HOW DO I
SATISFY REQUIREMENTS AND MEET DEADLINES?

NAVIGATE CONFLICTING AND COMPETING DEMANDS

WITH CLOUD-BASED SAAS SOLUTIONS

LIFECYCLE INSIGHTS

Accelerating Engineering Transformation

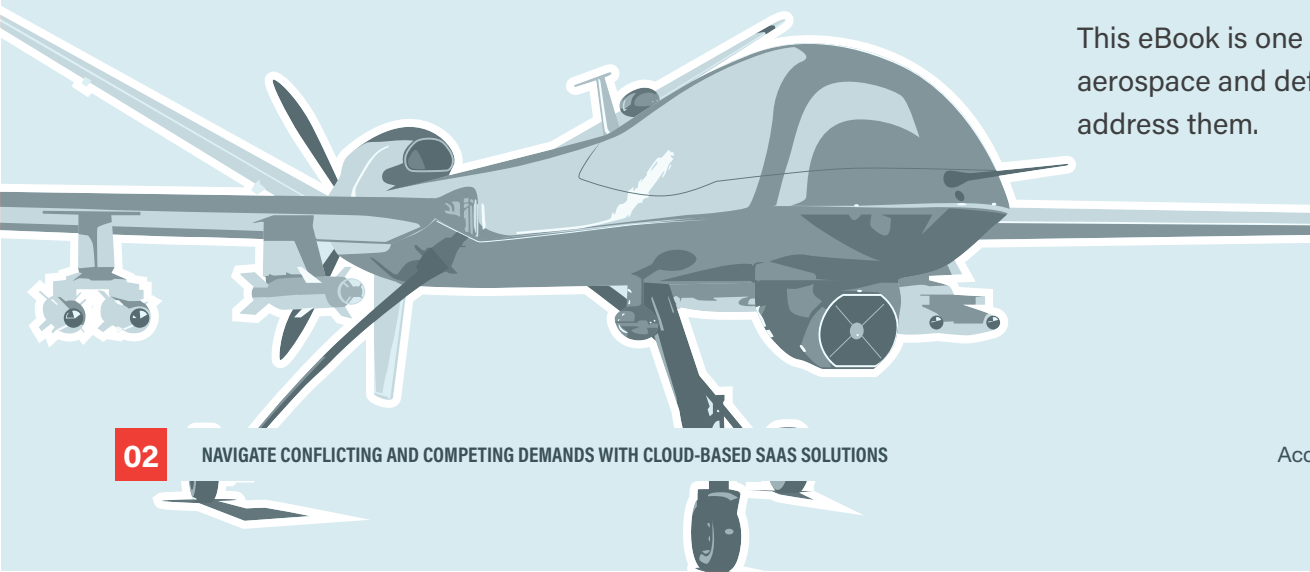www.LifecycleInsights.com

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Introduction

The aerospace and defense sector is entering a period of significant change, driven by the need to create more sustainable aircraft and reduce the industry's environmental impact. At the same time, the certification process—and the safety it ensures—remains an essential concern for every aerospace and defense company. As these companies strive to improve sustainability and maximize safety, they must also contend with the increasing complexity of their systems and products. Companies must efficiently coordinate engineering work across multiple domains to address this challenge while meeting project deadlines and controlling costs. They must also work closely with other vital stakeholders in their procurement, manufacturing, and service departments and integrate the efforts of suppliers and original equipment manufacturers (OEMs).

Managing all of these efforts using traditional tools and existing development practices can lead to difficulties. Serious performance and safety issues can arise if even minor design changes made by one team are not propagated to other departments. Those issues may not be evident until prototyping and testing occur, at which point the engineers must complete arduous, expensive redesigns. Similarly, if other departments or external stakeholders act on outdated or inaccurate product data, it becomes harder for them to source parts and supplies in a timely, cost-effective manner.

