How to Select a Quality 4.0 Solution

ALIGN TECHNOLOGY TO CREATE MARKET ADVANTAGE

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TABLE OF CONTENTS

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SECTION 1

Executive Summary

Releasing the Strategic Value of Quality

Over 60% of companies are now pursuing an Industrial Transformation initiative, often referred to as Industry 4.0, Smart Manufacturing, or the Industrial Internet of Things (IIoT). These initiatives are often approved or instigated at the board level, with the direct support of the CEO. In response, cross-functional teams are identifying gaps, risks, and opportunities, and prioritizing projects to align with targeted improvements; many have a pilot program in place with a detailed business case.

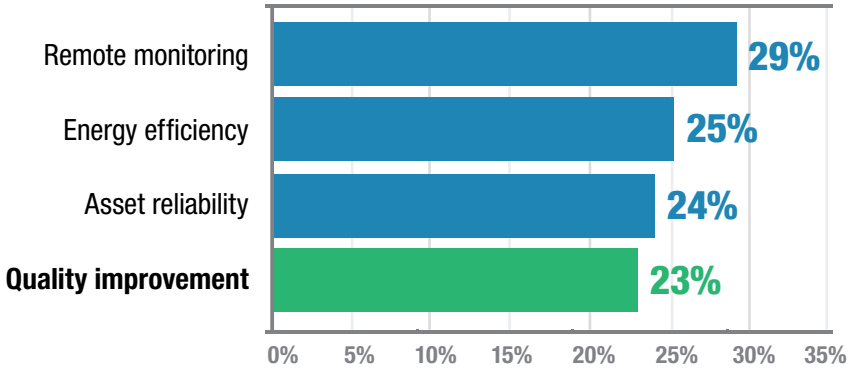
Quality improvement is among the leading use cases for Industrial Transformation, often pursued in concert with other use cases such as improving operational efficiency, connected products, Digital Twin, connected worker, or predictive asset maintenance. In prior publications, LNS Research coined the term Quality 4.0 to define this space, and captured early use cases and value. Quality 4.0 initiatives have broad appeal as they contribute to multiple goals, including reducing process and product variance, reducing cost of poor quality, reducing appraisal costs, improving time to market, product and process innovation, reducing lead time, improving workforce characteristics, compliance improvements, and creating brand differentiation.

Manufacturers across industry verticals and throughout the value chain, from raw material providers to OEMs, see Quality 4.0 as a critical differentiator for their business. Many have declared that Quality 4.0 initiatives must mature in the next two to three years to remain competitive.

Quality touches the entire value stream and product portfolio, and our research has consistently shown that firms with a cross-functional approach to quality processes, teams, and data achieve operational, financial and brand advantage. While a few leading firms have taken advantage of the immense opportunity, the market has largely underinvested in quality technology and data management for decades. In fact, by 2017 only 23% of the market had adopted enterprise quality management software (EQMS), and of these, only 16% integrated this technology to manufacturing operation management (MOM). Inaction has created significant gaps across management, planning, and quality execution.

Because Quality 4.0 is based on a solid traditional quality foundation, most of the market faces a fundamental challenge. How can a company build an effective strategy to leverage prior investments, makes up for lost time, and rapidly delivers on the promise of Quality 4.0?

Top Four IIoT Use Cases *(n=252, all respondents)*



Releasing the Strategic Value of Quality *(Cont.)*

To answer this question the enterprise must reevaluate the value of quality and compliance to corporate success, and institute a cooperative cross-functional approach to technology. The technology selection team must prioritize those use cases with which new technologies can transform teams, leadership, culture, processes, and outcomes to support enterprise objectives and priorities. Ultimately, every organization will face pressing questions about Quality 4.0; this publication addresses those of immediate concern:

- How can my organization build a successful Quality 4.0 initiative?
- How should we select Quality 4.0 technology to increase value and reduce time to value?
- What are the top risks in a Quality 4.0 tech selection project?
- What does a "successful" selection team look like?
- Is it possible to simultaneously reduce the cost of good quality and poor quality?
- Are there architectural considerations related to quality execution and management, and site and corporate quality?
- Where can leaders demonstrate progress with short-term wins while building toward a robust future state?

Early adopters are demonstrating that Quality 4.0 is a once-in-a-career opportunity to overcome traditional quality challenges and make quality a corporate competitive differentiator. This research provides high-level guidance to repeat and build upon early successes.

SECTION 2

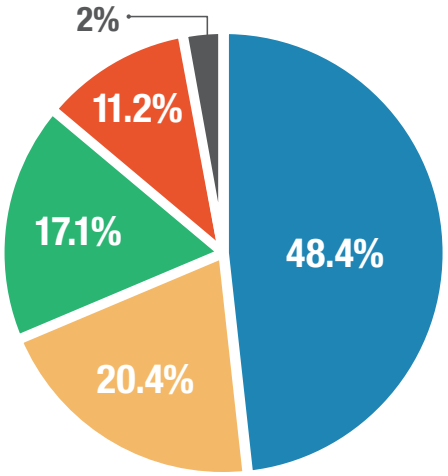
Demographics

Research Demographics

The research data presented in this eBook is from the LNS Research quality management survey with responses from over 1198 executives, business leaders and professionals across a broad range of company sizes, geographies, and industries. Survey questions examine the challenges and opportunities companies face, strategic objectives and goals, and best practices and technology adoption. Slightly less than half of the companies operate in batch manufacturing industries, with the remainder nearly equally split between process and discrete manufacturing.

