

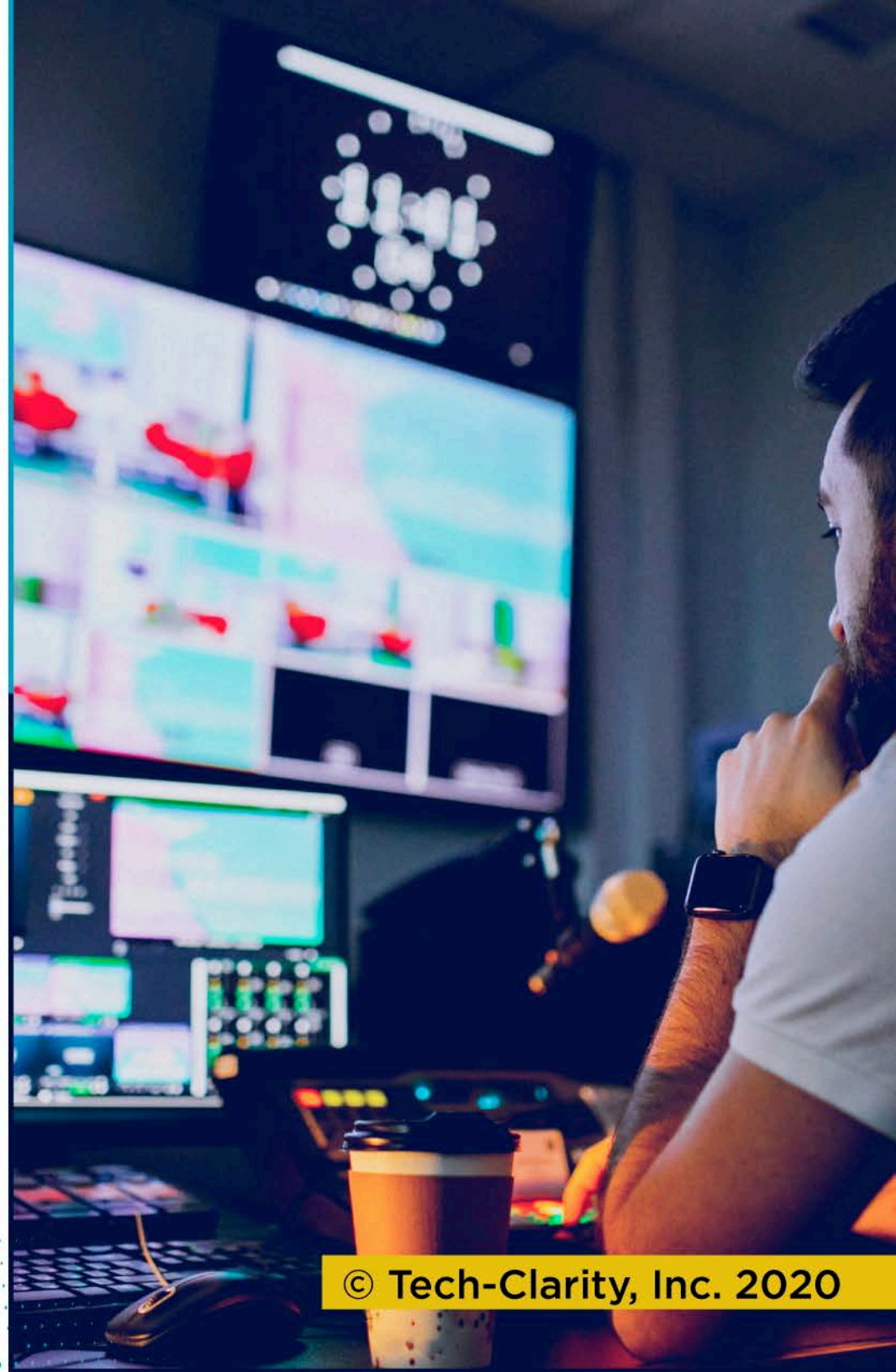
# Drive Higher Profits with IoT Machine Monitoring and Optimization

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**Jim Brown,**

*President, Tech-Clarity*

**Tech-Clarity**

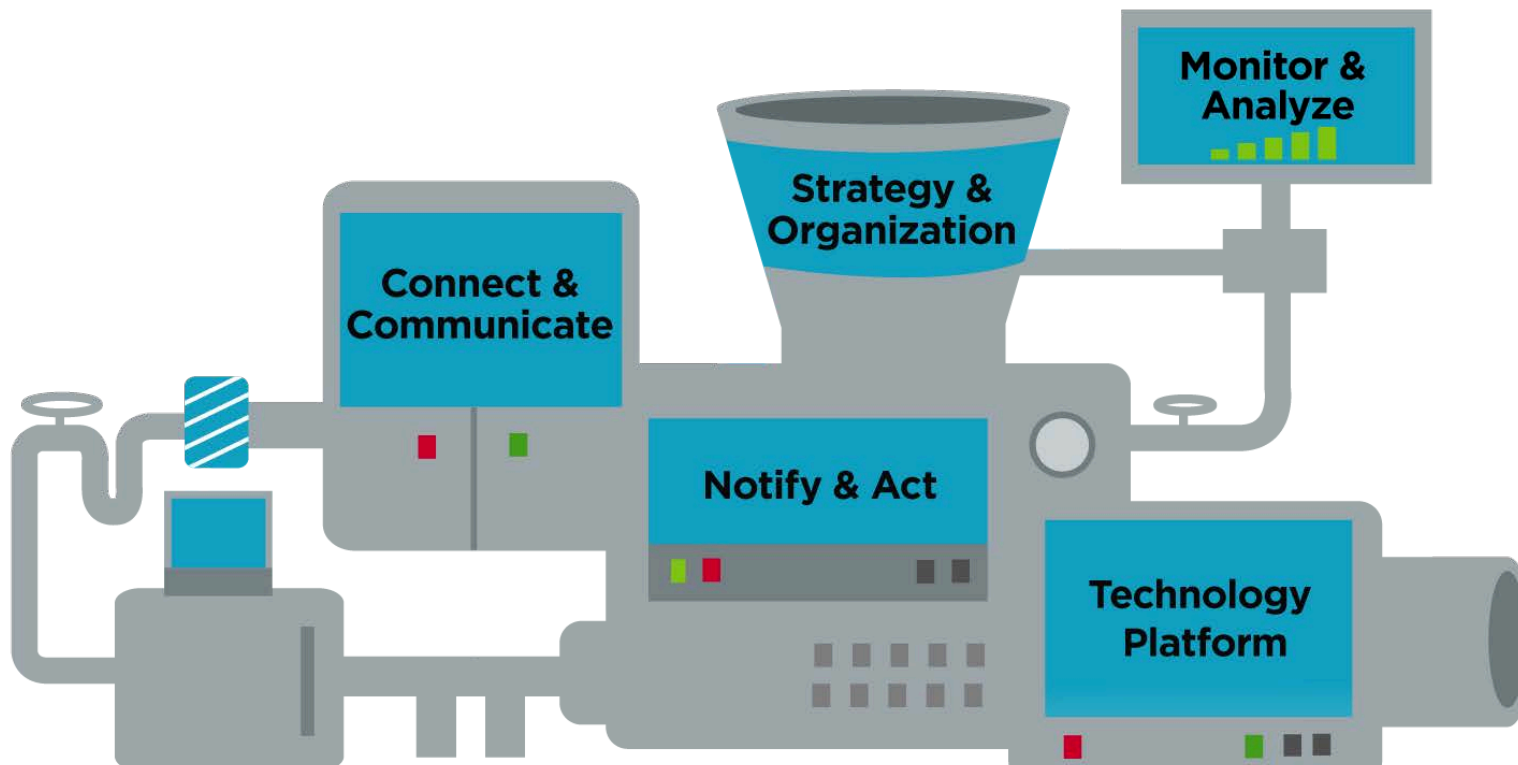


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# Top Performers Drive Higher Profitability Gains

## Survey Shows Top Performers Do Things Differently

How can manufacturers significantly improve profitability with IoT machine monitoring and optimization? We surveyed two hundred twenty-three (223) companies that manufacture, operate, service, sell, distribute, install, and/or integrate equipment to find out. The results show that top-performing companies take different approaches in all five of Tech-Clarity's Pillars of Machine Monitoring and Optimization and provide an example of best practices for others to follow.



