AVOIDING PILOT PURGATORY:

How to Choose the Right Use Cases to Accelerate Industrial Transformation

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Avoiding Pilot Purgatory:
HOW TO CHOOSE THE RIGHT USE CASES TO ACCELERATE INDUSTRIAL TRANSFORMATION

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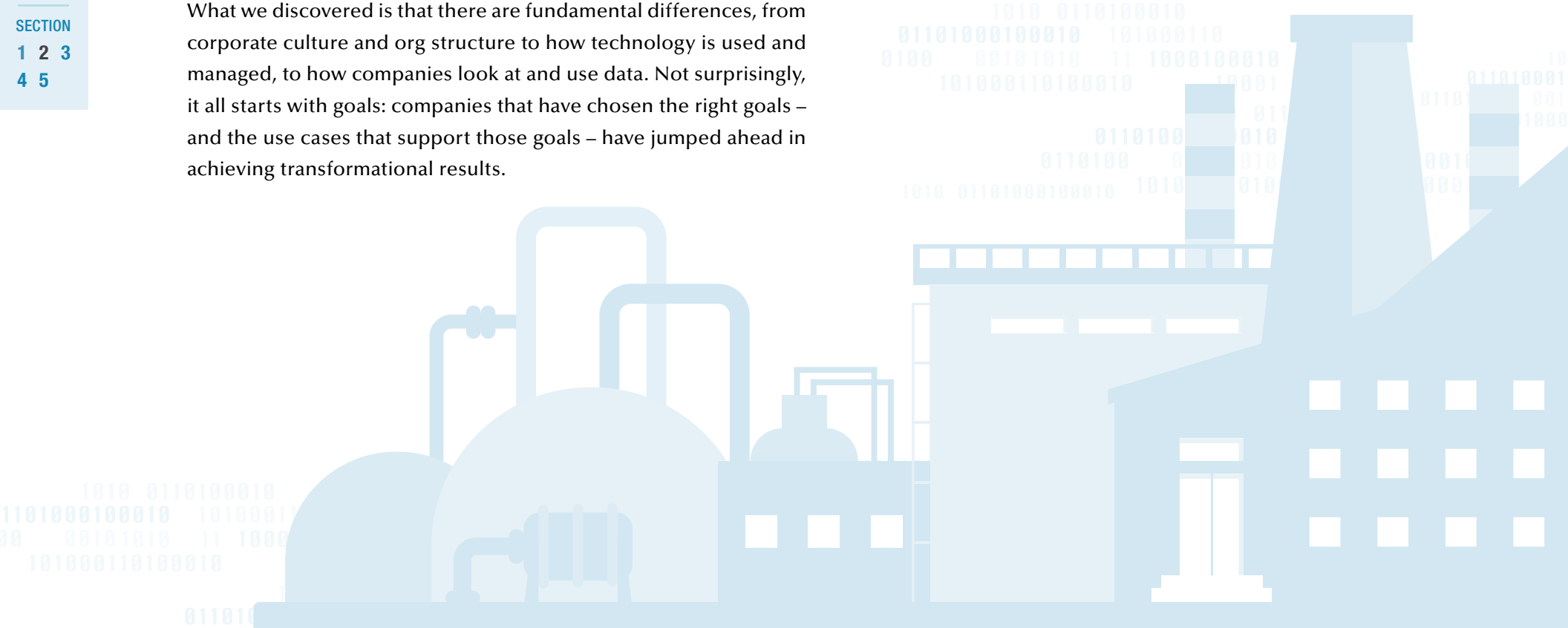
Section 1

Executive Overview

Learning from Industrial Transformation Leaders

Industrial companies have been pursuing the latest generation of "transformational" initiatives since prior to 2015, (in fact, the term "Industry 4.0" was first used in 2011); this means we now have more than five years of trials and pilots, attempts to scale, successes and failures from which we can learn. Although empowered by emerging technologies such as the Industrial Internet of Things (IIoT), Artificial Intelligence, and Big Data, the overall operational transformations within industrial companies have taken on a wider scope, focusing on achieving step change improvements in operations (as measured by KPIs) and, in some cases, fundamentally changing the products and services delivered to customers.

This research studies companies that have undertaken Industrial Transformation (IX) journeys, and asks the questions: Who is succeeding, and why? How are these leaders different than their peers? What we discovered is that there are fundamental differences, from corporate culture and org structure to how technology is used and managed, to how companies look at and use data. Not surprisingly, it all starts with goals: companies that have chosen the right goals – and the use cases that support those goals – have jumped ahead in achieving transformational results.



Section 2

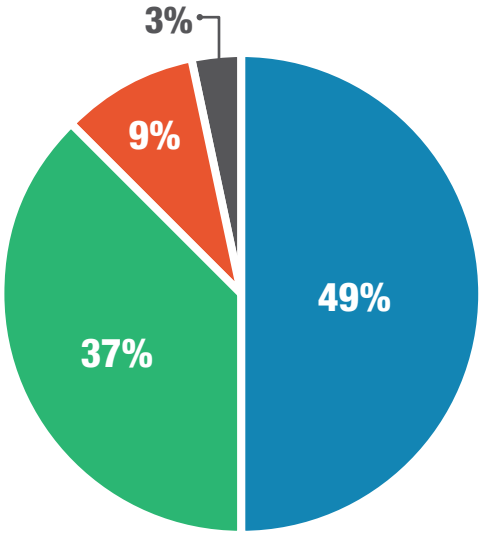
Research Demographics

Demographics

LNS Research executed a global survey on the state of Industrial Transformation programs. We surveyed executives, management and operations personnel across a wide range of industries and geographies. At the time of publication, there were 275 completed surveys. Given the extensive length of the survey we believe respondents had deep interest in the research topic.

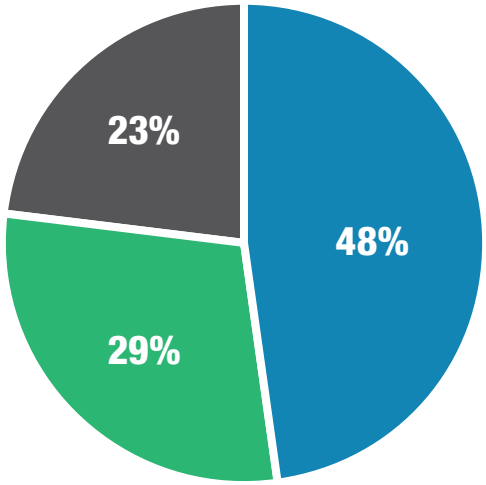
LNS Research conducts its surveys in English, with automatic translations for other languages, and primarily serves industrial companies in North America and English-speaking Europe. The survey responses were, though, quite global in nature given the English only limitation.

Respondents work for corporations with a wide range of business revenues with 33% of the companies having revenues over $1 billion and 45% having revenues less than $500 million.