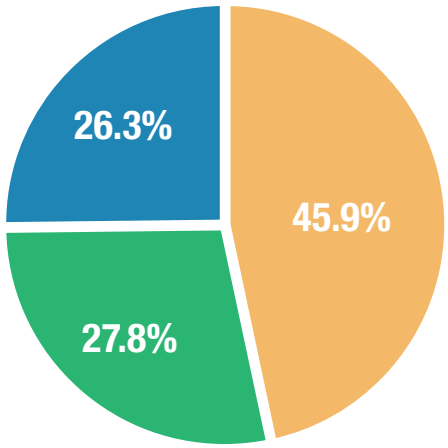
LNS Research conducts its surveys in English, and primarily serves industrial companies in North America and English-speaking Europe. The survey data represents that tendency, with just under half of respondents in North America.

LNS Research Quality Management Survey



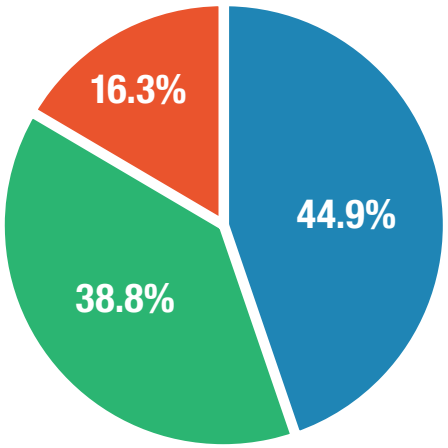
GEOGRAPHY

- North America
- Asia / Pacific
- Middle East & Africa
- Rest of World
- Europe



INDUSTRY

- Process Manufacturing
- Discrete Manufacturing
- Batch Manufacturing



REVENUE

- Small: Less than $250 Million
- Medium: $250 Million - $1 Billion
- Large: More than $1 Billion

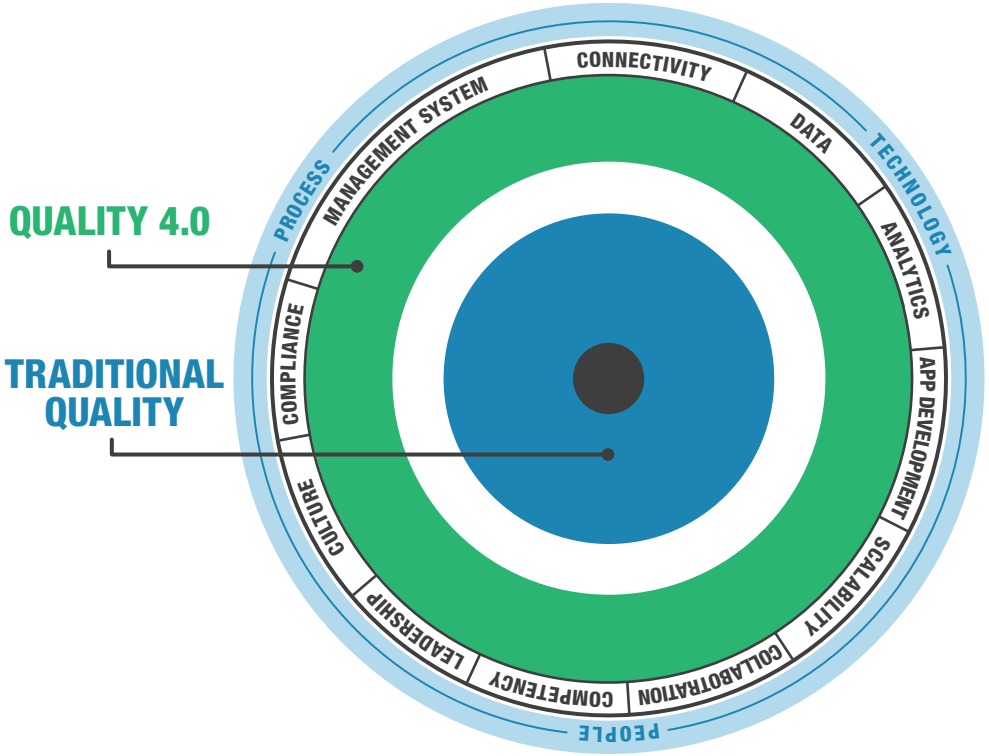
SECTION 3

Building Blocks of Quality 4.0

Quality 4.0 Overview

The most recent decade has seen rapid advances in connectivity, mobility, analytics, scalability, and data, spawning what has been called the fourth industrial revolution, or Industry 4.0. Industry 4.0 has digitalized operations and resulted in transformations in manufacturing efficiency, supply chain performance, and product innovation, and has enabled entirely new business models. While Industry 3.0 digitalized data and records in business and operational systems, Industry 4.0 extends this through inexpensive sensors, mobility, augmented reality (AR), virtual reality (VR), and new collaborative technologies such as social media and blockchain. Advancement and democratization of analytics, simulation, autonomous control, material science, and additive manufacturing have enabled organizations to merge the physical and digital worlds and open new frontiers in innovation.

Quality 4.0 is the digitalization of quality management, and the impact of that digitalization on people, processes, and product. LNS identified 11 axes of Quality 4.0, which companies can use to educate, plan, and act. Using this framework and research, leaders recognize how Quality 4.0 can transform existing capabilities and initiatives. The framework also provides a perspective on traditional quality, as Quality 4.0 doesn't replace conventional quality methods, but instead builds and improves upon them. Manufacturers should use the framework to interpret their current state and identify what changes are needed to move to the future state.



QUALITY 4.0 by LNS Research describes how manufacturers use modern technologies such as advanced analytics and digital connectivity to transform traditional quality and improve operational excellence; enabling enterprise efficiencies, innovation, performance, or strategic objectives.