Tech-Clarity's Five Pillars of Machine Monitoring and Optimization

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# Strategies

## Many Pursuing Machine Monitoring and Optimization

Researchers started by examining the state of machine monitoring in the manufacturing industries. Over three-quarters of surveyed companies report having a machine monitoring and optimization strategy. Some industries are pursuing it very aggressively; for example, a full 91% of industrial equipment / machinery companies have a strategy.

Even in companies earning less than \$250 million, who are less likely to be actively pursuing it, two-thirds share that they have a strategy.

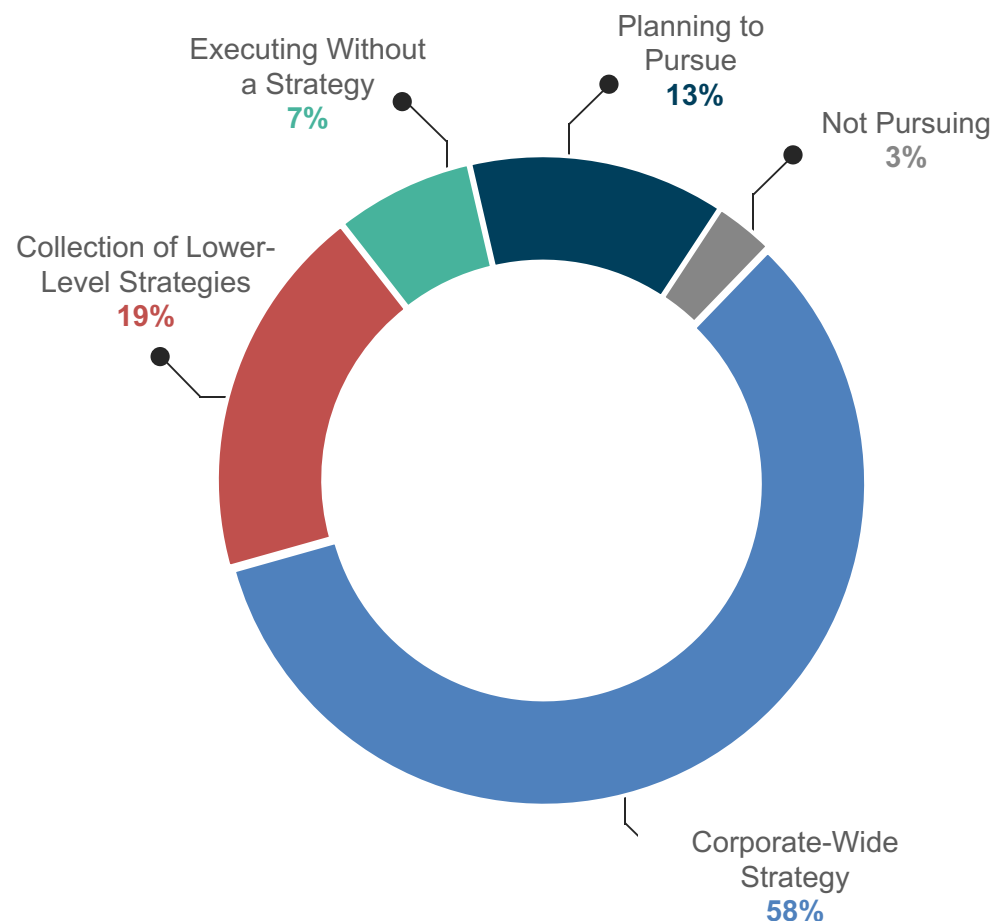
## Strategies Reflect a Broad Scope

Machine monitoring and optimization is getting attention at the highest levels of the organization. Over one-half of surveyed companies have a corporate-wide strategy. That figure climbs to about three-quarters for companies with revenue greater than \$1 billion.

## The Communication Gap

One interesting finding points to a potential need for companies to better communicate about their initiatives internally. "C-level" respondents are 20% more likely to report that they have a corporate-wide strategy than those in other roles. At the same time, 21% of individual contributors think there is no strategy, which is much more common than in higher level roles. This may indicate a gap in corporate communication.

Status of Machine Monitoring and Optimization Strategy



# Benefits

## Companies Target Broad Value

Machine monitoring and optimization offers broad-ranging benefits, which is reflected in the variety of goals companies report pursuing. Some goals impact service-oriented performance, including improved service revenue, higher service margins, and lower warranty / service costs. Other objectives impact plant performance, including those that drive higher OEE, such as increased equipment efficiency, greater equipment throughput, improved quality, and reduced downtime.

## Achieving even Broader Benefits

Not only are companies targeting broad benefits, survey results show that they are attaining more benefits than they target. For example, only 38% of companies set out to improve customer relationships or satisfaction, but 54% experienced this benefit. That's significant given that customer relationships are crucial to business success!

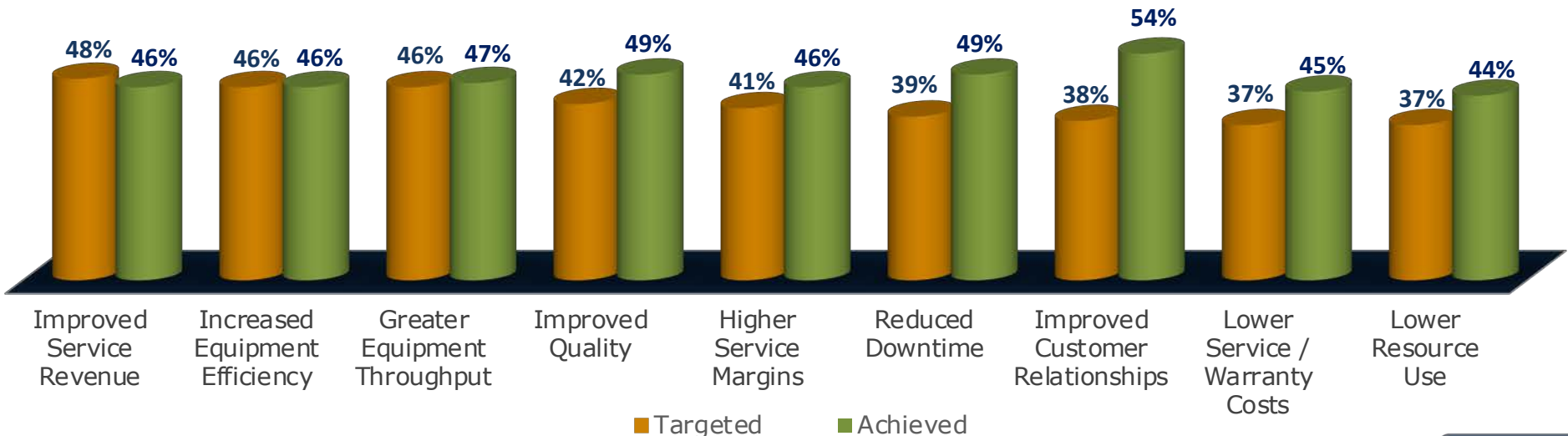
## Machine Monitoring and Optimization Provides Bottom-Line Impact

Machine monitoring benefits translate into real business results. The vast majority, 86%, say that their company's profitability has increased by monitoring and optimizing machines using the industrial IoT. Over one-third, 35%, say it has increased significantly. Larger companies were even more likely to report significant revenue growth; 44% of companies with revenues greater than \$1 billion reported significant profitability increases.