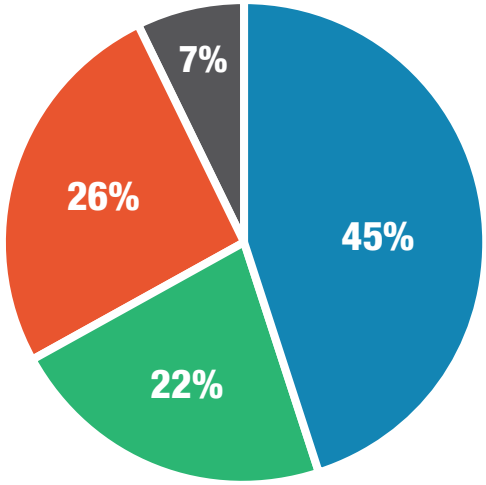
GEOGRAPHY

- North America
- Europe
- Asia/Pacific
- Rest of World



INDUSTRY

- Discrete Manufacturing
- Batch Manufacturing
- Process Manufacturing

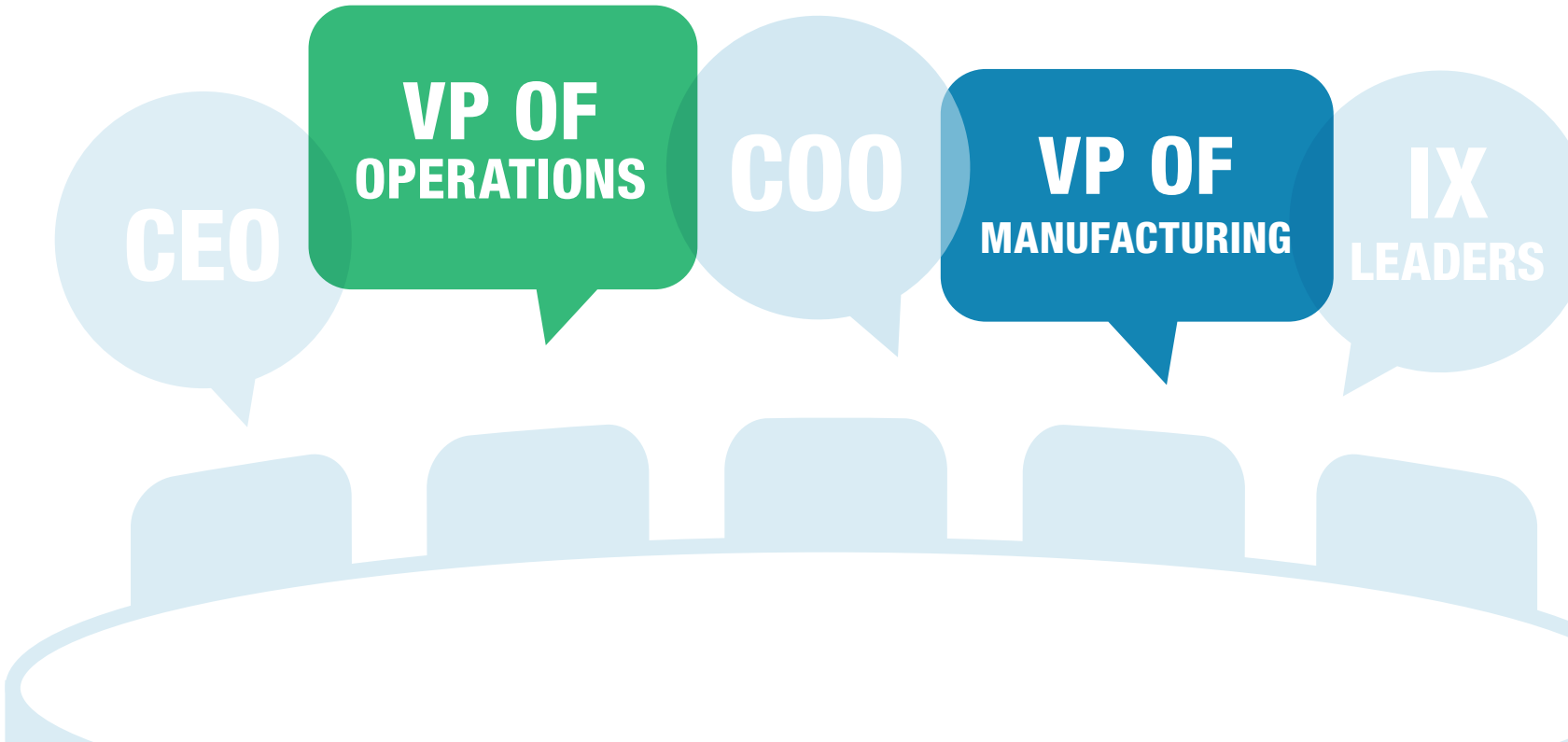


COMPANY SIZE

- Less than $500 Million
- $500 Million - $1 Billion
- $1 Billion - $10 Billion
- More than $10 Billion

Who Can Benefit from This Research?

This research is aimed at executives – COOs, VP of Operations or Manufacturing, and those leading Industrial Transformation initiatives – to guide them as they manage and plan their strategies for their IX programs. As shown in the results, assembling the right team, empowering them with the right amount of authority, and selecting the right use cases is essential in determining the results of these initiatives.



Section 3

IX Leaders, Followers, and Pilot Purgatory

Pilot Purgatory: It's Not What You Think

There has been a great deal of discussion about "Pilot Purgatory," particularly among vendors of IIoT technologies. These technology providers have given the impression that a high percentage of their users are getting stuck in the pilot phase of deployments, with little or no progress. As it turns out, this is far from the truth: Pilot Purgatory is a much smaller issue than the industry has been led to believe (though still serious enough for the companies suffering from this challenge).

In order to find these companies who are stuck in Pilot Purgatory, define the size of the problem, and identify both reasons why it happens and how to avoid it, LNS Research analyzed results of our survey and broke down the respondents into three categories:

Leaders: respondents who reported significant progress in their IX programs, and/or who are reporting they are seeing positive impact from their transformational initiatives.

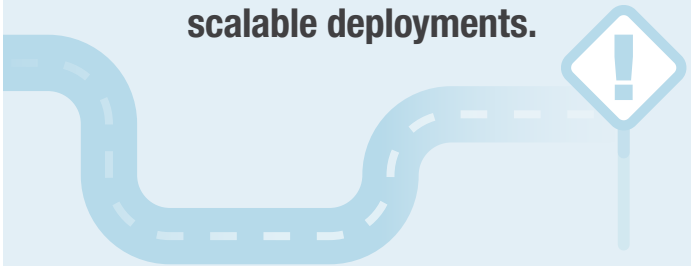
Followers: companies reported ongoing engagement with IX initiatives, but which are still in early stages; have not yet made the progress of and are not yet achieving the results of the leaders but are still moving ahead.

Stuck Companies: respondents who are self-reporting that they are having trouble achieving results and whose programs are "stuck" in early stages.

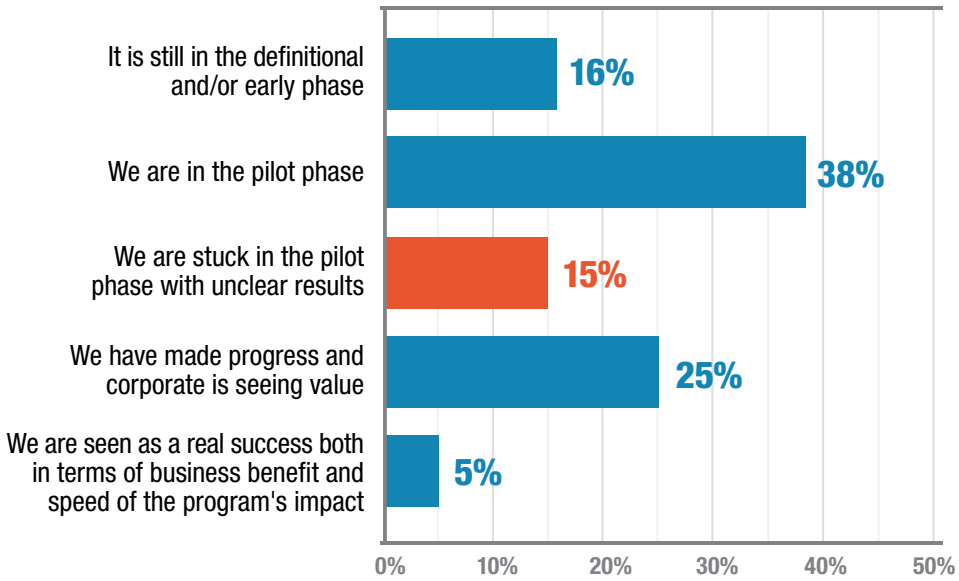
The percentages were not surprising – except for the notably LOW number of companies reporting they are stuck:

- Leaders: 30%
- Followers: 54%
- Stuck Companies: *Just 15%*

PILOT PURGATORY:
the status of a company "STUCK" IN PILOT OR TESTING PHASE of new technology, UNABLE TO ACHIEVE PROGRESS towards measurable results or progress towards scalable deployments.



