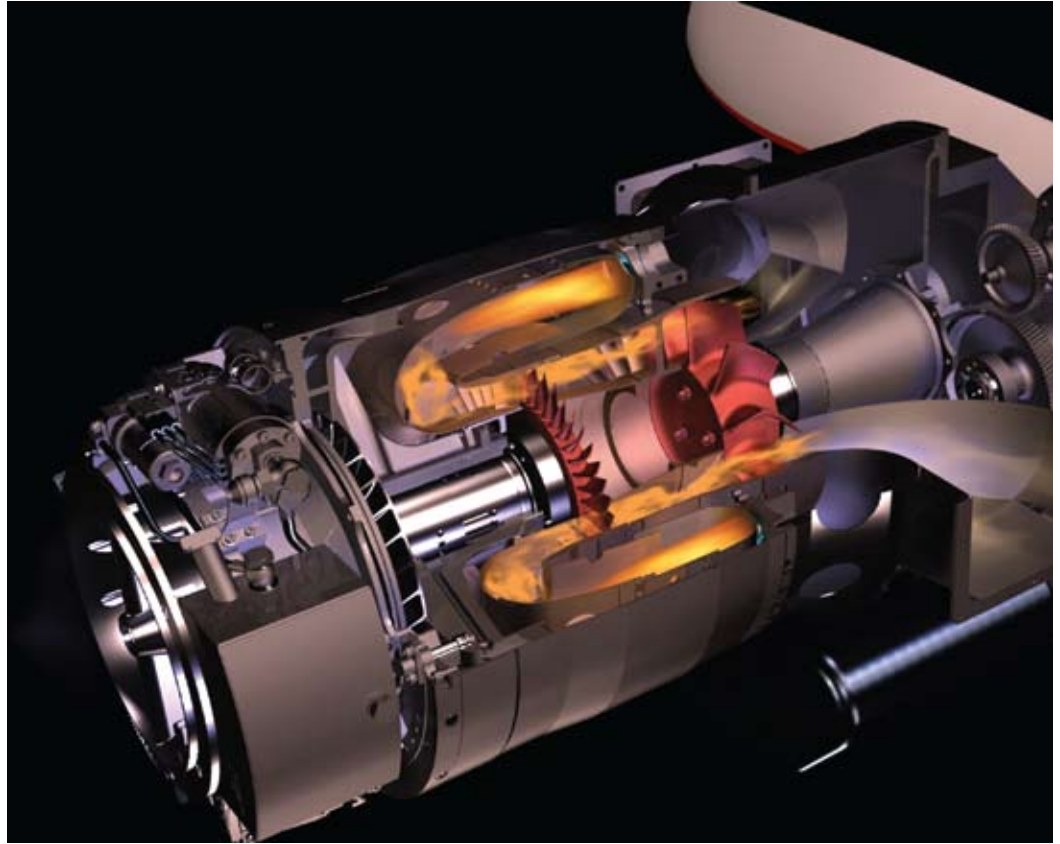


Digital Prototyping for the Aerospace Supply Chain



A Changing Market Amid Global Growth

Despite turbulence in the global economy, the aerospace industry continues to grow (AIA¹ ref). Following recent increases in defense spending, civil aviation is now expected to show faster growth than the defense market². From 2008 through 2027, airline passenger traffic is expected to increase by 5% and cargo by 5.8% annually, with Asia-Pacific leading as the largest single market³. This growth rate is twice the projected growth for the global economy as a whole⁴.

Amid overall market growth are larger trends affecting the aerospace supply chain, which have important implications on the capabilities and competencies required to thrive in this new market. In the past, aerospace OEMs and large Tier 1 suppliers took responsibility for the bulk of high-value-added engineering and manufacturing work. This model is transitioning to one where large manufacturers are outsourcing some manufacturing and subsystem assembly work and relying on middle tier suppliers to take on increased responsibility for design and manufacturing⁵. The changing landscape also affects the wider market for aerospace services. According to a recent study, the wage structures in low-cost countries make these markets attractive for labor-intensive Maintenance, Repair, and Overhaul (MRO) operations⁵.

Along with these trends, the number of skilled engineers in developed aerospace and defense markets continues to shrink, with more than a quarter of aerospace and defense employees in the US eligible for retirement within the next five years. At the same time, emerging countries are providing increasing numbers of graduates in science, technology, and engineering fields⁶.