**86%** Profitability has increased by monitoring and optimizing machines

**35%** Profitability has increased **significantly**

Benefits Targeted / Achieved from Machine Monitoring and Optimization



# Monitoring and Optimization is Transformational

## Machine Monitoring Benefits are Strategic

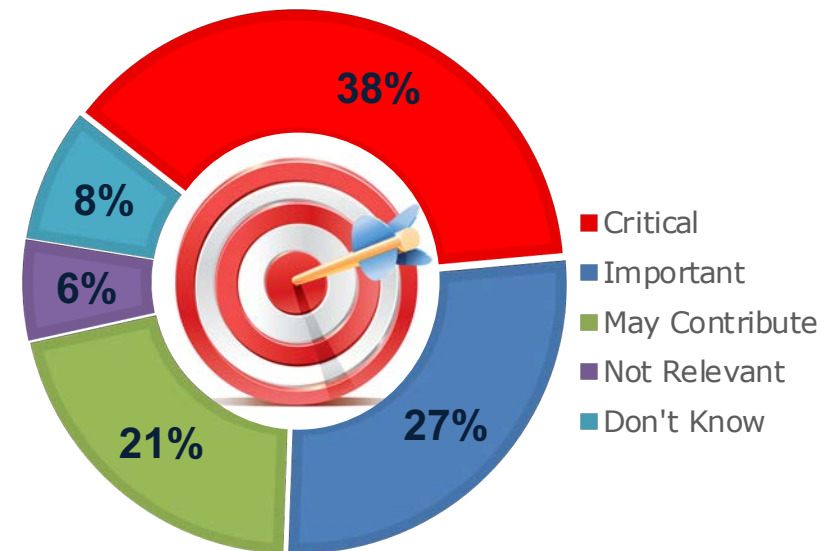
Beyond direct benefits, monitoring equipment via the industrial IoT is the foundation for greater business impact. Most survey takers report that their equipment monitoring strategy is part of one or more broader corporate initiatives. Machine monitoring and optimization supports a variety of important business initiatives including digital transformation, smart manufacturing, and service transformation. It can also help fuel continuous improvement programs such as Six Sigma, as reported by one-half of surveyed companies. Very few, only 2%, are pursuing it as a standalone strategy.

## IoT Machine Monitoring is Essential

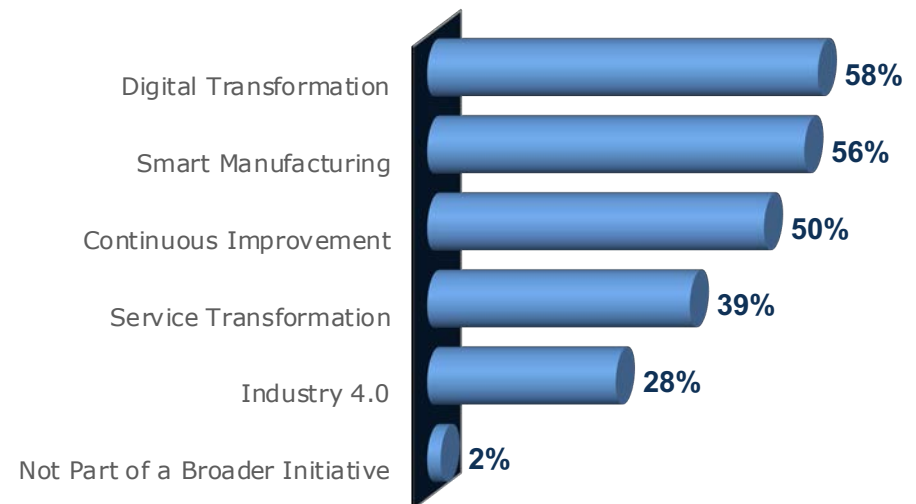
Machine monitoring and optimization drives success by fueling digital transformation. A recent, but separate, Tech-Clarity survey shows that more than one-half of manufacturers say digital transformation is “important” if not “critical” to achieving their business strategy.<sup>1</sup> This is particularly true in these challenging times. As evidence, another study finds that the vast majority of companies have either increased their focus and/or accelerated their digital transformation efforts or at least maintained their current level of focus.<sup>2</sup> Machine monitoring is much more than a tactical, operational initiative; it lays the structure for much broader digitalization.

Over one-half of companies report that machine monitoring and optimization is part of a broader digital transformation strategy (58%) and/or their smart manufacturing strategy (56%).

Digitalization Importance to Business Strategy



Strategy Included in a Broader Initiative



# Challenges

## What Inhibits Adoption?

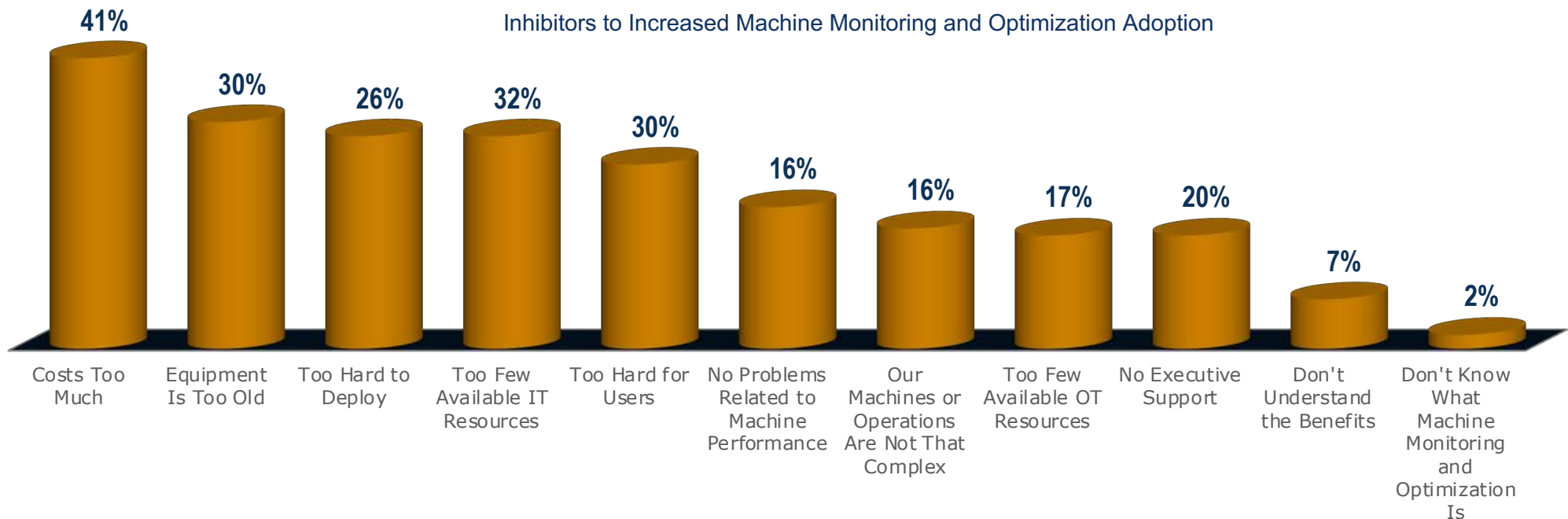
The industry has not seen as much growth in machine monitoring and optimization as the benefits would have you expect. Companies are still challenged to expand their implementations due to cost, legacy equipment, complexity, and resource issues. Many of these issues are likely due to "brute force" approaches that aren't scalable, as companies learn to better take advantage of the strategic opportunity.

## Challenges to Overcome

Companies report a variety of high-level challenges, including:

- Developing a business model / monetizing (49%)
- Technical issues (44%)
- Difficulty aligning with customers / partners (39%)
- Resistance to change (36%)

The range of challenges indicates that the industry is still in a learning phase regarding these initiatives. Companies implementing the IoT are seeing good results, but still have a combination of fundamental challenges that require guidance and the adoption of best practice processes, organizational approaches, and technologies. They face issues that go beyond their own operations, including change management and negotiating new relationships with customers and partners, such as distributors.