15% of Companies are Stuck in the Pilot Phase

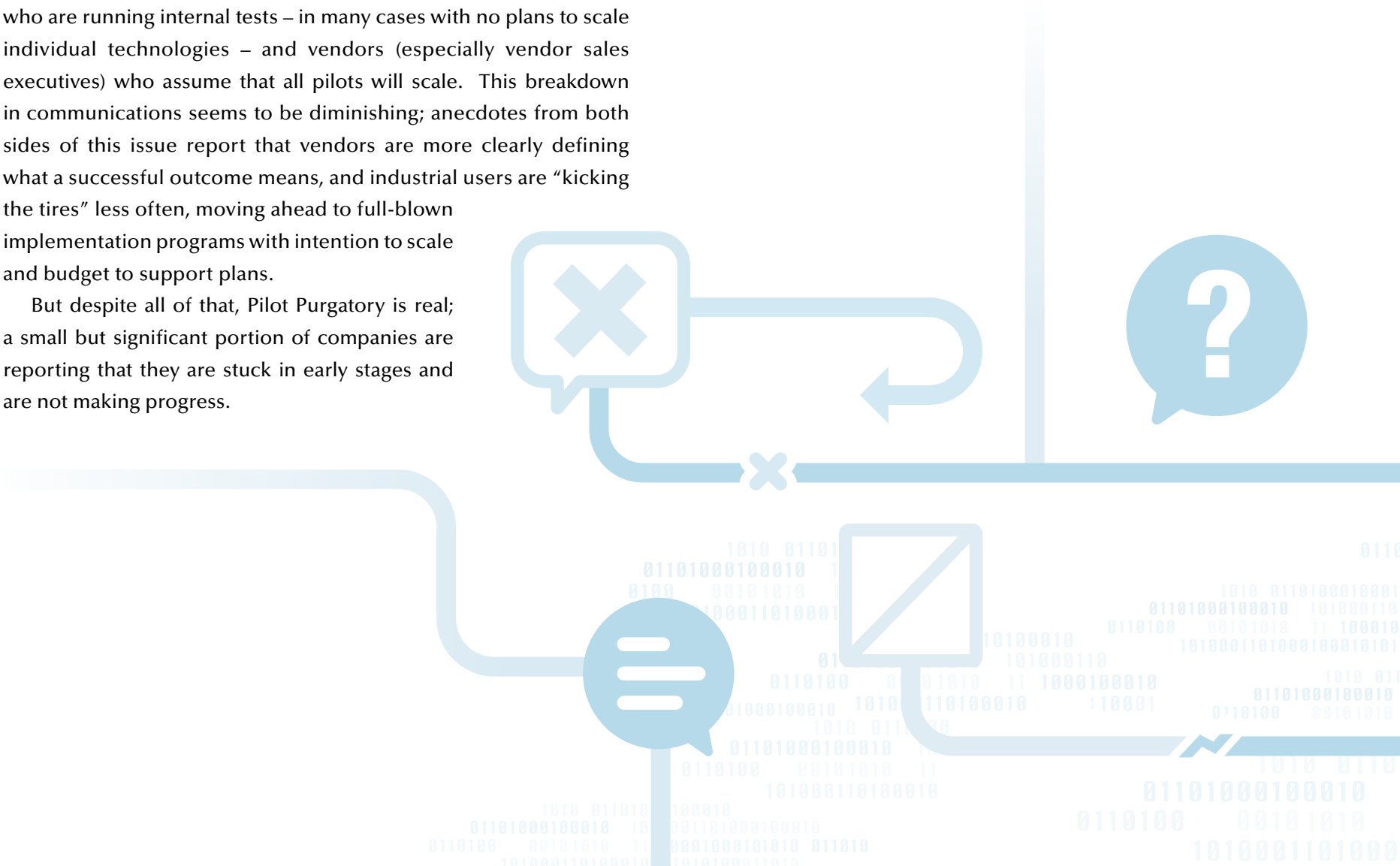


Pilot Purgatory: It's Not What You Think *(Cont.)*

This data point is supported by research done just a few months prior to this survey which showed just over 13% of companies reporting the same issue. Clearly, we're in the right range of responses, so the question is: what is the origin of this disconnection between actual rates of Pilot Purgatory and common perception?

From discussions with both end users and vendors, it appears that this is primarily a communications breakdown between users who are running internal tests – in many cases with no plans to scale individual technologies – and vendors (especially vendor sales executives) who assume that all pilots will scale. This breakdown in communications seems to be diminishing; anecdotes from both sides of this issue report that vendors are more clearly defining what a successful outcome means, and industrial users are "kicking the tires" less often, moving ahead to full-blown implementation programs with intention to scale and budget to support plans.

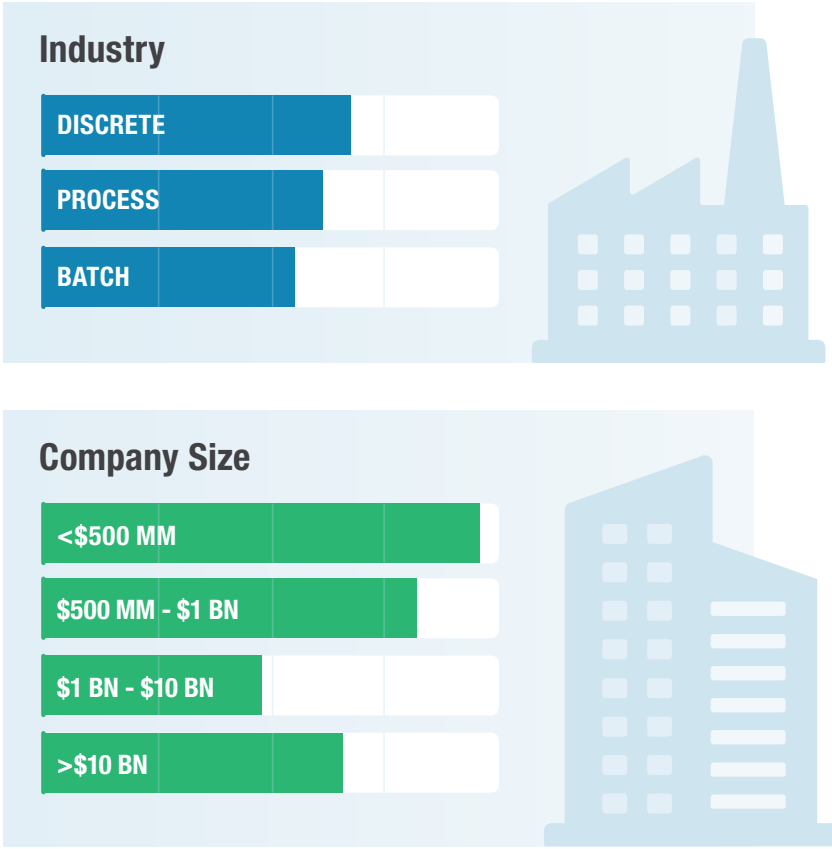
But despite all of that, Pilot Purgatory is real; a small but significant portion of companies are reporting that they are stuck in early stages and are not making progress.



Who's Getting Stuck in Pilot Purgatory?