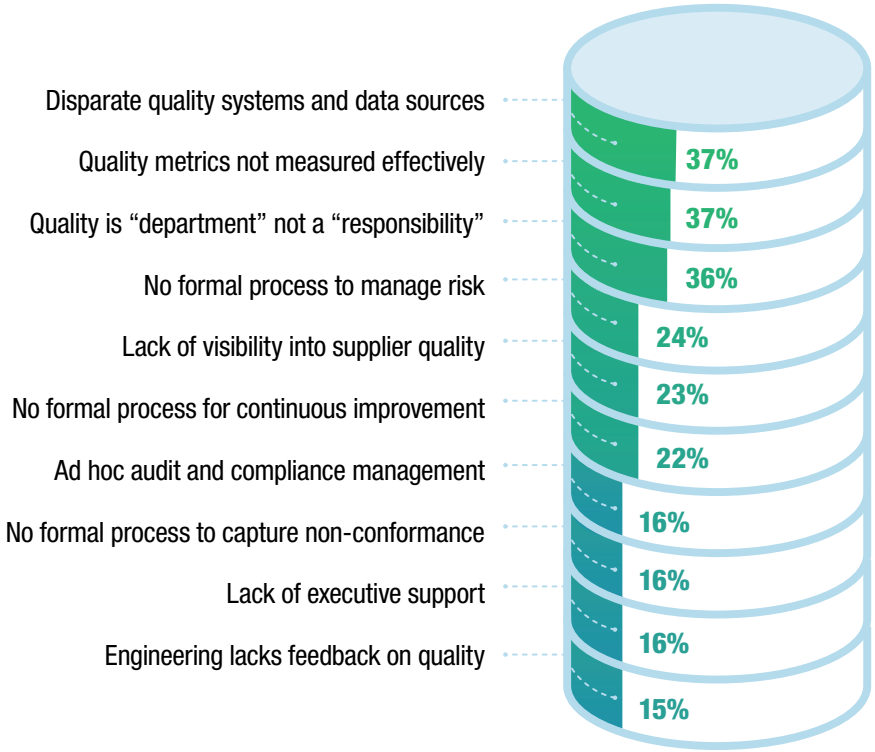
Click to learn more about the **Quality 4.0 Framework**

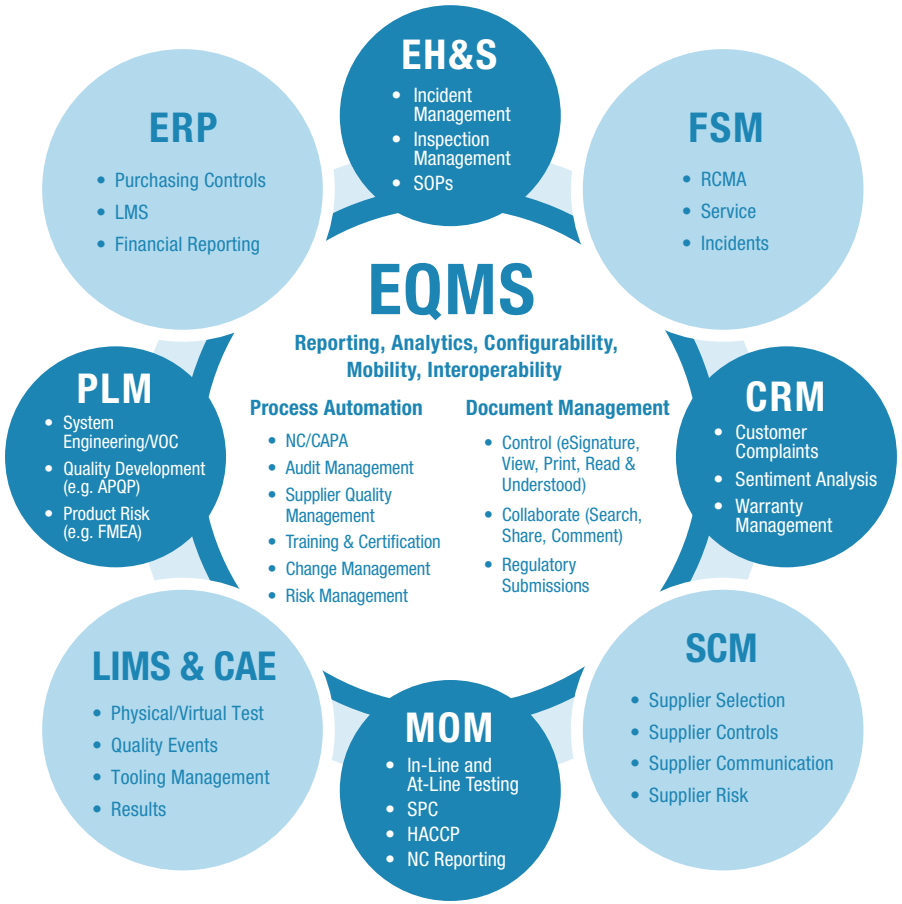
Core Tech for Quality 4.0

An effective Quality 4.0 strategy starts with data, which the organization gathers from people, processes, machines, online marketplaces, and third parties. Quality is a corporate-wide responsibility, and by extension quality processes and quality data connect with many IT systems. While manufacturers have made significant progress in enterprise resource planning (ERP), customer relationship management (CRM), and product lifecycle management (PLM) system adoption, quality data is still highly fragmented. Although EQMS adoption is accelerating, it is still only implemented by roughly 23% of manufacturers.

Poor quality data strategies are the leading cause of manufacturers failing to meet their quality objectives. As yourself: What is your hub for quality management? Is it integrated to other critical IT systems? Do you struggle with compliance or delivering performance improvements?

