IndustryWeek

Presented by

ORACLE

THE ROAD TO DIGITAL TRANSFORMATION:

A Progress Report for Manufacturers

Executive Summary

This is a time of enormous change for manufacturers, rife with threats as well as opportunities. Every industry segment seems to have disruptors who are creating new opportunities for themselves and threats for others. Today, this is being done through digital transformation, or fully leveraging new digital technologies in a strategic way.

82%

of manufacturers already have or plan to develop a digital transformation strategy; 30% feel they have a competitive advantage

Digital transformation is rapidly moving into the mainstream; 82% of manufacturers already have or plan to develop a digital transformation strategy. However, both progress and results are mixed, with some not yet involved, but nearly a third feeling they have already gained a competitive advantage.

What differentiates the more mature and successful companies? As a foundation, they have already set a digital transformation strategy and are executing on it. They have gained consensus, educated and trained their employees, and are more likely than others to have gained tangible benefits from leveraging new technologies. These companies continue to mature, being much more likely to see themselves as ahead of the curve, or seriously ahead of the curve.

For the more mature manufacturers, digital transformation is becoming pervasive across the organization. These companies are trying many technologies, selecting strategic projects, devoting more resources to them, and are more likely to be seeing benefit. For example, the more mature manufacturers are ten times more likely to have implemented cloud computing widely with good results than others (<30% vs. 3%).

Three advanced technologies are important to digital transformation for the widest array of manufacturers: the internet of things or the industrial internet of things (IoT/IIoT), cloud computing, and machine learning. More mature companies are not just investing in these new technologies, they are also upgrading ERP, MES and PLM, and integrating applications as well as training employees and mapping out workflows. As a result, they are more likely to be meeting project expectations.

This report looks at manufacturers' progress. This includes where companies are investing, the benefits they expect, how well companies are succeeding with new technologies, and the challenges. It is a snapshot of a rapidly progressing digital transformation strategy for production industries to guide your company's journey forward.

Digital Transformation

In this new age of global competition and industry disruption, manufacturers must meet ever increasing expectations. Customers expect to see improvements in cost, quality, speed, variety and product capability simultaneously. Digital transformation with the related new emerging technologies is a dual-edged sword. It both drives new requirements while also enabling innovative new capabilities to support the business. These new capabilities create many new opportunities for manufacturers.

Advances in connectivity are leading to improvements on many fronts at once, which can rapidly improve a company's competitive position. The value in digital transformation is clearly in reducing costs, increasing automation, improving throughput, and in making better decisions. However, another major benefit is expanding revenue opportunities on the top line through supporting new connected business models or improved execution.

We asked respondents to rank four primary areas to get a clearer view of where companies expect digital transformation to have the greatest impact. (**Figure 1**) Interestingly, all four of these areas play together as an organization moves through digital transformation. For example, manufacturers normally also need to improve business processes and operations to enable any increased revenue associated with new or changing business models. Plant and supply chain operations are the delivery mechanisms for any revenue.

Figure 1: Ranking of digital transformation investment impact by strategic impact area

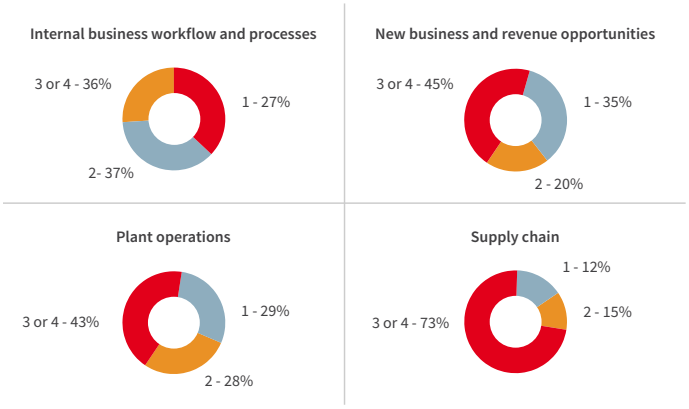
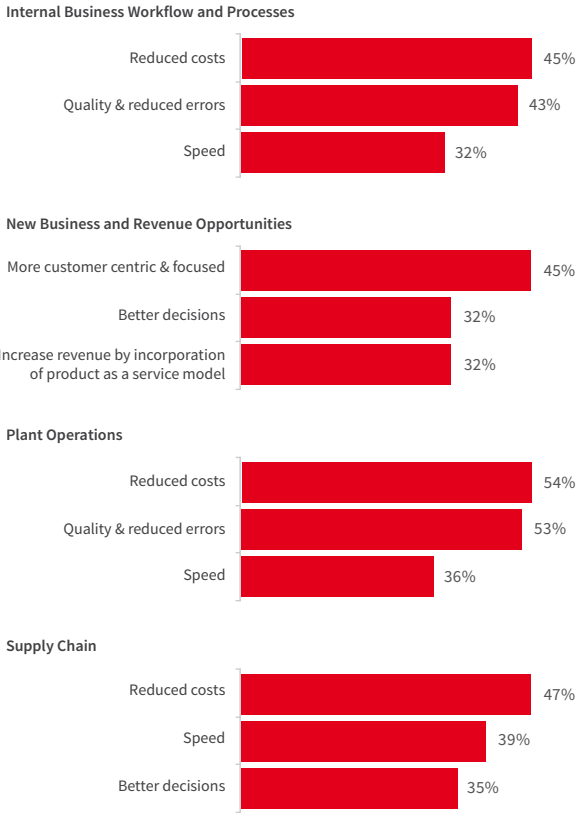


Figure 2: Investment in digital transformation is expected to have somewhat different benefits across areas



Benefit in supply chain:

"Ship completed and on deadline"

When digital technology is truly transformational, end-to-end digital information flow is at the core of the business and its ecosystem, not a bolt-on. Until now, much of the business value from digital technologies has either been limited because the business processes did not change to fully leverage them or they were lost due to departmental disconnects.