As we delve into the data from companies who are reporting being stuck, an obvious pattern emerges: smaller companies (under $1 billion in revenues) are getting stuck at a higher rate, and companies in discrete manufacturing are getting stuck at a rate significantly higher than their process and batch peers. WHY these things are true takes some additional analysis.

Process industries (and to a lesser extent, batch processing industries) have been using data in advanced simulation and modeling for decades. This gives these companies both the experience and expertise required to utilize advanced data technologies and to handle terabytes of data in those advanced tools. The discrete industries do not have this same history of handling operational (i.e., factory) data, and so finding experienced personnel and knowing the resources and budgets required to address these challenges is more difficult for these companies. Combining this with the generalized manpower shortage among discrete manufacturers, and there are obvious disadvantages for these companies. (Note: the one discrete industry that has extensive experience with advanced data simulation, the Aerospace & Defense industry, is the exception that proves the rule. A&D companies do not experience Pilot Purgatory at anywhere near the same rates as other discrete industries.)

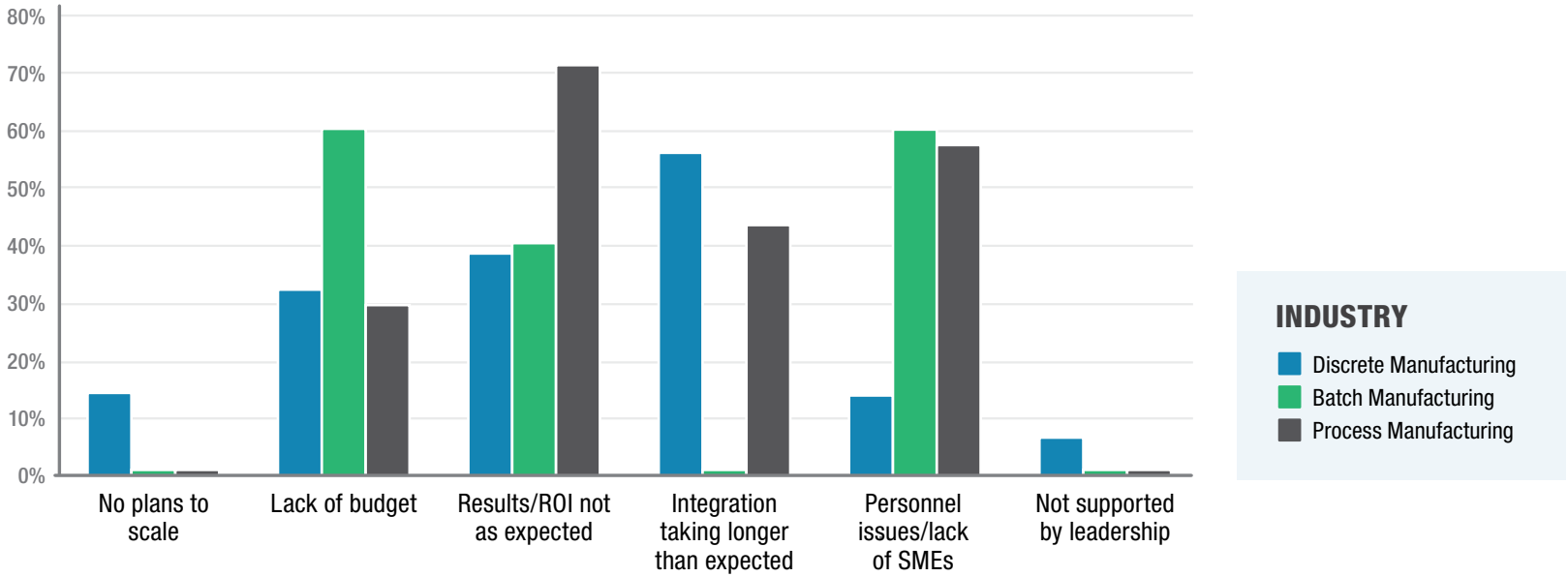


Who's Getting Stuck in Pilot Purgatory? *(Cont.)*

These conclusions are supported as we dig into the reasons companies have stated as to why they are not making progress. These are not the same reasons that enterprise technology projects have failed over the last thirty years, e.g., lack of executive support, failure to plan adequately for heavy customizations that end up taking much longer than anticipated, etc.

Instead, the reasons listed by these companies have to do with technical complexity and lack of expertise or experience. This is especially true when looking at discrete vs other industries; in discrete manufacturing, "integration taking longer than expected" is the single biggest reason for being stuck. All industries also report "lack of subject matter experts/personnel issues" as one of the leading causes of stuck projects; closely tied to this is "results not as expected," which is likely caused by the lack of subject matter expertise. As IX progresses and advanced data technologies and techniques become more commonly used, we anticipate this problem ameliorating; in the meantime, competition for data scientists with industrial experience, or for manufacturing engineers with training in advanced data techniques, will remain high.

Causes of Pilot Purgatory

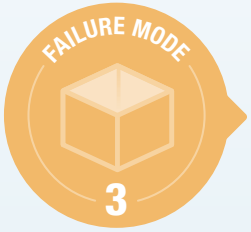


The Four Failure Modes of Industrial Transformation

Building on the survey data above and combining these findings with data from our IX Maturity Assessment Model and other research, LNS has defined four primary failure modes for Industrial Transformation initiatives.

FAILURE TO CONVERGE
IT-OT organizations, culture, and technology architectures

SILOED APPROACH to data management and decision making



FOCUSING ONLY inside the four walls

NOT FOCUSING on factory/plant operations

FAILURE MODE 1: FAILURE TO CONVERGE

LNS Research has written extensively about converging IT and OT (operations technology) teams, including why this is happening and why it's so important. Leaders in IX (not surprisingly) are also leaders in IT-OT convergence. This goes beyond having joint meetings and having both teams report up to the same C-level executive; true convergence includes changing the org structure, migrating to a data-centric, services-centric culture focused on business and operational challenges, and evolving compensation models to focus on solving business challenges rather than "managing" systems.

FAILURE MODE 2: SILOED APPROACH

Functional silos within industrial organizations evolved in response to challenges with the last major round of technology deployments, including privacy issues, requirements for mission-critical systems, and much more. For example, there could be very good reasons the finance team doesn't want anyone outside of finance looking at or touching financial data, e.g., the company cannot afford any potential corruption issues in financial data, or pricing data may be highly proprietary and must be kept private. However, these same silos have grown into monsters that prevent future evolution of systems. Companies that take an OT-only view of data and IIoT solutions are missing out on the full impact of IX, and without access to multiple points of data outside of OT, are doomed to limited results and ultimate failure.

Combining financial data, supply chain data, customer data, and OT or IIoT data can lead to dramatic improvements in business

The Four Failure Modes of Industrial Transformation *(Cont.)*

functions and outcomes. This is true of IX functional teams as well; the team that leads an industrial organization's IX initiatives should be comprised of a cross-section of IT and OT personnel as well as representatives from multiple departments who own and are dependent on the systems that may be impacted by the new programs, and from which data must be integrated into the IX initiatives.

FAILURE MODE 3: INTERNAL FOCUS

Building on the siloed approach to data and organizations mentioned above, LNS has identified an "internally focused" mindset and set of practices that also hamper the success of IX programs. In some companies, both IT and OT are focused on internal challenges and assume that internal data is all that's needed to solve those issues. But limiting the data (and the systems they're looking at) to only internal systems and processes gives a naturally limited view. These companies don't consider incorporating data from suppliers, from customers, or from third party systems, despite the impact that those external systems and processes have on internal operations. As a simple example, incorporating weather data can reveal patterns within on-time deliveries, or within manufacturing operations (as humidity and other weather factors can affect manufacturing processes) ; including customer data may uncover order patterns that the customer isn't aware of, and including supplier data can affect production scheduling based on premium delivery prices or seasonal fluctuations in commodity prices.