Challenges to Achieve Quality Objectives *(n=1328)*



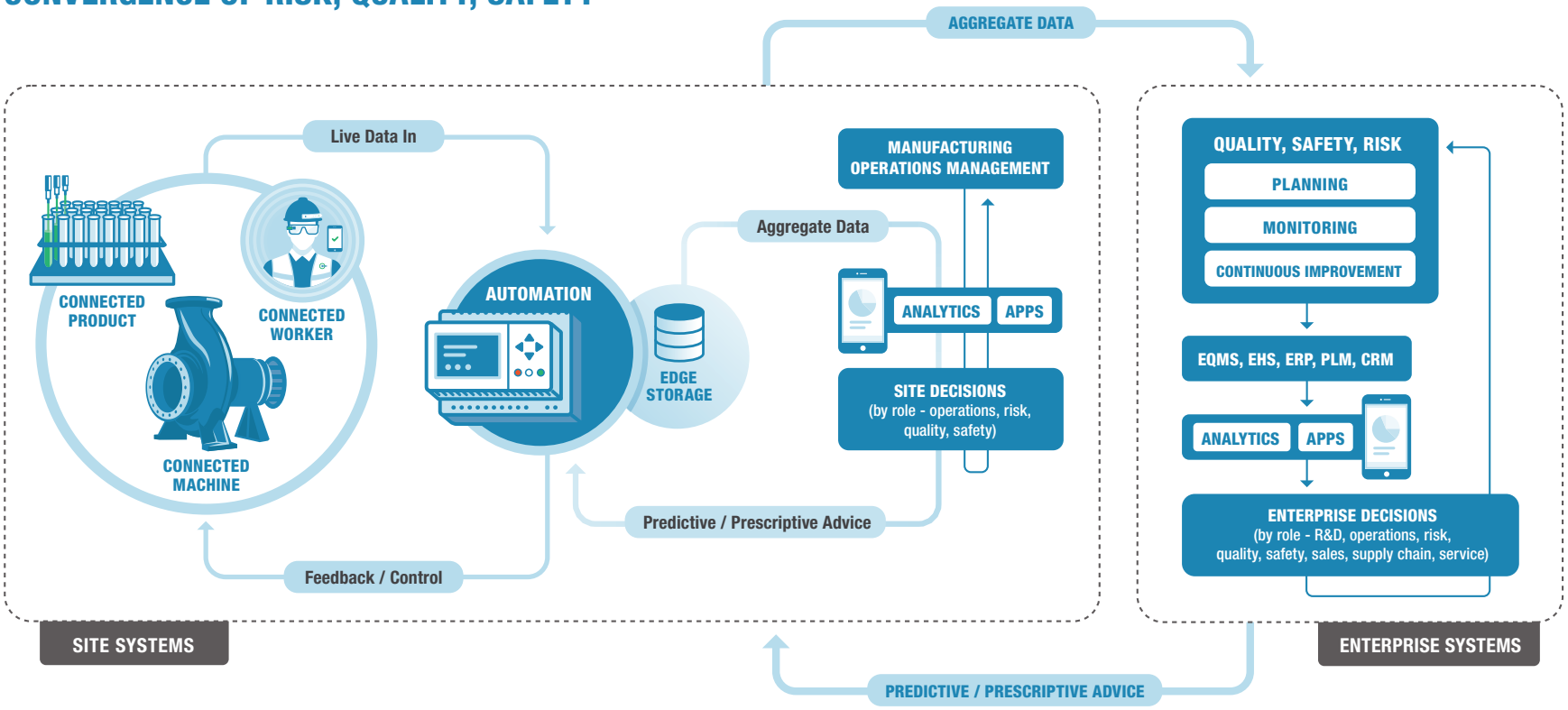


Connecting IT and OT

Most industrial organizations face significant data gaps across the management, planning, and execution of quality. Those that have automated quality processes and centralized quality data in an EQMS still have a siloed approach. For instance, only 16% of manufacturers have integrated EQMS with the manufacturing operations management (MOM) system. This disconnect prevents knowledge transfer between sites, teams, functions, and corporate. Not only is quality fragmented from operational and business systems, but alarmingly so between site, business unit, and corporate quality. Data fragmentation reduces monitoring effectiveness and increases monitoring costs by relying on people and processes versus data and analytics. It also creates knowledge silos, slowing knowledge transfer from lessons learned and forcing quality leaders into a reactive mode.

Conversely, industry forerunners have taken a substantially different approach, connecting manufacturing, service, and laboratory operations planning and execution with management, risk, and continuous improvement. This closed-loop approach enriches processes and products through lessons learned from data and the workforce across the enterprise.

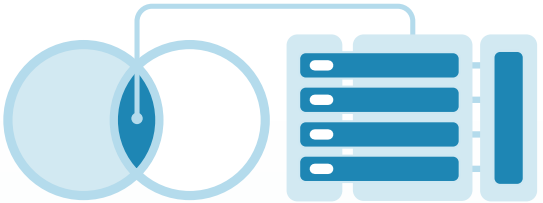
CONVERGENCE OF RISK, QUALITY, SAFETY



Connecting IT and OT *(Cont.)*

When an organization extends the discipline of IT architecture through from IT systems to manufacturing assets and connected products to deliver value and progress against strategic objectives, LNS Research calls the approach "operational architecture."

New technologies permit greater connectivity between critical business and operations systems, which solve long-standing challenges. Quality leaders cannot afford to be complacent about technology and data-driven insights. Those that think broadly can use this opportunity to overcome traditional barriers that block knowledge sharing among sites, enterprise, operations, and management.



OPERATIONAL ARCHITECTURE is a critical component of Industrial Transformation. It extends traditional enterprise architecture, to holistically manage the convergence of information technology and operations technology. It's an approach to align people, process, and technology in context of the value chain, and in support of enterprise Strategic Objectives.

