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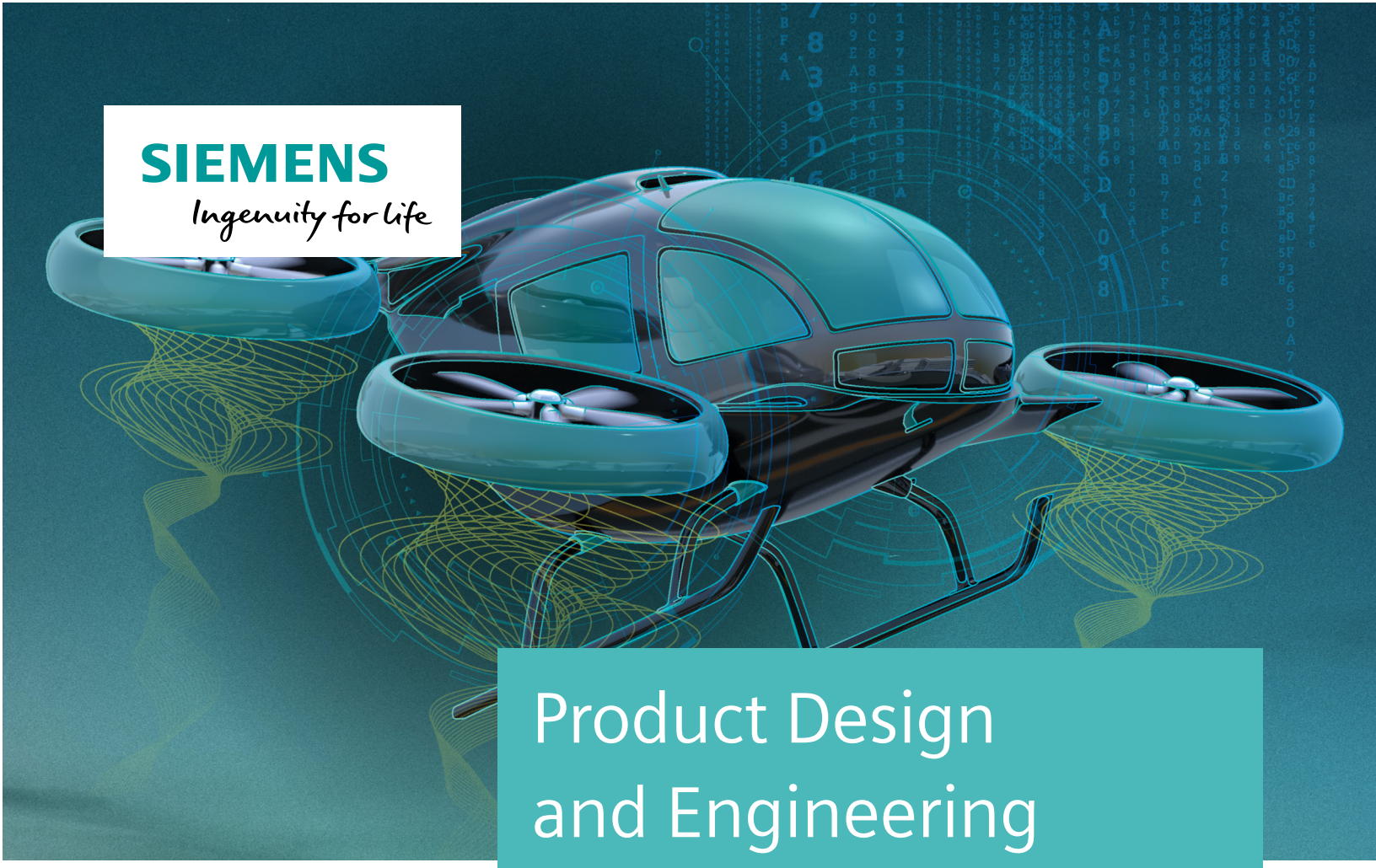
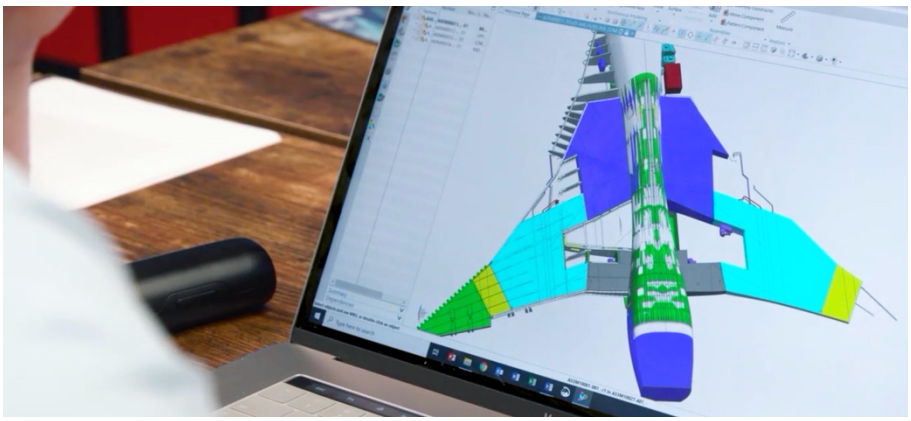
Ingenuity for life