Manufacturers expect major benefits from this digital transformation. **(Figure 2)** Companies are expecting gain from having digital information flow through the entire enterprise and supplier/customer network. Clearly, these end-to-end flows impact operations as well as enabling business processes designed to fully use that coherent information. All of this fuels new customer-centric business models.

Strategy: Foundation for Success

The path to success in digital transformation appears to be through developing an encompassing strategy. While there are many new technologies to experiment with, stepping back to create a digital transformation strategy aligned with the overall success of the business sets the stage.

As you would expect, manufacturers are at various stages with their digital strategy. **(Figure 3)** 82% of companies either have a strategy, are developing a strategy, or plan to develop one in the near future. Over a third (37%) already have a strategy and are executing on it and the leaders are clearly getting ahead as they are not only executing their strategy, but are also working to refine it. With the rapid technology advancements happening today, it is not difficult to see how this may help them move ahead of their competition. As with any classic bell curve, most companies are in the middle, with an almost equal percent of manufacturers on both sides of the spectrum.

It is the 15% who have no plans to develop a strategy that may face greater difficulties than they anticipate. This research shows that companies not yet executing on a strategy are far more likely to face common digital transformation project pitfalls such as disagreement about direction, lack of budget for expenditures and personnel, and management commitment. They are also less likely to be gaining some of the strategic benefits that make a company more agile and profitable. In fact, those with a defined strategy are over twice as likely to feel they are ahead of the curve.

It's interesting to note that those in management are far more likely to say they are executing on a strategy and improving it than others, and less likely to say they have no plans to develop a strategy. This raises questions as to whether management is working

a strategy but not communicating it clearly, not involving all stakeholders, or not providing adequate education and training. Any of these can thwart the success of a digital transformation initiative.

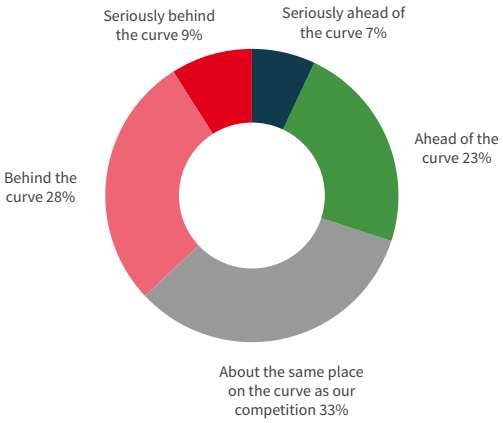
Typically, setting a strategy involves taking a broader view. The companies already executing on a strategy are more likely to expect or have achieved benefits from digital transformation such as increased revenue, customer-centricity and improved visibility in the business processes and workflow area. They also see digital transformation improving visibility in the plant and supply chain, and increased speed driving new business opportunities. Beyond that, they are more focused on cloud-based software and internal communications. In fact, these companies are making a broad array of investments in both new and established technologies.

Current State of Manufacturers

How much progress are manufacturers making with digital transformation? Clearly the goal is to gain an advantage in the market. So, we asked respondents to rate how they are in comparison to their competition. (**Figure 4**) Note that a similar number of respondents feel they are ahead, even, or behind the curve. This again provides a normal distribution with similar numbers of respondents rating themselves as seriously ahead or seriously behind the curve. Those seriously ahead of the curve are the disruptors seeing success and driving change in the market. It is all of those in the middle

Figure 3: Status of digital transformation strategy

Figure 4: Companies are divided in their assessment of where they are in digital transformation compared to the competition



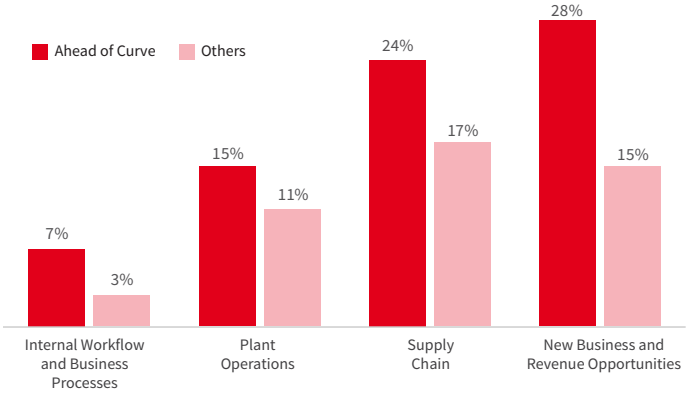
or behind that need to review their priorities and determine where they want to focus.

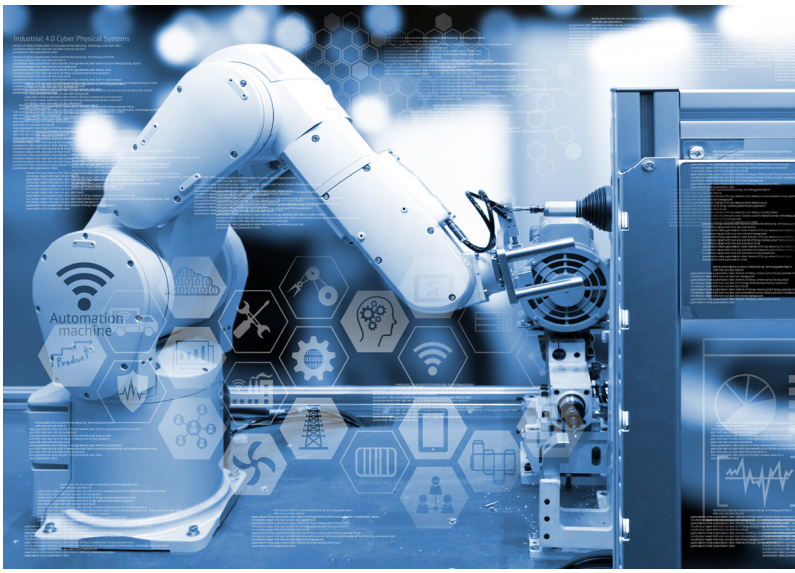
Most of those who feel they are ahead of the curve are already executing to a digital transformation strategy. What's more surprising is that some who do not have a strategy believe they are ahead of their competition. They may be correct today, but they may also simply not be aware of the internal progress others are making as they lay the foundation for digital transformation.