Digital product lifecycle management (PLM) solutions give aerospace and defense companies the capability to deal with rising system complexity while pursuing safety and sustainability priorities. These solutions connect internal and external stakeholders, processes, and technologies through a common digital thread. Because this thread provides a single source of truth for team members throughout the organization, development decisions are always made based on up-to-the-minute product data. This improves the systems integration process and reduces the rounds of prototyping and testing required to achieve sustainable designs that meet the industry's rigorous certification standards. As a result, companies can control costs and keep projects on schedule.

This eBook is one of a series focusing on the challenges facing aerospace and defense companies, and how PLM solutions can address them.

Accelerating Engineering Transformation

LIFECYCLE INSIGHTS

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The Product Development Leader's Dilemma

Aerospace and defense companies are facing new and unprecedented product development challenges. Trade wars and pandemics are recent examples of the disruption affecting today's manufacturing companies, driving new norms. To understand these issues at a strategic level, Lifecycle Insights conducted the 2020 Engineering Executive's Strategic Agenda study.

Findings from the study show that product development leaders face two competing constraints that are forcing change across the board. Fifty-three percent of respondents cited "satisfying target requirements" as the top-ranking issue. Forty-five percent ranked "keeping up with development schedules" as the second-most pressing issue. Reconciling these two demands is difficult because increasingly complex requirements traditionally translate to longer development schedules. But today's aerospace and defense companies do not have the luxury of addressing one issue or the other. They must do both.

While these challenges are significant, they are not insurmountable. Success, however, requires the right combination of people, process, and technology changes. This eBook provides guidance on these changes. It reveals more of the study's findings, providing insights into the dynamic issues that will transform product development in the years ahead. It also provides guidance to product development organizations, explaining the competencies and capabilities required to address these challenges.


Figure 1

Respondents in the 2020 Engineering Executive's Strategic Agenda study ranked the issues driving changes in product development. Satisfying target requirements and keeping up with development schedules are the two biggest issues.

	1ST	2ND	3RD	4TH	5TH
SATISFYING TARGET REQUIREMENTS, EITHER FROM CUSTOMERS OR COMPETITORS	30%	23%	20%	15%	13%
KEEPING UP WITH DEVELOPMENT SCHEDULES	20%	25%	24%	21%	11%
COORDINATING WITH SUPPLIERS AND PARTNERS	21%	17%	24%	20%	19%
SHRINKING DEVELOPMENT BUDGETS	16%	17%	19%	22%	26%
COMPLYING WITH REGULATORY REQUIREMENTS	13%	17%	15%	23%	32%

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Growing process complexity is a significant stumbling block in product development. Fifty-one percent of respondents in the 2020 Engineering Executive's Strategic Agenda study ranked it as "increasing" or "increasing greatly."

DECREASING
DECREASING GREATLY
INCREASING GREATLY — 13%
2%
8%
39% — SAME
INCREASING — 38%
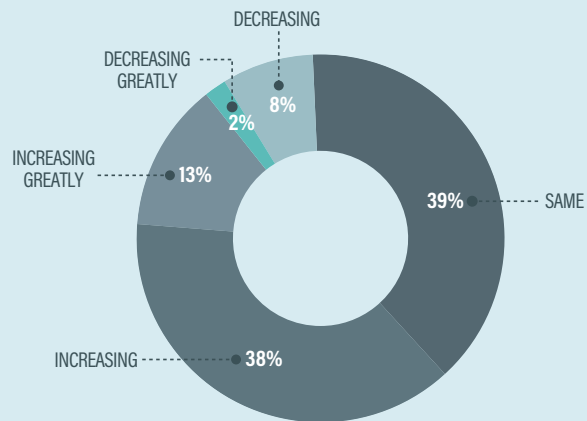
The Tide of Rising Process Complexity

Many product development projects are slowed, hindered, or strangled altogether by increasing complexity. Some 51% of study respondents reported that process complexity is "increasing" or "increasing significantly."

Process complexity is rising quickly due to mounting regulatory compliance requirements. Organizations must meet different requirements in diverse geographies to comply with constantly changing regulations. Product certification and regulatory process documentation is already a complex undertaking in the aerospace and defense industry. But rapid technological advancements and an increase in smart, connected products and systems has driven that complexity to new levels.

