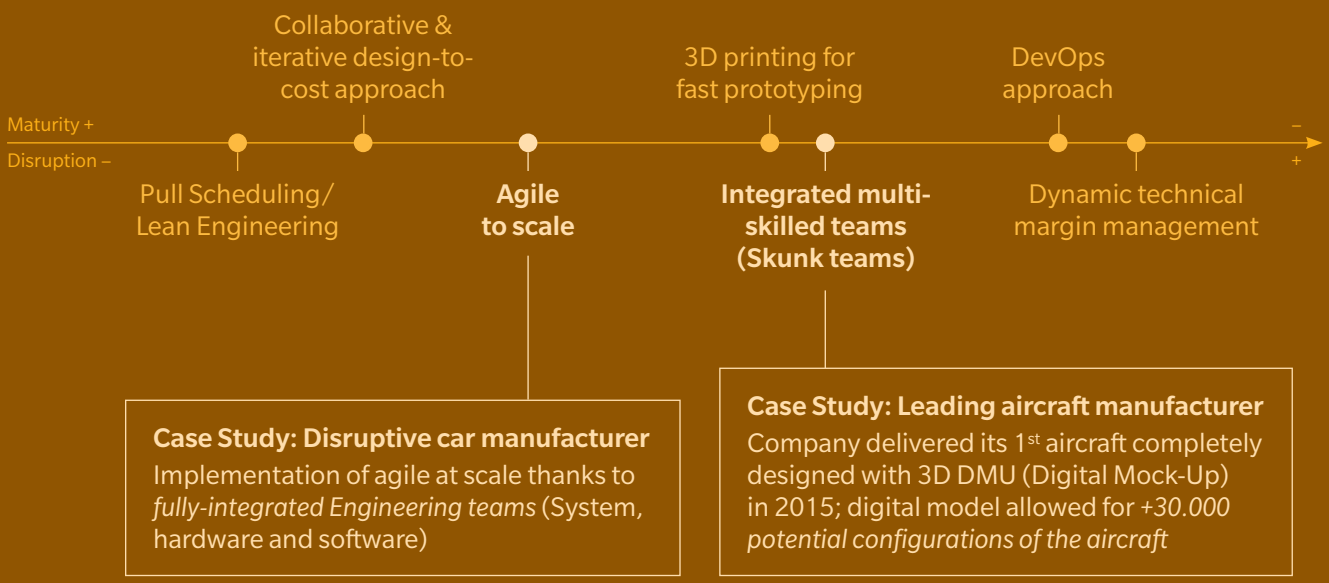
IMPACTS

Incremental approach reduces development times and leads to cost reductions up to

50%

Collaborative & iterative design-to-cost approach shortens innovation cycle and generate **disruptive ideas**

UNDERLYING BREAKTHROUGHS WITH ASSOCIATED MATURITY AND DISRUPTION LEVELS



Source: Oliver Wyman

MASSIVE USAGE OF PRODUCT DATA TO OPTIMIZE THEIR DESIGN

Currently, engineering processes, industrialization phases, and operation by end users represent multiple data sources that have yet to be leveraged. Collecting and analyzing this data can provide critical feedbacks to OEMs, with a twofold benefit:

Internal: the data can bring a better understanding of the way solutions perform in the real world; this in turn allows defense firm to adjust their designs to accelerate development or industrialization and add value for end users

