PLM &
The Digital Enterprise

Strategic Manufacturing Industry Initiatives and How PLM Enables Them

2018

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Executive Overview

Discrete Manufacturing organizations are going through a significant, digital transformation that is disrupting the industry status quo. Companies are investing in digital transformation, smart manufacturing, Industry 4.0, Internet of Things (IoT), and other related initiatives. They are weighing their options and considering a number of investments, many of which are related and all competing for budget, time, and attention.

Which initiatives are getting the most attention? How are manufacturers addressing the opportunities? How are they leveraging PLM solutions as an enabler? ArcherGrey commissioned a survey of over 130 manufacturers by independent research firm Tech-Clarity to find out. The program most frequently cited as critical to the business strategy is Digitalization / Digital Enterprise. More than one-half of respondents say that these digital initiatives are "important" if not "critical" to their business strategy (Figure 1).

- Critical 38%
- Important 27%
- May Contribute 21%
- Don't Know 8%
- Not Relevant 6%
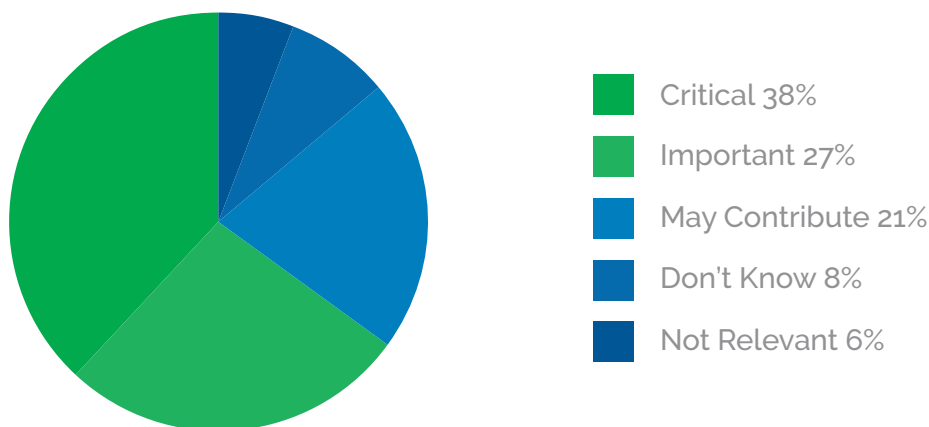
One can learn a lot about the importance companies place on initiatives by who is sponsoring them and how they're funded. We'll cover survey results by initiative for each of these later, but we found two broad conclusions. Survey analysis also shows that:

        - For the most part, what's budgeted matches the perceived value to the business strategy

        - The more enterprise-level initiatives are sponsored at higher organization levels and executed by cross-functional teams
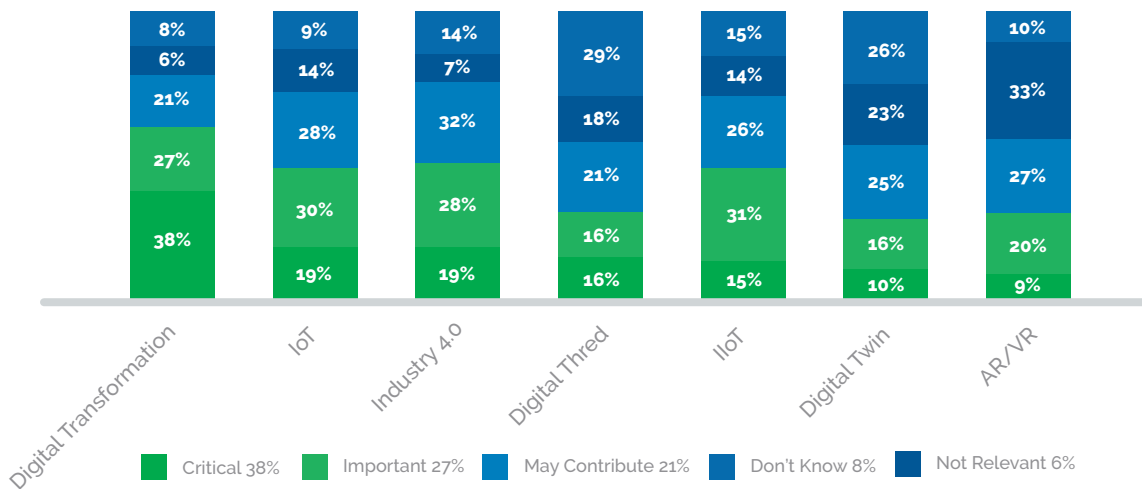
The alignment and high-level sponsorship are encouraging because they show manufacturers are acting on their strategies appropriately.

The survey also investigates how Product Lifecycle Management (PLM) is perceived and how it supports strategic manufacturing initiatives. This completes the picture on how initiatives are being enabled. The study confirms that in addition to having proven operational value, companies also recognize PLM's strategic role. PLM not only provides strategic value to existing operations, it maps well to the manufacturers' strategic initiatives, particularly the digital enterprise. This reflects PLM's importance as the backbone of the digital manufacturing enterprise. Let's take a deeper look.