¹ Aerospace Industries Association, December 2008

² Aerospace Industry Forecast to 2013, RNCOS, April 2009

³ Current Market Outlook 2008-2027, Boeing, July 2008

⁴ Outlook for the Global Commercial and Business Aircraft Industry, Deloitte Touche Tohmatsu, March 2009

⁵ The Growing Role of Emerging Markets in Aerospace, McKinsey & Co., April 2008

⁶ 2009 Industry Outlook: Aerospace & Defense, Deloitte Touche Tohmatsu, January 2009

Strategies To Succeed In A Changing Market

To thrive in this changing global market for products and services, aerospace and defense suppliers will need to adapt. Suppliers will be participating in a market with new entrants from around the globe. These entrants will initially possess specialized capabilities and will compete based upon the ability to perform those tasks with high quality and in a cost-effective manner. However, over time new entrants will develop broader capabilities as well as tight collaboration links with other companies to deliver more complete, higher value added products and services.

To compete effectively with these new entrants, even small and mid-sized companies will need to develop deeper global collaboration capabilities. Companies will need to develop the capability to deliver products and services with a low-cost footprint while controlling capital expenditures. They will need to develop alliances and partnerships with companies around the globe, and they will need to effectively integrate and manage global supply chains. To boost the top line, they must expand beyond current customers to develop new business throughout the world. All of this must be done while protecting core intellectual property and assuring quality of products and services.

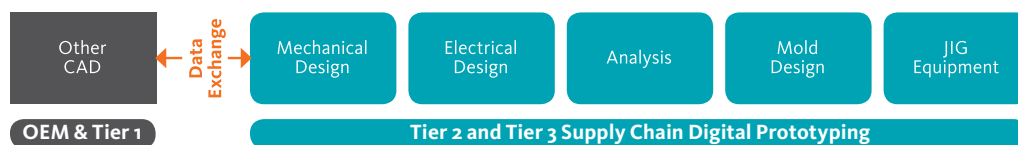
Key Success Factors And Development Solutions

Implementation of these strategies requires both technology and business solutions. Successful suppliers must effectively manage, coordinate and exchange product designs, best practices and processes while protecting intellectual property. This will require new business models as larger work packages are assigned to suppliers further down in the supply tier. In addition, suppliers need to adapt to new technical challenges while retaining and improving upon the cost and efficiency advantages they possess today. In short, the challenge is for suppliers to be simultaneously technically capable, nimble, and cost-effective.

To meet this challenge, suppliers must possess several key success factors:

- The ability to collaborate with a diverse global network of suppliers, partners, and customers
- Effective collaboration among intra-company engineering, manufacturing, and service sites
- Efficient development methodologies emphasizing continuity of engineering data
- Reuse of engineering data for manufacturing and

Figure 2 - Data Exchange Workflow



MRO operations

- Continued focus on cost control and efficiency improvement

To achieve the levels of collaboration needed, it is important that data flow smoothly from one stage of development to the next. Suppliers need to deploy design software solutions that are appropriate for each stage of the development chain, while also ensuring clean transmission of data from one workgroup to the next. Consider the diversity of design and engineering tasks across the workflow – everything from designing large scale airframe structures to assembly jigs and fixtures and repair documentation. A single software solution will typically not be suited to each of these tasks while also meeting the economic needs of suppliers. Companies therefore need to deploy solutions that best meet the cost and technical demands for each phase of the workflow.

