THE 2022 DIGITAL TWIN REPORT

EXAMINING DIGITAL TRANSFORMATION MATURITY FOR PRODUCT DESIGN AND PRODUCTION ENGINEERING

LIFECYCLE INSIGHTS

EXECUTIVE OVERVIEW

There's no doubt about it: Digital transformation (DX) initiatives are gaining momentum among today's manufacturers. Each one has unique value and potential.

Lifecycle Insights' 2021 ROI of DX Study examined how various DX efforts can help manufacturers realize real value for their businesses. The research revealed that targeted DX initiatives provide significant ROI. The most progressive companies pursued an average of 12.5 investment initiatives per year, while the least progressive averaged only 3.5. Those investments paid off on multiple fronts. The most progressive companies were more likely to hit or exceed margin targets for their projects. They also required fewer prototypes and fewer days of inventory to hit those targets.

To gain additional insights into today's digital transformation efforts, Lifecycle Insights conducted the 2022 Digital Twin Study. The study surveyed respondents from automotive, aerospace, electronics, industrial machinery, medical devices, energy, and consumer products sectors. The study revealed marked differences between the most progressive companies and their least progressive peers.

This report shares the study's findings and offers new insights into the value delivered by more mature digital twins and digital threads as well as more mature integration between the two. The publication is broken into four sections:

- **Benchmarking the Respondents:** This section details the benchmarking methodology used to separate respondents into groups and compares their digital maturity for digital twins and digital threads.
- **Digital Maturity for Product Design:** This section shares more specific findings about the digital maturity of the most progressive compared to the least progressive in product design artifacts and processes.
- **Digital Maturity for Production Engineering:** This section examines the differences between the most and least progressive in digital maturity for artifacts and processes related to production engineering.
- **Realizing Value from Digital Maturity:** This section explains why higher levels of digital maturity deliver value for both product design and production engineering organizations.

Many manufacturers are pursuing DX initiatives today, but they don't all realize value from their efforts. This report offers powerful insight into how to derive benefits from such investments.

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BENCHMARKING THE RESPONDENTS

Findings from the 2021 ROI of DX Study revealed that many companies are changing their tools and processes in both product and production engineering to become faster and boost profitability. To explore the maturity of these approaches, Lifecycle Insights conducted the 2022 Digital Twin Study. This benchmark study split respondents into groups to reveal differences in their digital twin, digital thread, and integration maturity. This section explains:

- how the study categorized respondents and analyzed group performance; and
- how the digital maturity of product design and production engineering compared across groups.

SPLITTING RESPONDENTS INTO GROUPS

Respondents were questioned about the tactical initiatives in their product and production engineering areas. They received points based on their answers. These points were tallied to create an overall maturity score for three different dimensions: digital twin maturity, digital thread maturity, and integration maturity. Lifecycle Insights then segmented the respondents into three groups according to their maturity score: least progressive, moderately progressive, and most progressive.

These designations—least, moderately, and most progressive—capture the maturity of companies in their pursuit of technology-led initiatives. With the help of these technology led initiatives, organizations can improve how they operate and realize value in a variety of ways. Some want to protect margins by controlling product cost. For others, it is about delivering products on shorter timeframes. Regardless of the desired outcome, findings from the ROI of DX Study show that those that pursue more DX initiatives perform better.

COMPARING PRODUCT AND PRODUCTION ENGINEERING MATURITY ACROSS GROUPS

The main objective of the analysis was to separate respondents into groups with similar traits and characteristics. The differences between those groups revealed insights into their digital twin, digital thread, and integration maturity. High-maturity organizations use advanced digital solutions, a single source of truth for their digital twins, and an integrated approach to their digital threads. They also link those entities using a standardized technology.

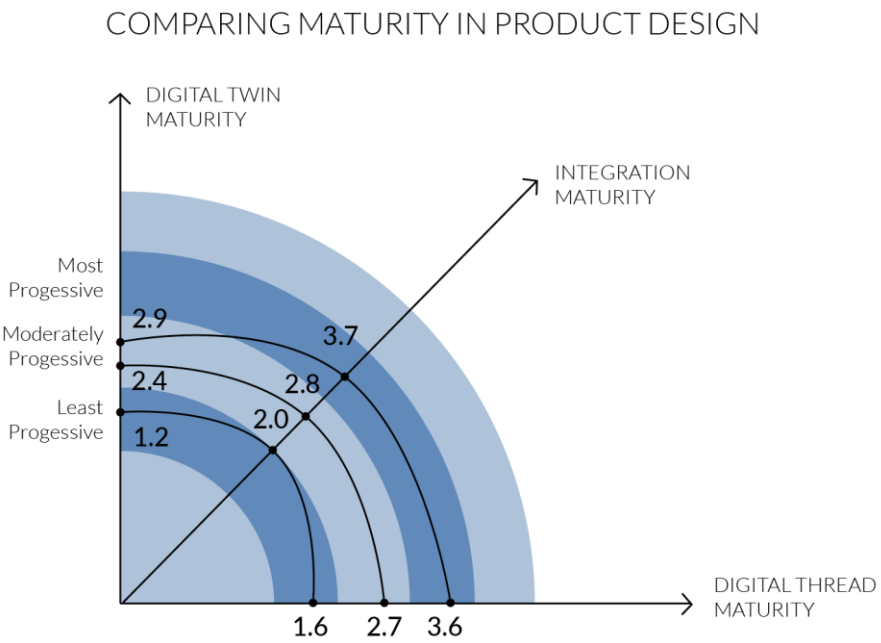


Figure 1: Maturity in product design along the parameters of digital thread, digital twin, and integration between the two.

The most progressive product design organizations had an average digital twin maturity score of 2.9, compared to 1.2 for the least progressive. Their digital thread maturity scores were 3.6 and 1.6, respectively. For integration maturity, the scores were 3.7 and 2.0.

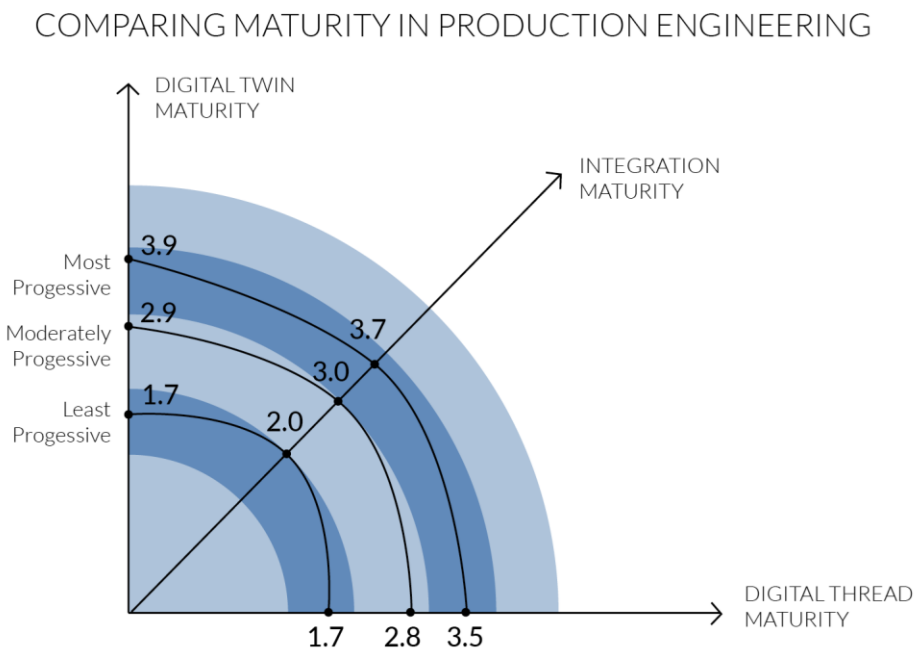


Figure 2: Maturity in production engineering along the parameters of digital thread, digital twin, and integration between the two.

For digital twin maturity, the most progressive production engineering companies had an average score of 3.9 compared to 1.7 for the least progressive. Their digital thread maturity scores were 3.5 and 1.7, respectively. For integration maturity, they scored 3.7 and 2.0.

DIGITAL MATURITY FOR PRODUCT DESIGN

Designing today's smart, connected products is challenging. Engineers developing mechanical hardware, electronics, electrical distribution systems, and software must coordinate their work so it all fits seamlessly together. Digital twins, digital threads, and the connection between the two can deliver value here by bridging silos, ensuring superior collaboration, and speeding up the digital transformation implementation.