# Impacts of COVID-19

## Global Disruption Boosts Digital Transformation

A prior survey found that the global disruption of COVID-19 has had a net positive impact on digital transformation as a whole. Almost one-half of companies (46%) increased focus and/or accelerated their digital transformation as a result of global challenges, such as; COVID-19, earthquakes, tsunamis, volcanic activity, hurricanes, and human-created events, like 9/11. Another 42% said that it stayed the same, and only 1%

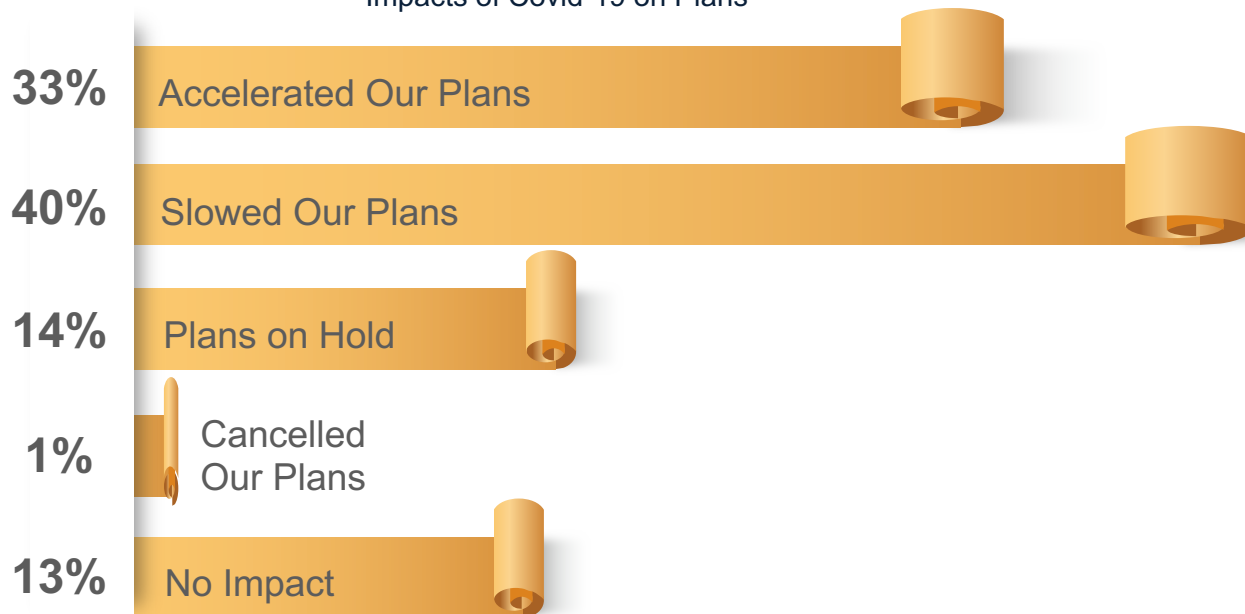
said that they put their initiatives on hold.<sup>2</sup>

## COVID-19 Disruption Impacts Machine Monitoring Plans Differently

In contrast, COVID-19 is having a mixed impact on related machine monitoring and optimization plans. For 40% of responding companies, the disruption has slowed down their plans. On the other hand, 33% of surveyed companies (including almost one-half of

executives) say that COVID-19 has accelerated their machine monitoring and optimization plans. It appears that some companies are looking to find ways to come out of the economic slowdown and coinciding supply chain challenges, caused by the pandemic, in a better position than where they started. Although 14% say they put their initiatives on hold, only 1% say they canceled their plans. Companies still see the value in digitalization and IoT machine monitoring, even if they have had to hit the pause button.

Impacts of Covid-19 on Plans



Companies still see the value in digitalization and IoT machine monitoring, even if they have had to hit the pause button.



# How Can Companies Improve Performance?

## Identifying Top Performers

Researchers used a benchmarking process called "Performance Banding" to determine the approaches that drive better machine monitoring and optimization performance. They looked at performance against a number of operational capabilities related to machine monitoring and optimization as compared to competitors:

- Capturing Data from Equipment
- Communication and Connecting with Equipment
- Monitoring and Analyzing Equipment Data
- Utilizing Equipment Information for Machine Optimization

Then they created an aggregate metric across these and labeled the top 19% of them "Top Performers" and called the rest "Others."

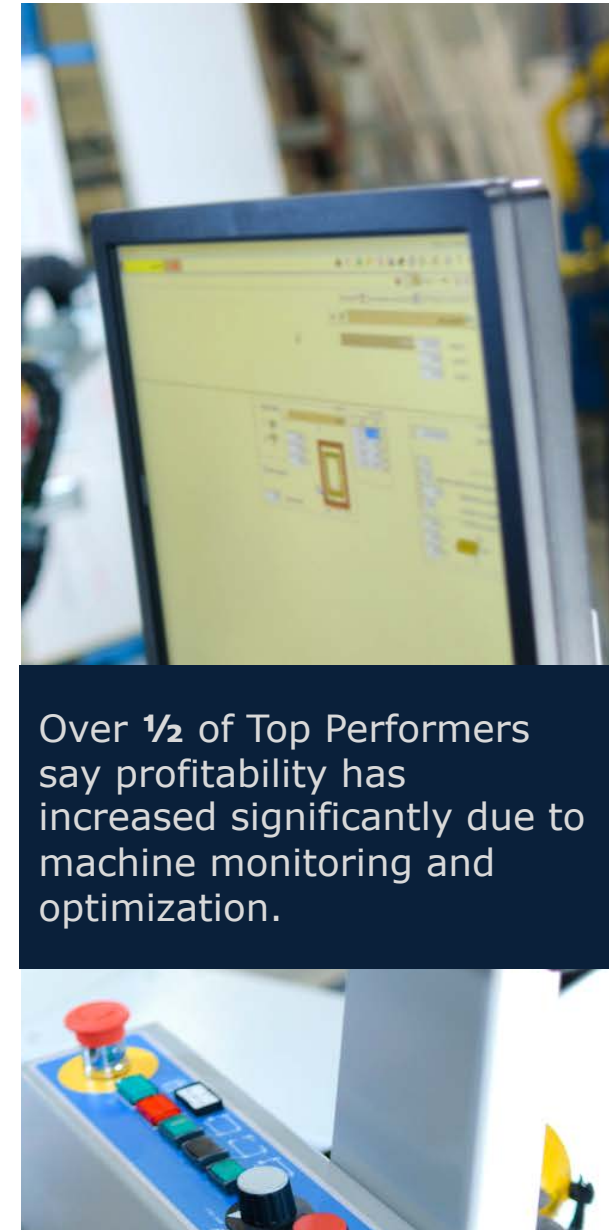
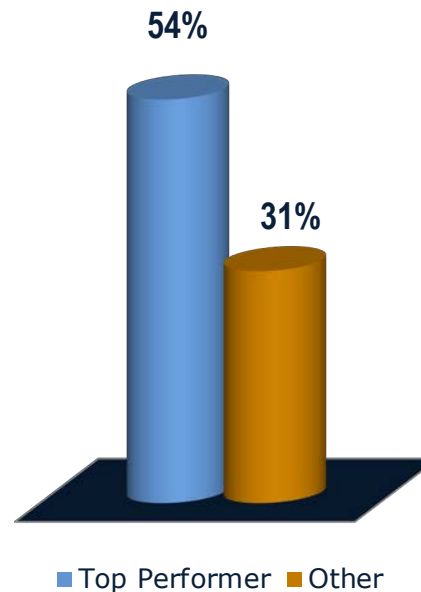
## Analyzing What Top Performers Do Differently

Once the Top Performers were identified, researchers looked into their organizational, process, and technical capabilities across Tech-Clarity's Five Pillars of Machine Monitoring and Optimization to understand how they achieve their higher performance levels. Then, researchers used those differences to make improvement recommendations for the Others.

## Understanding the Value of Performance

While the metrics used to identify Top Performers were performance oriented, researchers evaluated profitability growth across the Performance Classes and found that Top Performers are 74% more likely to report that machine monitoring and optimization with the IoT has significantly increased their profitability. This finding shows that the leaders' ability to better monitor and optimize equipment results in tangible business benefits.

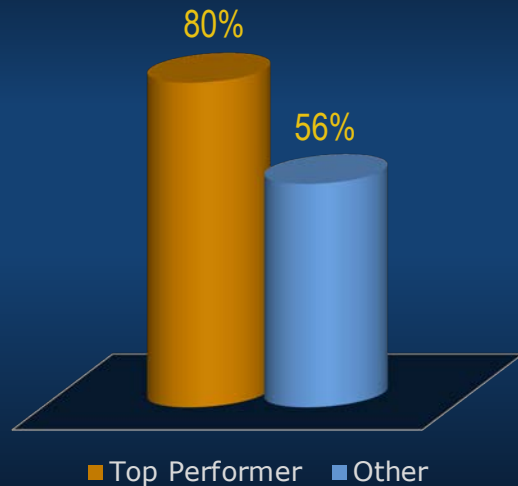
Significant Increase in Profitability by Performance Class



Over 1/2 of Top Performers say profitability has increased significantly due to machine monitoring and optimization.