Click to learn more about
Operational Architecture

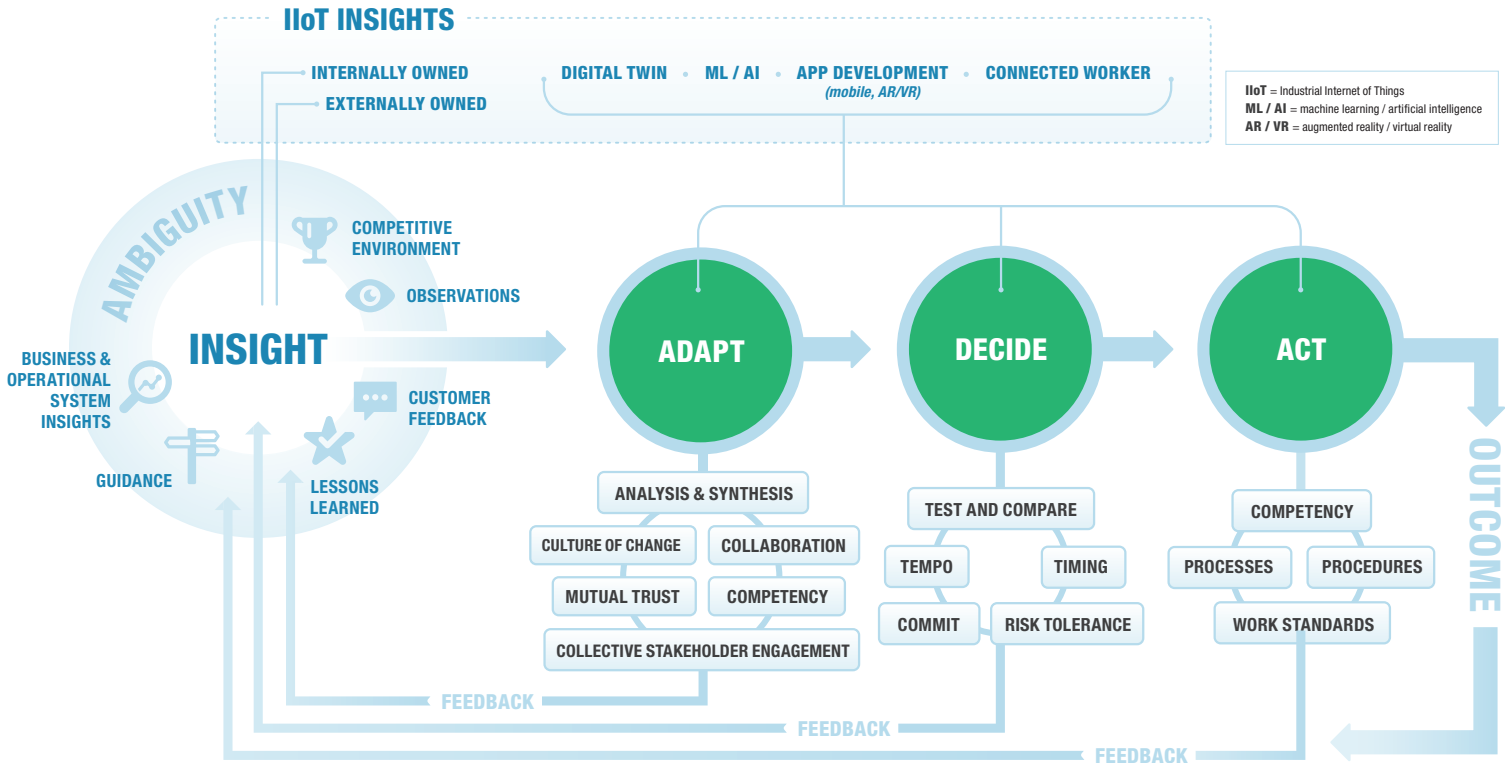
Digital Innovation Cycle

Agility, adaptation, and innovation are prized competencies in today's business climate. Disruption is top of mind because it is a genuine opportunity for the organization that creates or leverages it, and a serious risk to established brands. Today's manufacturers are exposed to unprecedented external forces, but also have the potential to access unprecedented insights. However, while the insights from across IT and OT and enterprise and site are powerful, they are only part of the solution.

Even with the best insights, are the correct subject matter experts involved who can interpret the insights and lead adaptation? Will biases prevent teams from pivoting to the best competitive decision? Will internal friction slow decision-making, missing the market? The Digital Innovation Cycle by LNS Research explains the connection between insights and ambiguity, culture, competency, and corporate capability to adapt and act in a decisive, off-tempo rhythm. The Digital Innovation Cycle doesn't replace existing processes such as phase-gate, agile, or plan-do-check-act. Instead, it provides a framework for the industrial enterprise to embed innovation and digital insights into its existing process of choice.

Outcomes should portray all insights — including the new, critical digital insights — but successful adaption comes from teams that have cross-functional perspectives, mutual trust, and a culture of change. Truly disruptive outcomes require insights and adaptation, combined with timely and off tempo decisions and execution.

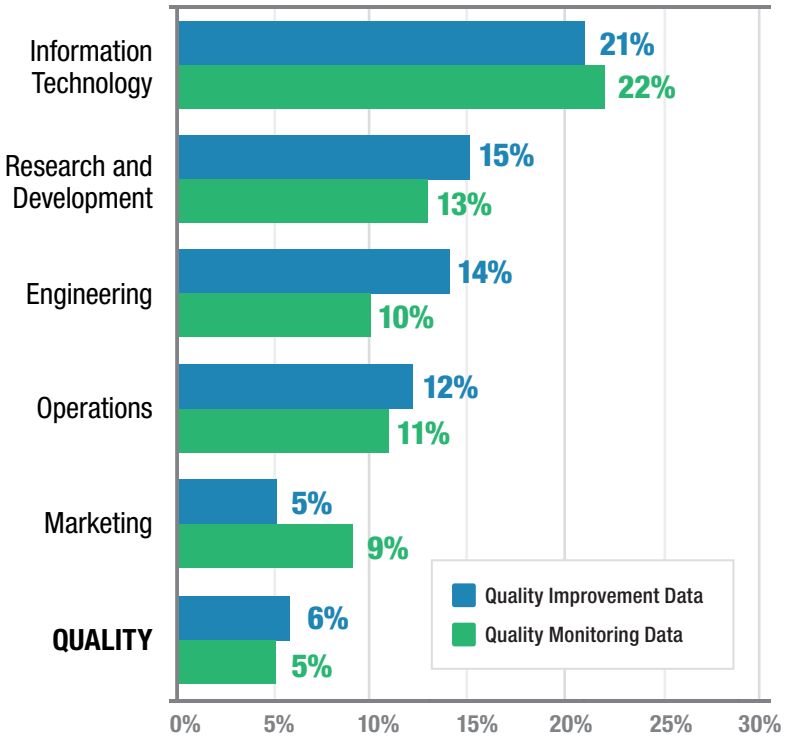
DIGITAL INNOVATION CYCLE



Who Cares About Quality 4.0 Technology?