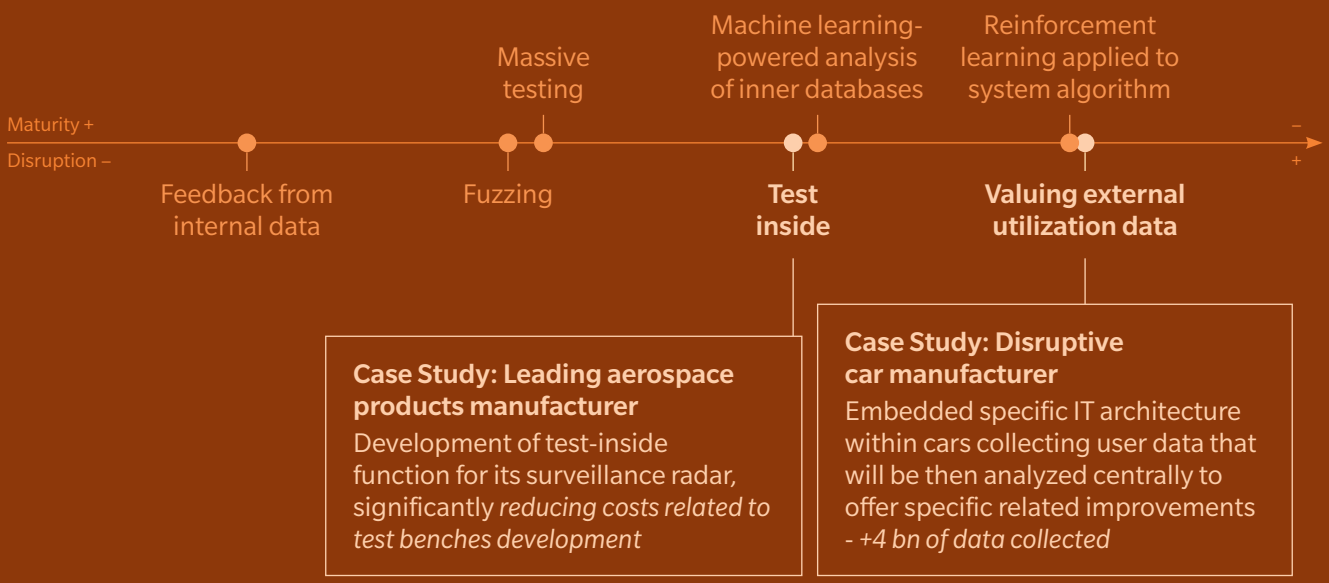
External: data can be monetized to offer new services, such as predictive maintenance or equipment management as long as it fits with national sovereignty constraints

IMPACTS

Significant **reduction of the number of physical tests** and related costs with the adoption of fuzzing, massive testing and test inside techniques

Gathering and analyzing user data allows to **adapt products** to customers' observed behaviors

UNDERLYING BREAKTHROUGHS WITH ASSOCIATED MATURITY AND DISRUPTION LEVELS



Source: Oliver Wyman

USER-CENTRIC PRODUCT DESIGN

User-centric product design brings contractors and end users into the process early on. Involving both contractors (agencies) and end users in engineering processes allows defense players to understand their needs and operational patterns and thus get better value and more suitable solutions for clients. This approach requires to define a new approach tripartite model between Agencies, OEM and end-users.

IMPACTS

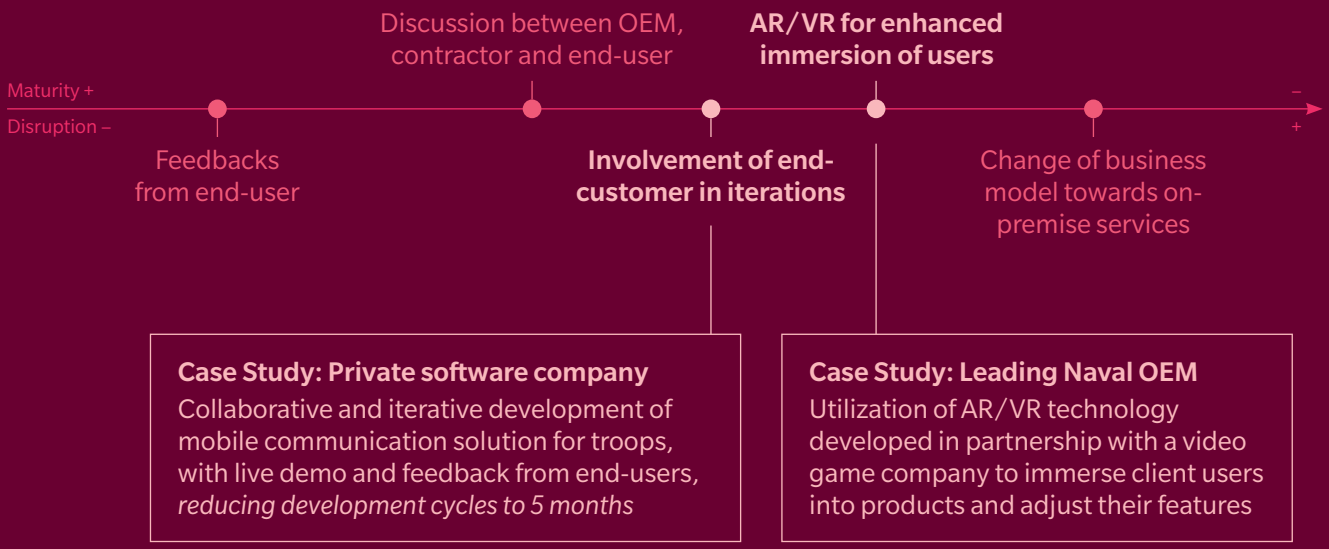
User-centric development cycles can be reduced to