# Pillar 1: Strategy and Organization

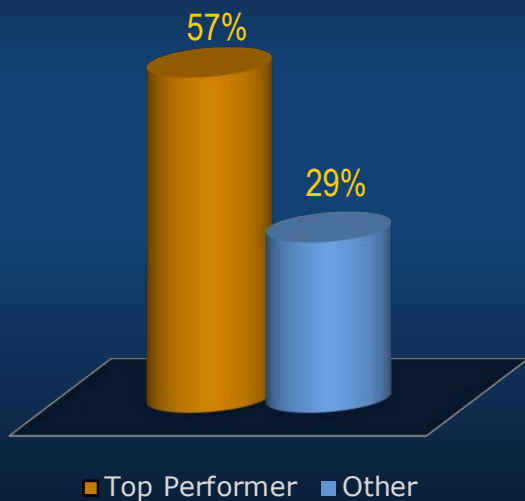
Machine Monitoring and Optimization Strategy by Performance Class



## Develop a Corporate-Wide Strategy

As mentioned earlier, researchers evaluated capabilities across Tech-Clarity's Five Pillars of Machine Monitoring and Optimization. From a strategy perspective, Top Performers appear to view machine monitoring and optimization at a higher level across the company. Top Performers are 43% more likely to pursue it with a corporate strategy. They are also 25% more likely to have their strategy aligned with a broader digital transformation strategy versus a more manufacturing-specific initiative. Machine monitoring and optimization provides value in manufacturing but can impact performance and profitability more significantly if it is applied more extensively across the enterprise.

C-Level Executive Responsible for Machine Monitoring, Analysis, and Optimization by Performance Class



## Put a C-Level Executive in Charge

Researchers examined the highest level of the organization that is responsible for machine monitoring, analysis, and optimization. They found that Top Performers are almost twice as likely to have a C-level executive, such as a Chief Digital Officer or Chief Information Officer, directly responsible for their strategy. This organizational level can help drive a vision for transformation and ensure that it spans departmental and regional boundaries.

# Pillar 2: Connect and Communicate

## Create Data Standards

The next pillar evaluated includes connecting with equipment and communicating data. Participants reported whether their company has a standard way to capture and store machine data. Top Performers are 89% more likely to have a standard way to capture and store machine data, which helps with repeatability and scalability.

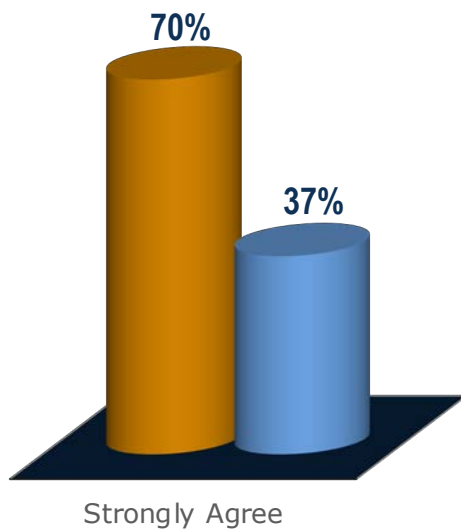
## Pre-process Data

Participants were also asked whether their company pre-processes machine data, such as consolidating information through edge computing, before they store or communicate it. The survey shows that Top Performers are 76% more likely to strongly agree that they pre-process data. Pre-processing can reduce data clutter and improve responsiveness by leveraging edge computing to make monitoring and analysis more effective.

## Centralize Data in a Data Lake

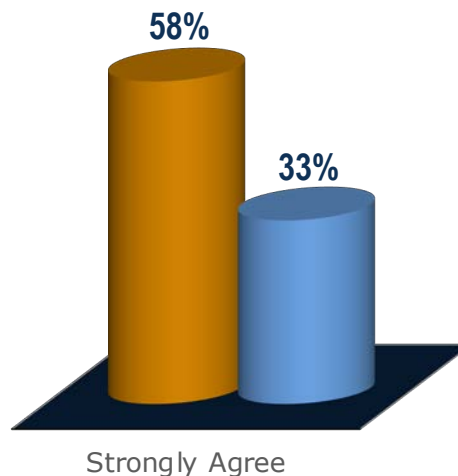
Researchers asked whether responding companies have a centralized data lake to store machine data. Top Performers are 91% more likely to centrally store machine data from their equipment. Data lakes can consolidate information of different forms and from different systems to provide a strong foundation to build analysis on.

Standard Way to Capture and Store Machine Data



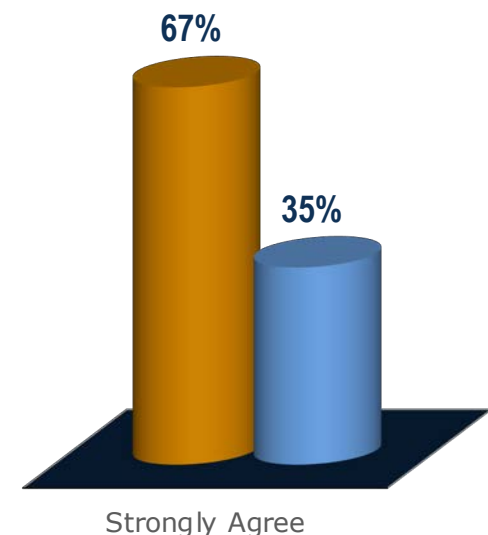
■ Top Performer ■ Other

Pre-process Data by Performance Class



■ Top Performer ■ Other

Centralized Data Lake by Performance Class



■ Top Performer ■ Other

# Pillar 3: Monitor and Analyze – Prepare Data

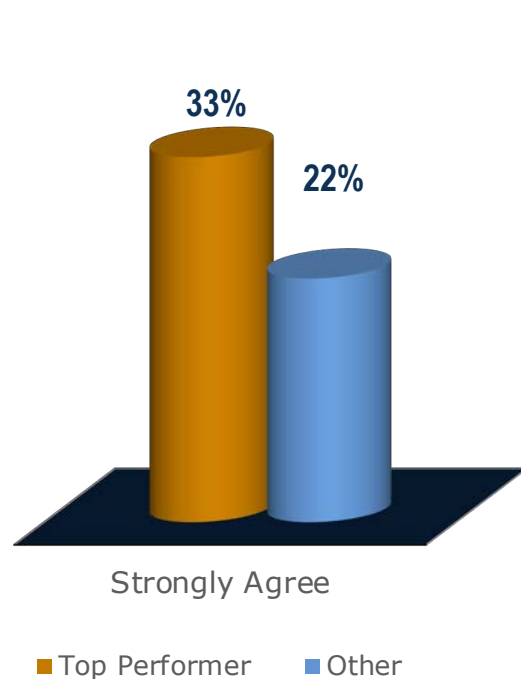
## Cleanse Equipment Data

The next pillar includes monitoring data from machines and creating useful information from it. The first capability researchers considered was whether participants' companies cleanse equipment data to remove noise. Top Performers are 50% more likely to do so. Data cleansing, sometimes performed on the edge, provides a more valuable set of data to analyze and draw conclusions from.