Quality and Quality 4.0 are topics of broad interest and priority across the industrial landscape. The new product introduction (NPI) research conducted by LNS examined quality from a cross-functional perspective. We found that leaders across engineering, operations, and quality all singled out quality as the top success criteria of NPI. More importantly, the data showed that all teams felt ownership toward final product quality. Interest in Quality 4.0 is even more wide-spread. For every professional in a quality role prioritizing Quality 4.0 use cases, there are 19 others corporate-wide doing the same.

Which roles are planning to use IIoT to monitor and improve quality?



Accountability by Function

	ENGAGED ONLY FOR SPECIFIC TASKS	INFORMED AND ACT WHEN NECESSARY	RESPONSIBLE FOR SPECIFIC TASKS	FULLY ACCOUNTABLE
Information technology	57%	43%	0%	0%
Operations	20%	20%	30%	30%
Product development	31%	15%	38%	15%
Quality	7%	10%	69%	14%

Who Cares About Quality 4.0 Technology? *(Cont.)*

Case in point: Quality improvement is the number one use case in manufacturing analytics initiatives.

This finding reveals two important facts. First, product quality and Quality 4.0 are currently top of mind across the enterprise. Second, a Quality 4.0 selection team should be comprised of an extended team, with cross-functional representation.

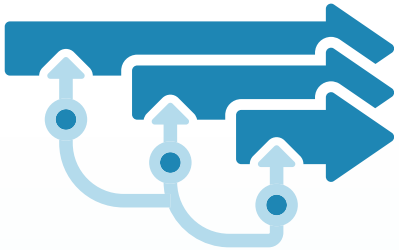
TOP 5 USES OF ANALYTICS IN THE MANUFACTURING ENTERPRISE

SECTION 4

What Defines "Success" in Quality 4.0 Solution Selection?

Digital Transformation Framework

The Digital Transformation framework by LNS Research guides the industrial organization's transformation efforts. While it's iterative, companies that start at the beginning with Strategic Objectives improve alignment of business outcomes, operational enhancements, IT-OT convergence, value, and technology. Each stage requires significant thought, and skipping steps is a leading cause to failed or delayed selection and value realization.



DIGITAL TRANSFORMATION FRAMEWORK
by LNS Research describes a systematic approach to simultaneous and interconnected digital initiatives, in order to manage transformation across all levels and functions of the organization.

Click to learn more about the
Digital Transformation Framework

The Ideal Outcome

Often, technology selection teams identify success criteria that are too narrow ("We need specific functionality at a given budget, and complete the project within a certain timeframe,") which limits project goals, scope, impact, and recognition. To deliver successfully, it's important to pinpoint the right outcomes. But, exactly what does that mean in terms of Quality 4.0?

Recall that many challenges can thwart quality objectives; technology is a common root cause. A Quality 4.0 project is an excellent opportunity to improve culture, collaboration, and process.

It is also a critical opportunity to innovate and disrupt. Therefore, the effort should be examined in context of the Digital Innovation Cycle; timing and tempo are crucial. One particularly important consideration is total time to value. Project teams usually look at combined software, hardware, and service project costs, and compare it to value using metrics like return on investment (ROI) or breakeven point. This definition is incorrect because it looks at the costs and value post-procurement. True time to value begins from project inception, based on insights gained on changing market dynamics. This definition reflects the organization's ability to adapt and decide, as well as to act.

Defining Success in Solution Selection

- ☑ Project costs
- ☑ Documented impact, quantified success metrics
- ☑ Optimum time to value
- ☑ New, high velocity, high veracity insights
- ☑ Team recognition
- ☐ User adoption
- ☐ Cultural improvement
- ☐ Competency creation
- ☐ Innovation
- ☐ Increased organizational agility

Cost of Poor Quality Versus Cost of Good Quality

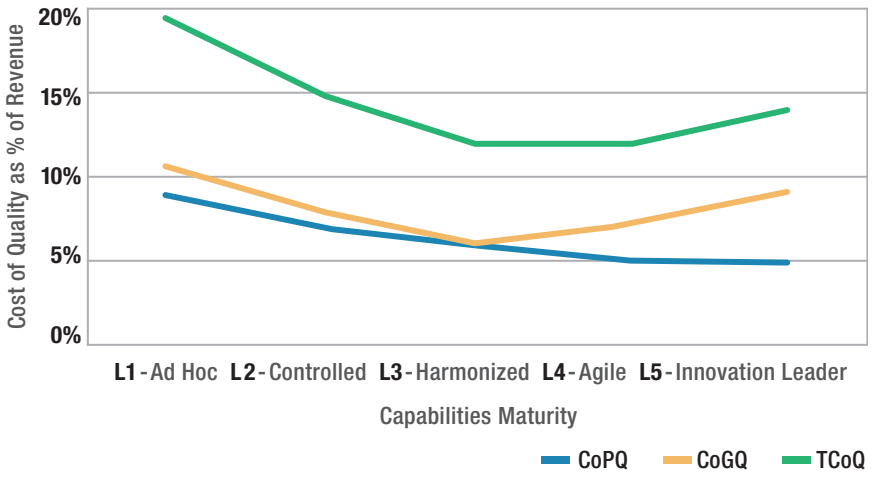
TRADITIONALLY, TO IMPROVE waste, scrap, rework, recall, and warranty costs that impact cost of poor quality (CoPQ), a company needed an approximately equivalent investment in quality appraisal and prevention, which drive the cost of good quality (CoGQ). We view this as the original premise of Philip Crosby's statement, "Quality is free." An investment in good quality is offset by reducing poor quality.