Those who believe they are ahead today actually appear to have a different view of digital transformation. For one, they expect different results. These companies are far more focused on accommodating variety and specials than others. They believe digital transformation will help them achieve this not only in production, but also see this as a way to generate new business and revenue opportunities, and in addressing the difficult challenge of coordinating a supply chain for responsiveness and high mix. **(Figure 5)**

These companies with an edge today also are more focused on agility and the ability to respond. As digital-driven disruptions to manufacturing markets continue, this capability is worthy of focus. Clearly, to grasp new opportunities as they arise, companies need consistent information inside their enterprise and shared across the supply chain.

Figure 5: Those leading their industry expect digital transformation will help every aspect of the business accommodate variety and specials





Investment Choices

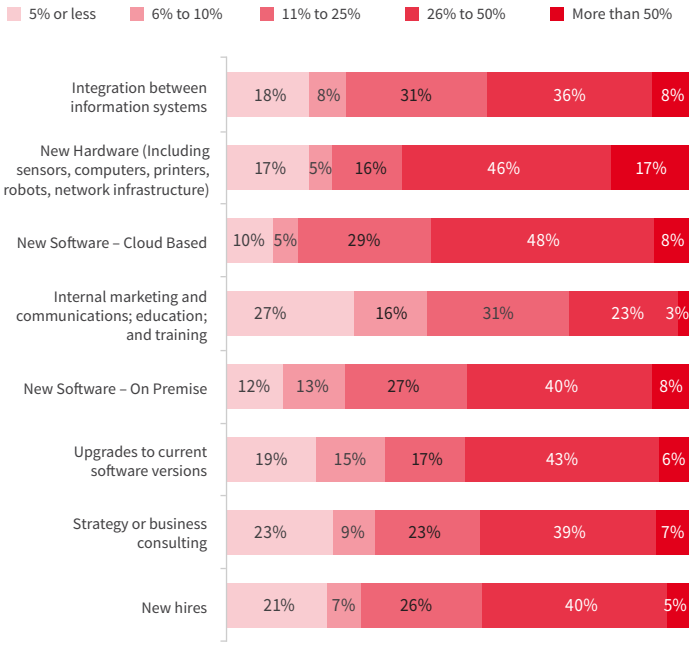
Digital transformation presents a wide array of potential investments for manufacturers. Clearly, these span technology, people and processes. When asked about the top three items in the budget, the importance of achieving end-to-end information flows becomes clear. This rests firmly on integrated information systems. Many companies do not currently have all the hardware elements they need, and many also recognize that investing in cloud-based software will also lead to the flexibility, agility and visibility they need to compete. **(Figure 6)**

The companies executing on a strategy are far more likely to be focused on cloud computing and integration between systems. They are more likely to be reaching out to employees with education, communication and marketing as well as to be hiring new employees.

Budgeting for top priority digital transformation activities is another factor to consider. Typically, companies budget between 11% and 50% for each of their top three digital transformation line items. **(Figure 7)** The clear exception is internal marketing and communications, where many expect to spend less to achieve the desired results. Whether this is a sound view is debatable, since it's clear that having employees' buy-in is a foundation for the success of a digital transformation initiative.

Figure 6: The top three items in digital transformation budgets

Figure 7: Budget portions allocated for top three digital transformation line items



Naturally, companies must spread budget across all the investments needed to achieve digital transformation. Yet those top three line items need substantial investment. So why is it so many companies (10% to over 20%) expect to spend less than 5% of their digital transformation budget on a top three item? We suspect they are dabbling, and trying many new technologies, not necessarily making strategic bets on a few projects that might allow them to disrupt their market.

This may not be a wise course of action. Those ahead of the curve are much more likely than others to spend over 5% of the digital transformation budget on their top three items. Those ahead are twice as likely to allocate more than 5% to developing integrations between applications and upgrading to current software. They are seven times more likely to allocate over 5% of budget to cloud computing. These software investments are keys to success in creating the coherent information flows that digital transformation promises and cannot be taken lightly.

The specific projects companies are investing in are also widely distributed. We provided respondents 15 project choices, and a good portion have invested in half of those. **(Figure 8)** The top projects span strategy, people, process and technology. Every aspect needs to keep pace for the transformation to be complete and to provide the benefits manufacturers are expecting.

Figure 8: Top projects for digital transformation

Benefit in new business and revenue opportunities:

"Our quotes are much more accurate. We have run no money losing programs for the last 4 years!" now much lower."

Benefit in plant operations:

"Information reconciliation costs are now much lower."

In fact, to gain a benefit, companies may need to consider other projects. Those ahead of the curve were much more likely to be investing in all 15 project types we listed. So, they are placing strategic bets on certain projects, but they are also gaining experience with both new technologies and shoring up the foundations of their IT systems. (**Figure 9**) This suggests a bigger vision, where information flows readily across core and new technologies to enable the best decisions and actions across the enterprise.