This section of the report examines the maturity of digital twins, digital threads, and their integration in the area of product design. The study found that progressive companies extract value by improving their digital maturity across all three areas. These companies decreased development times, increased efficiency, and created data transparency, among other benefits. This section explains:

- the role of standardization and centralization for digital twin maturity;
- how automation and normalization increase digital thread maturity; and
- why connecting product twins and design threads is key to optimizing the design process.

PRODUCT DIGITAL TWINS: STANDARDIZATION AND CENTRALIZATION

Engineers use a digital twin to develop and test the product, during various stages of development. The digital twin of a product consists of the definitions, documentation, and simulations that detail the form, fit, and function of every aspect of a product: every system, every assembly, and every item. Within product design, these digital representations may include the product's mechanical hardware, electrical distribution systems, electronics board systems, and embedded software. Engineers use the digital twin to develop and test the product, both digitally and physically.

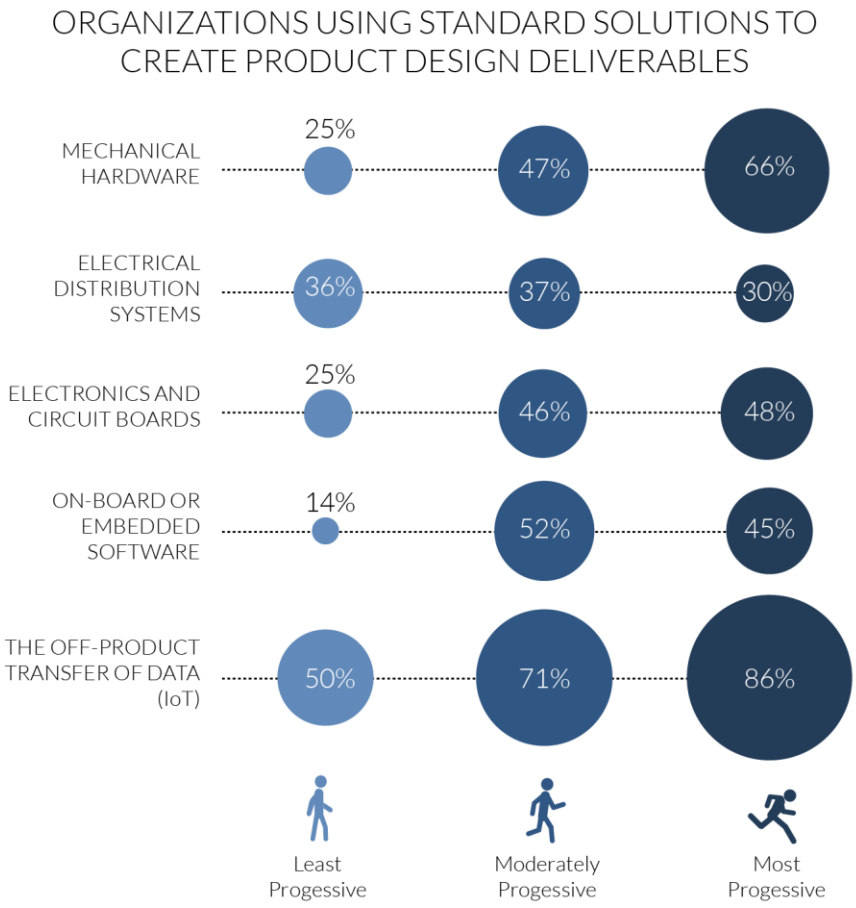


Figure 3: The most progressive are more likely to employ standard solutions to create digital deliverables across many domains.

The 2022 Digital Twin Study considered several things when assessing the maturity of a company's product digital twin efforts. First, it examined the degree to which an organization creates digital representations of products using a standardized set of tools. Standardization refers to using the same tool to create a deliverable. Standardization in mechanical hardware design means every designer in the company is using the same CAD solution to create all mechanical designs.

The study revealed that standardization is not constant across the board. For IoT and mechanical hardware, many companies standardize their tools. But this level of standardization is less pronounced in electronics and embedded software design. For electrical distribution systems, companies tend to use many solutions from different solution providers.

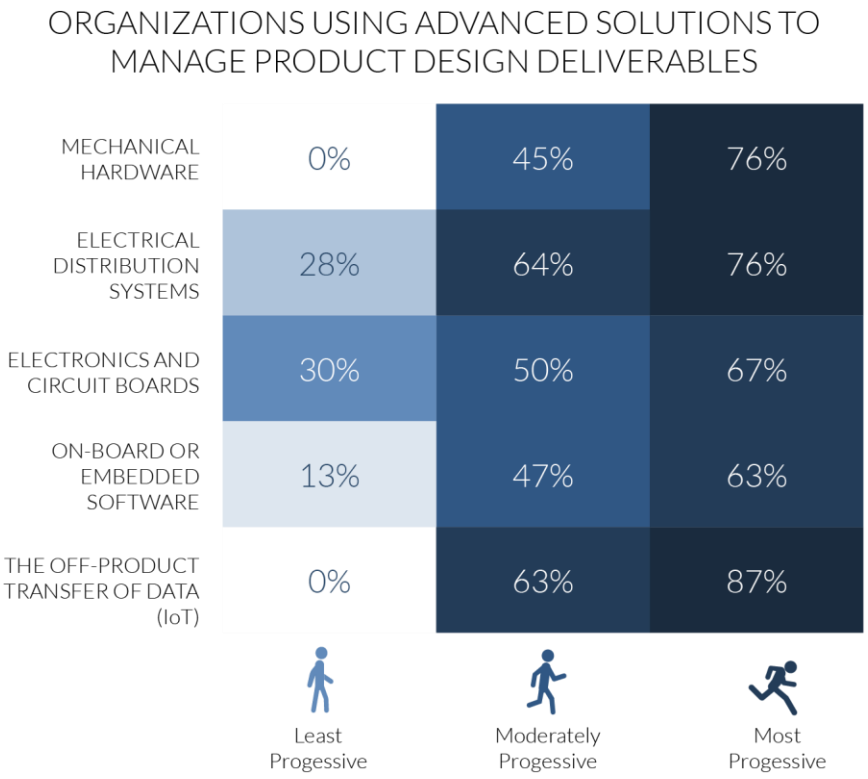


Figure 4: The most progressive are more likely to employ advanced solutions to manage digital deliverables across many domains.

When assessing digital maturity, the study also evaluated how companies manage their digital representations with advanced solutions like product data management (PDM), product lifecycle management (PLM), and application lifecycle management (ALM).

At least 63% of the most progressive companies manage all digital representations of product design documents using modern data management solutions, including PDM, PLM, or ALM systems. Less than 30% of the least progressive companies can say the same. Additionally, compared to their least progressive peers, the most progressive companies are at least three times more likely to execute product design processes using one or many standardized solutions (including PDM, PLM, or ALM systems).

Higher levels of standardization, both in terms of creating and managing deliverables in product design, offer significant benefits. Standardized solutions for the creation of design deliverables allows for easier sharing across teams. A single source of the truth provides access to digital definitions across teams, organizations, companies, and even supply chains. Both allow the most progressive to realize more value from their DX efforts. A more in-depth explanation appears in the “Realizing Value from Digital Maturity" section of this report.

DESIGN DIGITAL THREADS: AUTOMATION AND NORMALIZATION

The digital thread maturity for product design is a key concept. A digital thread is a discrete, linked, traceable sequence of tasks and activities. Digitized and automated activities vary widely in their scope. But every digital thread provides users with a fast, intuitive way to navigate through all systems of record.

Some digital threads are executed completely in engineering, and others may be run only in manufacturing. Some may span both engineering and manufacturing. Likewise, some focus exclusively on the product or on production, while others straddle the two. Furthermore, additional digital threads may connect products across operation and service, as well as other key product development areas. In product design, digital threads govern and drive how engineers design and validate products.

As part of the research, Lifecycle Insights assessed two aspects of digital thread maturity in product design: the tools and technologies used to create the digital thread and the standards used to execute and manage those tools and technologies.

The first area assessed was the degree to which companies use a standardized process. Teams, departments, or entire companies can adopt a standard for how they execute tasks and activities in product design. Alternatively, they may not use any standards, and execute these processes using ad-hoc approaches instead.