Manufacturing Strategies

Surveyed companies clearly view Digitalization / Digital Enterprise as the initiative most critical to achieving their business strategy. In fact, "Digital Transformation" may serve as a strategic umbrella for many of the initiatives investigated. The focus on digital transformation is in line with our experience with the changes occurring in the industry.

The two most commonly cited strategic initiatives beyond digitalization are IoT (Internet of Things) and Industry 4.0 which was defined as "Industry 4.0 / Smart Manufacturing." Roughly one-half of companies surveyed say that these initiatives are important or critical to achieving their business strategy (Figure 2).

	Digital Transformation	IoT	Industry 4.0	Digital Thread	IIoT	Digital Twin	AR/VR
Not Relevant	8%	9%	14%	29%	15%	26%	10%
Don't Know	6%	14%	7%		14%		33%
May Contribute	21%	28%	32%	18%	26%	23%	27%
Important	27%	30%	28%	21%	31%	25%	20%
Critical	38%	19%	19%	16%	15%	16%	9%
				16%		10%	

Legend: **Critical 38%** **Important 27%** **May Contribute 21%** **Don't Know 8%** **Not Relevant 6%**
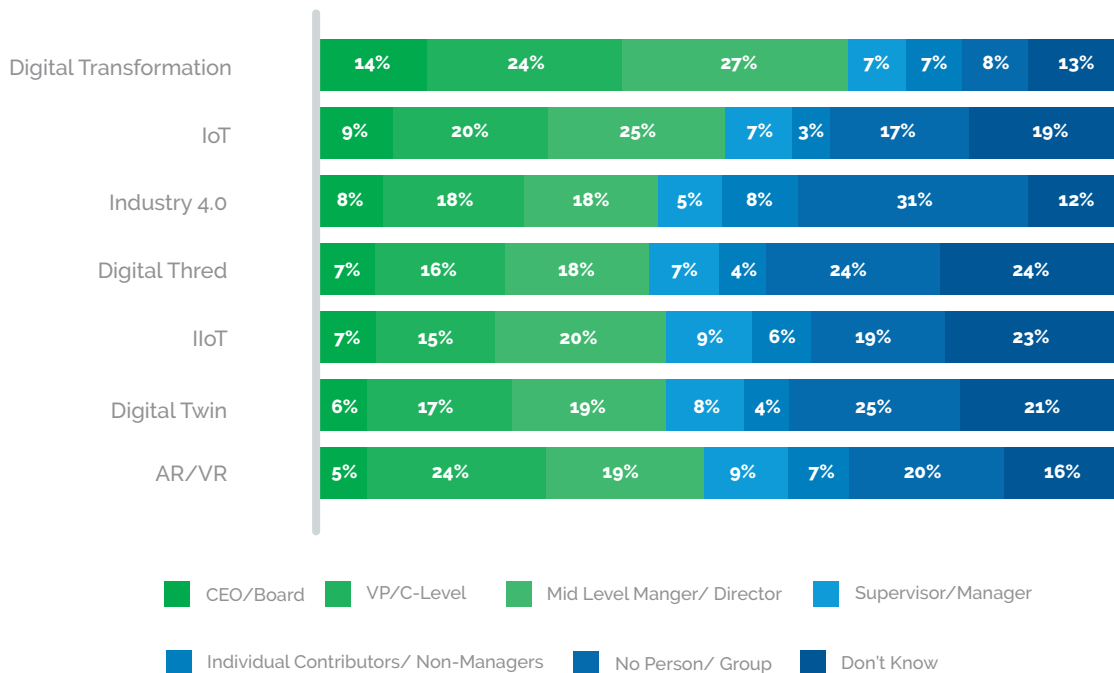
One of the more interesting findings of the study is that manufacturers appear to be confused about the value of Digital Twin and Digital Thread initiatives. For each, more than one-quarter of respondents claim that they don't know how important these initiatives are to their business. These are both newer concepts, or at least more

prevalently discussed today. They are also more closely aligned with products than the other, more general concepts. These factors may contribute to misunderstandings. Manufacturers should educate themselves on the potential of these important initiatives and explore the value.

Other initiatives explored may be more enablers than initiatives, such as augmented and virtual reality (AR/VR). AR is showing significant promise in the manufacturing industries, but is not frequently indicated as a top factor in the corporate strategy. AR is likely a component of other strategic initiatives related to service, product development, marketing, or encompassed in a digital umbrella. There are also other initiatives such as model-based design (MBD) and model-based systems development (MBSD) which are each important aspects of digitalization on their own, but not investigated in this study.

Manufacturing Strategies Budget & Program Strategy

As stated earlier, the initiatives more frequently reported as critical to the business strategy are Digitalization, IoT, and Industry 4.0. Let's look beyond what companies say is important to understand who is sponsoring them and how they're budgeted. This provides visibility to how companies are acting on each of these strategies. In other words, let's look at what's on the executive agenda (Figure 3).