Product Design and Engineering

Take flight with agile product development in aerospace and defense

Aerospace and defense innovators are already starting to figure out how to get 20 engineers to do the work of 50 without requiring additional overtime costs while exploring more design ideas in the process. The industry has sought to enable faster product development by adopting integrated product development teams. Many companies are turning to agile engineering as the answer, but this involves more than just throwing 20 engineers in a room and saying “go” in order to make it work.



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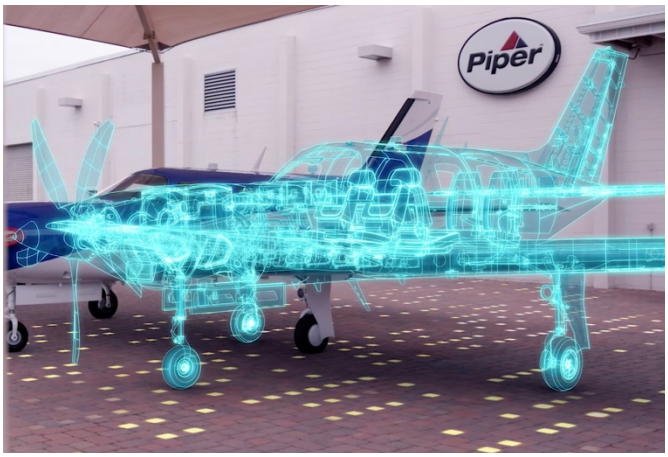
Path to innovation

Aerospace and defense companies have been pushing the envelope to develop innovative new products that address changing customer demands and reduce costs. Most have adopted integrated product development teams to coordinate work across disciplines, which has created a more collaborative environment by improving communications across the different specialties involved in a project.

In light of this progress, the fundamental approach to product design hasn't truly evolved in decades. Engineers on the same team often work with specialized tools for electronics, electrical, mechanical and software engineering. Manual efforts are required to interpret and incorporate needed information from other disciplines within a consolidated final design. Over time, companies have optimized processes around these specialized tools to improve the performance of these engineering specialists.

Although the push for more effective design and engineering tools and processes has been well intentioned, the unintended consequences have led to manual handoffs between specialists that limits the ability to efficiently explore new design iterations that may be more cost effective or perform better.

To better integrate across specialized disciplines and tools, leaders often hold coordination meetings to foster and encourage improved communication across teams. Even with coordination meetings, some managers today still face challenges in keeping everyone aligned and working on the latest version of the design across disciplines.



The limits of traditional engineering

Startups have begun proving that agile engineering practices can deliver innovative new products and services more efficiently, sometimes at a rate hundreds of times faster than incumbents. Bye Aerospace, for example, has gone from being able to iterate two to three times across the life of a program to iterating on a weekly basis and using a team of 20 engineers to do the work of 50.

As products become more complex, traditional development practices cannot maintain the same pace as they had been able to meet previously. This results in not being able to change designs in response to new customer requirements, technologies or regulations. Some symptoms of this disconnect include manual data translations between teams, the need to manage separate digital mockups and many coordination meetings. The net result is significant design rework since team designs mature at different rates across specializations.

When a manager sees a problem, the temptation is to have more coordination meetings or invest more resources in managing digital mockups to improve communication across teams. Engineering managers struggle to figure out how they can keep everyone aligned and working on the latest version of designs across disciplines. For example, the electrical team may be designing using revision B of the hydraulic system, while the hydraulic team is designing revision D. As a result, teams struggle to keep control over the configuration and alignment of different parts of the airplane.

Innovative aerospace and defense companies are adopting more mechatronic systems dominated by software to improve product performance and cost. These products require significantly more integration than traditional products. Companies that do not develop better strategies for interface control definitions (for example, integration of software, wiring and structures) will fall behind companies that are aggressively pursuing model-based strategies. For example, the Airbus A380 suffered $6.1 billion in added costs from delays attributed to integration issues associated with the wiring. Although manual testing can find these issues, this can result in late changes and rework that can drive up cost and delay the schedule.

