

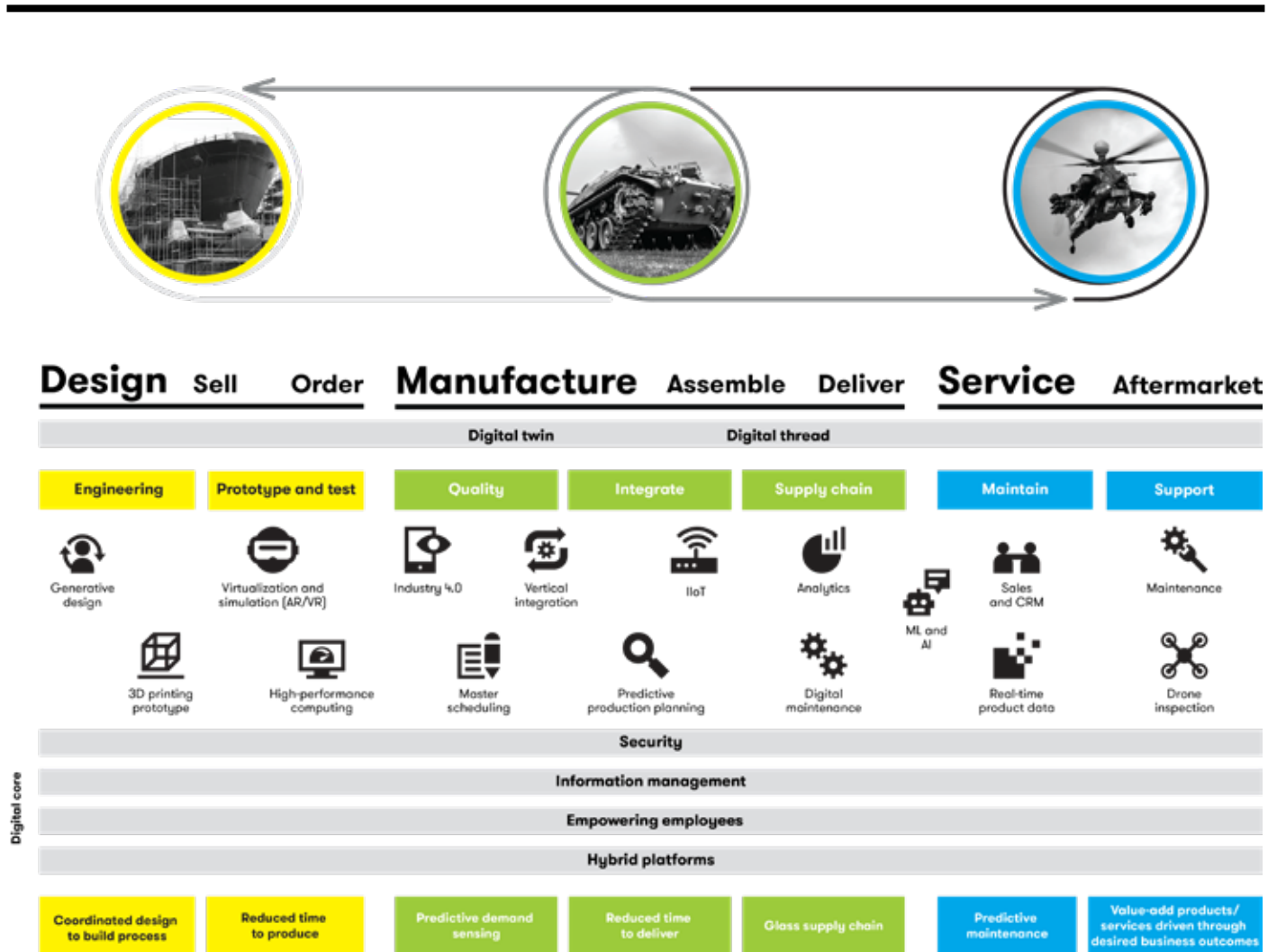
# Aerospace & Defense digital value chain

How digital transformation can improve production  
and profitability



In the aerospace and defense industry, tremendous growth opportunities are emerging through new business models, blended partnerships and technological advancements, although that growth can frequently be held back by outdated processes, aging technology and fragmented value chains. By adopting and integrating new technologies, and deploying them at scale, businesses can thrive in the digital age.