	CEO/Board	VP/C-Level	Mid Level Manger/ Director	Supervisor/Manager	Individual Contributors/ Non-Managers	No Person/ Group	Don't Know
Digital Transformation	14%	24%	27%	7%	7%	8%	13%
IoT	9%	20%	25%	7%	3%	17%	19%
Industry 4.0	8%	18%	18%	5%	8%	31%	12%
Digital Thred	7%	16%	18%	7%	4%	24%	24%
IIoT	7%	15%	20%	9%	6%	19%	23%
Digital Twin	6%	17%	19%	8%	4%	25%	21%
AR/VR	5%	24%	19%	9%	7%	20%	16%

The CEO / Board is more focused on Digitalization than other programs. Digital transformation initiatives are by default enterprise-level issues and require high-level support. There is more focus a level down at the VP / C-Level on additional items including Industry 4.0 and IoT. Most initiatives, however, are more likely to be sponsored by mid-level managers / directors.

IoT is unique in that it has lower CEO sponsorship but then is just as likely as Digitalization initiatives to be sponsored at the VP / C-Level. This might be because the Board is focused on becoming digital while those that are more close to operational needs recognize the need to invest in IoT to accomplish digital transformation objectives.

Let's look at each initiative in more detail to understand the budget status and who's responsible for sponsoring and executing the initiative.
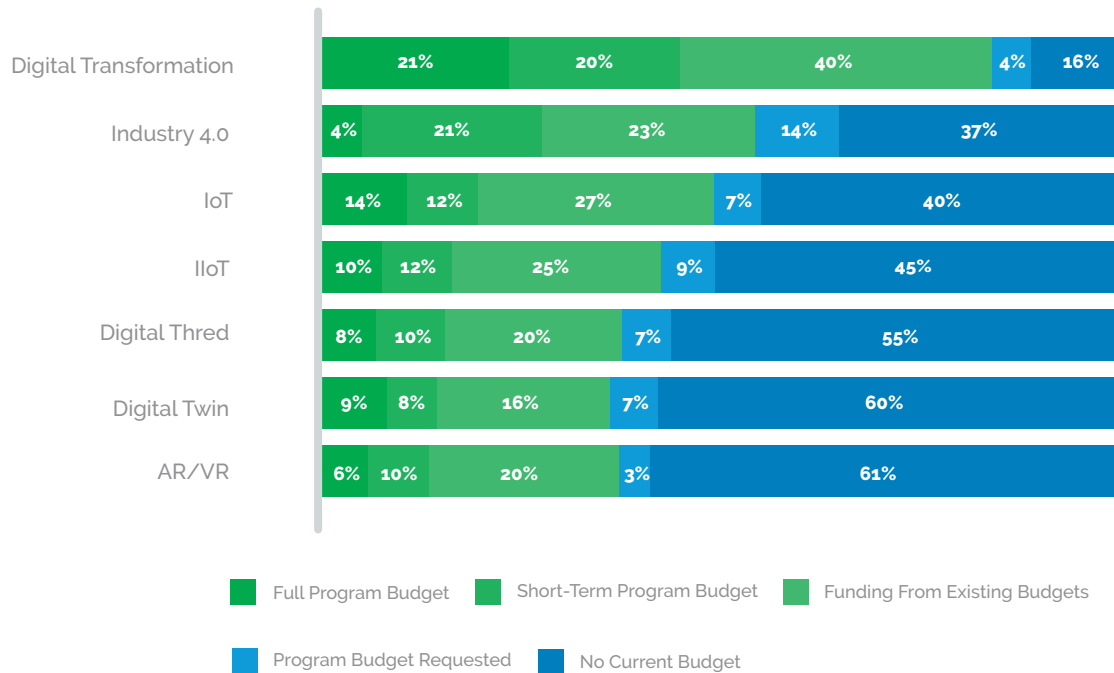
Digitalization

Digitalization involves streamlining operations so that product innovation flows seamlessly from concept to delivery, leading to increased innovation, speed, agility, and quality. They leverage integrated information to make information more accessible and employ analytics to gain new insights. Digital initiatives typically extend beyond the enterprise to integrate with customer demand and support products later in the lifecycle. More mature digital transformation initiatives can transform the relationship between the manufacturer and their customer to provide significant additional value to both parties.

Over one-third of companies share that the Digitalization initiative is critical to their business strategy, and two-thirds in total said it was at least "important." Digital transformation is a clear issue to top management with just over three-quarters of executives viewing it as critical to business strategy. Digitalization has the most pronounced statement regarding strategic importance, with only 6% of respondents indicating they believe it isn't relevant to their business strategy.

About two-thirds of companies have at least mid-level management / directors focused on Digitalization. This initiative is the most well-funded with 21% of companies having a full program budget, another 20% with a short-term budget, and another 40% indicating it's funded from existing budgets. Perhaps this isn't surprising given the high-level focus.

	Full Program Budget	Short-Term Program Budget	Funding From Existing Budgets	Program Budget Requested	No Current Budget
Digital Transformation	21%	20%	40%	4%	16%
Industry 4.0	4%	21%	23%	14%	37%
IoT	14%	12%	27%	7%	40%
IIoT	10%	12%	25%	9%	45%
Digital Thred	8%	10%	20%	7%	55%
Digital Twin	9%	8%	16%	7%	60%
AR/VR	6%	10%	20%	3%	61%

The data shows that manufacturers are investing significant resources in Digitalization initiatives. In total, over three-quarters of companies have a funded initiative (Figure 4). It's also one of the two most likely initiatives to be executed by a cross-functional team (Figure 5).