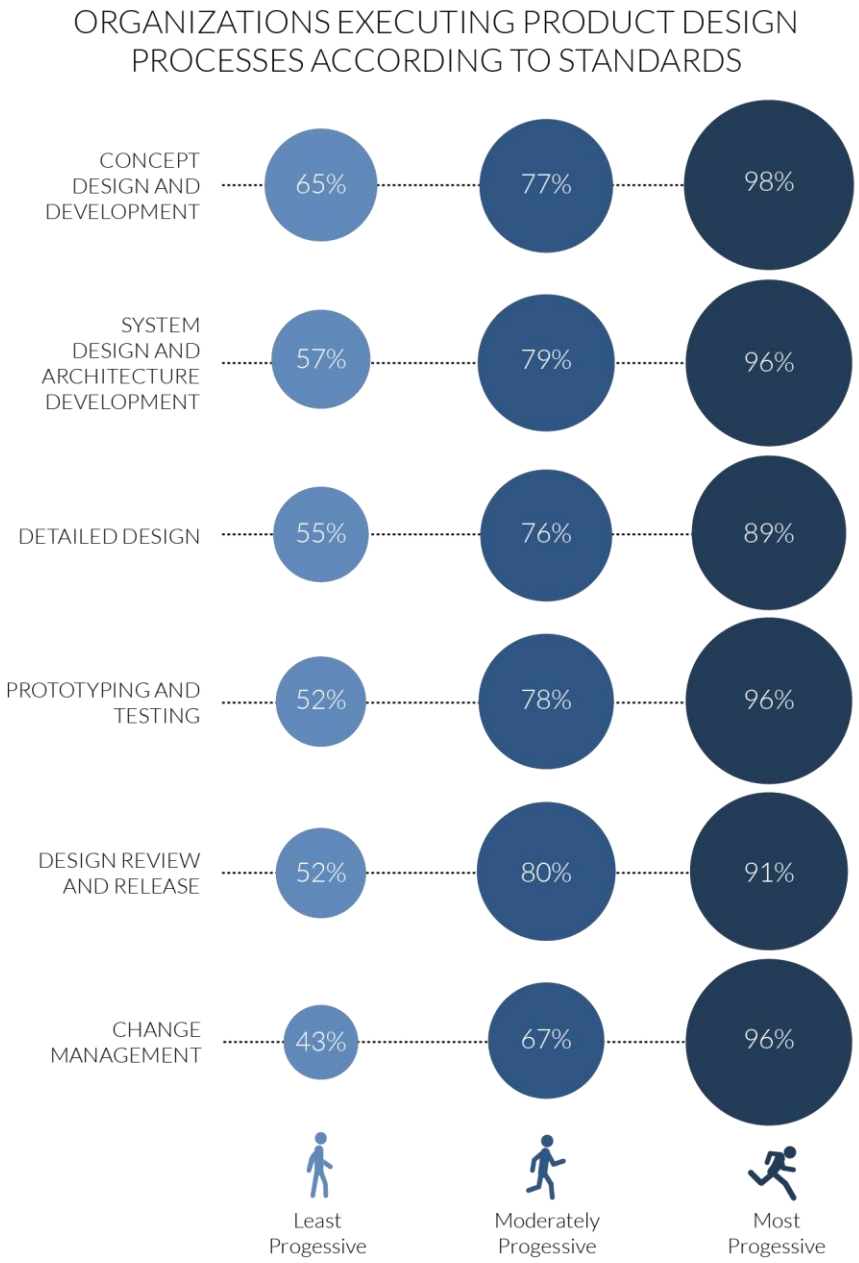


Figure 5: The vast majority of the most progressive employ standard processes for product design, compared to roughly half of the least progressive.

Overall, more than 90% of the most progressive companies execute the vast majority of their design processes according to an established standard. By contrast, only about 52% of the least progressive companies can say the same.

Process standardization is not the only indicator of a company's digital thread maturity. The second area assessed was the degree to which companies employ a standard solution to automate and execute their processes. Companies can use different types of solutions for different domains, such as a PDM, PLM, or ALM system. Or they can use emails, documents, and spreadsheets. Alternatively, companies may not use any particular tool or technology to execute their product design process.

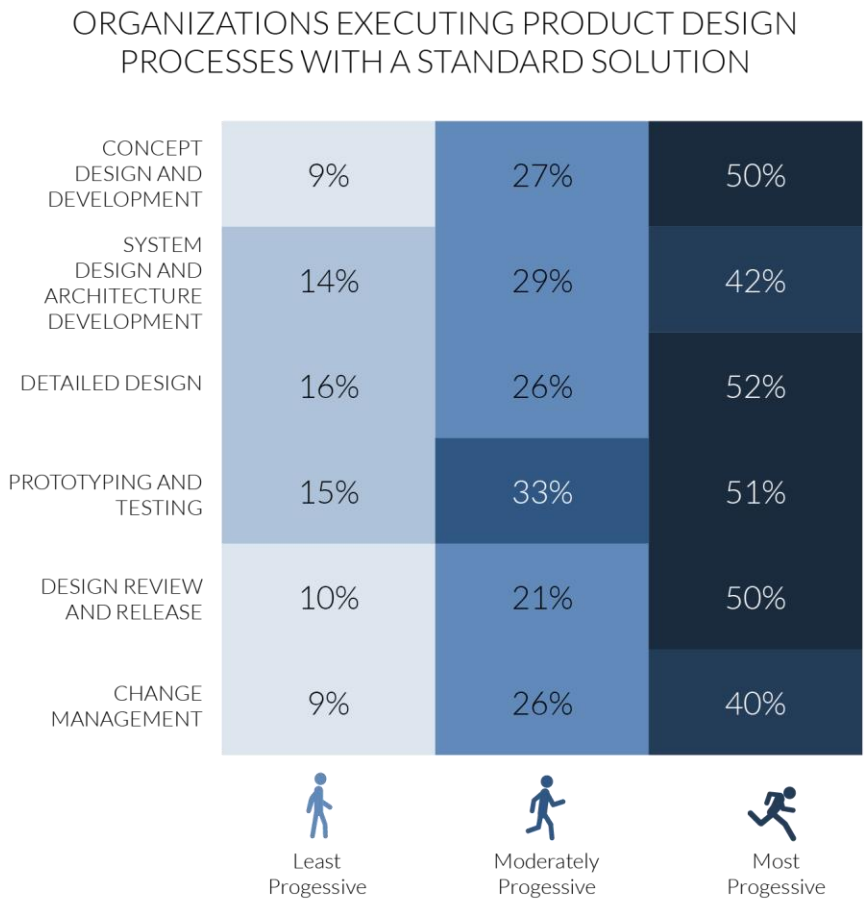


Figure 6: The most progressive are far more likely to use a standardized solution to automate and execute their product design processes.

The study revealed two key findings concerning process execution using solutions. First, almost half of the most progressive companies execute their various product design processes using one solution. Second, only 10-16% of the least progressive companies execute their product design processes with a single solution.

Organizations that execute common processes using standard solutions gain efficiencies due to familiarity and repetition. They can catch issues far

earlier in the development process by leveraging tools that automate processes and enforce well-defined activities and gates. Progressive companies are realizing value from their high digital thread maturity on these fronts.

A more in-depth explanation of how these companies are executing digitally mature product design processes appears in the “Realizing Value from Digital Maturity” section of the report.

CONNECTING PRODUCT DESIGN DIGITAL TWINS AND THREADS

During the product design process, engineers and other stakeholders must execute various tasks. For example, a manager may need to sign off on a design. To execute that task efficiently, he or she will require access to concept design, design drawings, and possibly simulation results.

Finding the right information for specific tasks can be challenging given the complexity of products and their corresponding digital definitions. Integration between the digital twin and digital threads is crucial to making well-informed decisions and accelerating the development process. To assess digital maturity in this area, Lifecycle Insights looked at how process stakeholders find the right information for tasks in a given process.

The study found that, compared to the least progressive companies, the most progressive companies are at least five times more likely to find product design content using links from the process task in PDM, PLM, or ALM solutions.

Progressive companies realize value in product design by connecting their digital twin and digital thread. Stakeholders in progressive companies are using PDM, PLM, or ALM solutions to more efficiently find and access the right design-related information, such as models, drawings, simulation, and more, while executing their tasks. A more in-depth explanation appears in the “Realizing Value from Digital Maturity” section of the report.