Left unaddressed, this mounting and multi-faceted complexity is a looming threat. It prevents aerospace and defense companies from meeting the two competing challenges of satisfying target requirements and tighter deadlines. This complexity also slows down the product development process, undermining companies' ability to launch or deliver products on time.

The Challenge of Growing Organizational Complexity

Before the difficulties of the last few years, companies were already dealing with rising organizational complexity. Manufacturers increasingly outsourced the development of entire systems to suppliers. Additionally, many of these companies entered into co-development partnerships, sharing technologies and systems with external partners. The network effect of manufacturing continues to grow unabated.
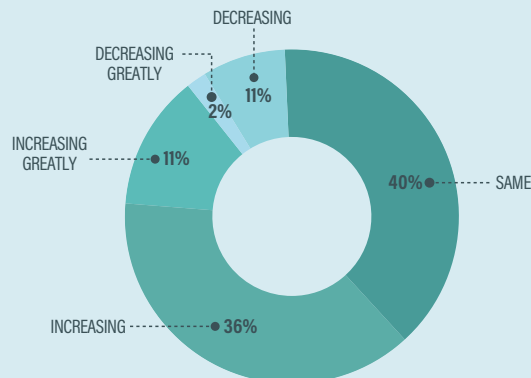
New challenges appeared in 2020, most notably due to the pandemic. Entire functional departments were forced to work from home. This inability to work face-to-face or walk the production floor exacerbated all of the pre-pandemic issues. Cross-departmental and cross-organizational communication was severely hampered, reducing collaboration and slowing development lifecycles. This lack of coordination between teams also hindered companies' pursuit of their certification goals.

Forty-seven percent of the study's respondents stated that organizational complexity was "increasing" or "increasing greatly." Companies were forced to address this challenge and transform their remote working options over the course of the last year. However, this is not an easy undertaking. Many companies are still honing their remote working practices.

Figure 3

Growing process complexity is a significant stumbling block in product development. Forty-seven percent of respondents in the 2020 Engineering Executive's Strategic Agenda study ranked it as "increasing" or "increasing greatly."

DECREASING 11%
DECREASING GREATLY 2%
INCREASING GREATLY 11%
SAME 40%
INCREASING 36%

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The Difficulty of Mounting Product Complexity

Products are changing. Manufacturers in multiple industries are transforming their traditional, mechanical products into smart, connected ones. Increasing product complexity has introduced a range of new product development challenges. Fifty-nine percent of respondents stated product complexity was "increasing" or "increasing greatly."

As products become smarter and more connected, their composition must change. The size and complexity of electronics must increase, fulfilling requirements for more powerful processors. Demands for network bandwidth and electrical power distribution are rising accordingly. Mechanical hardware must not only accommodate more internal components, but also vent heat generated from electronics. Software, a key growth area, enables intelligent features. The changes to product complexity, however, aren't limited to the product itself. The rise of the internet of things (IoT)—and a corresponding increase in streaming data between product sensors and cloud platforms—adds another layer of complexity.

The evolving composition of products forces companies to change their underlying processes and technologies. They must take measures to mitigate this rising complexity. This includes implementing practices and systems to more formally manage the digital design definitions of hardware and software and foster increased collaboration across their engineering domains.

/ **Figure 4**
Product complexity grows as companies transition to smart, connected products. Fifty-nine percent of respondents in the 2020 Engineering Executive's Strategic Agenda study ranked it as "increasing" or "increasing greatly."

DECREASING 9%
SAME 31%
INCREASING 46%
INCREASING GREATLY 13%
DECREASING GREATLY 2%
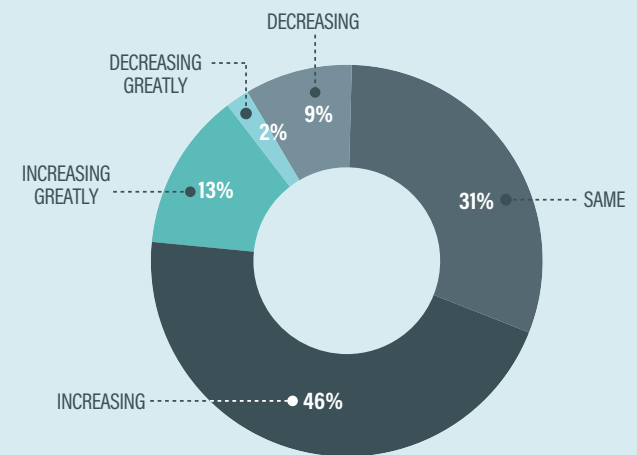
NUMBER OF PRODUCT DEVELOPMENT PROJECTS THAT
HIT PRODUCT LAUNCH OR DELIVERY DATES