Larger companies are much more likely to view this initiative as important, with almost three-quarters of companies over $5 Billion in revenue indicating it's strategic to their business strategy. It's interesting to note, however, that our experience shows many smaller companies are starting operations as digital companies, indicating there will be disruption at the smaller end as well.

Industry 4.0

The second most frequently mentioned initiative tied to strategy is known by many names including Industry 4.0, Smart Manufacturing, the Fourth Industrial Revolution, Made in China 2025, and Smart Factory. The concept consists of creating more automated, streamlined plants that increase production efficiency and agility. More agile plants are better able to support customization and product configurations approaching a lot size of one at the efficiency and cost of mass-produced items. These initiatives typically include connecting design to the plant through CAM, automated commissioning of product equipment, additive manufacturing, and other techniques. This initiative, like some of the others, serves as a part of the digital transformation.
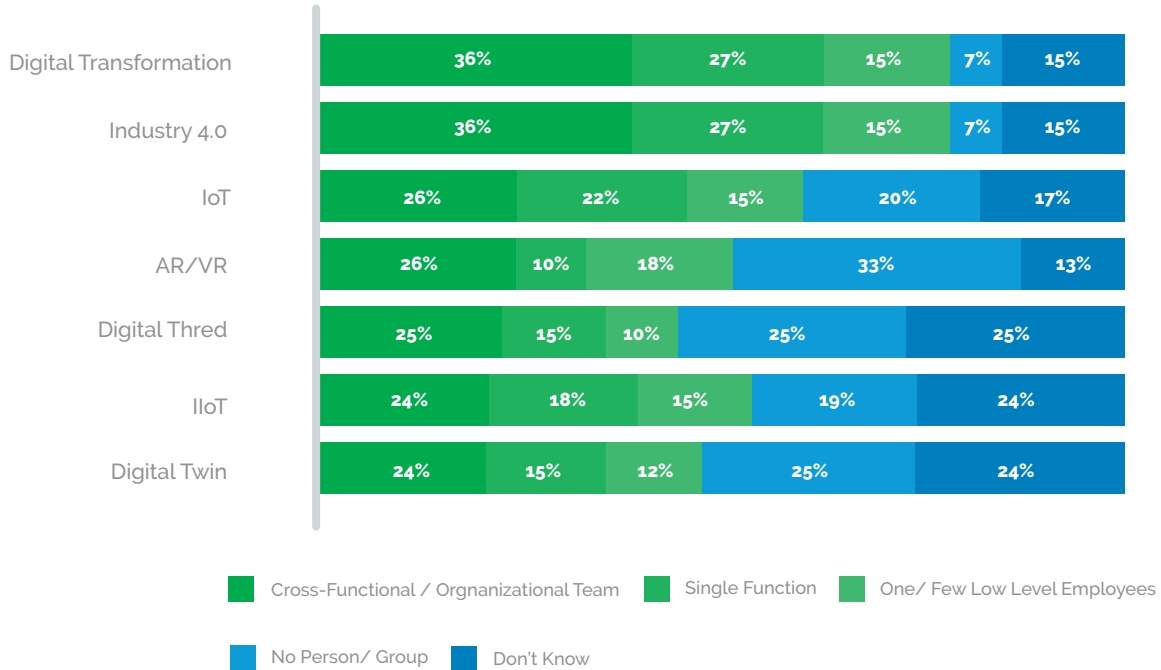
Almost one-half of responding companies said that Industry 4.0 initiatives are important to achieving their business strategy. This initiative is being put into action. Almost two-thirds of companies have this budgeted, although very few (only 4%) have a full program

budget. These manufacturing improvement programs are more likely to have a short-term budget or be funded from existing budgets, most likely Manufacturing.

Despite the potential for it to be more departmentally focused in Manufacturing,

Industry 4.0 initiatives are being sponsored at almost as high a level as Digitalization itself. The only difference is that it's less likely to have a Board-level sponsor and that more companies are unaware of who may be sponsoring it, so perhaps it has less organizational visibility.

It's also interesting to see that it's one of the most likely initiatives to be executed by cross-functional teams, with over one-third of survey companies working in this way (Figure 5). This is important because these initiatives integrate manufacturing more closely with other departments, streamlining the flow of innovation, information, and orders through the enterprise much more rapidly. It's encouraging to see that Industry 4.0 initiatives are funded and have executive sponsorship, reflecting their potentially significant contribution to the business.