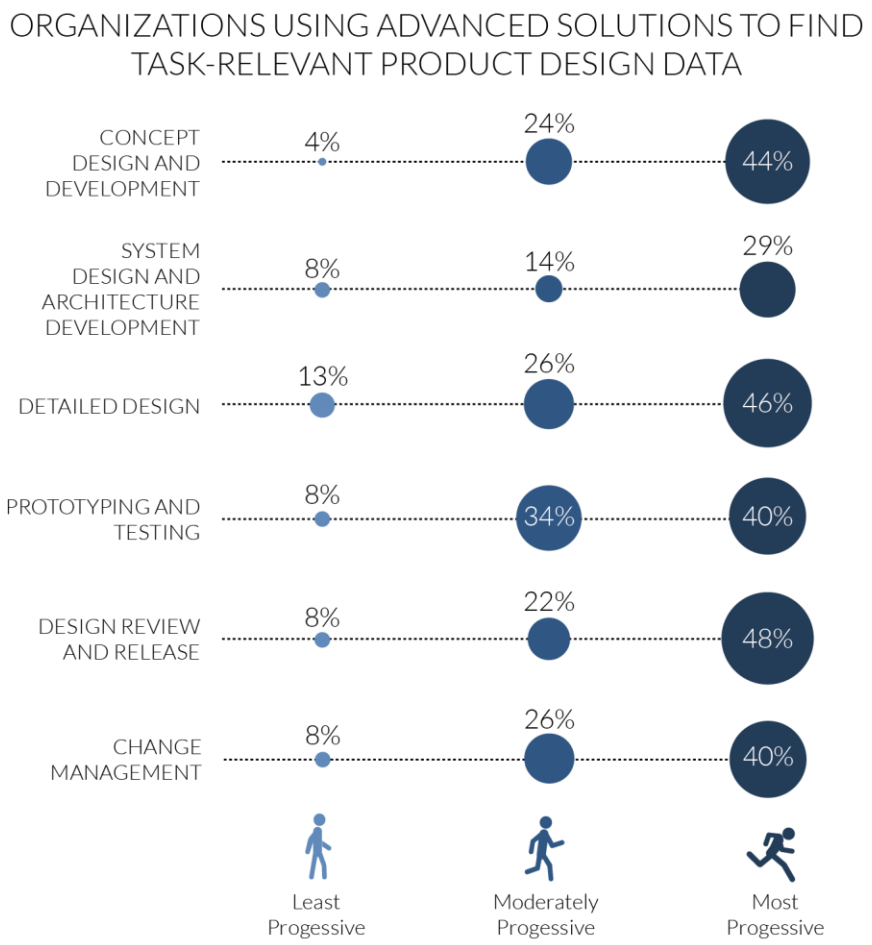


Figure 7: The most progressive are more likely to use advanced solutions, such as PLM or ALM, to find the right data or information for steps in a process.

TAKEAWAYS

- At least 63% of the most progressive companies manage all digital representations of product design documents using one or many standardized solutions (including PDM, PLM, or ALM systems). By contrast, less than 30% of the least progressive companies can say the same.
- The most progressive companies are at least three times more likely than their least progressive counterparts to execute product design processes using one or many standardized solutions (including PDM, PLM, or ALM systems).

- More than 90% of the most progressive companies execute a vast majority of their design processes according to an established standard (either a company-wide or team-wide standard). In comparison, this figure is around 52% for the least progressive companies.
- The most progressive companies are at least five times more likely than the least progressive to find product design content using links from the process task in PDM, PLM, or ALM solutions.
- By employing standardized solutions (including PDM, PLM, or ALM systems), the most progressive companies achieve higher profitability and reduce their time to market.

DIGITAL MATURITY FOR PRODUCTION ENGINEERING

When it comes to production, manufacturers face significant challenges. Like products, today's work cells and production systems are chock-full of electronics and software, and therefore data. Manufacturers want to know how to make manufacturing operations as efficient as possible. Digital twins, digital threads, and the connection between the two can deliver tremendous value here.

This section of the report shares detailed findings from the study on production engineering. It examines the maturity of digital twins, digital threads, and their integration. Findings from the study reveal that progressive companies realize value by improving their digital maturity across all three areas. This section explains:

- the role of standardization and centralization for digital twin maturity;
- how automation and normalization increase digital thread maturity; and
- why connecting manufacturing digital twins and threads is key to optimizing the production engineering process.

PRODUCTION DIGITAL TWINS: STANDARDIZATION AND CENTRALIZATION

The definition of a production digital twin is similar to the definition of a product digital twin. The production digital twin encompasses everything in manufacturing production, spanning every operation, every cell, every line and system, and even entire facilities. Companies create and manage plans, models, test results, documents, robot and human simulations, and other such assets to create a digital twin of their production environment. This digital twin is then used for manufacturing tooling, NC machining, production lines, manufacturing facilities, and production floor data transfers. The 2022 Digital Twin Study assessed each group's production digital twin maturity by measuring how many organizations use advanced solutions to track and manage their production engineering deliverables.

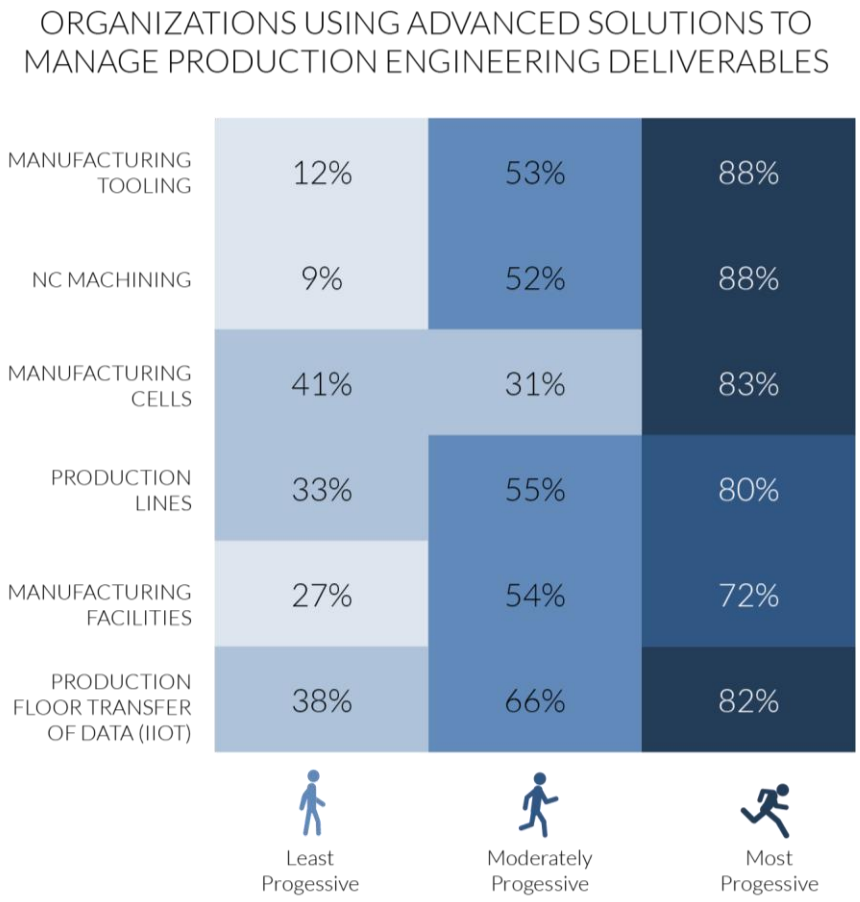


Figure 8: The most progressive are more likely to employ an advanced solution, such as PDM, PLM, or ALM, to manage digital deliverables for production engineering.

At least 70% of the most progressive companies manage all digital representations of production engineering deliverables using an advanced solution, including PDM, PLM, and ALM. That number is less than 43% for the least progressive companies.

Managing the deliverables for production engineering allows stakeholders across teams, departments, the company, and even the supply chain to access a single source of the truth from one, central location. This greatly minimizes the chances that someone will reference wrong or out-of-date deliverables. The most progressive realize strong value from this practice when managing product engineering deliverables. A more in-depth explanation appears in the “Realizing Value from Digital Maturity” section of the report.

PRODUCTION ENGINEERING DIGITAL THREADS: AUTOMATION AND NORMALIZATION

Just like in product design, digital thread maturity for production engineering is a key concept for manufacturing companies. A digital thread is a discrete, linked, traceable sequence of activities that is digitized and automated. In production engineering, the digital thread is broadly defined as a digitally enabled set of methods and practices specific to manufacturing planning and operation processes in cells, lines, and facilities. Digital threads range widely in scope and provide means to navigate fast and flexibly through all systems of record.

To assess the digital maturity of digital threads for production engineering, Lifecycle Insights assessed two traits of organizations: the standards used to execute and manage key processes in production engineering, and the degree to which organizations have converged on a single solution to manage these processes.