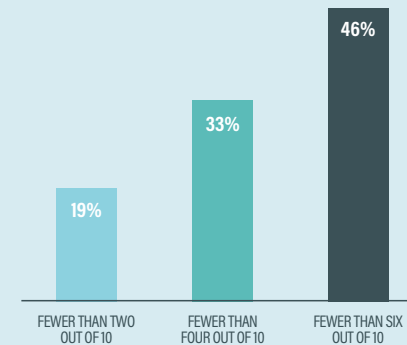|		46%
	33%	
19%		
FEWER THAN TWO OUT OF 10	FEWER THAN FOUR OUT OF 10	FEWER THAN SIX OUT OF 10

Figure 5
Findings from the 2020 Engineering Executive's Strategic Agenda study show that some companies are performing well while others are not. Forty-six percent of respondents stated that fewer than six out of 10 product development projects hit product launch or delivery dates.

Product Development Performance Is Lagging

Companies have experienced practical challenges for years. However, the study reveals these challenges are manifesting as an acute drop in product development performance. Forty-six percent of respondents stated that fewer than six in 10 of their product development projects meet their launch or delivery deadlines. This is a staggeringly high number of projects missing the mark.

For those companies delivering products to the market, this statistic represents a dramatic business failure. Being the second or third company to deliver a product to market adversely affects a company's market share and revenue. When companies fail to deliver products to a specific client, they fall short of customer expectations.

Both scenarios undermine the company brand, and often result in financial penalties that further slash company margins.

The competing constraints of satisfying requirements and staying on schedule, coupled with rising complexity across multiple domains, translates into a real impact on performance. Some companies regard such issues as the unavoidable, painful reality of modern product development. But when we review the findings from the study, it is clear that this is not the case. Some companies are clearly thriving while others are barely surviving.
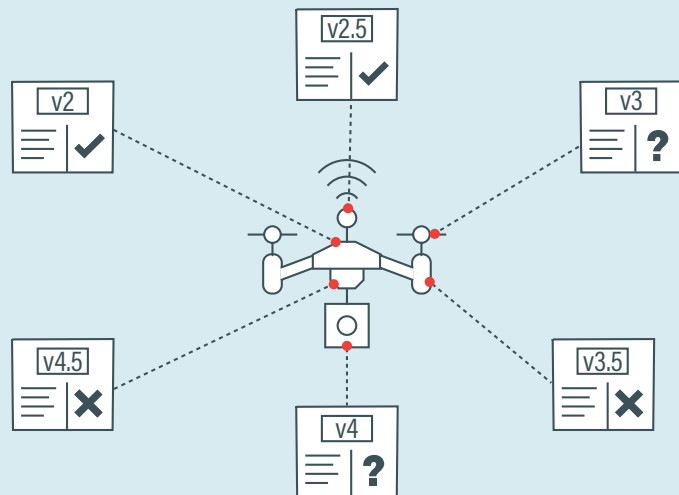
Figure 6
Requirements management is key to satisfying complex requirements while staying on schedule. PLM solutions play a crucial role in this effort.

Tracking and Satisfying Requirements Efficiently

Today's product development challenges are sizable, but aerospace and defense companies can overcome them. Some industry companies are implementing new competencies and technical capabilities to address these issues. Requirements management is key, both across design domains and the full development lifecycle.