Companies must learn to cast a wider net when building their enterprise data model and think more broadly about the challenges they're trying to address. It's only by radically changing their mindset that they can get the full benefit of IX initiatives.

FAILURE MODE 4: NOT FOCUSING ON FACTORY/PLANT

LNS Research has purposely focused our research on "industrial transformation" – NOT "digital transformation." Digital transformation is focused on using digital technologies to transform a wide variety of business functions, including sales and marketing, finance, customer support, and more. Industrial transformation, on the other hand, focuses on transforming industrial processes and operations using emerging technologies. The differences are important: first, LNS initiates our research focused on the business transformation rather than the technologies, and we strongly encourage industrial businesses to do the same; second, we focus on the transformation of industrial operations, which are the core business operations of the companies we serve.

However, many companies are seduced by the promises of digital technologies outside their core industrial operations or are intimidated by the complexities involved in changing these core operations to achieve their transformational goals. Let us be very clear: industrial companies who focus on transformation without focusing on their factory or plants are heading in the wrong direction. To earn the step-change improvements in business metrics that is the goal of IX, industrial companies must focus their IX initiatives on their core operations, in the factory or plant. Our research clearly shows that to do otherwise is the fastest path to IX failure.

Core to IX programs is a focus on experience management for customers; this is unfamiliar territory for many manufacturers, but manufacturing must be ready to deliver on the customers' expectations or else the experience won't be positive- no matter the investment in CRM or Experience Management (XM) solutions.

Section 4

A Methodology for Evaluating IX Use Cases

The IX Use Case Navigator

Over the last several years LNS Research has gathered and analyzed thousands of survey responses from executives at industrial companies regarding how their companies are pursuing IX, including initiatives in manufacturing operations, quality, environmental health and safety, and more. As stated above, we analyzed these first by focusing on the business challenges the companies were trying to address, rather than starting with new technologies. Analysis of these results enabled us to create the LNS Use Case Navigator, which classifies 35 industrial use cases into six functional categories. (Note that in several cases, new technologies such as analytics or digital twins can be utilized in multiple use cases, and so are mentioned in multiple places.)

Category Definitions:

CUSTOMER EXPERIENCE USE CASES: tracking and analyzing customer behavior for insights; includes purchasing/procurement activities, warranty data, sentiment analysis, and more.

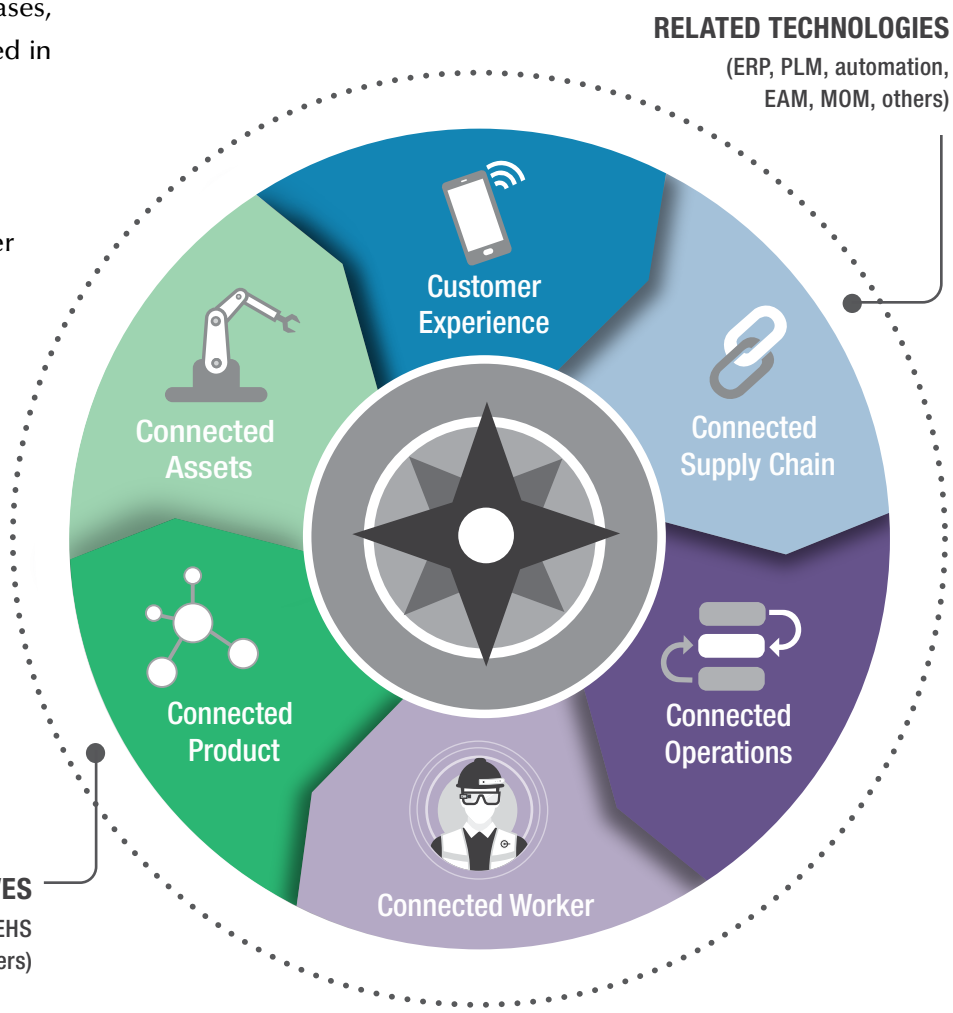
CONNECTED SUPPLY CHAIN USE CASES: Analyzing supply chain for inaccuracies, bottlenecks, and risks; improving end-to-end visibility of supply chain with the goal of improving efficiency; improving supplier quality and delivery.

CONNECTED OPERATIONS USE CASES: monitoring, analyzing and improving industrial operations, including manufacturing, manufacturing quality, uptime and throughput.

CONNECTED WORKER USE CASES: improving health and safety of workers, sharing expertise, and connecting workers to the data and expertise needed to improve operations and outcomes.

CONNECTED PRODUCT USE CASES: improving product quality, reducing downtime and risk, and increasing customer satisfaction through improved service and quality.

CONNECTED ASSETS USE CASES: for asset-intensive industries, reducing costs and improving asset performance.



The IX Use Case Navigator *(Cont.)*

Measuring and Ranking IX Use Cases

We asked survey respondents to tell us which of the six initiative categories they were focusing on, and where they were seeing actual results from their programs. We then dove deeper into each category and asked respondents to rank each of the 35 use cases on two criteria: amount of resources required to implement (including time, budget and personnel) and the impact of each of the use case initiatives – that is, the positive outcome. Rankings were on a scale of 1-10 with only whole numbers allowed. For both scales, 1 was the lowest score (i.e., the least impact, or the least amount of resources required) and 10 the highest. The goal was to find the "low-hanging fruit" – the Use Cases that took the least amount of resources to implement and had the largest impact. Happily, the results of the survey provided ample ammunition to rank the use cases.

Not surprisingly, maturity of Use Cases and technologies had an impact on the scores. Technologies such as predictive analytics, which have matured and been packaged as "off-the-shelf" products, impacted specific uses cases positively; use cases that required integration of several different technologies tended to impact negatively.