5 months

thanks to early customer feedback and rework reduction

Reinforcement of client intimacy paves the way to **on-premise services business models** and new sources of revenues

UNDERLYING BREAKTHROUGHS WITH ASSOCIATED MATURITY AND DISRUPTION LEVELS



Source: Oliver Wyman

POLARIZATION OF ENGINEERING SKILLS

Defense incumbents face a dual challenge: firstly, automating and outsourcing less value-added tasks for profitability and achieving capacity ramp-up, and secondly, meeting their ever-growing need for high-level talent, such as senior systems architects or experts on new digital fields to address the higher complexity of products and systems.

Therefore, incumbents have to reinforce their strategic resource planning to maintain their competitiveness and improve their attractiveness levels. At the same time, new competitors from the non-military space are entering the market and capturing talents due to more appealing job offers or brands.

IMPACTS

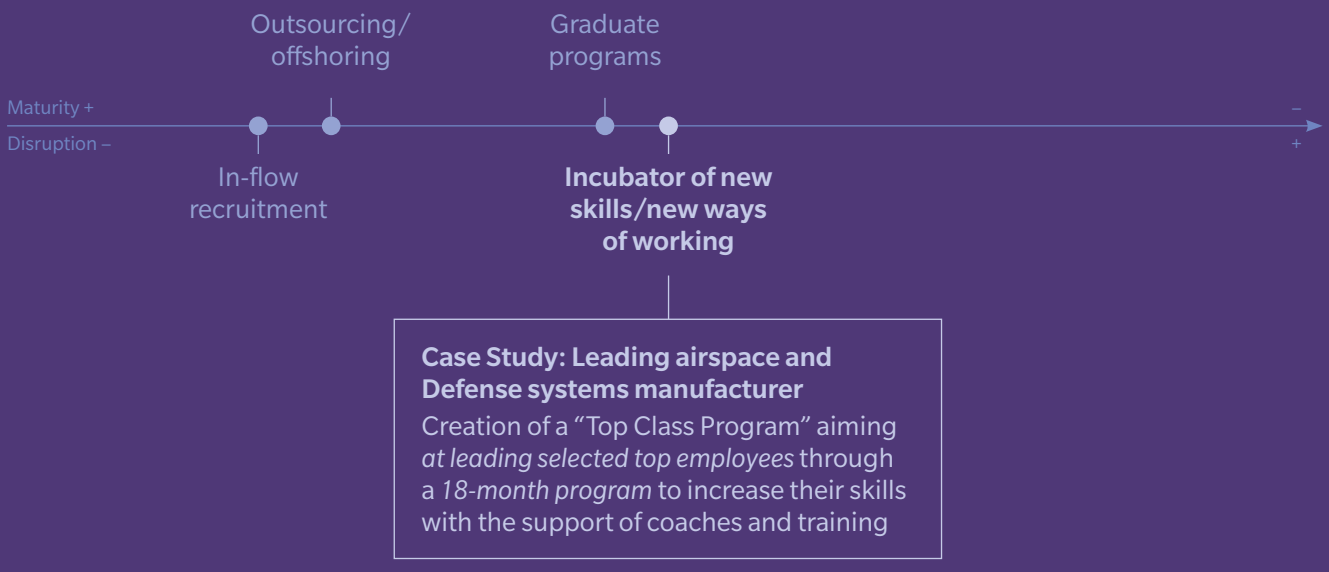
Incumbent competences should be refurbished as