Initiative	Cross-Functional / Organizational Team	Single Function	One/ Few Low Level Employees	No Person/ Group	Don't Know
Digital Transformation	36%	27%	15%	7%	15%
Industry 4.0	36%	27%	15%	7%	15%
IoT	26%	22%	15%	20%	17%
AR/VR	26%	10%	18%	33%	13%
Digital Thred	25%	15%	10%	25%	25%
IIoT	24%	18%	15%	19%	24%
Digital Twin	24%	15%	12%	25%	24%

IoT

The Internet of Things helps connect products and equipment in the field with the enterprise, and opens up significant new business opportunities through enhanced visibility to products in the field, analytics, and more. Innovative companies are leveraging IoT to change their relationship with their products, staying in touch with it over the complete lifecycle so they can offer enhanced services and drive additional, highly profitable services and revenue.

IoT is the second most commonly reported initiative as strategic to the business and is a significant contributor to the most common, Digitalization. Roughly one-half say IoT is important or critical to their business strategy (Figure 6). In fact, 44% of executives and 53% of mid-level managers see it as critical.

Critical 19%

Important 30%

May Contribute 28%

Don't Know 9%

Not Relevant 14%
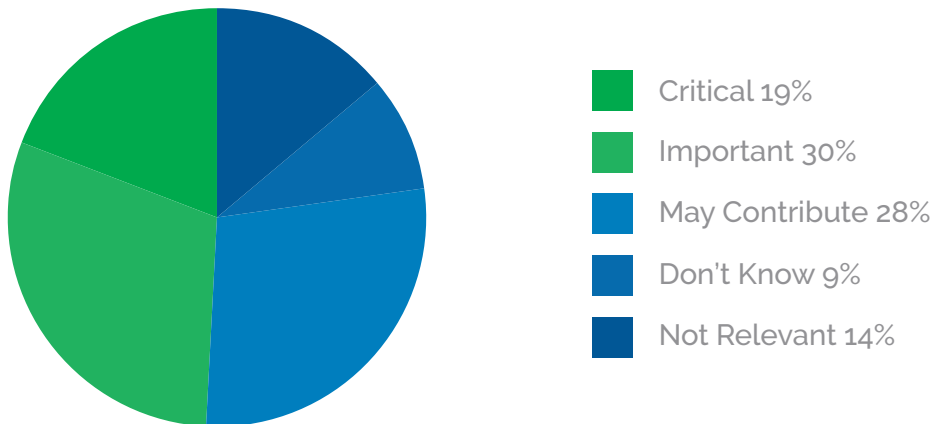
IoT is the second most likely initiative to have a full program budget (Figure 4). Over one-half of the companies surveyed have a budget for IoT. About one-half of the budgeted initiatives are from program budgets, but another one-half from existing budgets. It's clearly something that manufacturers are paying a lot of attention to given it's disruptive potential, whether at a corporate initiative level or from existing budgets. This may indicate that IoT is being addressed by departments if not a centralized focus.

IoT is just as likely to be sponsored by VP / Exec levels as Digitalization, showing it's importance to the business as a whole, although it's slightly less likely to be a Board-level issue on its own. The survey shows that IoT is a key initiative for today's manufacturers. Although companies view it differently in how strategically it's being sponsored, executed, and funded, IoT appears to be on most manufacturers' agenda.

Digital Thread

The Digital Thread is a continuous record of the product from conception throughout the lifecycle. Each step in the lifecycle is developed and added to a cohesive product model that builds as design data is developed. This streamlines the process and creates traceability. Ideally this traceability continues beyond production into the service lifecycle to continue to track product details to provide end-to-end traceability, particularly for regulated industries.

The data above shows that this initiative is identified as important to the business strategy by one-third of respondents. It is sponsored at relatively low levels in the organization, if at all, and is not likely to be budgeted. This may be because it's typically a departmentally focused initiative in Engineering and being executed below the radar of corporate initiatives.

The most notable finding about the Digital Thread initiative, however, is that it appears to be misunderstood by most organizations. The initiative is one of the two most likely for survey respondents to indicate that they "don't know" about strategic importance, budget, sponsorship, or party responsible for execution. The other, the Digital Twin, is similar in its responses. Clearly there is a lot of education needed to help companies understand and provide visibility to this initiative.

IIoT

The IIoT (Industrial Internet of Things) is the application of IoT capabilities to the manufacturing plant. This provides expanded connectivity and analytics to plant operations, connecting Operational Technology (OT) with corporate Information Technology (IT). This initiative could possibly be considered a subset of Industry 4.0, and clearly a contributor to it.

IIoT is very similar to IoT in regards to strategic importance, budget, sponsorship, and those responsible to execute it. It's clearly a relatively important initiative, with 45% of respondents saying it's important or critical. In fact, it was seen as critical by 44% of responding executives, showing that it's getting attention in the front office, not just Manufacturing.

Compared to IoT, it's perhaps slightly less strategic and a little less likely to have a budget or a strategic sponsor. In addition, respondents were a little less likely to know who is responsible for executing the initiative than they are for IoT. This may be because it is not budgeted, perhaps because it has lower visibility, or possibly because it is a subset of a larger IoT or Industry 4.0 initiative.

Digital Twin

The Digital Twin is an initiative that connects product models with their actual behavior. Although some will define a digital or virtual twin as a model of a product or production line that can be simulated, the most prevalent definition includes feedback from the actual equipment or product. This allows companies to compare actual to expected behavior to better understand performance in the field and improve simulation models to reflect reality, among other applications.