Requirements management formally defines, tracks, and manages requirements across the product development process. Aerospace and defense companies can realize value through process changes in which engineers and other stakeholders actively track and manage requirements at every stage of the development lifecycle. In this way, they can stay on schedule while meeting all requirements. Meanwhile, these companies will find that more product development projects hit their launch and delivery dates. Companies may need new roles and responsibilities to verify requirements at the component, systems, and product levels.

Note, however, that requirements management alone is not enough to achieve success. It must be closely integrated with other aspects of the product, such as design models, simulations, bills of materials (BOMs), drawings, documentation, and much more. Just as importantly, requirements must be tied into the product schedule, offering visibility into the initial definition, fulfillment, and verification of the satisfaction of a requirement. When requirements have this sort of context, stakeholders can track and fulfill them more easily.

Digital solutions play a starring role in requirements management. To successfully manage requirements, it is critical to track them individually, as separate entities that are versioned independently. Each requirement should be allocated to or associated with some aspect of the design. This makes clear how to fulfill the requirement. Product lifecycle management (PLM) solutions offer these capabilities, which can be used across both engineering domains and functional departments.

Mitigating Product Complexity With BOM Management

Requirements are a critical aspect of product development, but so are BOMs. BOM management for traditional, mechanical products was always relatively easy with information sourced from mechanical computer-aided design (CAD) applications. Today, however, the shift to smart, connected products has complicated matters. A BOM now has many potential inputs, including electrical and electronic CAD applications as well as software configuration management (SCM) and application lifecycle management (ALM). And that's not all. BOMs must include reference requirements, specifications, analyses, and many other deliverables from the design and development cycle. Modern BOMs are multidisciplinary deliverables, just like today's smart, connected products.

To track and manage multidisciplinary BOMs, aerospace and defense companies must make process changes and introduce new responsibilities. During the work-in-process design cycle, BOMs must be reconciled across design domains. Individuals must assess, track, and manage BOM-centric activities, including costing, sourcing, and collaboration with suppliers, among others.

Digital solutions allow aerospace and defense companies to synchronize, track, and seamlessly manage multidisciplinary BOMs. Modern PLM solutions can directly manage the design artifacts built by engineering teams in different domains. They can also connect to and communicate with workgroup data management tools. These BOMs are closely connected to the aforementioned requirements management capabilities, which allow teams to track the satisfaction of requirements allocated to specific components in the BOM. This further aids cross-organizational integration efforts.
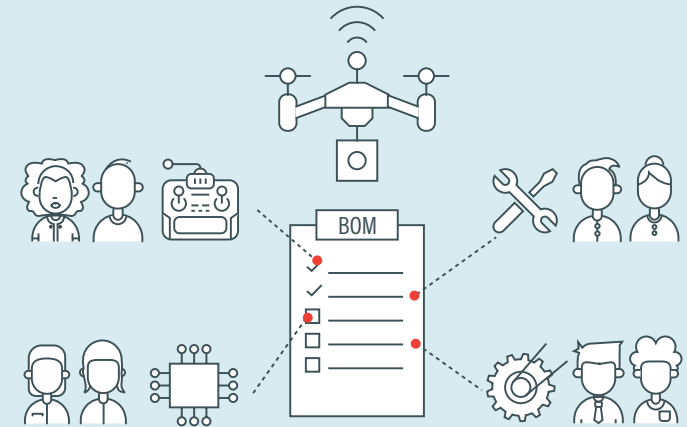

Figure 7
A modern BOM is assembled with inputs from many different design domains and their design tools, including MCAD, ECAD, and SCM systems, as well as requirements, specifications, and more. PLM solutions offer powerful capabilities to build, manage, and track these multidisciplinary BOMs.
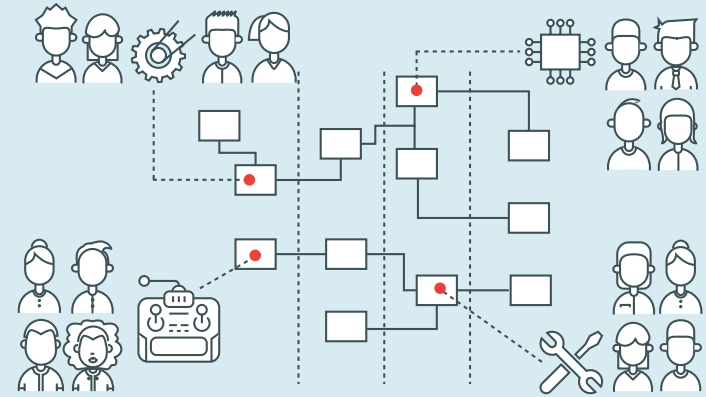
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Staying on Track With Project and Program Management