~25%

of engineering work will be automated

In-flow recruitment, graduate programs or new skill incubators are becoming critical to develop the right level of skills, as talent war is raging

UNDERLYING BREAKTHROUGHS WITH ASSOCIATED MATURITY AND DISRUPTION LEVELS



Source: Oliver Wyman

WORK IN OPEN-INNOVATION ECOSYSTEMS

With the shift of innovative capabilities from defense incumbents to rising civilian players and startups, operating as an innovation integrator among an open ecosystem has become the best way to offer competitive, state-of-the-art technologies without long and expensive innovation cycles.

Furthermore, broad and open ecosystems enable incumbents to offer more comprehensive solutions covering different technological fields by collaborating with companies from adjacent markets that bring expertise to the table.

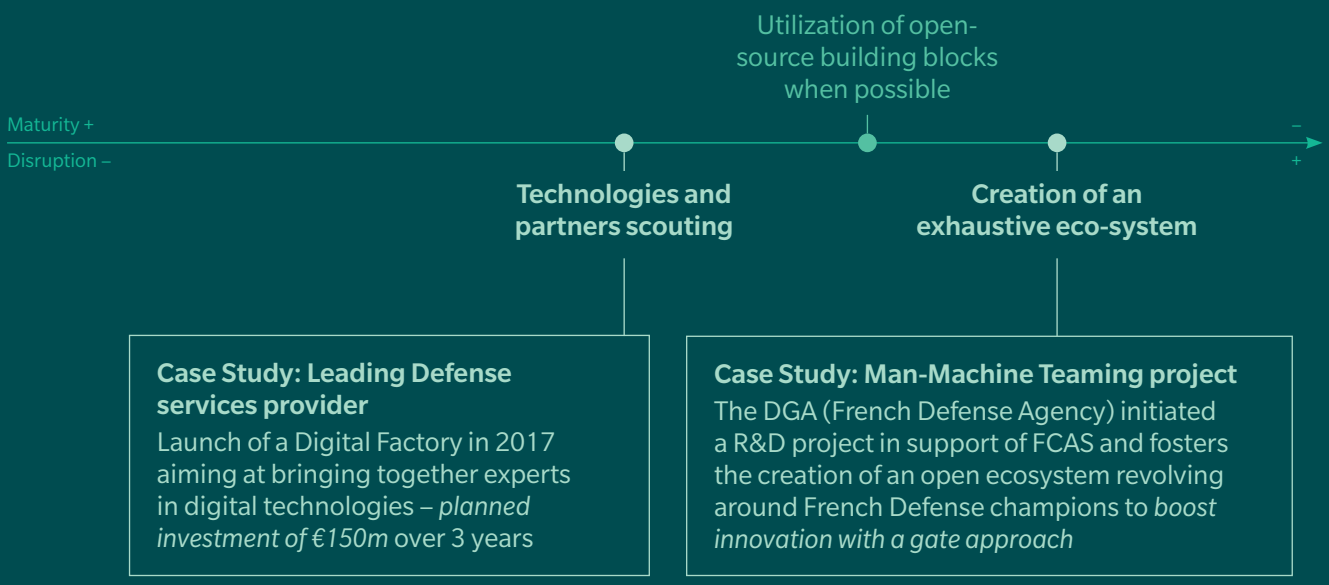
IMPACTS

Technologies and partners scouting optimize R&D investments and reduce innovation cycles from 2-3 years to