The Digital Thread and the Digital Twin are related, but separate initiatives. Both involve digital product models that help companies better understand their products. They are also both part of a manufacturer's digital enterprise. In addition, both have similar responses in this study, namely that they are sponsored and budgeted at low levels and are prime candidates for higher levels of visibility and education due to the number of respondents that weren't aware of how the initiative is budgeted or executed, or even how important it is to the business.

AR / VR

The last initiative analyzed in this survey is the use of AR and VR in manufacturing. AR and VR are exciting technologies that are coming of age. They help people visualize product designs and information in a more realistic setting. For example, AR can help companies visually overlay product information on the physical product itself, or VR can help companies with design reviews. They can also virtually place a realistic 3D product model in a simulated or real setting to help communicate product details digitally before the product has even been physically prototyped.
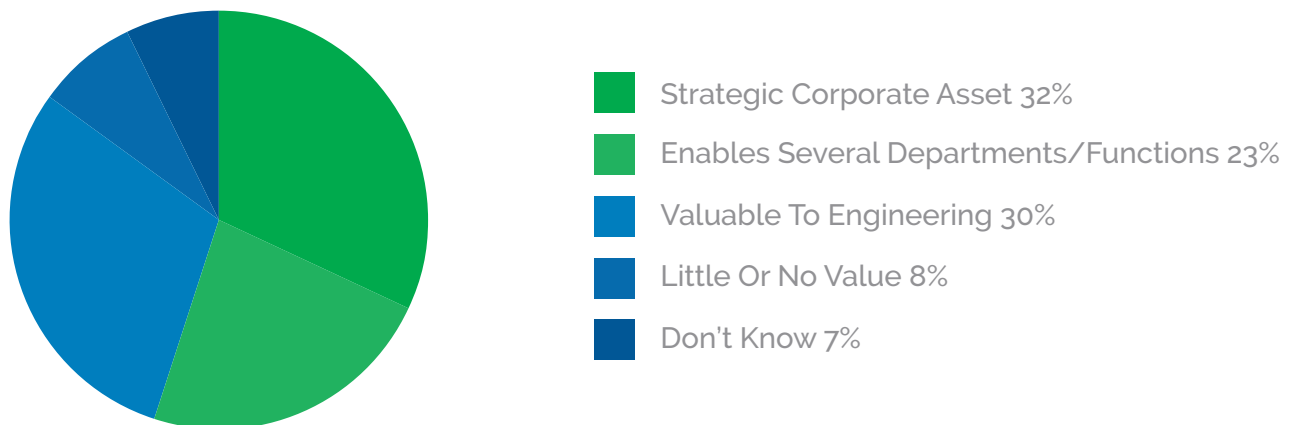
At first glance, it appears that this initiative isn't getting the attention it deserves, and that the survey results don't reflect the interest manufacturers are showing in the capabilities. On further analysis, we believe that the lower level of strategic importance is possibly because it's more of a capability or tool than an initiative on its own. As an enabling technology, however, it still registers that over one-half of manufacturers feel it is relevant to their product strategy.

It's also interesting to note that it is more likely to be addressed by a cross-functional team than other initiatives and has relatively strong corporate sponsorship. This may be because companies are exploring the capabilities and looking for the right business processes to apply it to. Based on our analysis and perspective, we believe this is a technology to watch in the future as more use cases and case studies develop.
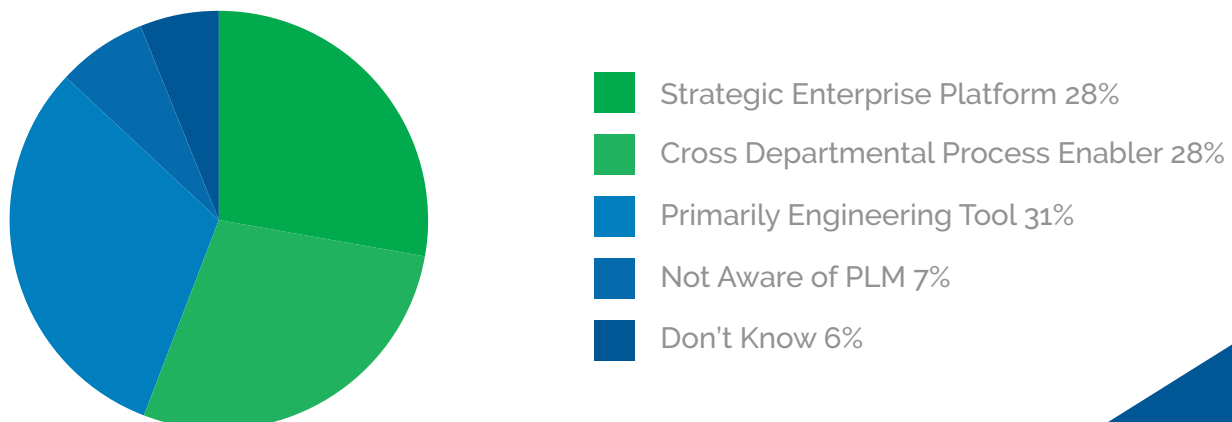
PLM As Operational & Strategic Enabler

Let's look at how PLM helps manufacturers achieve their business strategy. PLM has proven operational value and has been successfully applied to increase innovation efficiency, manage complexity, reduce cost, and more. While these values are important, PLM is capable of much more strategic value. PLM can be a transformational technology for Digitalization.