Capabilities maturity research by LNS illustrates this well. The total cost of quality (TCoQ) declines as a company matures, levels off for moderately mature organizations, and increases at the highest levels of maturity as CoGQ increases without a corresponding decrease in CoPQ (all median data, n=1198).

However, Quality 4.0 doesn't require this tradeoff. There are several use cases where data coupled with advanced industrial analytics reduce CoPQ and CoGQ, even in high maturity quality environments. For instance, LNS is aware of manufacturers of semiconductors and consumer durable goods that have identified opportunities to reduce the frequency of less instructive testing while simultaneously reducing scrap and warranty costs. The companies achieved this by applying advanced analytics to data sets that include product genealogy, product testing/screening, and anomaly data.

Data shows that manufacturers with less mature quality environments can improve TCoQ with traditional investments, while Quality 4.0 delivers TCoQ improvements across the maturity spectrum.

Cost of Quality in Context of Capabilities Maturity

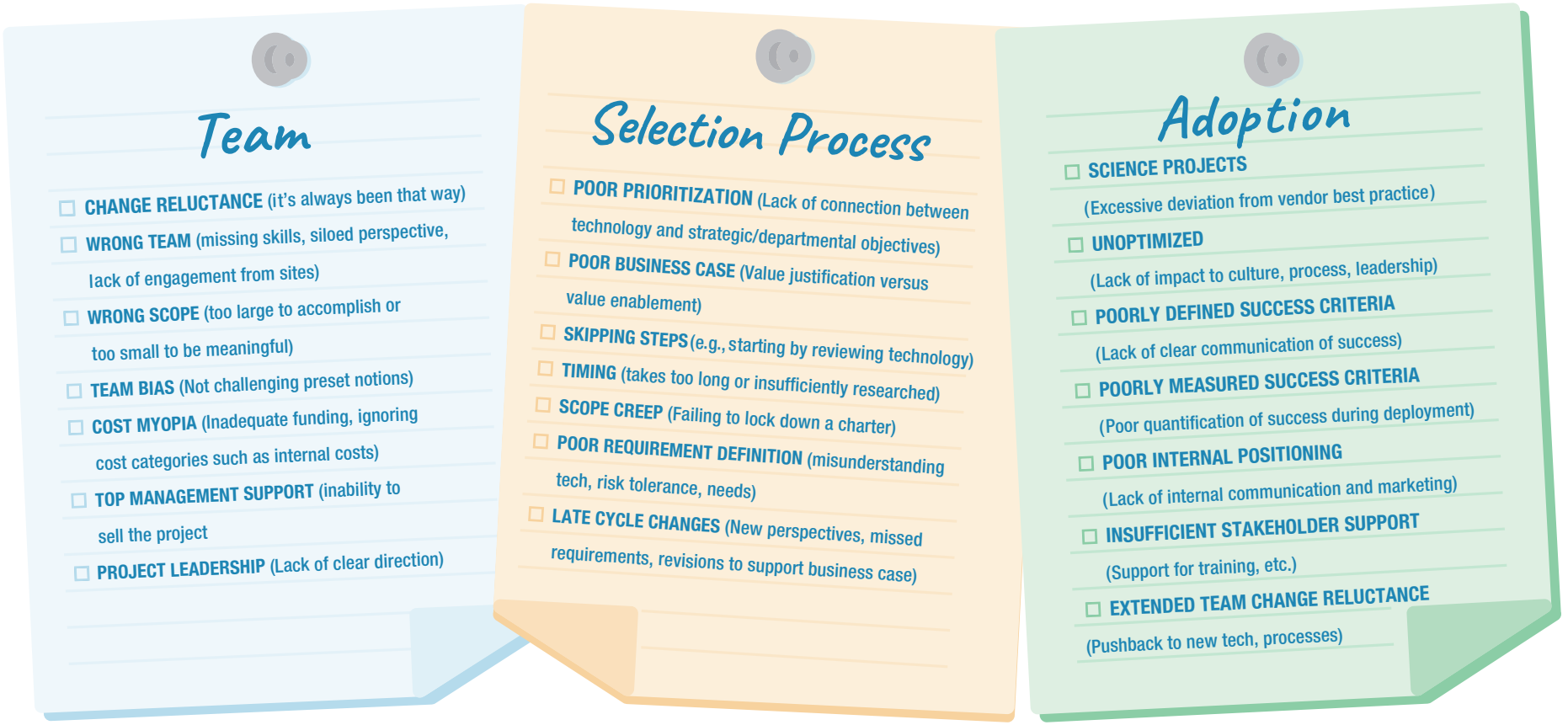


Project Risks

Without a structured approach like the one prescribed in the Digital Transformation framework, industrial organizations incur significant risks that don't necessarily manifest until late in the project. In many cases, not addressing risks early on reduces the impact of the solution, delays value, and increases costs. Manufacturers should strive to avoid or address the most common risks, which LNS uncovers most frequently in guiding solution selection initiatives.

WRONG TEAM

Often, the team is exclusive and does not include stakeholders from across the value stream, or from individual sites. Technology selection is a powerful opportunity to enhance the corporate culture by providing alignment up front, which results in downstream adoption.