When developing any complex product, project and program management are key to overseeing the coordination of schedules as a cohesive whole. With complexity rising across the board, project management competencies are required to coordinate development activities for different functional departments and engineering teams. This includes the development of design deliverables, definition and validation of requirements, authoring of specifications, and many more activities across domains and departments.

New checkpoints and activities are needed to provide project or program managers insights into the status of tasks across the project lifecycle. These managers occupy dedicated roles. They actively manage schedules and communicate the project status back to other managers, who can then take action.

Digital solutions are also important for these activities. The artifacts in a multidisciplinary BOM are associated with tasks. The tasks can range from defining requirements to developing concepts, creating detailed designs, and generating documentation. Each task is assigned to individuals in the development process. PLM solutions deliver this functionality with ease and can also be integrated across design domains and functional departments. When applied across engineering disciplines, this provides a holistic view of the project status and a forecast for completion.

Fast ROI With SaaS PLM Solutions

Traditionally, implementing a PLM solution can take months, or even years, and requires significant resources. But meeting today's product development challenges requires short development lifecycles. Aerospace and defense companies need solutions that can handle requirements management, multidisciplinary BOM management, and project and program management—and that can handle them quickly. Cloud-based software-as-a-service (SaaS) PLM solutions can help.

These solutions provide instant accessibility because the service is already up and running. The organization just needs to purchase a license or subscription for access. This dramatically reduces the time from payment to use, compared with solutions that must be installed, configured, and deployed. It also gives users the freedom to connect via browsers, allowing them access any time and from anywhere.

SaaS PLM solutions also require minimal IT support, with little to no experience necessary to install, update, or customize the solution. As such, aerospace and defense companies can utilize these solutions with small IT staff—or no IT staff—increasing productivity across the organization.

/ **Figure 9**
SaaS PLM solutions provide quick access to address immediate needs and require little to no IT support. These solutions offer an accelerated path to the capabilities that today's companies need.

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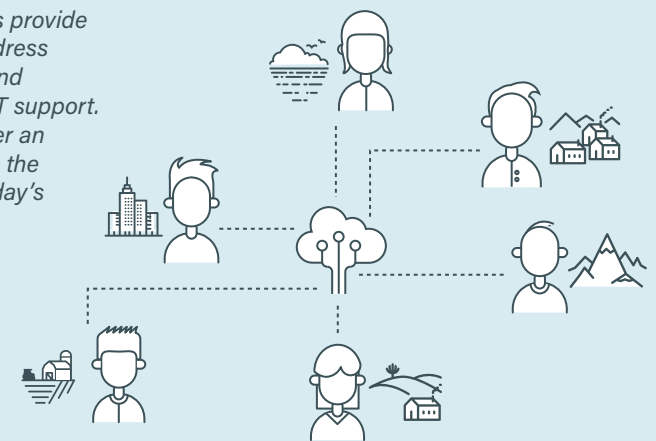
Efficiency and Productivity With SaaS PLM Solutions

PLM solutions are configurable, so organizations can easily change them to conform to their desired practices and standards. But doing so can take significant effort, delaying the availability of the solution to solve development problems.

But some cloud-based SaaS PLM solutions are different. They come with built-in, prescriptive best practices, which are often curated by the solution provider and, sometimes, by industry. On one hand, these standards can act as an enhanced development process for the company. On the other hand, they can serve as a baseline upon which the company can make changes. Either way, aerospace and defense companies can configure a cloud-based SaaS PLM solution to match their exact needs much more quickly than they can a traditional PLM solution.