The timing is right to transform and enable a rich system of information that improves design, manufacture and service (DMS) processes. Through an Aerospace & Defense (A&D) digital value chain, companies can streamline and connect DMS domains, digitize the continuous improvement cycle and apply connected factory, digital thread, and digital twin concepts to the DMS model to improve product availability and profitability.



**Figure 1.** Process and technology vision for the A&D digital value chain

## **The smart factory**

The connected factory coordinates “smart” cyber physical systems, physical machines, people and business processes supported by information-driven decision making. Encompassing this factory is Industry 4.0, the Fourth Industrial Revolution, in which technologies monitor physical processes, connect everything in the factory, exploit a virtual copy of the physical world and provide high levels of automation.

Cyber physical systems controlled or monitored by computer-based algorithms and collaborative robots communicate and cooperate with one another at an “atomic” level (the level with no further subsystems) and with humans in real time using machine learning and internet of things (IoT) capabilities and analytics.

IoT, the connecting technology that supports Industry 4.0, collects information and perceptions for product operation, faults, maintenance requirements, and so forth. It then feeds valuable insights and knowledge back into the DMS processes.

With these capabilities, organizations can move from linear, sequential supply chains to an optimized one that can use synchronized business signals and decisions to drive improvement across the value chain.

At the same time, A&D organizations are expected to have an understanding of the industry’s direction and challenges to keep pace with changing global politics, customer needs and regulations. Any new, digital approach to value chains will have to address compliance and protection of the enterprise, especially regarding intellectual capital, and company and national security data.

This paper details the challenges, disruptive forces, and breakthroughs that have an impact on the industry. It provides insights into how companies can leverage process transformation and automation, as well as adopt and integrate new technologies through collaboration and data-driven decisions. With the right strategy, businesses can transform into intelligent enterprises with countless benefits for financial growth and product improvement.

## **Keys to an effective A&D digital value chain**

A digital value chain consists of critical business stages that cover functionality in the DMS domains. Digital coordination of these stages enables companies to share and merge information across the domains. It also promotes learning that improves intelligence and decision support in each respective domain as well as across the entire A&D value chain.

Creating an A&D digital value chain brings immediate results. Here are the recommended steps and the benefits to expect:

### **Implement digital threads and digital twins**

Tying the core components of the value chain together creates a “digital thread” that enables an integrated view. The digital thread connects key planning and execution domains — product life-cycle management (PLM), supply chain management (SCM), enterprise resource planning (ERP) and customer relationship management (CRM) — and provides the capability of accessing, integrating, and transforming data into actionable insights. The digital thread also feeds the continuous improvement cycle and allows an open API strategy that can unlock new sources of value.

During the design phase, teams can use a “digital twin” — the replication of a physical asset in the digital world — to visualize, test and learn in a simulated environment. This modeling provides rapid “what if” iterations during the design stage before creating a physical prototype. Armed with feedback, companies can move confidently and expeditiously into the manufacturing stage.

### **Adopt information-driven decision making**

Advanced analytics create new opportunities to bring disparate information sources together and derive value from the internet of things (IoT). Acting on rich IoT data with machine learning (ML) and artificial intelligence (AI) creates the information and intelligence needed to empower information-driven decision making (IdDM). It also allows companies to use data to make continuous improvements to manual and automated processes throughout the value chain. Video analytics — automated data acquisition captured from the field via sensors embedded in products and various devices — can supplement IoT to deliver real-time insights from the factory floor and other locations.

IdDM enables significant business growth and efficiency. Powered by advanced technologies, analytics, agile methods and a collaborative partner ecosystem, IdDM leads to increased output, faster time to revenue, less scrap, reduced inventories, more accurate forecasting, greater supply chain efficiency and lower operating costs.

### **Move to hybrid platforms**

A key consideration for most A&D companies in the next few years is the transition to hybrid platforms. One example is the evolution of ERP from SAP ECC-based systems to SAP S/4HANA, including a cloud edition. As part of digital transformation efforts, this improvement allows enterprises to streamline processes, simplify integration and effectively use data assets to accelerate their desired outcomes: supply chain optimization, cycling manufacturing insights back to design, and new aftermarket service capabilities.

Whether implemented on a privately hosted or public cloud, a hybrid strategy offers the opportunity to move to core platforms that leverage analytical insight, automation, robotics and partner capabilities, which in turn provide new platform functionalities. Combining a hybrid platform strategy with applications rationalization and modernization is critical to success for application-led transformation.