USE CASE CATEGORY	USE CASE DESCRIPTION	RESOURCE REQS *lower is better*	IMPACT *higher is better*
Customer Experience	Online marketplaces: 5-star data analysis and product benchmarking	3.5	3.1
Customer Experience	Warranty data: Machine learning pattern assessment	4.8	3.4
Customer Experience	Social media: Sentiment analysis	5.4	3.7
Customer Experience	Warranty data: Statistical predictions	6.7	3.1
Customer Experience	Customer complaints: Statistical predictions	2.9	1.0
Customer Experience	Online marketplaces: Semantic analysis to characterize reviews	6.7	1.3
Customer Experience	Customer complaints: Machine learning/artificial intelligence (ML/AI) pattern assessment	6.7	1.3
Connected Supply Chain	Visibility of real-time supplier operations/inspection data	1.0	4.3
Connected Supply Chain	Predictive supplier quality variance reduction	4.2	5.5
Connected Supply Chain	Supplier and operations: Critical parameter optimization based on impact to operations or final product	5.7	4.0
Connected Supply Chain	Predictive risk-based reduction/optimization of final inspection - supply chain	6.4	3.4
Connected Supply Chain	Push data-driven prescriptive analytics inputs to supply chain	6.7	3.1
Connected Supply Chain	Full supply chain traceability	4.2	5.5

Continued...

The IX Use Case Navigator *(Cont.)*

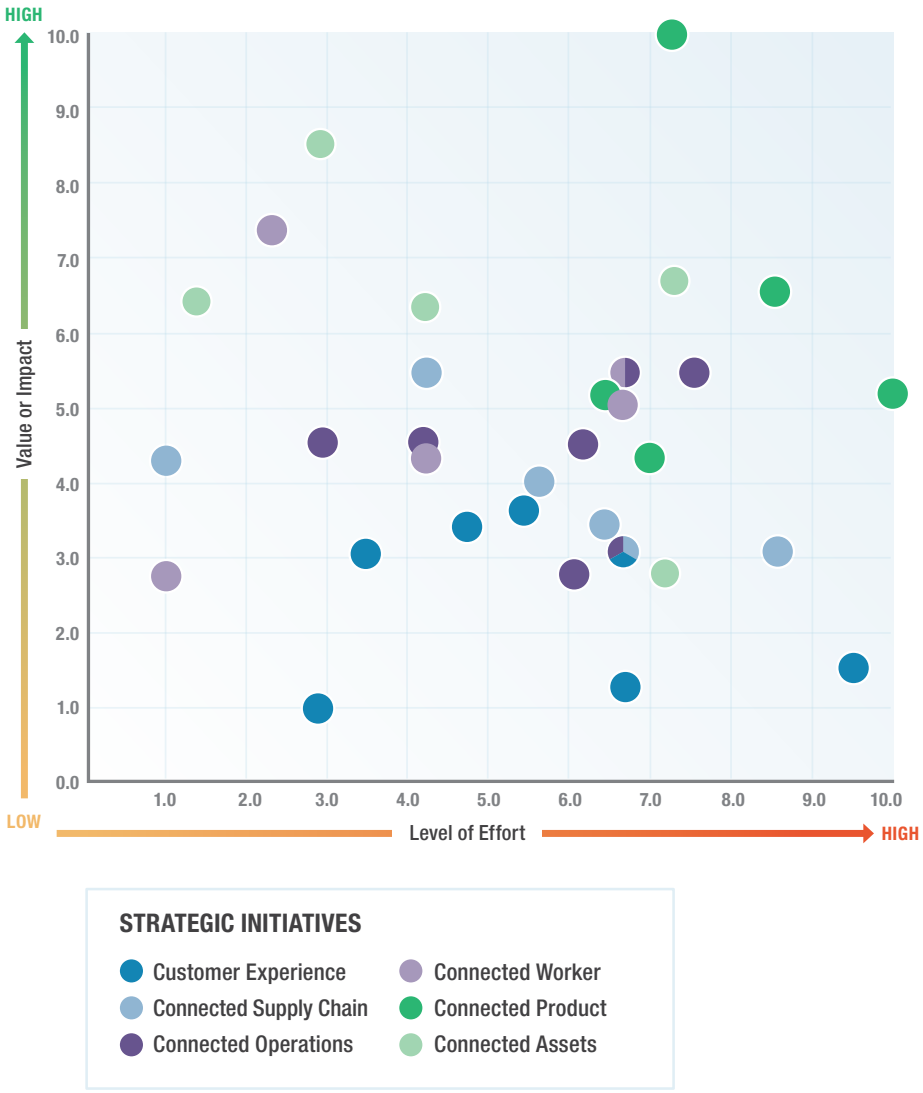
USE CASE CATEGORY	USE CASE DESCRIPTION	RESOURCE REQS *lower is better*	IMPACT *higher is better*
Connected Operations	Predictive risk-based reduction/optimization of final inspection - operations	2.9	4.6
Connected Operations	Predictive asset maintenance (based on sensors, not schedule) - operations	4.2	4.6
Connected Operations	Remote Operations Center deployed to scale rare/expert skills	6.7	5.5
Connected Operations	Predictive final product variance reduction	6.2	4.6
Connected Operations	Predictive in-service performance based on operational data	7.6	5.5
Connected Operations	Predictive in-service customer satisfaction based on operational data	6.7	3.1
Connected Operations	Predictive in-process variance reduction	6.1	2.8
Connected Worker	Mobile or Augmented reality enabled to scale rare/expert skills	2.3	7.3
Connected Worker	App strategy to improve worker/user engagement/retention	1.0	2.8
Connected Worker	Mobile or Augmented reality enabled standard operating procedures	4.2	4.3
Connected Worker	Mobile or Augmented reality-enabled data capture	6.7	5.5
Connected Worker	Mobile or augmented reality enabled in-context training (micro-training)	6.7	5.1
Connected Product	Predictive maintenance	7.3	10.0
Connected Product	Leverage digital twin for remote diagnostics - product	6.4	5.2
Connected Product	Early failure detection/recall control	8.6	6.6
Connected Product	Performance monitoring	7.0	4.3
Connected Product	Prescriptive service - product	10.0	5.2
Connected Assets	Asset performance monitoring	1.3	6.4
Connected Assets	Prescriptive service - asset	2.9	8.5
Connected Assets	Predictive asset maintenance (based on sensors, not schedule) - assets	4.2	6.4
Connected Assets	Predictive in-service process optimization	7.3	6.7
Connected Assets	Leverage digital twin for remote diagnostics - assets	7.2	2.8

The IX Use Case Navigator *(Cont.)*

The Results: Ranking Use Cases

The results, when plotted out below, shows clearly the high impact, low resource use cases.

IX Use Case Impact/Effort Index



Based on these criteria, the top IX use cases are:

- **Asset Performance Monitoring** for all systems, including assembly components, robots, closed loop systems, and more. Monitoring the performance of these systems based on sensor data has been performed for many years in other industries but is newer in discrete manufacturing. The science behind applications such as vibration analysis has improved greatly, for example, improving the value of these performance monitoring systems.
- **Predictive Maintenance for high-cost assets** (e.g. stamping machines, annealing ovens, robots, etc.). This model is based on sensor data, rather than usage data or schedule tracking. Given the high level of dependency on these mission-critical assets, anything that can improve uptime and/or lower costs of maintenance is highly desirable for these manufacturers. LNS has written extensively about the advancements in analytics, from descriptive to diagnostic to predictive and eventually, to prescriptive analytics. For now, the sweet spot seems to be the predictive stage.
- **Mobile Apps or Augmented Reality to scale rare or expert skills.** For example, a machine expert may use a mobile app or AR headset system to guide a remote technician through a complex diagnostic or maintenance app. Note that AR is not required here; it's just one option for delivering this type of service, with mobile apps and voice communications providing a simpler and less costly alternative. This Use Case is driven by the dynamics of human resources and the scarcity of expert skills, especially in remote or rural areas where many large factories are located.