6 months

Ability to attack **new value spaces** and generate significant **additional revenues** with the creation of a complete eco-system of innovative partners

UNDERLYING BREAKTHROUGHS WITH ASSOCIATED MATURITY AND DISRUPTION LEVELS



Source: Oliver Wyman

KEY SUCCESS FACTORS FOR THIS TRANSFORMATION JOURNEY

The disruption of engineering processes to respond to better performing civilian entrants implies a deep and holistic transformation of the company's way of working and culture. To turn this critical transformation into a competitive edge, Oliver Wyman has identified seven key success factors that need to be considered and thoughtfully implemented.

KEY SUCCESS FACTORS FOR BREAKTHROUGHS IMPLEMENTATION

Build a case for change

Develop a strong narrative as rationale for change, including your current and potential clients, to make the transformation more meaningful at all levels of the organization

Engage change management process

Define and implement change management actions to on-board and engage key stakeholders and ensure cultural change supports the transformation (e.g. agility to scale)

Complete your skills through partnership or M&A

Identify Make or Buy strategy on the different technologies selected and scout for partners or M&A targets – making sure you know how to integrate them without killing their value

Adapt your organization and governance to engineering breakthroughs

Ensure Engineering and Product organization are ready for these breakthroughs and becomes an enabler of digitization (e.g. break silos)

Define appropriate governance to foster co-engineering in the maturity improvement and deployment of these breakthroughs

Deploy holistic tools to support digitization

Develop a transversal data platform to gather and leverage internal data during development and industrialization process and make sure you answer client needs (explicit or future)

Deploy Engineering tools that are compatible with those of your ecosystem to fully activate cooperation

Identify relevant use cases

Identify breakthroughs that are most relevant to your challenges (competitiveness, growth, client satisfaction, etc.), to legitimate the transformation

Develop these breakthroughs on a limited number of use cases to ramp-up on technological skills and competencies and complete your case for change with concrete feedbacks from these use cases

Implement strategic workforce planning

Define key competencies needs to both deploy these breakthroughs (artificial intelligence, cybersecurity, data analytics, etc.) and keep your core military capabilities

Define internal competencies upskilling process (graduate programs, training, etc.)

Align recruitment actions to long-term needs and communicate on campuses to increase your attractiveness

Anticipate 'refurbishment' of current skills to new ones

CONCLUSION

The defense industry – once a unique "protected" sector that operated under a separate set of rules and was considered off-limits to market-driven concerns such as budgetary constraints – can no longer play by the old rules. New tech-savvy competitors are entering the defense space. Civilian digital players are taking advantage of the ongoing digitalization of military systems and the shift of value towards data-oriented approaches to leverage their technological leadership. By using their strength in domestic civilian markets, the new entrants have been able to experiment with disruptive and lean cost structures, offer lower cost of ownership to clients, build their skill set on less complex civilian equipment, which typically carries lesser security specifications.

To create a competitive advantage, incumbent defense companies must transform their engineering processes, which are central to their competitiveness. Based on its comprehensive benchmark of aerospace, automotive, digital, and military players, there are six major clusters of engineering breakthroughs that will become game-changers for the defense industry:

- System engineering model-based design
- Fully agile and digital development process
- Massive usage of product data to optimize design
- User-centric product design
- Polarization of engineering skills
- Work in open-innovation ecosystems

In order to achieve this transformation, incumbent defense companies COO, CTO and Engineering VP must consider following key success factors: Build a case for change, making transformation more meaningful at all levels of the organization; identify breakthroughs that are most relevant to your challenges and develop these breakthroughs on a limited number of use cases to ramp-up on technological skills; complete your skills through partnership or M&A; implement strategic workforce planning; deploy holistic tools to support digitalization; define and implement change management actions; and ensure that the engineering and product organizations are ready for these breakthroughs by defining the appropriate governance to foster co-engineering.

Oliver Wyman is a global leader in management consulting that combines deep industry knowledge with specialized expertise instrategy, operations, risk management, and organization transformation.

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