### **Leverage a digital workplace to improve employee productivity**

The crown jewels of any company are its intellectual capital — its know-how, people, services, and processes. A collaborative work environment using modern technology can help preserve the immense amount of knowledge embodied in the more experienced workforce as it attracts and retains the workforce of the future. This approach involves implementing knowledge management, modern productivity tools and devices, automation, AI that improves user support, and smart machines that augment human aptitude and capabilities.

Technologies such as augmented reality or virtual reality help provide remote support, guidance or learning in field locations or areas that are remote, hard to reach or dangerous. This effective use of new innovation leads to collaborative work environments and improved productivity. New workplace technology can also help meet organizational demands for digital identity management, security and easy employee onboarding. These also enable vertical integration and improve product delivery and differentiation.

### **Rely on partnerships**

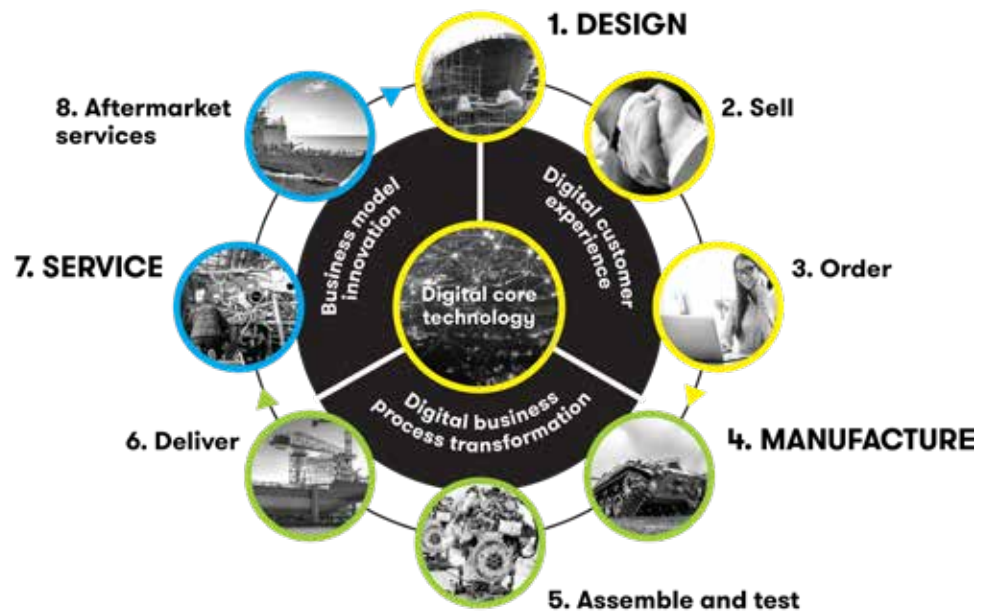
An effective digital supply chain sustains product quality by ensuring that the right physical materials and information are in the right place at the right time. This goal requires iterative collaboration — from ideation to execution — with executives, employees, IT and partners providing an outside-in perspective.

No single organization can do everything at scale in the digital world. True collaboration with partners is imperative for the advancement of both the business and in-house teams. This will help companies address complex deployment and

integration challenges and opportunities. Combining industry knowledge helps companies define their transformation strategy, realize its potential and figure out how to get there at scale.

## How to apply technology in the value chain

Technology can speed advances in the three main stages of the A&D digital value chain — design, manufacture and service (DMS) — and their corresponding activities.