The first area assessed was the degree to which companies use a standardized process. Teams, departments, or entire companies can adopt a standard for how they execute the sequence and type of activities in production engineering. Alternatively, they may not use any standards, but resort to ad-hoc approaches to execute these processes instead.

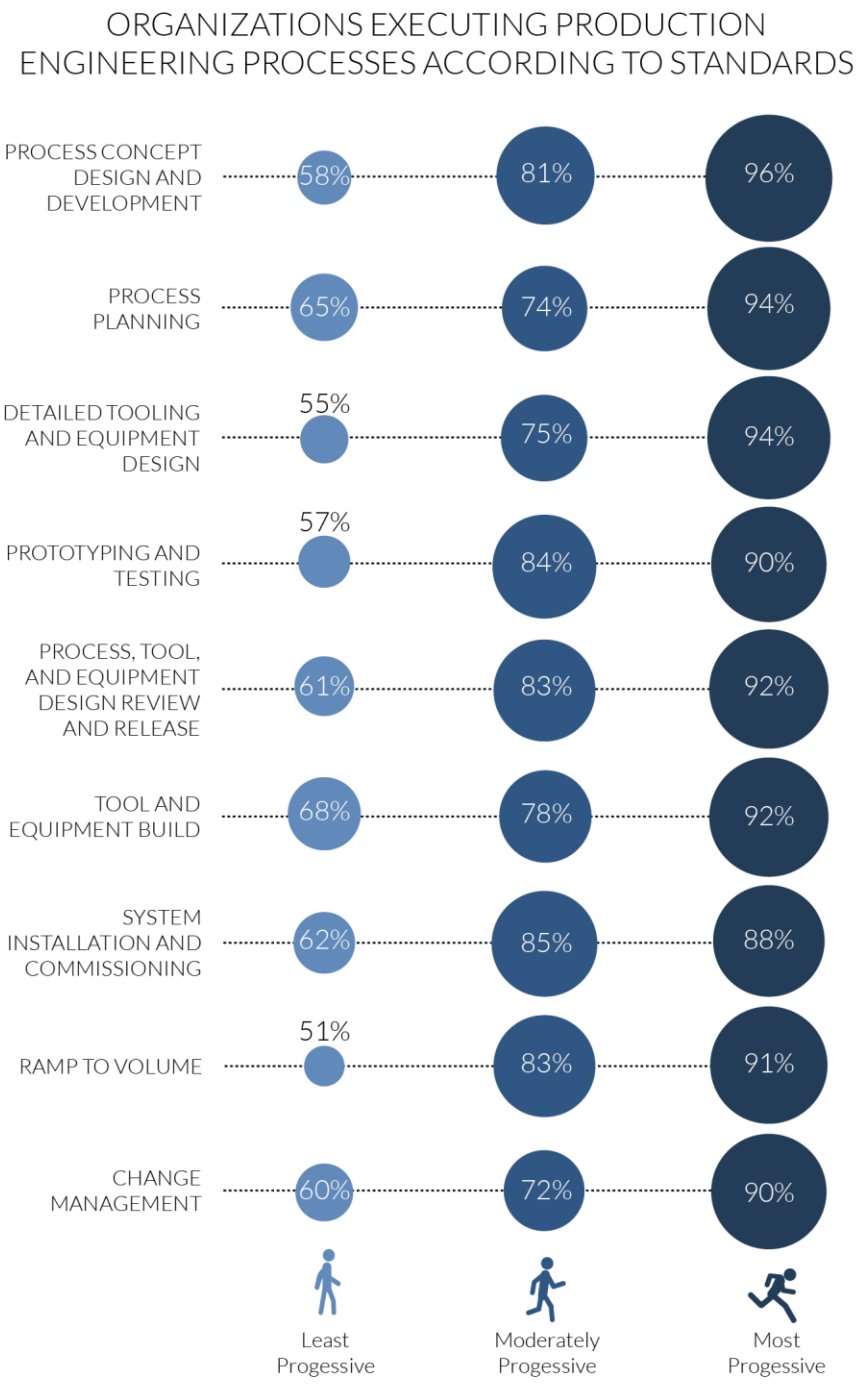


Figure 9: A little over half of the least progressive employ standard production engineering processes compared to the vast majority of the most progressive.

More than 90% of the most progressive companies execute manufacturing planning processes according to an established company-wide or team-

wide standard. In comparison, that number is around 60% for the least progressive companies.

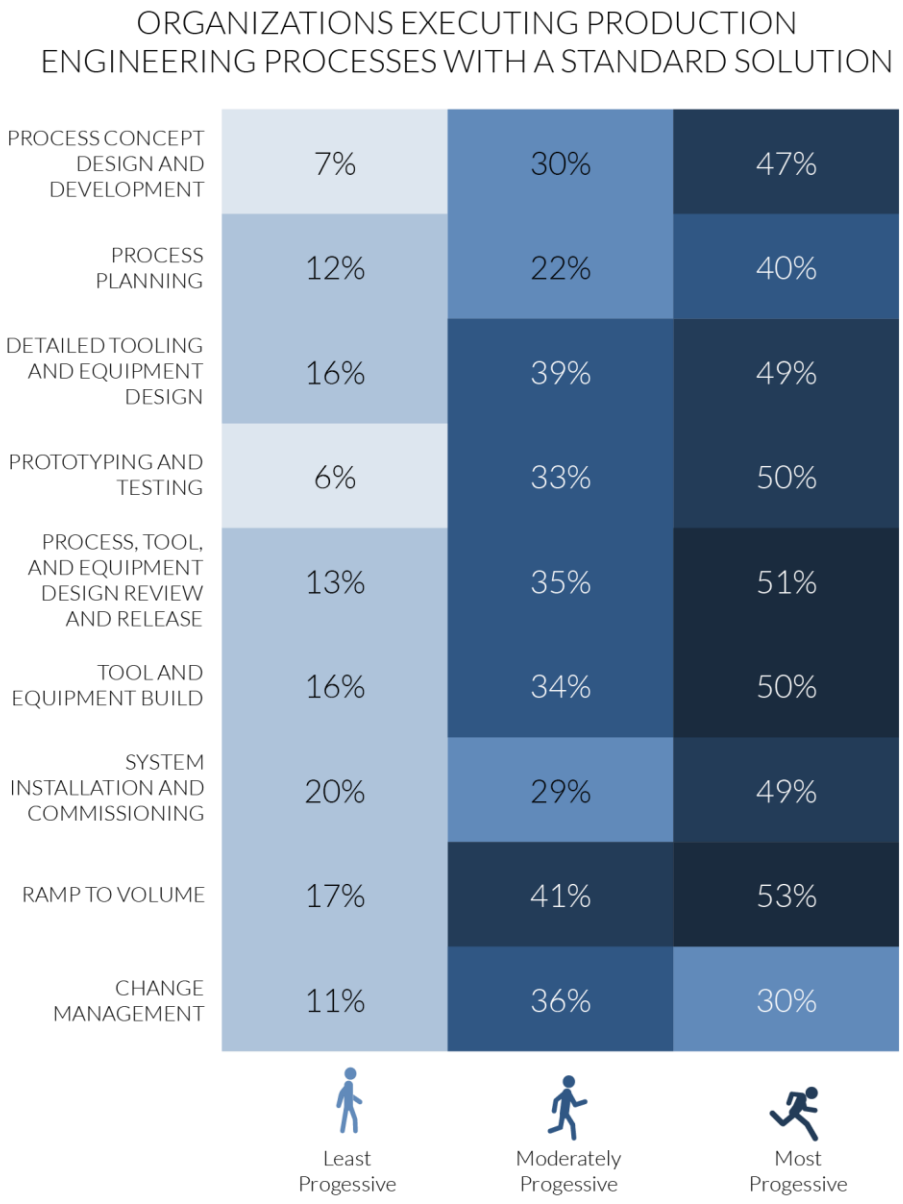


Figure 10: The most progressive are far more likely than their less progressive peers to use a standardized solution to automate and execute their production engineering processes.

Leveraging a standard process is a differentiated practice, but not the only one. The second area assessed was the degree to which companies employ one solution to automate and execute their processes, including PDM, PLM, or ALM. Alternatively, they can use emails, documents, and

spreadsheets, or no particular tool or technology to execute their manufacturing planning process.

Approximately half of the most progressive companies execute production engineering processes with just one solution. By contrast, less than 20% of the least progressive companies execute production engineering processes with a single solution.