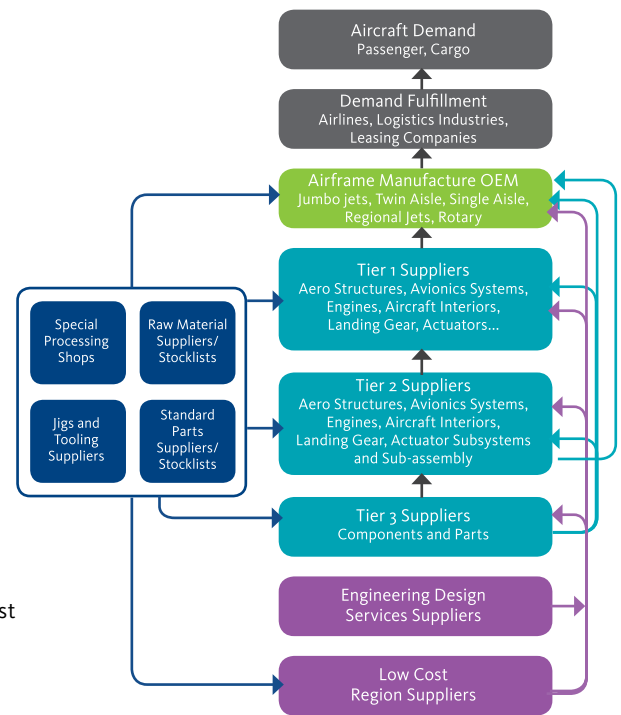
Adoption of standard neutral data exchange formats is a common means of promoting interoperability, but these neutral formats are not always available, or may cause problems in translation. Therefore, to ensure effective reuse of data, it is important to support the direct import and export of non-native file formats in addition to neutral formats. While exchange of 3D data with partners and customers is essential, it is also important to collaborate with lower tiers in the supply chain. It is common to find suppliers in lower tiers working with 2D design data, often created in AutoCAD®. In all of these exchanges of data, it is critical to protect intellectual property from improper disclosure.

To be competitive as they take on more design responsibility, suppliers need cost effective solutions that provide functional design capabilities, complete 3D modeling, finite element analysis, simulation, electrical wiring/harness design, and jig and fixture design. These solutions must offer two-way data exchange with traditional aerospace design tools typically used by OEMs and Tier 1 manufacturers as well as 2D solutions used at lower tiers in the supply chain.

Consequences For Design And Engineering

Challenges affecting the global aerospace industry will drive changes throughout the supply chain. Design and engineering functions will need to source and procure flexible and cost effective

Figure 1 - Aerospace Supply Chain



solutions to create and manage design knowledge and at the same time undertake improvements in their ability to manage designs within the demands of agile manufacturing processes. Investments will also need to be made in selecting and hiring high-caliber project leaders/engineers to manage integration and technical constraints.

Companies will be faced with finding ways to effectively deal with increasing pressure to shorten development timelines, reduce costs, increase competitiveness, and manage growing levels of product complexity. Supply chain companies will need to prove to OEMs that they can take on larger work packages while maintaining compliance with inter-company processes. To do this they must identify and adopt best-in-class digital prototyping solutions to cost effectively streamline their business operations.

Assurance that speed, accuracy, and collaboration can be maintained will be critical to suppliers. They must pay close attention to detail, and be able to find flexible ways to exchange design data within domain disciplines and across the supply network. Supply chain companies will have limited time and budgets to work with complicated design tools that require extensive training to operate effectively. Their preference will be for design tools that are easy to use, capable, flexible and affordable.

The Autodesk Solution For Digital Prototyping

The Autodesk® solution for Digital Prototyping helps aerospace suppliers to better design, visualize, and simulate product and process designs before they are ever built. Autodesk offers a broad set of interoperable solutions across all phases of product

development to reduce development costs and promote collaboration.

Autodesk is uniquely positioned to fill the needs of aerospace suppliers by putting scalable, attainable, and cost effective desktop technology in the hands of global design and engineering teams, allowing them to design, visualize, and simulate their product and process designs. Workflows based on the Autodesk solution for Digital Prototyping allow teams throughout the extended enterprise to change the way they think about their concept to manufacturing processes and help them get to market faster.

Autodesk helps suppliers address business challenges that directly impact their ability to compete in the increasingly competitive global aerospace and defence supply chain market.

Cost Reduction

The Autodesk solution for Digital Prototyping provides aerospace suppliers with cost-effective and interoperable tools that enable products, tooling, and processes to be optimized early in the design process, reducing errors as well as the cost and waste associated with physical prototypes.

Autodesk provides a complete solution for Digital Prototyping, supporting interoperability across the entire workflow so that data authored in both Autodesk and other design applications by supply chain partners and OEM's can be reused effectively to save time and money in development and implementation. The Autodesk solution for Digital Prototyping, with Autodesk Inventor® software as its foundation, provides cost-effective tools to design, visualize, and simulate product function and manufacturing processes so that product, tooling, and process designs can be optimized before committing to physical prototypes and tooling. Autodesk Navisworks® software helps manufacturers eliminate waste and reduce costs in manufacturing by providing a solution to integrate equipment and factory layouts to visualize and simulate the manufacturing facility before it is built.