**Figure 2.** Stages of the A&D digital value chain

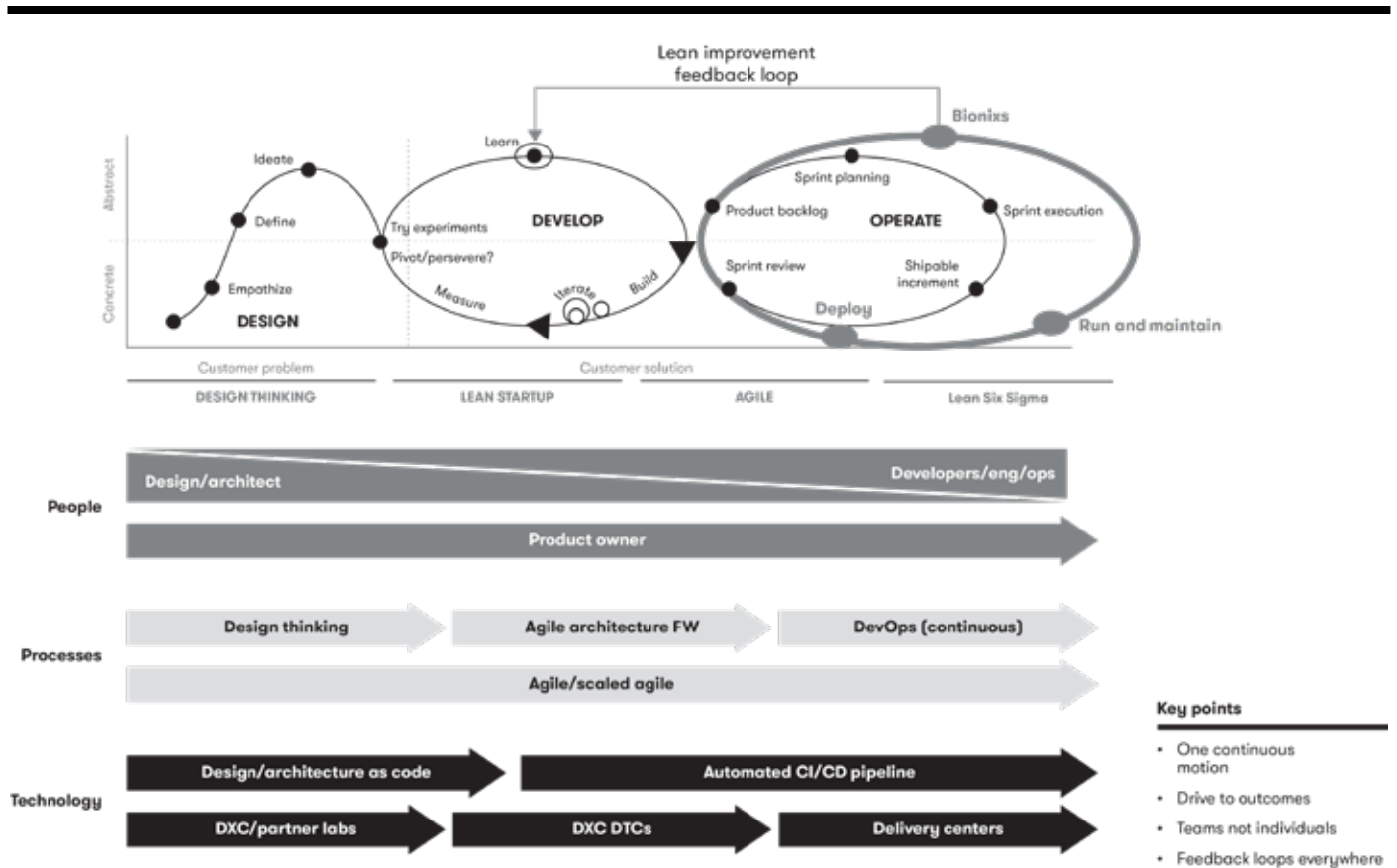
### Design: Coordinate for faster speed to market

Shortening the time from design to manufacture is a top priority for A&D companies. The opening of global commerce in the A&D market fuels this challenge and underscores the importance of digital transformation.

Adopting new technology for collaboration in product ideation, computer-aided design, data management, and engineering can reduce the time it takes to design products. Merging information heightens learning, anomaly detection and problem resolution during ramp-up periods. Opportunities in the design phase include:

**Virtualization.** Optimizing software and technology assets enables peers and partners to collaborate despite geospatial limitations. Teams share and develop information and drawings in real time, rapidly providing insights for accelerated decisions and quicker design adoption.

**Digital twin.** The replication of a physical asset's performance via technical simulation allows for the early discovery of asset performance deficiencies before physical processes and products are completed. Models and simulations can be applied during the entire value chain life cycle to optimize operations, manufacturing, inspections and sustainability.



**Figure 3.** Design to retire

Example: An aircraft engine manufacturer uses digital twin technology to ingest engine usage data for every flight. This data is then used to predict exactly when to bring the aircraft in for inspection.

**High-Performance Computing (HPC).** Model-based engineering doesn't just replicate existing products; it also creates and optimizes theoretical and arithmetic designs. Computerized analysis and design save significant costs while enhancing product quality. HPC can also be utilized for computational fluid dynamics (CFD) or other types of analytics. Incorporating government and public clouds with HPC can accommodate growth and capacity spikes, and also provide elasticity, performance and scalability.