The use of a standardized process yields many benefits, including familiarity that can accelerate production engineering. This advantage is further amplified by the use of a standardized solution to automate and execute those processes. Progressive companies are realizing value from their high digital thread maturity in these areas. A more in-depth explanation appears in the “Realizing Value from Digital Maturity” section of the report.

CONNECTING PRODUCTION DIGITAL TWINS AND THREADS

Many key activities are part of the production engineering process. Any of them could slow down or jeopardize the speed and efficiency with which a product is created. Stakeholders and entire teams must find and use the right information for each step of the process. Otherwise, decisions in the process are made against the wrong information, resulting in delays and cost overruns. Integration between the digital twin and digital threads is crucial to making well-informed decisions and accelerating the production engineering process. To assess digital maturity in this area, Lifecycle Insights looked at how process stakeholders find the right information for tasks in a given process.

This finding shows that the most progressive companies are more than twice as likely as their least progressive counterparts to find production planning content using links from the process task in an advanced solution such as PDM, PLM, or ALM.

Connecting the digital twin and digital threads in the production engineering process ensures that stakeholders have the right information at the right time. Access to material flow simulations, cell layouts, production line models, and more ensures everyone is on the same page. Production engineering executives can make informed decisions to create a faster, more flexible manufacturing environment. A more in-depth explanation appears in the “Realizing Value from Digital Maturity” section of the report.

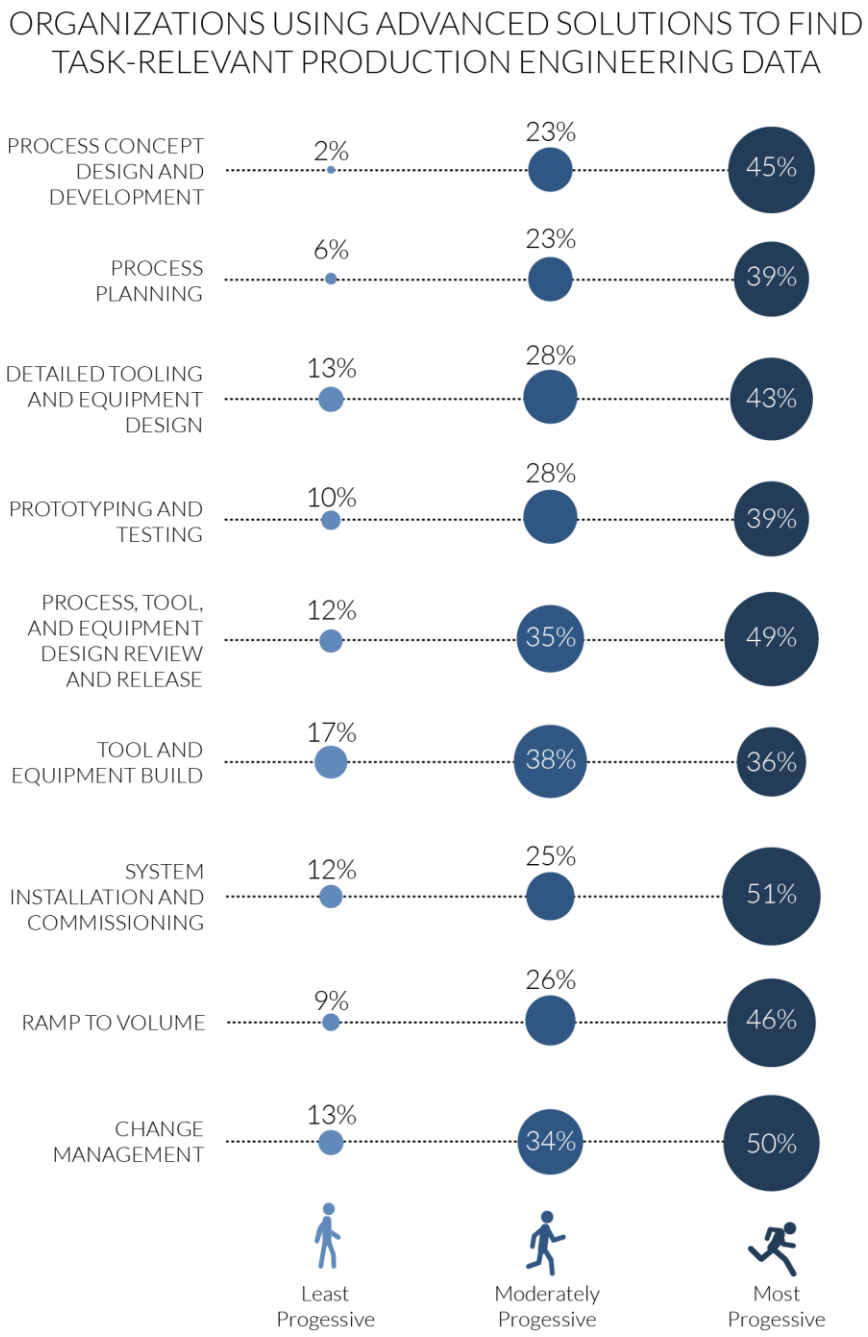


Figure 11: The most progressive are more likely to use advanced solutions, such as PLM or ALM, to find the right data or information for steps in a process.

TAKEAWAYS

- At least 70% of the most progressive companies manage all digital representations of production engineering documents using one or many standardized solutions (PDM, PLM, or ALM). That figure is less than 43% for the least progressive companies.
- Between 40% and 50% of the most progressive companies execute the majority of their manufacturing planning processes using one PDM, PLM, or ALM solution. For the least progressive companies, this figure is between 6% and 20%.
- More than 90% of the most progressive companies execute manufacturing planning processes according to an established company-wide or team-wide standard. In comparison, that number is around 60% for the least progressive companies.
- The most progressive companies are more than twice as likely as the least progressive to find production planning content using links from the process task in PDM, PLM, or ALM solutions.
- By employing standardized solutions (including PDM, PLM, or ALM systems), the most progressive companies achieve higher profitability, reduce their time to market, and improve collaboration between stakeholders.

REALIZING VALUE FROM DIGITAL MATURITY

Findings from Lifecycle Insights' 2022 Digital Twin Study revealed stark differences between the most and least progressive organizations in product design and production engineering. But how do these differences impact the competitiveness of companies? This section answers that question by examining the values and benefits that companies can realize by enhancing their digital maturity. These include:

- improved data accessibility and communication enabled by a single source of the truth;
- design process improvements stemming from enterprise-wide controlled access;
- accelerated product development;
- better accountability and quality; and
- getting the most out of the industrial IoT (IIoT).

SINGLE SOURCE OF TRUTH AND ENTERPRISE-WIDE ACCESS

Access to a single source of the truth for digital twins is one advantage of higher levels of digital maturity. PDM, PLM, and ALM systems provide a single source of the truth that is readily available across an organization and to all its stakeholders. Using these systems, engineers can access one unambiguous source of truth for their models, drawings, and other artifacts. As a result, companies can manage the digital definitions of the product design and production process holistically.

With this single source of the truth in place, all stakeholders work with the latest digital representations. This enables a different advantage of higher levels of digital maturity: enterprise-wide controlled access.

This capability allows engineering teams to release design artifacts to downstream stakeholders. Individuals in procurement, manufacturing, marketing, quality, service, and other departments can then access the design data directly from the PDM, PLM, or ALM system. They can access it from anywhere and at any time, which is especially useful for remote workers and those with non-standard schedules. By working with PDM, PLM, or ALM solutions, companies enable even external stakeholders such as contractors, regulating bodies, and consultants to access relevant data.

Procurement teams can now share the right designs with suppliers during the request-for-proposal process, benefiting the whole organization. Machinists will manufacture the right tooling. Marketing can create the correct photorealistic rendering of the final product for their campaigns. Service planners can provide appropriate maintenance procedures at product launch. Decision-makers can access the latest documents and production data from their factories.

If the design artifacts change, either before the design release or afterward, as part of a change process, stakeholders can be notified about the modification. Stakeholders are aware of the latest changes made to the digital representations so they can make corresponding changes to their work, or different decisions. They also know the origin of the changes. The notification process reduces the errors in downstream operations due to incorrect product design representations.

Organizations can control access to their digital representations at different stages of development. During development, the PDM, PLM, or ALM system controls what is available and when. Once the designs are finalized, the design release data is available to key stakeholders. Production engineers with the right level of access can develop tooling, NC

toolpaths, cell layouts, and more based on the finalized design representations.