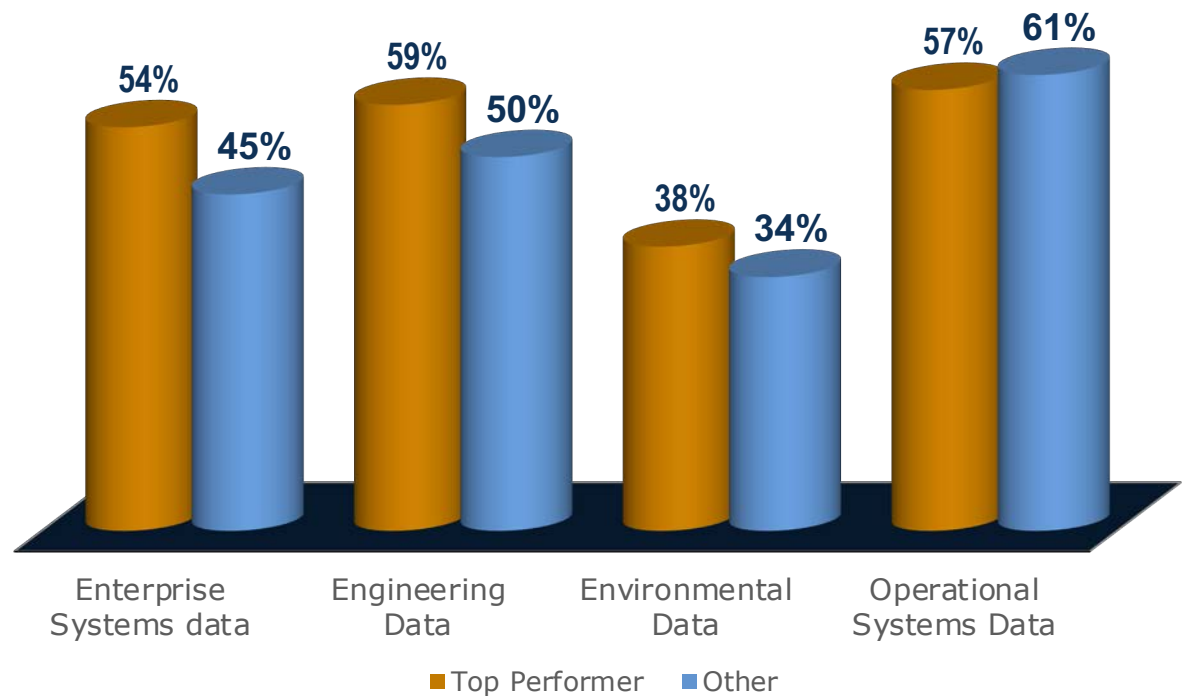
## Combine Data from Other Sources

Respondents were asked to share what types of systems data they combine with machine data. Top Performers most commonly combine operational systems data, but the most differentiated capabilities include combining information from enterprise systems and engineering data. Equipment data is valuable, but it is only one part of the equation. Combining equipment data with business, engineering, environmental, and other operational data creates valuable insights.

Cleansing Equipment Data by Performance Class



Combining Machine Data by Performance Class



# Pillar 3: Monitor and Analyze – Analyze Data

## Leverage a Variety of Analysis Techniques

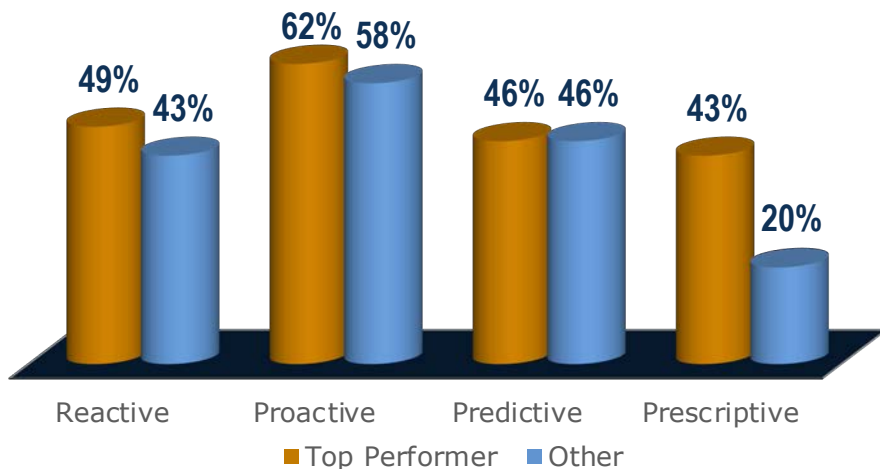
Companies shared the techniques they use to gather insights from machine data. Top Performers use a variety of approaches. They are more likely to use advanced methodologies to gather insights from machine data, being 59% more likely to use algorithms and 35% more likely to compare machine data to simulations and/or a digital twin. Despite their reliance on more advanced approaches, the use of AI and machine learning are reported by only 35% of companies and aren't differentiated, as of yet. These technologies are emerging and showing great promise but don't appear to be mainstream yet. In addition, using a variety of techniques allows companies to choose the right approach for each situation.

## Move to More Proactive Approaches

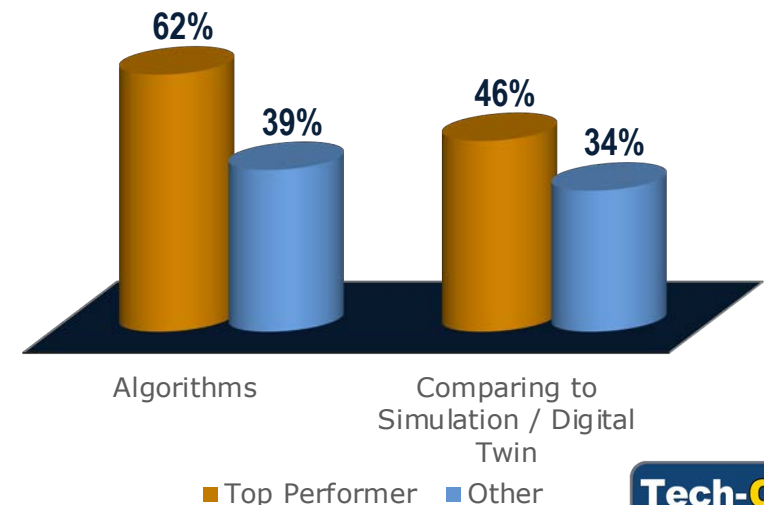
Companies across Performance Class use a variety of methods to determine actions based on machine data analysis. The most common is a proactive approach, although the most differentiated is prescriptive, which is reported more than twice as often by Top Performers. The earlier companies can develop insights, particularly if they can precede an adverse event like a breakdown, the more valuable the information is. Based on experience, we believe that participants reporting predictive and prescriptive approaches are not relying on it pervasively, and that they still rely on less proactive approaches as well.

Analysts also looked at closing the loop with a model / simulation / engineering. This approach is reported 17% more commonly in Top Performers, but not reported by many companies of either Performance Class. This capability is emerging, however, and showing great promise.

Determining Actions from Machine Data and Analysis by Performance Class



Techniques to Gather Insights from Machine Data by Performance Class



# Pillar 4: Notify and Act

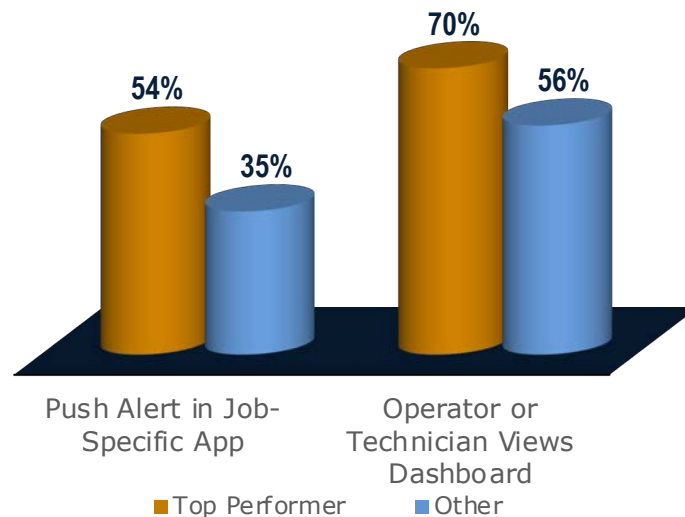
## Focus on Speed

Researchers evaluated how quickly responding companies can act on information and insights from machine monitoring and analysis. Top Performers are 75% more likely to have the ability to act in near-real-time, although only about one-third report that ability. However, 59% of these leading companies can act in minutes. While companies are trying to develop insights sooner, they must be able to act on them in a timely way in order to drive the greatest business value.