Digital Technology: Fuel for Progress

To implement any of these strategies and projects, companies are leveraging advanced technologies and approaches. Some are emerging new technologies in hardware or software. Others are more conceptual approaches that leverage technology to achieve a broader vision.

Respondents selected the technologies they believe are most important to the success of their digital transformation initiative. Then we asked them additional questions only about the technologies they

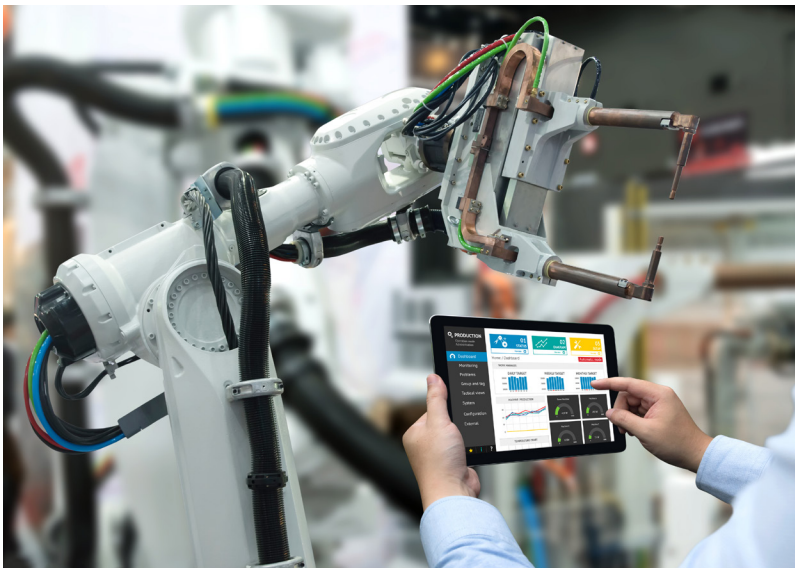
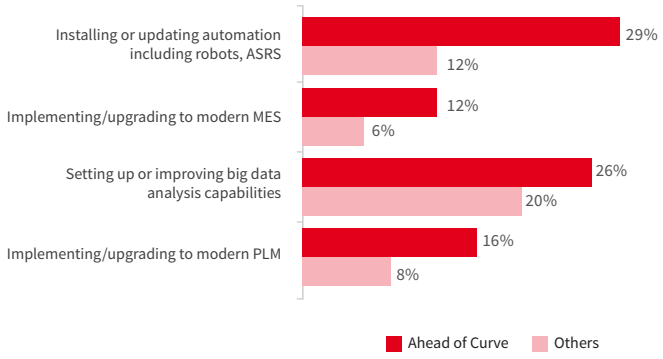


Figure 9: Those ahead of the curve are taking additional action



selected. These questions covered application areas, benefits, status of deployment, and level of success.

Top Transformational Technologies

There are three advanced technologies that nearly every production company might use: the industrial internet of things (IIoT), cloud computing, and machine learning. All of these are being used across departments and complement current systems and processes.

IIoT/IoT is a top digital transformation technology for half of respondents with increased agility and ability to respond the most commonly identified benefits expected **(Figure 10)**. Many companies are also spending on IIoT to gather and incorporate a wider array of data streams into their information flows and analytics. IIoT dovetails with improving data collection, which is the top digital transformation budget item. As further evidence of the importance and growth of this technology, IDC notes that manufacturers spent $176M on IoT in 2016.

Manufacturers are scattered across the spectrum of experience with IIoT. **(Figure 11)** As evidence that manufacturers are seeing value, most of those ahead of the curve have implemented IIoT in with good success. More than half of those with projects feel it is meeting at least 75% of expectations. It seems clear that IIoT is already having an impact in transforming the digital landscape.

Figure 10: Expected or achieved benefits of IIoT

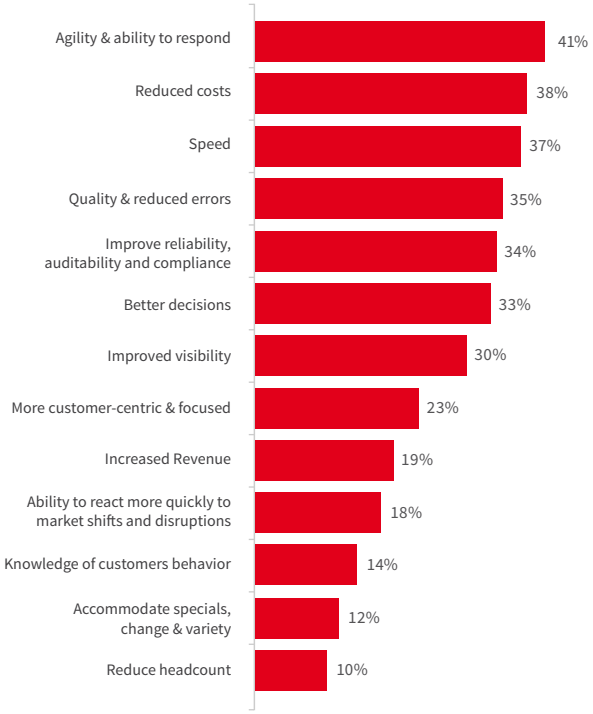
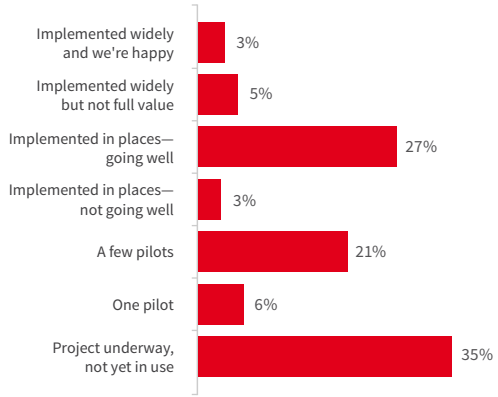


Figure 11: Implementation status for IIoT



Cloud computing is delivering agility, reduced costs, and improved speed for companies of all sizes and across most manufacturing industries. **(Figure 12)** Four out of five are using cloud computing to improve internal business workflows and processes. Over a third are also using it for plant floor operations, showing that cloud data latency and security for operations is becoming less of a concern for production use.