Most manufacturers are aware of the operational value of PLM, supported by the fact that the vast majority of survey participants report they see value (Figure 7). A smaller percentage of respondents recognize the greater potential of PLM. About one-third believe it's a strategic corporate asset, about one-quarter say it enables cross-departmental value, and close to a third believe it's primarily valuable to Engineering. Our experience shows that this is less based on the capabilities of the PLM systems used and more about the goals set for PLM and how the system and related processes are implemented.

- Strategic Corporate Asset 32%
- Enables Several Departments/Functions 23%
- Valuable To Engineering 30%
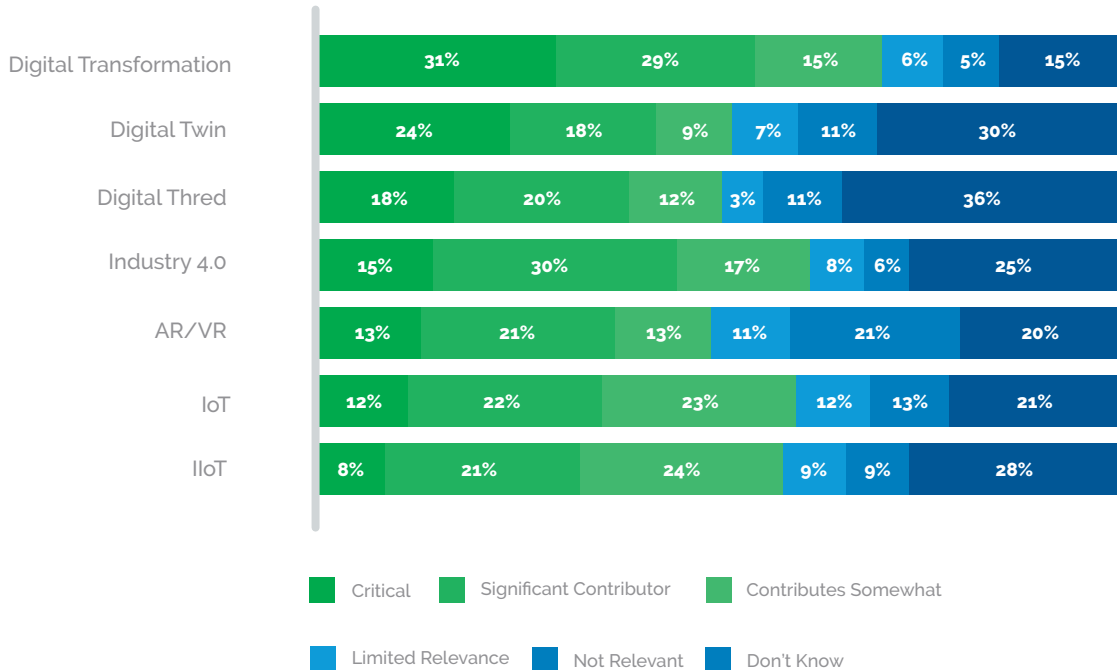- Little Or No Value 8%
- Don't Know 7%

Survey responses also reflect the varied views companies have on the role their PLM systems play in their company. About even one-third of the survey respondents see PLM as: an enterprise platform, a cross-departmental enabler, or an engineering tool (Figure 8). For the most part, participants' views of and the role and value of PLM are aligned.

- Strategic Enterprise Platform 28%
- Cross Departmental Process Enabler 28%
- Primarily Engineering Tool 31%
- Not Aware of PLM 7%
- Don't Know 6%

People in different roles may perceive the role and value differently as well. For example, the percentage of executives that view PLM as a strategic enterprise platform and a strategic corporate asset is much higher, 44% for each. The higher in the organization the more apparent the enterprise-level value becomes.

PLM Enables Strategic Initiatives

Beyond the general role and value of PLM, the survey analyzed how PLM supports the strategic initiatives discussed earlier. The responses show that PLM plays a critical or significant role in many of the initiatives (Figure 9). This highlights the importance of PLM as the innovation backbone for the digital enterprise.

Initiative	Critical	Significant Contributor	Contributes Somewhat	Limited Relevance	Not Relevant	Don't Know
Digital Transformation	31%	29%	15%	6%	5%	15%
Digital Twin	24%	18%	9%	7%	11%	30%
Digital Thred	18%	20%	12%	3%	11%	36%
Industry 4.0	15%	30%	17%	8%	6%	25%
AR/VR	13%	21%	13%	11%	21%	20%
IoT	12%	22%	23%	12%	13%	21%
IIoT	8%	21%	24%	9%	9%	28%

Legend:
- Critical
- Significant Contributor
- Contributes Somewhat
- Limited Relevance
- Not Relevant
- Don't Know

PLM is seen as a major contributor to achieving a Digitalization strategy. PLM can provide the digital backbone, providing product context for data. It's also a contributor to the two less strategically viewed (and understood) initiatives, the Digital Twin and the Digital Thread. PLM can help track product development history, tie data together from step to step, and provide the product details needed to enable a complete digital twin, including revisions and configurations.