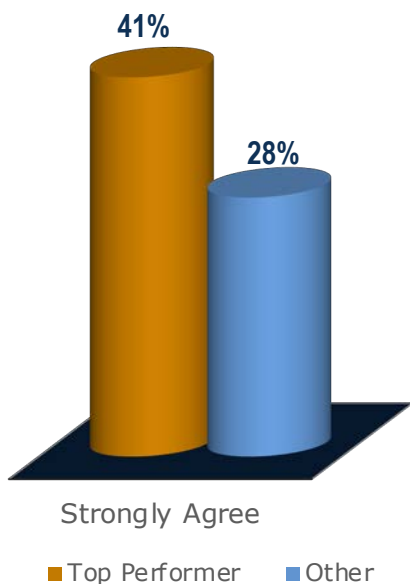
## Rely on Direct Communication

The ability to act quickly relies on strong communication. Survey analysis shows that Top Performers use more real-time communications methods than Others. They are over 50% more likely to have operators or technicians receive a push alert in a job-specific application, which could be a custom application or a packaged solution. They are also 25% more likely to have an operator view a dashboard. Interestingly, they are actually 27% *less* likely to rely on email or text alerts.

How Actions Are Initiated By Performance Class



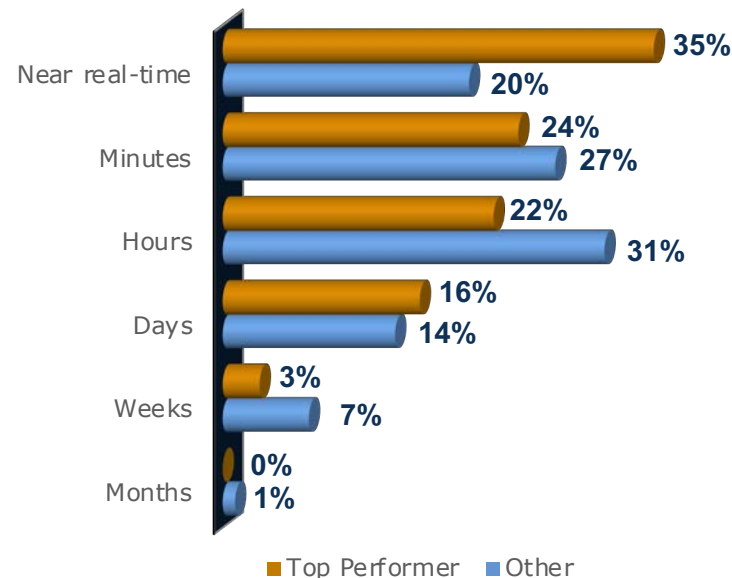
Bi-directional Communication With Equipment



## Establish the Ability to Communicate Bidirectionally

Top Performers are 27% more likely to employ automatic corrective actions, such as self-healing (reported by 19% of the Top Performers). These actions, among other approaches including remote upgrades and service, rely on the ability to communicate instructions to equipment. Top Performers are 89% more likely to have the ability to communicate back to equipment. Researchers also investigated automated actions, like shutdowns to avoid an incident, and found no significant difference by Performance Class.

Speed to Act by Performance Class



# Pillar 5: Technology Platform – Systems

## Employ Industrial IoT Technology

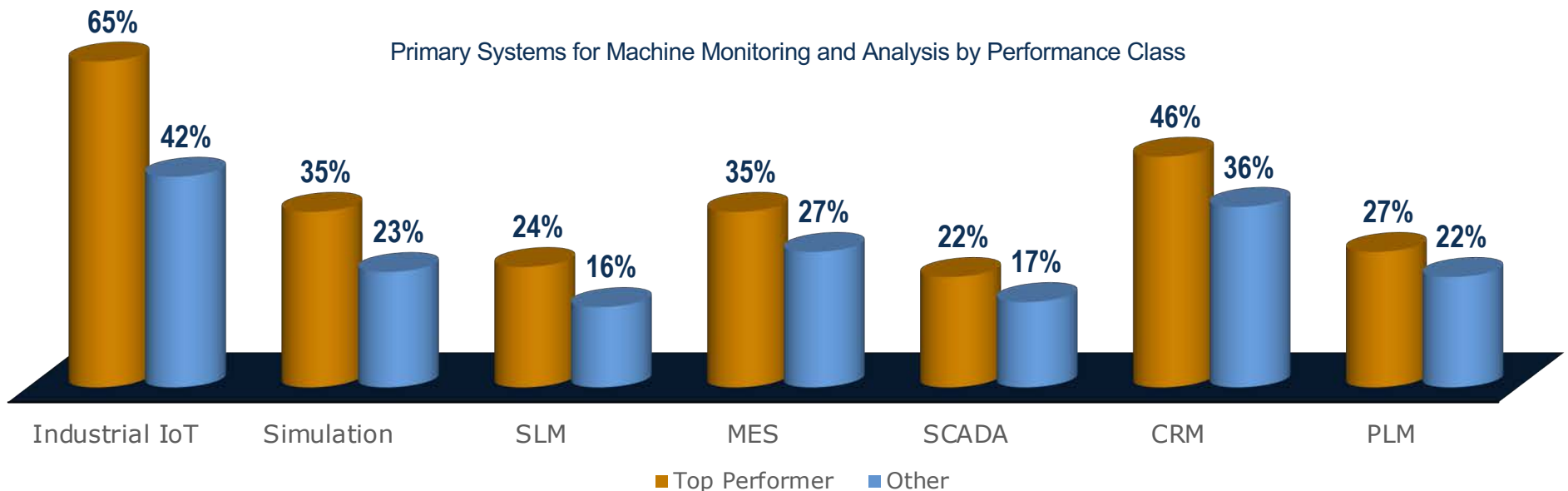
The final pillar investigated includes the technology used to support the other pillars. Effective machine monitoring and optimization relies on a wide variety of technical enablers. Not surprisingly, Top Performers take differentiated approaches. Top Performers use a variety of systems to support their equipment monitoring strategies. The most common, and most differentiated, is the use of industrial IoT, which is used by about two-thirds of Top Performers.

## Leverage Operational Systems

Other solutions that are more commonly used by Top Performers include Service Lifecycle Management (SLM), MES, and SCADA solutions. These solutions are execution-oriented systems controlling operations and maintenance of equipment. These systems contain crucial data but also provide the ability to act on information and analysis. CRM can also play a role in providing customer- and service-related information and may provide another way for companies to act on insights.

## Include Engineering Systems

Top Performers are also about 50% more likely than Others to report the use of simulation software, although only about one-third of Top Performers use it. This may contribute to their ability to react prescriptively to potential issues based on a better understanding of their equipment. PLM systems contain master data and may also help provide ways to capture and follow up on issues.



# Pillar 5: Technology Platform – Integration

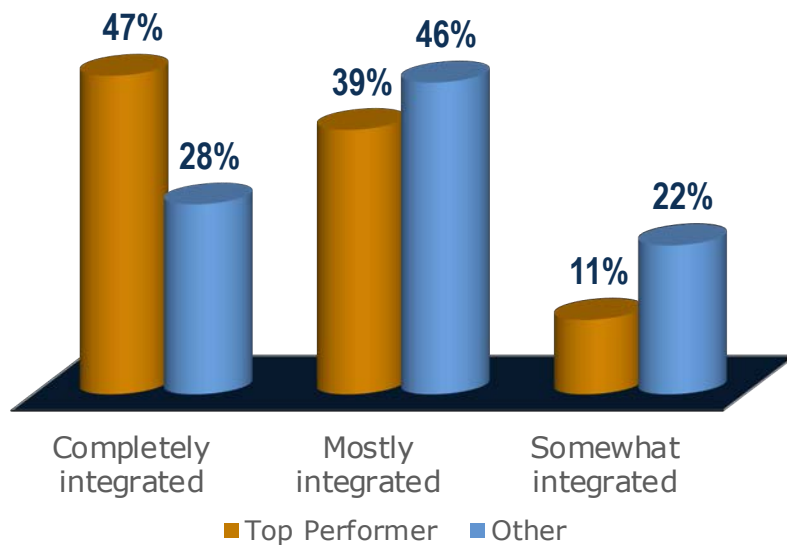
## Integrate Systems

The most differentiated technology finding in the study was not about which systems are used, but about how they are used together. Top Performers are about two-thirds more likely than Others to report that the systems they use to support machine monitoring, analysis, and optimization are completely integrated. A full 86% of these leading companies say that their systems are at least mostly integrated. Integration provides benefits across all pillars of machine monitoring and optimization. Based on experience, the number of companies that indicate they have a “completely” integrated system is likely optimistic. That could be due to self-selection of survey respondents or because there was no standard definition of “completely integrated.”