Over half of companies are now actively using cloud in places and most of the rest already have pilot projects in place. Most companies using cloud are seeing benefits and are finding it delivers on their expectations. **(Figure 13)** Because of the wide array of applications, the expectations and returns for each application hosted in the cloud can be unique to the business.

There is good evidence that cloud computing delivers competitive advantages to those on the road to digital transformation. Manufacturers that see themselves as ahead of the curve are 10 times more likely to report widespread use with good success as others. **(Figure 14)** These leaders demonstrate that cloud supports the agility that can help a company pull ahead of the pack.

Machine learning is a form of artificial intelligence that is not yet in wide use. However, nearly three-quarters of respondents use or plan to apply it in plant operations. Machine learning is particularly

Figure 12: The top five expected or achieved benefits of cloud computing

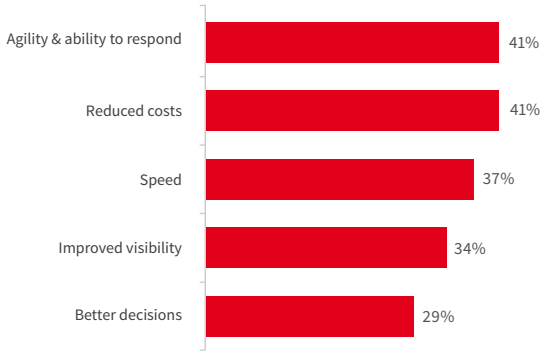


Figure 13: Implementation and success rates for cloud computing projects

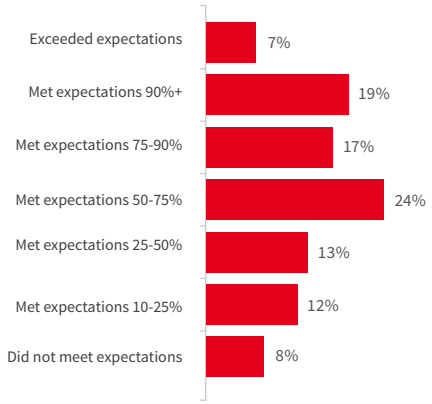
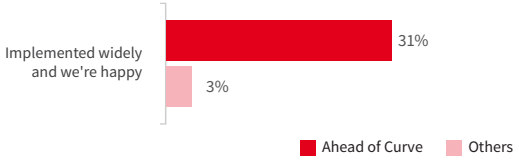


Figure 14: Those ahead of the curve are far more likely to have widely implemented cloud computing with good results



common in operations and asset management to spot trends that might cause unplanned downtime or quality problems if not corrected. Clearly when computers learn to spot patterns and analyze what's happening, they can improve quality, reduce errors, increase throughput, and reduce costs. **(Figure 15)**

More than a quarter are also applying machine learning to spot patterns that will improve internal business workflow or indicate new revenue opportunities.

The fact that fewer than one in five manufacturers are applying machine learning across the supply chain points to some need for education and application upgrades. Some of the most beneficial supply chain applications are now incorporating machine learning to improve forecast accuracy, distribution efficiency, and transportation planning to lower costs and improve on-time delivery.

Machine learning is clearly in earlier stages than IIoT or cloud. Less than a third have it in use, and most have found it has not met expectations. In these early stages, it can be challenging for companies to gain the expected benefits right away. **(Figure 16)** As the name suggests, this technology learns as it goes and requires significant data to be successful. As a result, the benefits tend to increase over time as more data becomes available and the system continues to learn. Because of the early stage of implementation, many companies have not yet achieved strong results.