Collaboration

Autodesk solutions facilitate collaboration among global engineering teams through integrated 2D and 3D design technologies, coupled with data management and design review tools. Together, these solutions support supplier efforts to improve collaboration with supply chain partners and the sharing of digital data throughout the extended enterprise, while protecting core intellectual property.

Autodesk applications like Autodesk Inventor, the Autodesk Alias® family of software products, AutoCAD® Mechanical, AutoCAD® Electrical, Autodesk Navisworks, and AutoCAD® provide unsurpassed ability to import and export data in a variety of neutral and application specific formats. Autodesk Inventor provides the ability to shrink-

wrap designs to enable design sharing without risking disclosure of core intellectual property. Autodesk collaboration tools like Autodesk Vault Manufacturing manage design changes and engineering workflow internally, while Autodesk Streamline® and Autodesk® Design Review securely share and globally manage access to valuable design data, protecting intellectual property throughout the extended workflow.

Innovation

Autodesk delivers a holistic approach to product design by providing a complete set of integrated design, simulation, and visualization capabilities that enable concurrent engineering across multi-disciplinary teams using a single digital model. This approach promotes reuse of modular design elements to improve reliability and time-to-market while facilitating design innovation.

The Autodesk solution for Digital Prototyping allows engineers to simulate and evaluate the impact of material choices, design options, and manufacturing processes before the development of a physical prototype. This reduces the need for costly and time-consuming prototype iterations and enables the evaluation of more design options to accelerate the process of product innovation. In addition, the functionality of complex electromechanical assemblies can be evaluated before the first prototype is built. Active elements can be incorporated for evaluation, and stress analysis and dynamic simulation can reveal design and functional issues early in product development, avoiding costly and time-consuming downstream changes.

Agile Manufacturing

By extending Digital Prototyping to the factory floor, Autodesk tools provide manufacturing and industrial engineers with the ability to access and utilize design data from the digital prototype to make informed decisions about manufacturing equipment and tooling, resulting in fewer errors and shorter lead time.

The Autodesk Inventor product line provides efficient workflows for designing tools, jigs and fixtures. These capabilities help manufacturers reduce time and cost associated with tooling design while reducing variability in the finished product. Autodesk Inventor, AutoCAD Mechanical, and AutoCAD provide the ability to associatively work with 3D equipment and tooling designs and 2D equipment layouts while incorporating 3D product design data from Inventor or other mechanical design solutions. Autodesk Navisworks enables the integration of building, product, equipment, and other data to create a complete digital model of the factory, improving design decision-making, construction implementation, and performance prediction and planning, straight through to management and operation of the facility.

Design Solution Needs in the Aerospace Supply Chain

- Affordable and scalable solutions to develop products and manufacturing tooling
- Digital Prototyping solutions to design, visualize, and simulate designs before manufacture
- Improved collaboration among design, manufacturing, and service engineering teams
- Effective data management for distributed workgroups
- Effective reuse of design data and engineering knowledge throughout the design pipeline
- The ability to protect intellectual property while collaborating
- Improved collaboration with OEMs and Tier 1s as well as lower tiers of the supply chain

Maintenance Repair and Overhaul

The Autodesk solution for Digital Prototyping provides aerospace maintenance providers with easy to use solutions to design and fabricate maintenance tools and fixtures from 3D product geometry, as well as solutions to develop clear and visual maintenance instructions and documentation to improve maintenance productivity.

Autodesk Inventor software provides the ability to incorporate 3D product geometry from a variety of sources to develop tools and fixtures used in aerospace maintenance procedures. The associative interoperability between Inventor, AutoCAD Mechanical, and AutoCAD provides an efficient way to create and update documentation for these tools and fixtures. Vault Manufacturing data management software helps aerospace engineering and service professionals effectively reuse design data, as well as collaborate and share documentation for repair procedures, tooling, and supplies, while managing revision levels, change orders, and bills of material. Autodesk Inventor provides the ability to reuse 3D product geometry from a variety of sources to create repair and maintenance documentation in the form of drawings or lightweight formats that can be easily viewed and annotated by service and repair professionals using freely available Autodesk Design Review.

Request More Information

The Autodesk solution for Digital Prototyping can provide aerospace and defense suppliers a compelling business advantage. By using a Digital Prototyping solution to design, visualize, and simulate their products and processes, suppliers can cost-effectively collaborate globally and innovate more rapidly. To learn more, or to find a local reseller, visit www.autodesk.com today.