ACCELERATED PRODUCT DEVELOPMENT

With a PLM, PDM, or ALM system, engineers can deliver the right design information to the right people at the right time using automated processes. Organizations typically do this by incorporating models, drawings, and other design information into an automated workflow. This information can then be used across design reviews, design release, project management, and change management details.

Engineering teams rarely get products right the first time. Changes to products are inevitable. Executing changes efficiently reduces development time. When a change is required, engineers must identify and work with the correct digital representation to make that change. Using a standard system such as PDM, PLM, or ALM, stakeholders have fast access to the most accurate digital representation. They spend less time searching for and verifying the correct data.

Additionally, such automations also aid in enforcing process standards within the organization. Stakeholders cannot circumvent steps or activities that have been designated as part of the standard for the organization. As a result, there are fewer variations of the process. Workflows powered by PDM, PLM, or ALM are a key part of this capability.

Another advantage to such automations lies in avoiding lost, forgotten, or deferred tasks. When process activities are ignored or forgotten, new notifications can be shared with the responsible party. But just as importantly, if these go unaddressed, such automations can elevate the status of the task to managers, allowing them to take corrective action or explicitly defer the process.

IMPROVED PRODUCTIVITY AND EFFICIENCY, BETTER ACCOUNTABILITY AND QUALITY

Progressive teams, departments, and companies execute their design and production processes using well-defined standards. By conforming to standards, stakeholders avoid resorting to guesswork or wasting time trying to identify ways to execute processes. Also, by following a

prescribed standard, stakeholders execute every task in a pre-defined way. The output is not dependent on the person executing the task. These industry best practices boost product consistency, driving high-quality standards and enabling organizations to improve the efficiency with which they execute tasks. Plus, a standard process is easy to identify and work with, allowing organizations to operate with consistency and speed. Standardized processes eliminate many mistakes that result from using ad-hoc processes.

Executing processes that conform to set standards boosts productivity and improves accountability. Stakeholders execute every task in a pre-defined way. Employees do not have to ask for the correct procedure when they encounter a task. It is clear who needs to do what, and when. They just need to refer to the standards list to get answers. If they find a better process, the company can easily change the standard to improve it. Likewise, if there is a problem, it's clear whose job it is to fix it. As a result, engineers and other stakeholders can now spend their precious time on important, value-adding tasks.

A major source of error in the product development process is the use of incorrect data. But when using a PDM, PLM, or ALM system, engineers work with the correct version of the digital representation, eliminating such errors. When the latest data is linked to the digital task for an individual, there is no ambiguity. The individual simply clicks on the link to find the most recent and relevant data and then uses that information to make an accurate decision or create new digital representations.

INDUSTRIAL IOT

All of these practices and solutions yield benefits in product design and production engineering. However, their value extends far beyond that. By adopting a standardized solution to manage all processes from design to production, organizations build a base on industrial IoT (IIoT) initiatives.

Companies can use the data from their production environments to improve the quality of their products, reduce downtime for customers, save energy, accelerate production, and introduce products and services to augment their revenue stream. Edge computing devices, end-to-end IIoT services, and low-code platforms are some of the critical technology enablers of IIoT. Complete digital twins and digital threads act as the foundation for IIoT efforts.

TAKEAWAYS

- Progressive companies with a high level of digital maturity realize value that helps them stay ahead of their competitors.
- These companies maintain a single source of truth for their digital representations using PDM, PLM, and ALM solutions. All stakeholders are able to access the latest iteration of the digital data. When the status of any digital representation changes, a standardized solution automatically notifies all stakeholders.
- Progressive companies guarantee controlled access to the digital artifacts to both internal and external stakeholders. At the right time, stakeholders can access accurate and relevant data. Moreover, the data access is linked to the process.
- Progressive companies boost the productivity and efficiency of their employees and shorten the time to release products to market.
- By maintaining accountability across their teams and enabling IIoT, companies release high-quality products and continue to improve them.

SUMMARY AND RECOMMENDATIONS

DX initiatives are diverse in both their adoption rates and maturity. When implemented correctly, these initiatives offer organizations many rewards across both product design and production engineering. Lifecycle Insights' 2022 Digital Twin Study examined the maturity of respondents' DX initiatives on multiple fronts. This report highlighted the following findings:

- Companies are changing their processes, practices, and solutions in both product and production engineering. The study investigated digital twin, digital thread, and integration maturity for companies at varying stages of DX adoption.
- The research revealed that high maturity in digital twins, digital threads, and integration comes with many benefits. Businesses with a mature digital twin benefit from a single source of truth that streamlines their collaboration and design decisions. As a result, these companies can better develop complex products.
- Digital thread maturity increases when a connected, integrated product or production view is available. Collaboration is seamless, and automation tools further optimize and accelerate the development process while reducing errors. Functional departments are also connected, providing traceability and continuity across the project lifecycle.

- Integration between the digital twin and digital thread is vital, allowing engineers fast access to the correct digital definitions. Standardized technologies such as PDM, PLM, and ALM systems can minimize the number of errors and optimize the product development process.

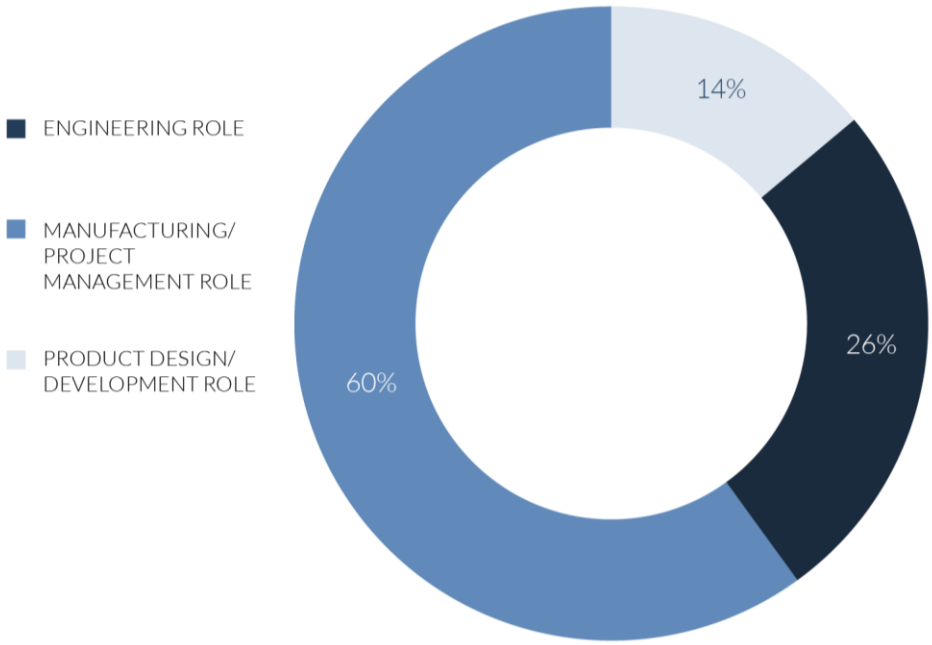
Based on these findings, Lifecycle Insights offers the following recommendations:

- Companies should define a strategic plan to develop and manage their product design and production engineering digital definitions using standardized tools and technologies.
- Companies should consider how a comprehensive digital twin, an unambiguous definition of the product, and digital threads, the digital processes used to execute development, can be enhanced over time by various DX initiative investments. At the same time, integrations between the digital twin and digital threads are necessary to avoid errors and accelerate product development.
- Companies should identify their position in the maturity map based on the findings in the report in both product design and production engineering. Then, they should implement strategies to bridge gaps on the maturity scale.