The IX Use Case Navigator *(Cont.)*

- **Predictive Quality** - Leveraging sensor and machine data for predictive quality pays high returns for discrete manufacturers. While many discrete manufacturers have improved quality drastically in the last 20 years, the returns for classic "Continuous Improvement" and "World Class Manufacturing" programs have been diminishing in recent years as the low-hanging fruit has been harvested and there are fewer areas for improvement. This new model for predictive quality, based on sensor and machine data, is proving fruitful for companies.

These Use Cases have several factors in common:

They address well-known business challenges with clearly defined financial parameters. This makes it easier to define a successful outcome for an implementation, with an easily measurable ROI.

Additionally, the Use Cases map to larger issues within industrial companies. For example, every company we talk with is attempting to address the well-known worker shortage issue, with Baby Boomers retiring from the industrial workforce by the thousands monthly. The ability to deliver expert analysis and guidance – from anywhere, at any time – ameliorates some of the impact of this shortage and allows companies to get by with fewer experts than previously.

And, as stated above, these were some of the earliest Use Cases to emerge from IIoT technologies, and the solutions for these business challenges are quite mature. In other words, it's simple to purchase an analytics application for predictive maintenance, for example, without the need to cobble together a multi-vendor solution. This simplifies deployments and limits costs of a project. Note, too, that these are all factory or plant-based initiatives; while not necessarily limited to factory-only programs, it's clear the most impactful use cases in industrial transformation must begin with industrial operations. As IX initiatives continue to mature, we expect use cases that start in the plant and go beyond those four walls, bring the plant closer to the business and other IT functions.

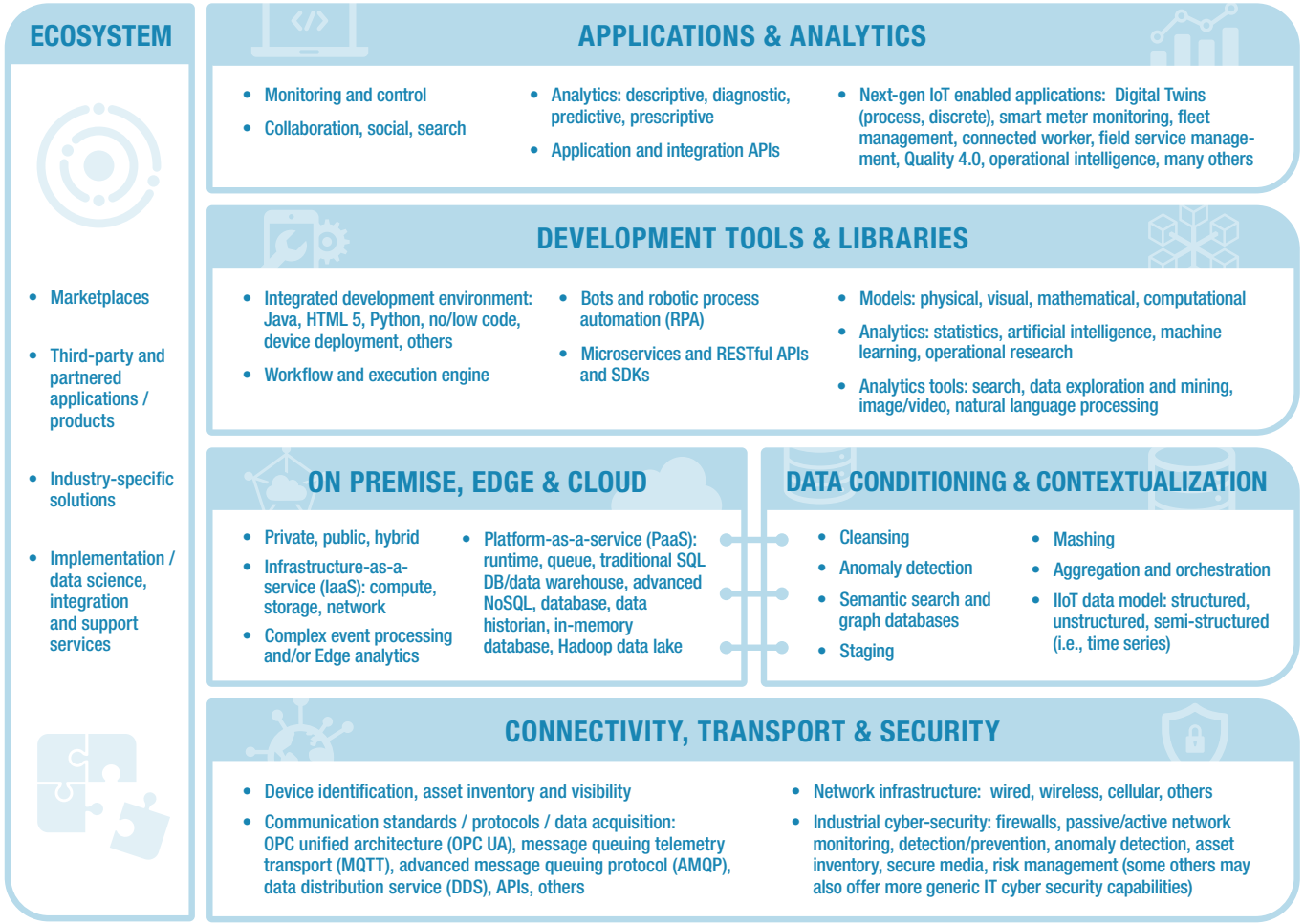
A word of caution, though: just because a Use Case scores low within this matrix does not mean that it is not worth pursuing. It means, instead, that the business case for a project focused on that use case must be conservative in its calculations of ROI, and that realistic expectations regarding time, personnel and budget resources must be included in the project plan; otherwise, the project will be doomed to failure to meet expectations. Any company's choices of which use cases to pursue should still be based on business needs; however, the priority given to each of the IX use cases being pursued within an organization may be influenced by this matrix. Companies in early stages of IX maturity, for example, may focus on the "low-hanging fruit" within this matrix in order to build early successes and earn the credibility to take on larger, more complex programs.

IX Use Cases and the IX Reference Architecture

Fundamentally, IX is enabled by data - though data alone will not drive transformation, without data transformation is nearly impossible. This should make intuitive sense, as one of the major driving factors for Industrial Transformation (IX) is recognition of new ways to use the data generated in factories and plants; the idea is to use this data to empower new business insights that were previously unreachable. In fact, gathering and utilizing operational data has become the foundation for virtually all IX initiatives.

An effective IX Program starts with data, which the organization gathers from people, processes, machines, online marketplaces, and third parties. IX Leaders use data to gain new insights into performance, restructure work to reduce organizational silos, and redefine

Industrial Transformation (IX) Reference Architecture



IX Use Cases and the IX Reference Architecture *(Cont.)*

their business models. The second critical commonality is in connecting IT and OT. The data required for this transformation typically exists but is fragmented across any number of automation, manufacturing, test, lab, business, warranty, quality, customer service and marketing systems, databases, and reports. So, in fact, IX is about connecting IT, OT, and IIoT data sources.

Recently, LNS Research rolled out our Industrial Transformation Reference Architecture. This "reference architecture" goes beyond a technology architecture to provide a framework for technologies, processes and functions that are required for industrial companies pursuing transformation programs. As you can see, we put Data Connectivity, Transport and Security as the foundational layer in the Reference Architecture.

How does this impact choices of use case? The maturity of an industrial company's internal operations architecture (as compared to the reference architecture) should be one of the guiding principles for choosing which uses cases to prioritize, and which to put off until later (when the company's maturity level and operational functioning are higher). Successfully implementing any of the use cases defined above are dependent on having the people, processes and technologies in place, and the Reference Architecture should assist companies in assessing their strengths and weaknesses.