As products become more complex, engineers need to design for manufacturing and serviceability earlier in the process. For example, designers might develop the "perfect" wing only to realize later that it will not accommodate technicians taller

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than five feet. Then they will have to add hatches for access that will increase manufacturing costs and delay product release or hire more short technicians.

A better way to iterate

Enterprises are adopting the agile approach to engineering, which involves iterating development in multiple closed-loop sprints. This provides a cultural shift to allow issues to be addressed early in the design process. National Institute of Standards and Technology (NIST) research has suggested it can cost 30 times as much to fix a problem in production as it does in the requirements phase.

Agile engineering practices have proven their value in the software industry. As the industry undergoes rapid change, aerospace and defense enterprises have an opportunity to adopt the same approaches to succeed. Teams struggling with accelerating product development may benefit from exploring disconnects between their organization chart and the way the teams work in practice. Agile engineering allows them to proactively address the fundamental barriers to collaboration across specialties and work packages early in the design process, and minimize the effort required to mitigate problems after the fact.

The future of aerospace and defense will be owned by companies that are able to break projects into smaller manageable chunks, respond to changes in technology and requirements and test earlier in the development of new products. Much like software companies, they are able to continuously and reliably update the latest working versions of products like clockwork. By breaking the scope of requirements into smaller more manageable chunks, they make it easier for smaller teams of people to work together to solve problems and collaborate faster.

Organizations also can benefit from thinking about improving communication across teams and focusing work on the objectives of the program to rapidly incorporate customer requests or program issue resolution. Some organizations find a new cadence by simply reducing the number of meetings. This forces engineers to be more collaborative in working with other specialists to solve problems. This is easier when organizations can find a way to sync everyone up naturally across the program rather than trying to sync everyone up at a checkpoint.

Aerospace and defense companies can also benefit from adopting a culture of collaboration that makes it easier to share requirements, engineering and simulations across teams and partners. This may involve embracing cultural change around the way they train engineers, structure teams and promote systems engineering approaches that span traditional disciplines.

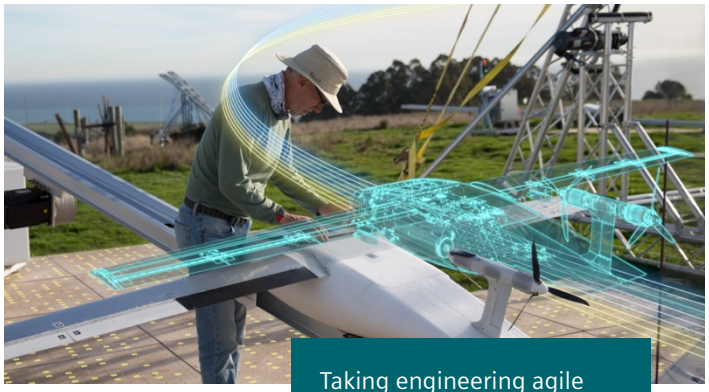
Better tools that make simulation models faster, easier to set up, more robust and accessible to more people can also improve this transition. More importantly, these tools also make it easier to quickly perform virtual verification of design and manufacturability.

These capabilities allow engineers to evaluate designs in short sprints to set a new baseline that can be used for the next sprint. Product lifecycle management (PLM) tools can help you manage the baseline, retain knowledge of design decisions, maintain configuration control and enhance change management. These tools have matured to the point where organizations can enable new processes that allow them to innovate faster.

Leaders like SpaceX are already proving the power of using a comprehensive digital twin to dramatically change engineering practices to accelerate product development. Original equipment manufacturers (OEMs) need to adopt agile engineering practices in order to flexibly respond to new opportunities while still ensuring safety and quality and meeting cost goals. Adopting new digital engineering tools that make it easier to use new manufacturing technologies, artificial intelligence (AI) design tools and user experiences like augmented reality (AR) will be needed to make these efforts succeed.

Conclusion

Undertaking a digital transformation isn't just digitization, it’s about digitalization that includes process improvement. Aerospace and defense organizations can benefit from adopting new engineering practices to keep pace with innovative new startups. These firms will also need to consider how to affect cultural change and adopt the right tools to make this work. Companies that adopt these practices are designing higher performing aircraft faster (sometimes 20 to 30 percent or more) at less cost. Adopting tools that can facilitate collaboration across teams and accelerate testing will help make this transition successful.



Taking engineering agile

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