Project Risks *(Cont.)*

POOR BUSINESS CASE AND SKIPPING STEPS

These are closely entwined. In our experience, 100% of solution selection projects by quality teams start with a review of existing technology. This is a "start wrong, end wrong" story, with companies choosing technology based on features and efficiencies rather than strategic importance. This route also negatively impacts top management support. Successful solution selection begins instead with an internal view of how the Quality 4.0 tech selection will impact the objectives of top management and cross-functional leaders.

TIMING

In many cases, technology selection can stretch on for years and in the process incur substantial internal costs and delay value. The median manufacturer engaged LNS Research to aid in solution selection after approximately 15 months of technology investigation. A drawn-out selection process is a significant challenge for EQMS selection, but catastrophic for Quality 4.0 selection, which is intended to be a fast-paced pilot.

SCIENCE PROJECTS

Manufacturers should evaluate vendors for presence in their specific industry, positioning for delivering the scope of the project, and potential for leading the market. Merely assessing capabilities is insufficient. As markets mature and vendors deploy capabilities repeatedly, the solution selection team should also examine vendor pre-configurations and content along with capabilities. EQMS is an excellent case in point. More than a decade ago, EQMS deployments were heavily customized. Later, they were highly configured. Today, there are preconfigured solutions aligned to specific markets.

SECTION 5

Selecting Tech for Quality 4.0

A Plan for Solution Selection Success

Manufacturers have achieved substantial success following the process that LNS prescribes for solution selection. While we organize and communicate the steps sequentially, even within groupings, there is almost always iteration. The three underlying factors that selection teams should consider throughout the effort: selling to the ecosystem, positioning with top management, and time to value.

11-STEP SOLUTION SELECTION PLAN

- **STEP 1** | Gather insight
- **STEP 2** | Build the team
- **STEP 3** | Set direction
- **STEP 4** | Launch internal communication
- **STEP 5** | Gather requirements and create implementation strategy
- **STEP 6** | Revisit the business case
- **STEP 7** | Create vendor shortlist
- **STEP 8** | Conduct solution selection
- **STEP 9** | Procure and socialize
- **STEP 10** | Prep for deployment
- **STEP 11** | Deploy

A Plan for Solution Selection Success *(Cont.)*

STEP 1 | GATHER INSIGHT

- What insight drives this technology project?
- What is state of the market and competitive landscape?
- How are market and competitive landscape expected to change over the next 12-18 months?
- How does our organization compare to market leaders?

STEP 2 | BUILD THE TEAM

- Core team
- Extended team including site liaisons, value stream representatives

STEP 3 | SET DIRECTION

- Map Strategic Objectives to people, process, and technology
- Prioritize desired outcomes (initial)
- Site-level survey (optional, encouraged); cover IT and OT, what's working, what isn't
- Build project charter

STEP 4 | LAUNCH INTERNAL COMMUNICATION

- Communicate charter to extended team
- Begin developing internal brand

CHECKPOINT #1

Top management and extended team, set budget placeholder.

STEP 5 | GATHER REQUIREMENTS AND CREATE IMPLEMENTATION STRATEGY

- Define requirements: in/out of scope, priorities based on direction, business and tech requirements, operational excellence and operational architecture requirements; What are we harmonizing? What do we want to see connected? Which sites, and what process order?
- Prepare summary, attach to charter, use to communicate with internal brand

A Plan for Solution Selection Success *(Cont.)*

STEP 6 | REVISIT THE BUSINESS CASE

- Map to value, define success metrics; identify sites/ process areas
- External benchmarking
- Value assessment

CHECKPOINT #2

Proceed? If low value, "no."
If "yes," then communicate business value and approach to top management and ecosystem.

STEP 7 | CREATE VENDOR SHORTLIST

- Build a vendor list
- Identify top candidates
- RFP
- Shortlist

CHECKPOINT #3

Refine budget placeholder.

STEP 8 | CONDUCT SOLUTION SELECTION

- Solution demonstrations and RFQ for shortlist
- Pilot
- Revisit implementation strategy

CHECKPOINT #4

Secure final capital / expense approval, identify top management support/involvement in implementation.

STEP 9 | PROCURE AND SOCIALIZE

- Procure
- Promote internal brand, tech

STEP 10 | PREP FOR DEPLOYMENT

- Configure
- Integrate
- Train site leads

STEP 11 | DEPLOY

- Deploy per implementation strategy
- Measure success (measure before/after)

Drive Momentum with the Right Partner

One of the most important tactical decisions in the process is where to deploy initially. Survey data collected by LNS clearly shows that initial deployment site can either accelerate or substantially delay value. Organizations should evaluate sites for current process repeatability and reproducibility, data integrity, and workforce competency. Some sites excel at adopting new technology, which moves them up on the priority scale. We can't overemphasize the importance of finding a good internal partner site for initial deployment. Although laggard sites may benefit more from technology, an internal success story is a powerful beacon and motivator.

While quality teams often drive Quality 4.0 and enterprise quality management software (EQMS) technology selection processes, in many cases quality may play a supporting role in larger technology selections such as Digital Transformation, Industry 4.0, or Smart Manufacturing.

SECTION 6

Recommendations

Action Steps to Deliver on the Promise of Quality 4.0

A Quality 4.0 initiative is once-in-a-career opportunity for manufacturers to establish enterprise differentiation through product quality and the cost to attain it. Given the momentum across the industry and the growing set of published use cases, we encourage quality leaders and Digital Transformation teams to collaborate to deliver successful Quality 4.0 initiatives. Teams should focus now on:

- Building a successful Quality 4.0 initiative by aligning Strategic Objectives and including cross-functional teams that support these objectives.
- Leveraging Operational Architecture practices to connect quality across IT and OT systems.
- Solving historical quality challenges, including core quality data management processes.
- Using a proven framework and strategy for solution selection.

Author:

Dan Jacob
Research Director and Principal Analyst
dan.jacob@lns-global.com

Connect:

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