IX Use Cases and the IX Reference Architecture *(Cont.)*

The Data Layers

As you can see from the diagram above, LNS Research defines six main buckets of capabilities that are critical in enabling manufacturers to capture the true value of IIoT and transform their industrial operations. Research indicates that multiple vendors will be required to deliver all six sets of capabilities. However, for our purposes we will focus on the two foundational layers:

1. CONNECTIVITY, TRANSPORT, AND SECURITY

This layer includes:

- All necessary hardware and software to connect to and network devices, equipment, and leverage sensors;
- Support for the existing and emerging standards for integrating machines, clouds, and applications;
- Capabilities to move data to the appropriate application, domain (edge, premise, cloud), or user. One of the key differentiators of IIoT is the ability to break the ethernet limitation: IIoT leverages a wide range of alternative networks including wired, wireless, and other lower power alternatives. LNS Research believes the widescale deployment of 5G telecommunications will be a key accelerant for IIoT.
- The technology for quickly and efficiently identifying and managing devices and triggering events;
- Industrial cybersecurity capabilities focused on device and operational security that are foundational to the whole IIoT solution space (in addition, many vendors also offer more typical IT cybersecurity capabilities focused on data security as well).

In many ways the fundamental concepts of IoT and IX are really around this layer. It is the increasing ability to cost-effectively connect to things/devices/equipment in ways that were previously impossible or too costly that offers the potential to leverage them in smart-connected ways.

2. DATA CONDITIONING AND CONTEXTUALIZATION

The days of thinking that moving everything to a data lake and finding sudden, magical answers are over. Early products and projects found that data without context is of marginal operational value. In addition, IX Leaders regularly report that data clean-up is often as much as 80% of the total workload of their IX initiatives. Increasingly vendors and implementers are focused on the sources, quality, and manipulation of industrial data. Vendors now offer products and services to clean (eliminating spurious and anomalous data), stage, aggregate, and orchestrate operational data. A key and defining capability for IIoT Platforms is to go beyond structured data from an SQL database (such as financial or inventory levels) to also leverage unstructured (video, social) and semi-structured (most importantly, time series) data. The goal is to unify all this data into an IIoT data model (today, primarily around assets only). Given that operational insights are a core benefit of IIoT Platforms, these capabilities are critical.

Honestly assessing your organization's readiness with regards to these two components of our Architecture will help ensure your team is ready to take on the Use Cases as defined above.

Section 5

Recommendations and Resources

Summary and Recommendations

Industrial Transformation programs have demonstrated success in several areas over the past five years, and clear best practices and leading use cases have emerged from our research. Companies must begin their IX programs by analyzing and identifying the business challenges they wish to address, and then match use cases and technologies to those business challenges. True transformation – with real step-change business improvements – are more likely when companies follow these recommendations:

- Companies must pursue a converged IT-OT organization, culture and technology architecture. Putting together a cross-functional team to identify business challenges and brainstorm use cases and technology requirements is the right place to start IX programs. From there, building an IX operational architecture is a natural next step, serving as a roadmap for all future technology decisions.
- Start with data: every use case begins with well-planned, well-documented data connectivity and transport, and data conditioning and contextualization. A well-executed data model empowers all of these emerging technologies, including IIoT analytics, AI/ML, and much more. This is another great project for a cross-functional, converged IT-OT team.
- Transformative use cases go beyond the four walls of the company. Industrial companies must learn to incorporate data, expertise, and decision-making authority from beyond traditional corporate boundaries. Trusting data from suppliers, service organizations, and customers is a difficult leap for many organizations and is a cultural change as much as a technological one; trusting these same organizations to make business decisions that impact *your* operations is an even bigger leap of faith – one that many companies will need to "kick down the road" for now.
- In the immortal words of Shakespeare, "Know thyself." Industrial companies must identify the IX maturity level of their organizations, including the individual plants or factories where they are undertaking projects. Successfully matching the IX maturity level of these sub-organizations with the appropriate use cases and technologies goes a long way towards building credibility within the organization, and ultimately to the success of each project.
- Focus on the factory: industrial transformation starts in industrial operations, and that's where the biggest impacts are felt. 10 of the top 14 use cases we identified are factory operations oriented. For industrial companies looking for step-change improvements in operations, these are the operations that matter. Rather than focusing primarily on customer experience or sales or financial operations, focusing on industrial operations *in conjunction with these* other business functions is the right way forward for most industrial companies.

Industrial Transformation Resource Guide

Companies use digital technology to drive transformation across the value chain. Use these resources to learn how to align the people, processes, and technologies required to achieve Operational Excellence in your organization.

INDUSTRIAL TRANSFORMATION

BLOG | Understanding Industrial Transformation: Definition and Framework for Success

View Blog →

RESEARCH | Industrial Transformation: Architecture and Analytics Just the Beginning

View Research →

RESEARCH | Industrial Control Systems and Edge Computing: Enabling an Operational Architecture for Applications and Analytics

View Research →

INDUSTRIAL ANALYTICS

RESEARCH | Build a Flexible Industrial Analytics Strategy for Today and Tomorrow: Why Business Leaders Should Adopt a Use Case Approach

View Research →

BLOG | How the Right Operational Architecture Powers the Analytics That Matter

View Blog →

RESEARCH | Analytics Really Do Matter: Driving Digital Transformation and the Smart Manufacturing Enterprise

View Research →

FACTORY OF THE FUTURE

RESEARCH | Improving Continuous Improvement: Reinvent Lean Today with Digital Technology

View Research →

RESEARCH | Forging the Digital Twin in Discrete Manufacturing: A Vision for Unity in the Virtual and Real Worlds

View Research →

RESEARCH | MOM and PLM in the IIoT Age: A Cross-Discipline Approach to Digital Transformation

View Research →

APM 4.0

Solution Selection Guide | Asset Performance Management (Platform Vendors), 2018 Edition

View Solution Selection Guide →

RESEARCH | APM 4.0: Prescription for Better Profitability in Operations

View Research →

RESEARCH | The Road to Digital Transformation Success: A Methodology to Modernize Operational Excellence

View Research →

Industrial Transformation Resource Guide *(Cont.)*

QUALITY, COMPLIANCE

RESEARCH | Quality 4.0 Impact and Strategy Handbook
View Blog →

RESEARCH | Driving Operational Performance with Digital Innovation: Connecting Risk, Quality and Safety for Superior Results
View Research →

RESEARCH | Roadmap to Supplier Status: Think Risk Performance, Not Compliance
View Research →

ENVIRONMENT, HEALTH AND SAFETY

WEBCAST | EHS 4.0: Using Technology to Reach New Levels of Safety and Environmental Performance
Watch Webcast →

RESEARCH | Unify EHS and Quality: Capture Synergies and Turn Policy into Action
View Research →

RESEARCH | The Connected Worker: Mobilize and Empower People to Reduce Risk and Improve Safety
View Research →

INDUSTRY FOCUS

AUTOMOTIVE RESEARCH | IATF 16949-2016: A Pivotal Opportunity in Automotive Quality Management
View Research →

AUTOMOVTIVE AND A&D RESEARCH | Manufacturing Performance: Automotive and A&D Gaining Momentum with Analytics
View Research →

LIFE SCIENCES RESEARCH | Digitalized Quality in Life Sciences: Roadmap to Sustainable Growth and Speeding Profitable, High-Quality Products to Market
View Research →

LIFE SCIENCE RESEARCH | Quality 4.0 in Pharmaceutical: Use Cases and Advantage in a Digitally Maturing Market
View Research →

METALS AND MINING RESEARCH | Data for Balanced Scorecard: Driving Profits in Mining, Metals, and Materials Industries
View Research →

POWER GENERATION RESEARCH | Driving Better Decision Making with Big Data: A Roadmap for Digital Transformation in the Power Generation Industry
View Research →

Avoiding Pilot Purgatory:
HOW TO CHOOSE THE RIGHT USE CASES TO ACCELERATE INDUSTRIAL TRANSFORMATION

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