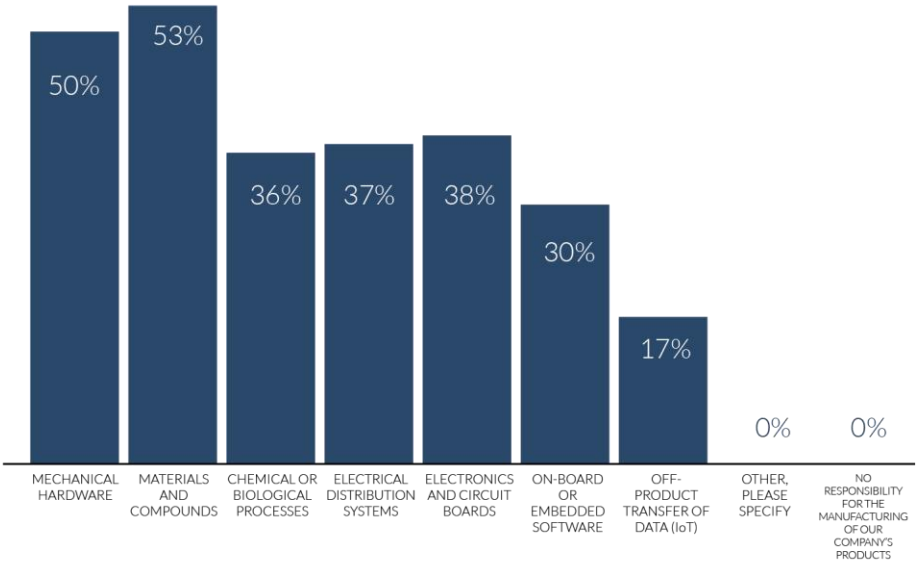
APPENDIX

The following graphics provide more information about the respondents in Lifecycle Insights' 2022 Digital Twin Study. The figures show the respondents' roles, the industries and locations they serve, and the size of their companies.

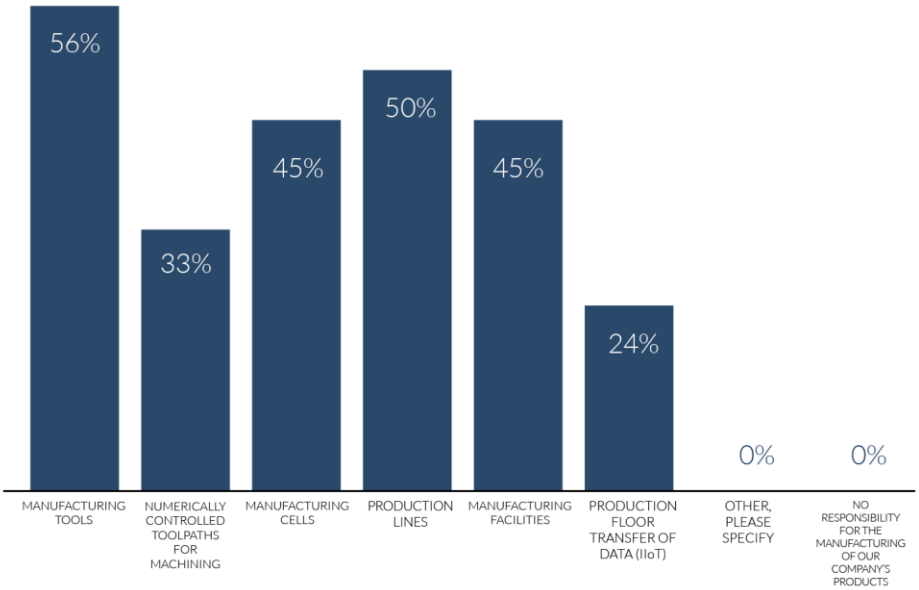
ROLES OF THE STUDY'S RESPONDENTS



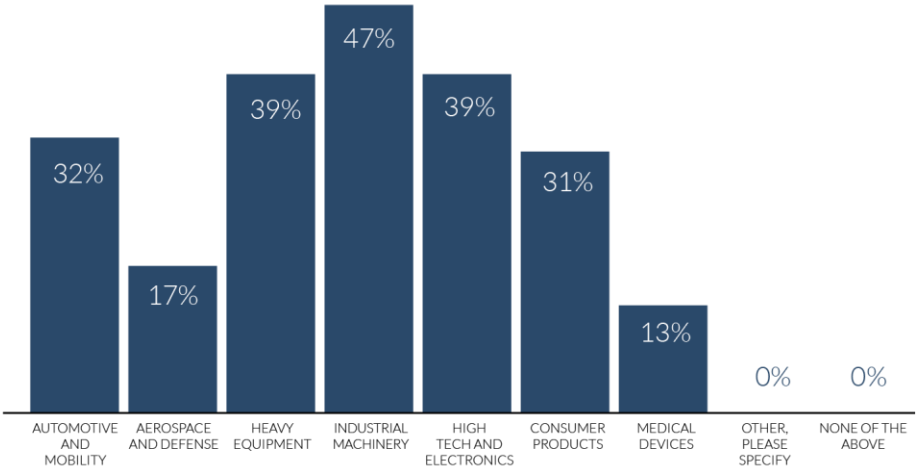
PRODUCT DESIGN RESPONSIBILITIES
OF THE STUDY'S RESPONDENTS



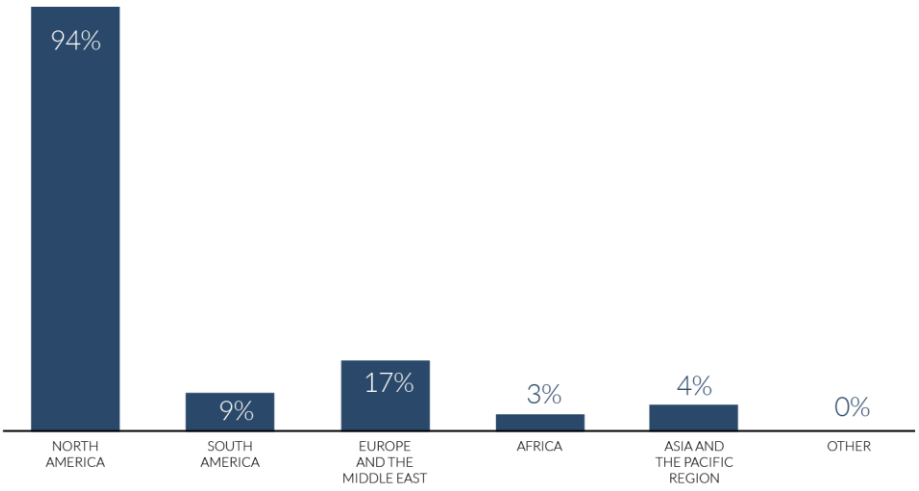
PRODUCTION ENGINEERING RESPONSIBILITIES
OF THE STUDY'S RESPONDENTS



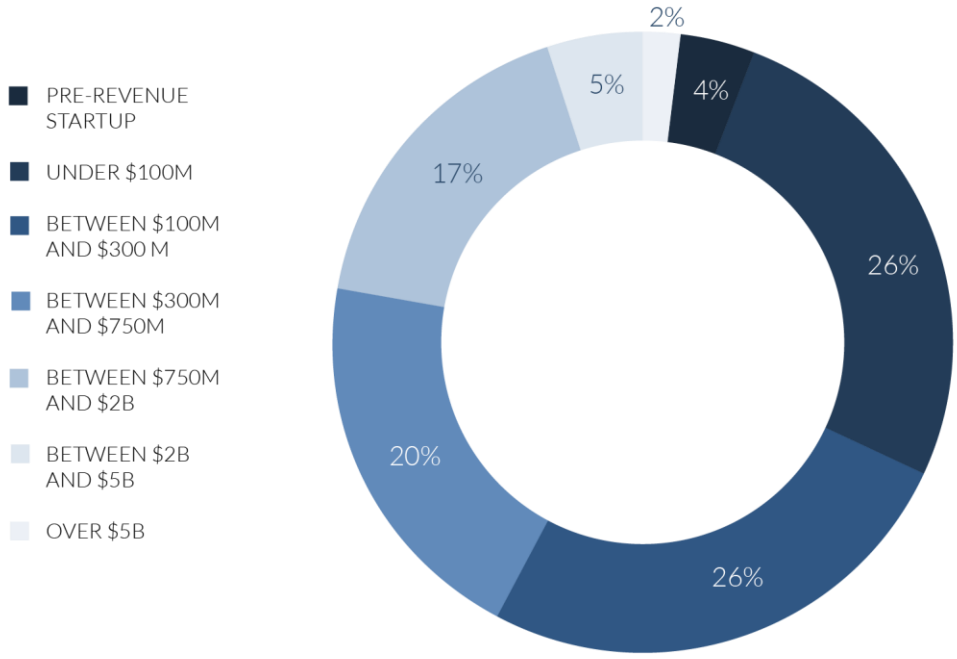
INDUSTRIES SERVED BY THE STUDY'S RESPONDENTS



GEOGRAPHIC WORK LOCATIONS OF THE STUDY'S RESPONDENTS



REVENUE OF RESPONDENTS' COMPANIES



Chad Jackson leads Lifecycle Insights' research and thought leadership programs, attends and speaks at industry events, and reviews emerging technology solutions.

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