Example: HPC can analyze both the metals already used on combat ships, and new, lighter replacement metals. Increasingly, companies can also use 3D printing to quickly produce sample parts for design validation and testing.

**Digital life cycle.** A pipeline approach with one continuous motion of change can be geared to the organization's individual pace for achieving business outcomes. Integrated teams can collaborate through design thinking, lean startup, agile

execution, and Lean Six Sigma optimization. In the spirit of rapid prototyping, a series of feedback loops support, test and learn in an agile, minimum viable product (MVP) approach.

Although not every design attempt will be successful, an untraditional “fail fast” mentality with a “design to retire” approach drives process optimization and ever-increasing automation into day-to-day operations.

### **Manufacturing: Increase throughput**

In the manufacturing stage, increasing throughput and improving efficiency is critical. Reducing unnecessary waste and scrap and creating “good” inventory is the name of the game. As products move through various stages of the manufacturing process and production line, different components are required, and it’s important to make sure those products meet quality parameters and are available on time.

To take A&D organizations into “good” manufacturing — increasingly manufacturing products right the first time — the value chain has to promote vertical integration, partner collaboration and increased supply chain visibility in what The Central Group calls the glass supply chain.

Implementing the glass supply chain provides leaders with product details at every point, facilitating real-time decisions that improve output. Increased visibility helps spot delays in real time, enables predictive-demand adjustments, and tees up opportunities where improvements in component parts can be shared with suppliers.

Technology opportunities in manufacturing include:

**Hybrid platforms.** Combining a hybrid platform strategy with applications rationalization and modernization enables A&D companies to leverage new manufacturing technologies and analytical insights that provide scalability for growth, performance, elasticity and agility. Ongoing reductions in operating costs can then be reinvested in broader digital transformation.

**Automated tracking.** Supply chain information that was previously created by people can now be generated by sensors, radio frequency identification (RFID) tags, meters, actuators, GPS, and other devices and systems. Instead of relying on labor-based tracking and monitoring, shipping containers, trucks, products and parts can report on themselves. Today’s technology can display dashboards with real-time status of plans, commitments, supply sources and pipeline inventories.

**Cognitive analysis and machine learning.** Intelligent systems can support procurement staff, supply chain analysts and logisticians in evaluating trade-offs. These systems assess constraints and alternatives, allowing decision makers to simulate various courses of action. Cognitive automation models are capable of learning and training based on historical data, enabling them to make decisions by themselves, for example in reconfiguring supply chain networks when disruptions occur.

Example: In order management, cognitive robots running in production environments learn from and work with staff in virtual workspaces to optimize manufacturing resource planning (MRP) and production schedules.

## **Service: Support the purchase and grow the business**

Applying technology to the service component increasingly opens opportunities to know customers better, improve service and provide insights into current products and new product development. Investing in modern collaboration tools, knowledge management, information management, analytics and open APIs is the key to effective service management.

Proactive and predictive maintenance both allow technicians to simultaneously perform maintenance tasks required immediately along with those needed in the future, reducing downtime, labor and untimely equipment breakdowns. Predictive maintenance goes hand in hand with prescriptive maintenance, which involves recommendations based on analyzing data captured from previous maintenance activities.

Technology opportunities in service include:

**Digital customer experience (CX).** As A&D clients strive to increase sales and grow aftermarket revenues, better CX is crucial. An exceptional CX means that all points of contact match their expectations, whether engaging in a new purchase or a critical aftermarket service experience.

**Wearables.** Wearables enable technicians to access the instructions, visuals and process steps required to successfully complete maintenance activities. Companies can also identify best technician practices, share maintenance information globally and operate more consistently.

**Drone support.** Drones can quickly assess maintenance requirements, schedule activities and keep assets running at peak levels.

## **Gain competitive advantage as an intelligent enterprise**

The needs of A&D organizations today go well beyond traditional manufacturing. Creating a competitive advantage is now about connecting the business so it can leverage the power of information more effectively to increase output and efficiency. It's about focusing on quality to deliver products and services quickly and cost effectively. It's about improving collaborative design between engineering and manufacturing and using input from service as part of the digital thread to improve existing products and provide insights for new products.

A&D companies that streamline and connect the DMS domains using a digital value chain approach — and connected factory, digital thread and digital twin concepts — can improve product availability, become more profitable and truly develop into intelligent enterprises.



### **About the authors**

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