Figure 15: Top expected or achieved benefits of machine learning

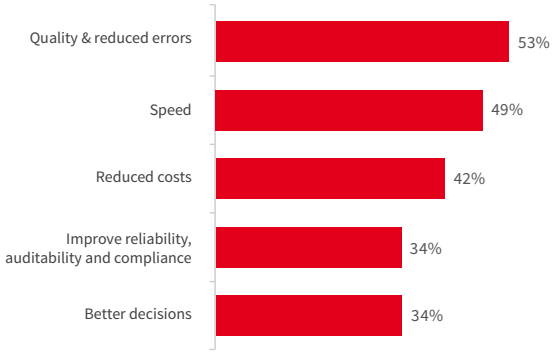


Figure 16: Implementation status for machine learning

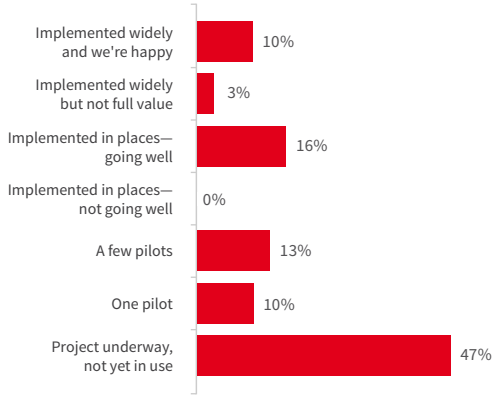
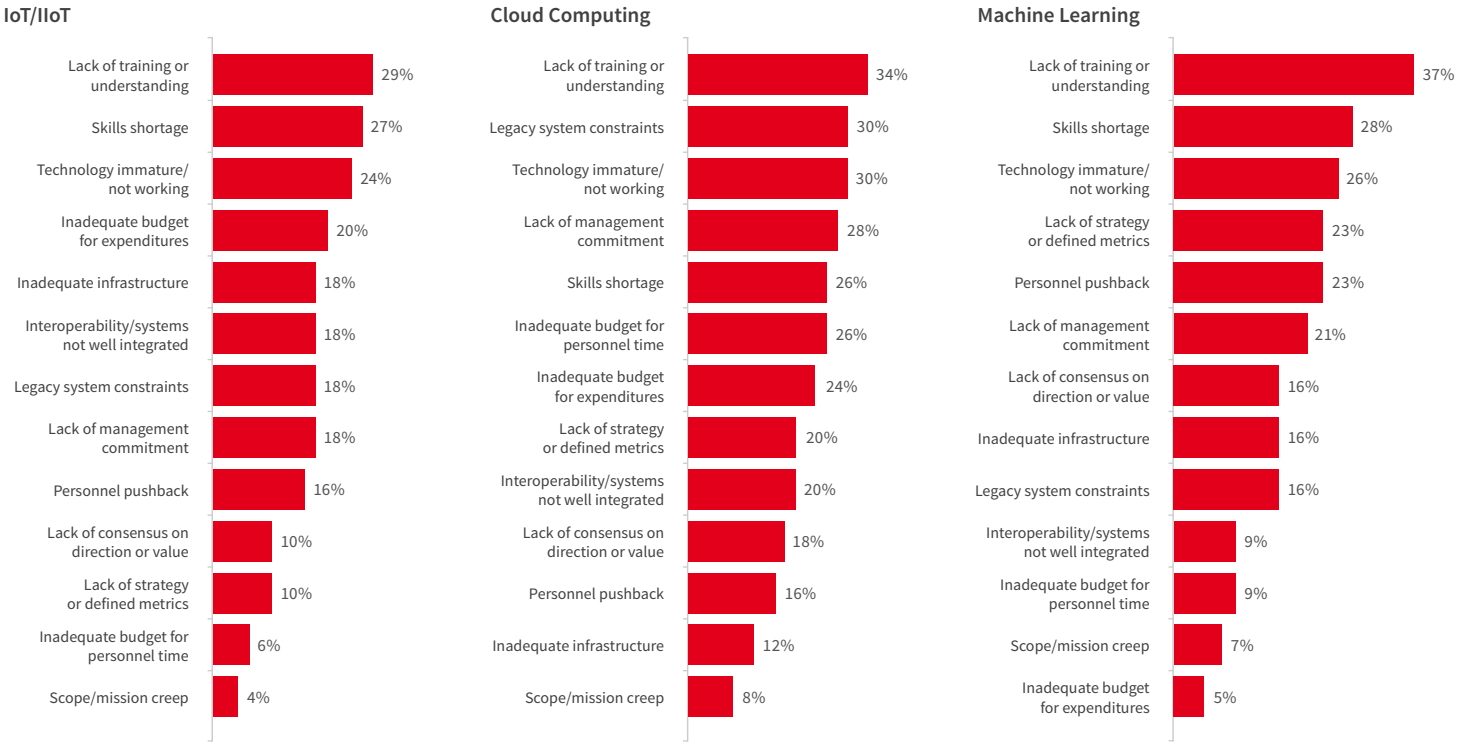


Figure 17: Challenges with top three advanced technologies for digital transformation



Challenges with Top Technologies

Many of the challenges with implementing new technologies are common and somewhat consistent across the technologies. **(Figure 17)** For example, the top challenge noted for all three of the top technologies was lack of training or understanding. When this is combined with some of the other resources issues such as skills shortage and personnel pushback, it is clear that people are an important component of any technology implementation. Many of the top issues could be resolved with a sound strategy backed by a well-crafted plan for education, training, staffing, and budgeting.

IIoT Challenges: To integrate IIoT into the end-to-end digital information flow, companies also must invest in infrastructure and integration. These are essential to handle the increased volumes of data flowing in multiple directions as a result of IIoT implementations which provides the ability for the business to actually act on the data.

In fact, those ahead of the curve cite integration between systems as a challenge for their IIoT projects more than four times as frequently as others (40% vs. 9%). So, they have done their homework on the core IIoT technology itself and have fewer challenges with that. Instead, they are focusing on how to get increased

business value from the new IIoT connectivity by integrating the data into their existing systems. It makes sense that that companies investing in integrations are seeing greater value in their IIoT implementations.

Cloud Challenges: Legacy system constraints are high on the list of cloud computing obstacles. **(Figure 17)** To succeed, companies and their cloud computing providers must take into account the differing infrastructure and ways of updating and integrating between systems.

Companies that are already executing on a strategy have some differing views on challenges of cloud computing. With their strategy in place, they are five times less likely to report lack of consensus and far less likely to report a lack of management commitment. On the other hand, they are much more likely to report inadequate infrastructure and personnel pushback as problems. This points again to the need for education of the workforce, and a readiness to invest in infrastructure to succeed.

Machine Learning Challenges: Apparently, there is still not strong enough understanding of this technology. Six of the top seven pitfalls companies found in machine learning projects relate to personnel and strategy. **(Figure 17)** As you might expect, personnel pushback is a big concern for machine learning where, at 23%, it is much higher than other technologies. Preparation and education

Most important to digital transformation success:

"We work at whatever level the customer is comfortable with."

are critical to overcome this obstacle. This might be why those already executing on a strategy are finding different obstacles to full success with machine learning. **(Figure 18)** They have more technology than people challenges. They are already focusing on the technology and data issues which should get them to success sooner.