Note that companies are not required to make any changes to a SaaS PLM solution. They can use it as-is with those built-in industry practices. The solution provider can also personalize, configure, customize, or otherwise adjust the solution to tailor it to the company's needs.

The application of artificial intelligence and machine learning are expanding the capabilities of SaaS solutions, and have the potential to improve productivity. This functionality helps aerospace and defense companies gain an in-depth understanding of their workflows, while providing suggestions on next steps and common practices, even in unfamiliar areas.
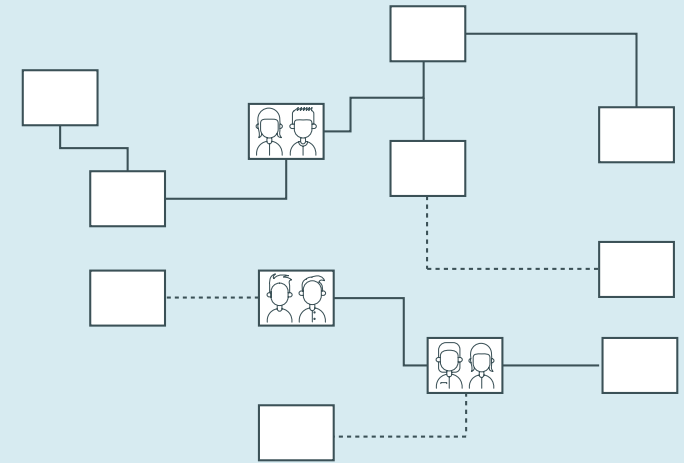
/ **Figure 10**
Companies can change a PLM solution to meet their specific needs. Some SaaS PLM solutions come with built-in best practices that can enhance a company's development process or act as a baseline for other, new modifications.

Easier Integration With SaaS PLM Solutions

The data and information stored within a PLM solution represent both a digital definition of the product and a digital execution of the development process. Aerospace and defense companies must share this critical information across the enterprise systems in other functional departments, including their enterprise resource planning (ERP), sourcing systems, manufacturing systems, and more.

Traditionally, these integrations are notoriously difficult to develop. Updates to either the PLM or an enterprise system can break the integration. To overcome this issue, IT teams must constantly plan, strategize, and upgrade any changes across the entire IT ecosystem.