PLM is also a significant contributor to another big priority, Industry 4.0, although it's identified as more "significant" than "critical." This is likely because Industry 4.0 requires an ecosystem of solutions including MES (Manufacturing Executing Systems).

Perhaps surprising to some, survey responses registered lower on the PLM's role in supporting the IoT / IIoT. These are very broad initiatives, where PLM can play an important role by providing product information into a much larger context. Experience shows that IoT requires much more than just PLM. Supporting these initiatives requires analytics, dashboards, equipment communication, edge computing, ties to other enterprise systems, and more. Many leading PLM vendors and consultants have expanded their suites beyond traditional PLM for this reason.

The same is probably even more true for AR / VR because they are tools used in combination with other capabilities and have broad applicability to the business. We've seen that they're better with PLM to provide product knowledge when they're used for product-related process. Using AR / VR in a product context requires strong PLM product modeling and configuration management. Because of this, AR / VR in PLM context is early in the adoption lifecycle and perhaps companies are more at the proof of concept stage. There's a lot more potential beyond just what PLM has to offer, and Manufacturing or Service may not be the first initiatives as Marketing, Sales, and others take advantage of the AR / VR opportunity to gain new value.

To summarize, PLM provides the digital product context to many digital transformation objectives, reflected in the fact that three-quarters of respondents recognize the value PLM plays in the Digitalization initiative. In addition, PLM plays a significant role in many others including Industry 4.0. Overall, PLM is clearly a key contributor to critical strategic initiatives pursued by manufacturers today

Conclusion

The manufacturing industry is changing rapidly and companies have to change or risk losing their market position. Manufacturers are responding, targeting a number of important strategic initiatives related to becoming a digital enterprise.

Digitalization is seen as the most critical initiative and has significant support at the Board level. It's also a funded initiative that's more likely to have cross-functional teams executing the program. Industry 4.0 and IoT Initiatives are also viewed very highly as contributors to the corporate business strategy.

PLM plays a key role in supporting these initiatives, serving as the digital innovation backbone. PLM also supports important digital capabilities, including Digital Twin and Digital Thread, which show promise but require some additional education for many companies. PLM is important to the entire Digital Transformation strategy because it provides the product context, history, and details required to support the digital product and manufacturing strategy.

Activity level is high, and so are the stakes in terms of impact on business performance. We expect to see a lot of change over the next few years. We believe it's time for manufacturers to make sure they review their business strategy, make sure they are educated on these high-level initiatives, and determine how to put these strategies into action. It's also important for them to determine how to transition PLM to be more strategic so it can go beyond operational improvements to enable digital transformation to support business into the future.

About ArcherGrey

Whether you're just beginning the PLM journey, looking for ways to optimize an existing solution, have poor adoption or no significant ROI, ArcherGrey is here to assess, guide and help you deliver along the way. ArcherGrey's comprehensive PLM service offerings span a system's complete life cycle – from initial strategy and planning, through design, development, and deployment, to ongoing system maintenance, upgrades and support, then finally, retirement. We strive to provide highly effective solutions that are aligned with your environment that enable your business objectives while equipping your staff with the proper knowledge and training to be self-sufficient moving forward.

About the Research

ArcherGrey commissioned Tech-Clarity to research current manufacturing initiatives and how they're supported by PLM. ArcherGrey chose to collaborate with Tech-Clarity to ensure the survey was conducted in an unbiased manner to provide a fair representation and objective analysis of the results.

Tech-Clarity gathered and analyzed over 130 responses to a web-based survey on designing software-intensive products. Survey responses were gathered by direct e-mail, social media, and online postings by Tech-Clarity and ArcherGrey.

The responding companies were a good representation of the manufacturing industries, including Automotive / Transportation (22%), Industrial Equipment / Machinery (22%), High-tech and Electronics (15%), Energy / Utilities (15%), Life Sciences / Medical (11%), Consumer Products (10%), Building Products and Fabrication (10%), and others including Consumer Packaged Goods and others. Note that these numbers add up to greater than 100% because some companies indicated that they are active in more than one industry.

The respondents represented a mix of company sizes, including 25% from smaller companies (less than $100 million), 21% between $100 million and $1 billion, 11% between $1 billion and $5 billion, and 22% greater than $5 billion. Another 21% did not choose to disclose their company size. All company sizes were reported in US dollar equivalent.

The respondents were comprised of almost one-half (49%) who were manager or director level. Over another one-third (38%) were individual contributors, staff, or engineers. A small number (8%) were executive level and another 5% reported they were in another role.

The respondents reported doing business globally, with most companies doing business in the North America (88%), just under one-half doing business in Western Europe (43%), over one-third doing business in the Asia (38%), under one-quarter in Latin America (20%), and others in Australia (10%), Africa (7%), Middle East (7%) and other geographies.

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