An Array of Advanced Technologies

These three technologies are not the only ones that manufacturers consider important to enabling digital transformation. We asked which three advanced technologies are most important to the company's digital transformation, and some selected every technology listed. **(Figure 19)**

A few of these disruptive technologies are more widely used in discrete industries, such as 3D printing, digital twin of the product, and model-based enterprise. On the other hand, process and batch processing companies are over twice as likely as discrete manufacturers to be using augmented reality and mesh networks.

Across the board, manufacturers are selecting specific technologies to improve their business and solve tough problems. Most of the technologies had reduced costs and improved speed as the common thread found in the top two or three of the benefits identified.

Figure 18: Respondents who are already executing on a digital transformation strategy have different views on why machine learning is not delivering

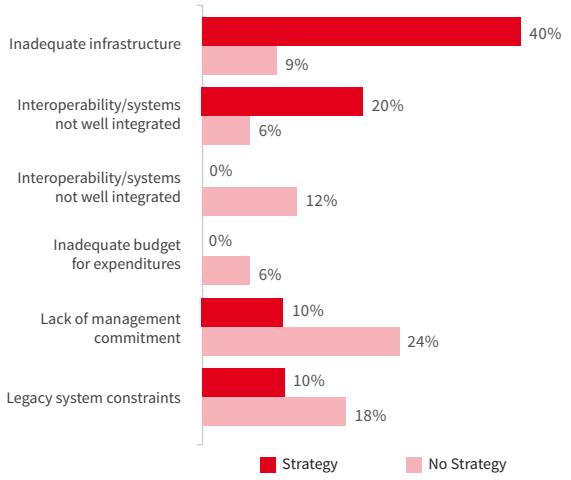
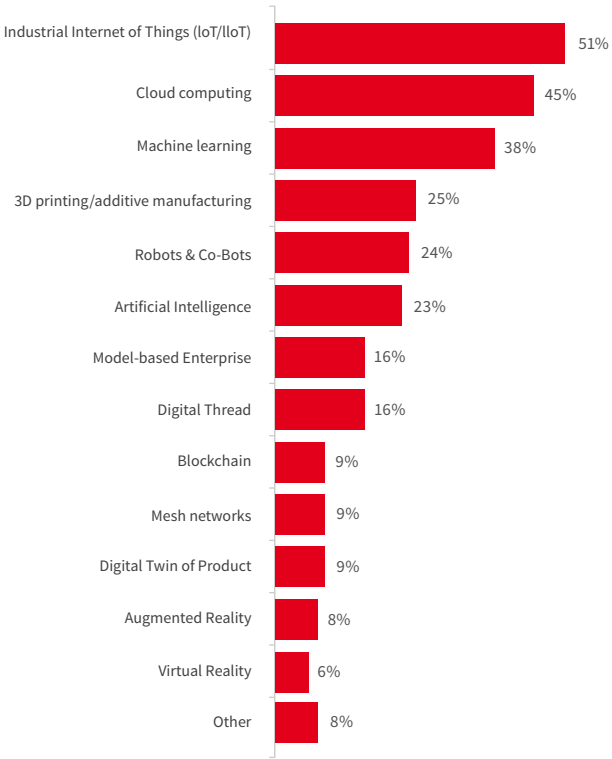


Figure 19: Advanced technologies manufacturers believe are important to their digital transformation initiatives' success.

New Business and Revenue Opportunities



Beyond that, it varies. Making better decisions is the key benefit noted for those working with artificial intelligence, digital thread and model-based enterprise. Improved quality and reduced errors is the top benefit cited for those implementing robots/co-bots. Those implementing additive/3D printing are looking to reduce costs and improve speed as the top benefits. With the flexibility that 3D printing provides, it is Interesting that the ability to accommodate specials, and increase agility was actually tied for number 4 on the list of identified benefits.

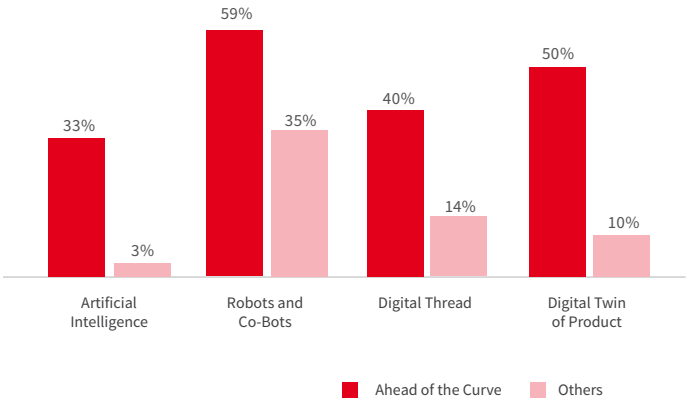
While many of these technologies are used across the business, some clearly have greater impact in specific areas.

- Over 70% of those focused on machine learning, IIoT and robots or co-bots expect to apply them to plant operations. Less than half cite each of these technologies in any other strategic impact area.

- While the survey indicates that cloud computing is being used throughout the businesses, the vast majority, at 80%, are planning to use cloud applications to help improve internal business workflows and processes.

- Over half of the respondents who see 3D printing or additive manufacturing as a high priority are applying it both in production and for new business and revenue opportunities.

Figure 20: Those ahead of the curve are far more likely than others to have implemented an array of technologies and are happy with the outcome



- The most even distribution across the business for any technology was for artificial intelligence (AI). Between 44% and 54% are already investing or are planning to invest in each of the four business areas. While the adoption may still be somewhat low (under 20%), the business value of using AI is clearly being seen across the business.