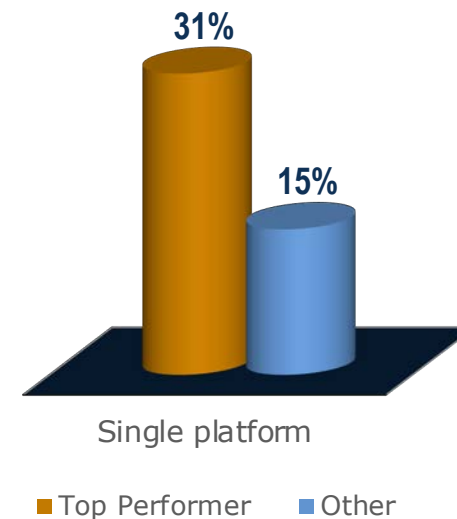
## Leverage a Platform

Integrating systems can take a lot of effort and ongoing maintenance. Researchers asked participants what best describes the technology they use to support machine monitoring, analysis, and optimization. Top Performers are more than twice as likely to employ a single platform to support this initiative, with 31% of Top Performers reporting that they leverage a single platform. Almost three-quarters of Top Performers, in fact, say they have a platform or an integrated suite of solutions. Platforms provide integration and a cohesive approach to monitor equipment, gain insights, and act on the data to improve performance and profitability.

Level of Integration by Performance Class



Type of Solution by Performance Class





# Key Findings and Conclusions

## Companies are Actively Pursuing Machine Monitoring

Over three-quarters (**84%**) of surveyed companies are pursuing machine monitoring and optimization, and another 13% plan to. Most companies are pursuing it as a part of a larger digital transformation, smart manufacturing, or service transformation initiative; as continuous improvement; or a combination of these.

## Machine Monitoring and Optimization Drives Benefits

Companies are pursuing – and achieving – business goals by implementing machine monitoring and optimization. Initiatives to monitor and improve equipment are resulting in improved profitability in the vast majority of companies.

## Top Performers Gain More Value from their Approaches

Over one-half (54%) of Top Performers, those that are executing better at the pillars of machine monitoring, report they have significantly improved profitability. These leaders are leveraging best practices and technologies to support machine monitoring and optimization. They are:

- Almost twice as likely to have an executive responsible for their strategy
- More likely to combine machine data with enterprise systems, engineering data, and environmental data in addition to operational systems
- Twice as likely to use prescriptive methods to act on data (although it's still an emerging practice and only a small percentage have adopted this)
- 50% more likely to initiate actions by notifying operators with push notification in job-specific apps, and 75% more likely to be able to act on information in near real-time

To support this, they are about two-thirds more likely to have fully integrated systems, twice as likely to have a single suite of solutions, and much more likely to leverage an Industrial IoT solution. Companies that follow the best practices across the Pillars of Machine Monitoring and Optimization are more likely to significantly improve their company profitability.



Companies that follow best practices across the Pillars of Machine Monitoring and Optimization are more likely to significantly improve their company profitability.

# About the Research

## Data Gathering

Tech-Clarity gathered and analyzed over 220 responses to a web-based survey on IoT Machine Monitoring and Optimization. Survey responses were gathered by direct e-mail, social media, 3<sup>rd</sup> party data collection, and online postings by Tech-Clarity.

## Industries\*

The respondents primarily represent the Industrial Equipment / Machinery industry (78%). In addition, 28% were Primary Materials / Metals, 19% Automotive / Transportation, 17% Electronics / High Tech, 10% Architecture / Engineering / Construction, and others including Aerospace Defense, Building Products and Fabrication, Consumer Products, Life Sciences / Medical Devices, and Energy / Utilities.

## Company Size

The respondents represent a mix of company sizes, including 25% from smaller companies (less than \$250 million), 35% between \$250 million and \$1 billion, 26% between \$1 billion and \$5 billion, and 13% greater than \$5 billion. 2% did not disclose their company size. Company sizes were reported in US dollar equivalent.

## Geographies\*

Companies report doing business in North America (57%), Asia (50%), Western Europe (39%), Eastern Europe (35%), Latin America (19%), Middle East (17%), Australia (14%), and Africa (6%).

## Operational Environment\*

65% of respondents monitor equipment in their own facilities or operations while 50% of respondents

monitor in customers' facilities. 13% of respondents monitor in the consumer environment.

## Role

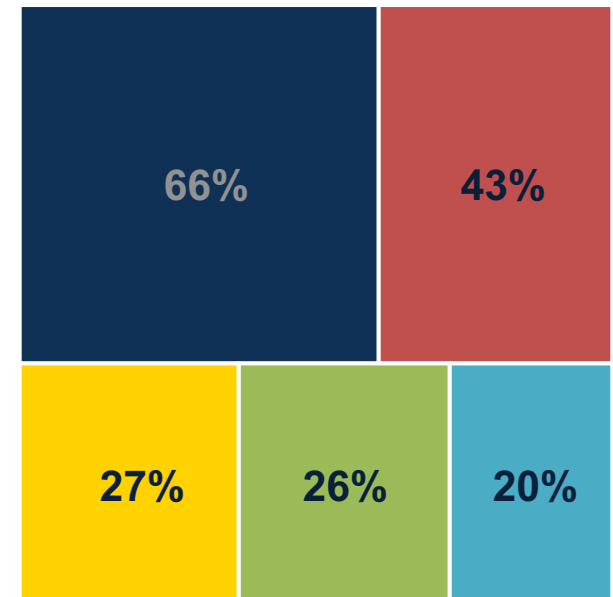
The respondents were comprised of 31% Manager level, 26% Directors, 11% Vice Presidents, 26% Executive / C-Level, and 6% individual contributors.

## Organizational Function

Of the respondents, 32% were in Manufacturing Operation roles, 26% in Design / Engineering, 11% Industrial / Manufacturing Engineering, and the remainder were from Plant / Facilities Engineering, Information Technology, Project / Program Management, and others.

\* Note that the values total greater than 100% because companies could select multiple responses.

Responding companies perform a variety of activities related to machines / equipment, representing different roles in the industry.\*



- Manufacturing Machines / Equipment
- Operating Machines / Equipment
- Servicing Machines / Equipment
- Selling and/or Distributing Machines / Equipment
- Installing / Integrating Machines / Equipment

# Acknowledgments

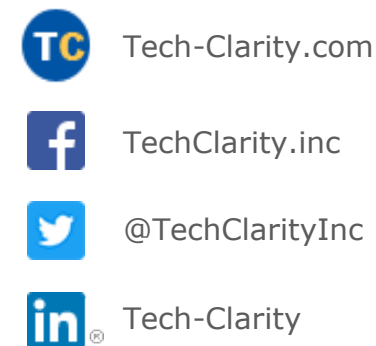


**Jim Brown**  
President  
**Tech-Clarity, Inc.**

## About the Author

Jim Brown founded Tech-Clarity in 2002 and has over 30 years of experience in the manufacturing and software industries. Jim is an experienced researcher, author, and speaker and enjoys engaging with people with a passion to improve business performance through digital enterprise strategies and supporting software technology.

Jim is actively researching the impact of digital transformation and technology convergence in the manufacturing industries.



**Tech-Clarity** is an independent research firm dedicated to making the business value of technology clear. We analyze how companies improve innovation, product development, design, engineering, manufacturing, and service performance through the use of digital transformation, best practices, software technology, industrial automation, and IT services.

## References

- 1) Jim Brown, "The State of Digital Transformation in Manufacturing," Tech-Clarity, November 2018.
- 2) Jim Brown, "Business Sustainability (and Survival) Strategies 2020," Tech-Clarity, September 2020.

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