It is much easier to leverage integrations and low-code business applications for cloud-based SaaS PLM solutions. These solutions utilize web services, helping aerospace and defense companies seamlessly communicate between one or more software systems. This approach also provides flexibility and simplicity, enabling fast changes. Integration between two or more cloud-based systems is also simpler, thanks to web services. Business users can also expand on the out-of-the-box capabilities with low-code tools. What's more, many modern PLM systems offer out-of-the-box integrations with other enterprise systems. In short, cloud-based SaaS PLM solutions provide ease of use at every level.
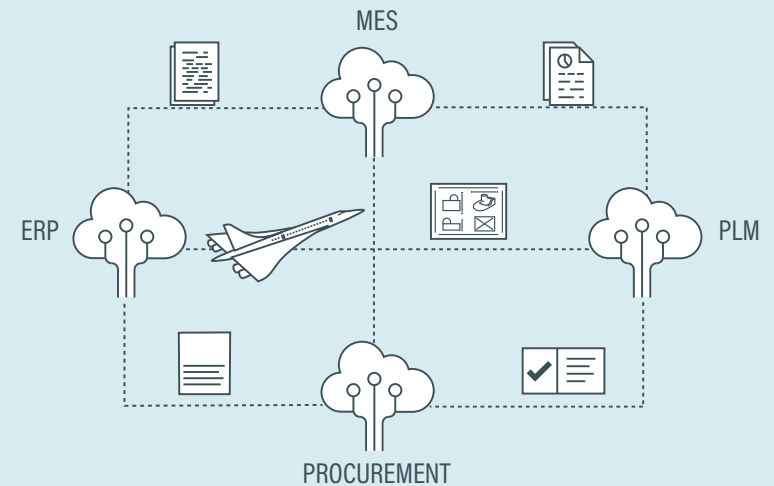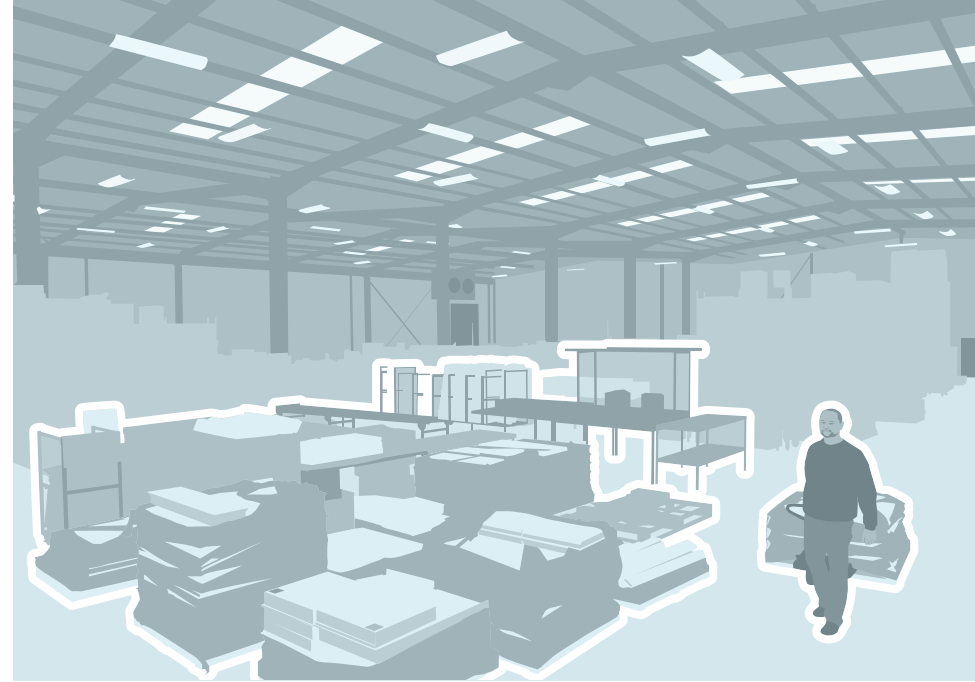

Figure 11
Cloud-based PLM solutions offer easier paths to integration between enterprise systems through the use of web services, allowing design teams and functional departments to share critical information with one another.

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Recap and Conclusions

Product development leaders in the aerospace and defense industry face two competing and contradictory constraints: satisfying target requirements and keeping up with development schedules, according to the 2020 Engineering Executive's Strategic Agenda study. Additionally, mounting and multi-faceted complexity prevents aerospace and defense companies from meeting these competing goals, slows down the development process, and complicates certification. The pandemic has increased organizational complexity thanks to enforced remote working initiatives, and these companies must continue to adapt to these changes. The study's findings laid bare these challenges. Forty-six percent of study respondents stated that fewer than six in 10 of their product development projects meet their launch or delivery deadlines. As a result, product development performance is lagging for many organizations, directly impacting key performance indicators (KPIs).

Based on these findings, Lifecycle Insights recommends the following:

- Companies should modernize development processes and technologies to mitigate the risks associated with rising product complexity.

- Companies should deploy solutions with comprehensive, integrated capabilities that can grow with their needs. These include:
  - requirements management, linking not only requirements but disparate engineering domains and functional departments;
  - multidisciplinary BOM management capabilities to synchronize, track, and seamlessly manage multidisciplinary BOMs, mitigating product complexity; and
  - project and program management capabilities across engineering disciplines and functional departments, tying development together and empowering proactive action.

- Companies should consider using cloud-based SaaS PLM solutions that require minimal IT support. These solutions also provide embedded best practices and easy cross-systems integrations with requirements management, multidisciplinary BOM management, and project and program management capabilities.

Deploy multidisciplinary BOM management capabilities to synchronize, track, and seamlessly manage multidisciplinary BOMs, mitigating product complexity.

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We empower better people, process, and technology decisions for tech-led engineering initiatives, driving the development of better products in less time.

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