Putting many of these advanced technologies into play appears to deliver a competitive advantage. Those who feel they are ahead of their competition are having more positive outcomes across the spectrum of advanced technologies. **(Figure 20)**

Integrating these advanced technologies with each other and to existing platforms such as ERP, PLM, SCM and MES can result in significant business

process improvements while also opening up new business model opportunities. Digital thread is an example: it points to the integrated end-to-end information flow across an enterprise. This aligns well to the transformational goal of enabling a fully connected enterprise. Even so, only a small minority of companies have implemented it beyond a few pilots. Model-based enterprise is another approach that even fewer manufacturers have in place, but that is delivering benefits to over 20% of companies already. Those who set sights on these broader approaches and not just the narrow individual technologies tend to be gaining on their competition.

Next Steps

Digital transformation is a direction most manufacturers are going, but the map for how to arrive is not yet fully drawn. With both the approaches and some of the technologies still maturing, the road ahead may not be easy to see.

The great news is, we can all learn from those who are executing on a digital transformation strategy and who have gained a competitive advantage as a result. They demonstrate that having a strategy helps overcome many of the communication and consensus problems. Clearly, they have a mindset for being responsive and ready to deliver more customized or customer-specific products even while gaining benefits in cost, quality and speed. They also give

us an understanding that in the right environment, digital transformation with all the associated new technologies can move forward with great success.

Essentially every manufacturer can move toward digital transformation. This research shows the value of:

- Setting strategy to ensure a big picture perspective and management commitment
- Budgeting adequately for expenditures, staff time, and addressing infrastructure and integration
- Communicating, educating and training personnel to ensure everyone understands and is helping to drive toward the shared vision

- Focus on application and system integration, infrastructure and upgrading core applications such as ERP, MES and PLM as well as investing in advanced technologies.

- Leveraging cloud computing for agility and to free up IT talent to ensure digital transformation success

- Creating end-to-end information flows and investing everywhere needed to ensure those are effective

Executing on a digital transformation strategy can deliver many benefits. It is an essential path to finding new transformational business opportunities and becoming more connected, customer-centric, agile, responsive and focused.

The old saying “he who hesitates is lost” was never truer than today. Digital transformation presents a great opportunity for companies to remain competitive in a rapidly evolving marketplace. The more you fall behind, the more difficult it will be to catch up. Those who are ahead of the curve are likely to continue gaining success and learning from their experience.

The old saying “he who hesitates is lost” was never truer than today. Digital transformation presents a great opportunity for companies to remain competitive in a rapidly evolving marketplace.

APPENDIX

Survey background

The data for this research was collected in an online survey executed by Informa, parent company of IndustryWeek, January 4-16, 2018. The response base consists of 261 individuals from a wide range of production and manufacturing industries. More than half are from discrete manufacturing industries such as machinery, fabricated metal, automotive, electrical equipment, and medical devices. The remaining portion are process or batch industries such as chemicals, plastics, primary metals, food and beverage, textile, and oil and gas. **(Figure 21)**

Every aspect of a business is represented, which helps keep departmental bias to a minimum. **(Figure 22)**

Nearly all the respondents are involved in developing a digital transformation strategy for their company. **(Figure 23)** So, these respondents are likely to represent their organization's actual progress effectively.

Thanks to everyone who responded to make this snapshot of the state of digital transformation in manufacturing possible.

Figure 21: Respondents by manufacturing mode

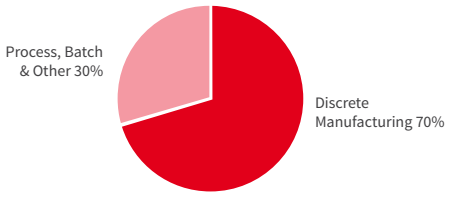


Figure 22: Role of respondents

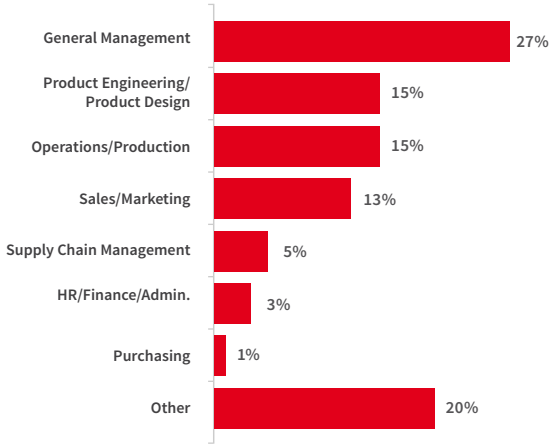
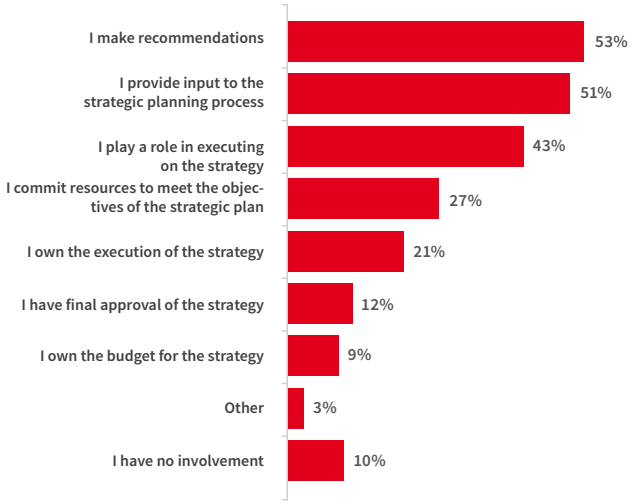



Figure 23: Respondents' involvement in digital transformation strategy