



TRANSFORMING TRAINING MANAGEMENT:

Impact of Digital Tech on Scaling, Developing, and Retaining Competencies

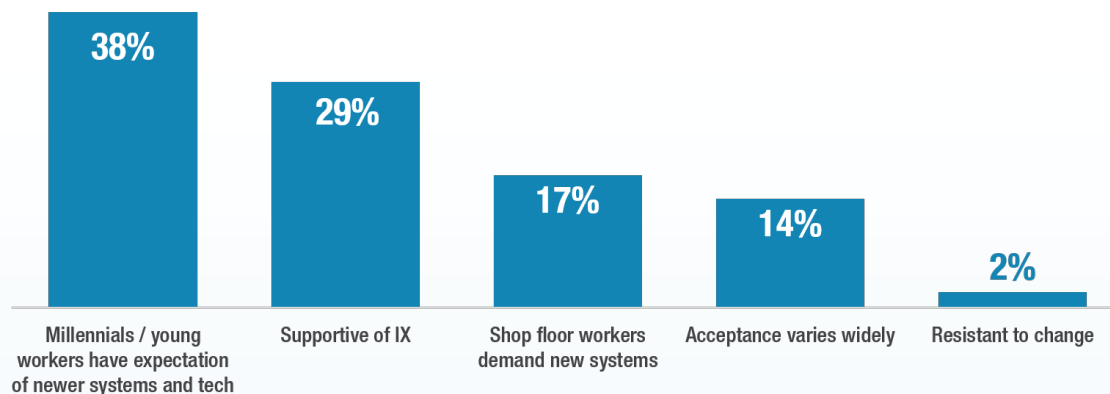
Workforce competencies — manufacturers have long had requirements to manage training and competencies, namely to document, assess, and develop/acquire skills. The requirements stem from their quality, regulatory compliance, and environmental, health, and safety management systems. These training management requirements are not new, are fulfilled by several methods in industry today, and are historically most commonly deployed as a compliance requirement. However, leading firms have recognized that a modern approach to training management has the potential to improve the agility of the workforce, ensure competency in an ever more dynamic workforce, and meet core business objectives. Training management can unlock the value of an increasingly critical operational asset: the competent and connected worker.

While worker competency is a compliance consideration, it is so much more to operations. Today, the digital transformation of industry is accelerating, and [Quality 4.0 — the digital transformation of quality — is a leading use case](#). Would it surprise you that 46% of firms investing in Quality 4.0 do so with the expectation of increasing employee efficiency or safety, and another 30% expect to improve employee recruiting, engagement, and retention?

“WHILE WORKER COMPETENCY IS A COMPLIANCE CONSIDERATION, it is so much more to operations. Today, the digital transformation of industry is accelerating, and Quality 4.0 — the digital transformation of quality — is a leading use case.

—DAN JACOB
Principal Analyst and Research Director

Worker Sentiment About IX of Operations



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If this was a surprise, consider the convergence of two powerful manufacturing dynamics: the millennial workforce’s growing expectations for technology, and a hot manufacturing job market. Even LNS Research’s [recent Industrial Transformation readiness survey data](#) clearly illustrates this trend; it revealed that nearly all workers expect or demand

technology upgrades. Also consider the [March 2019 Manufacturing ISM® Report On Business® from the Institute for Supply Management](#), which marks a 30-month growth trend in manufacturing employment. Workers have many options, expect a higher tech environment, and are easily able to leave to find gainful employment elsewhere if conditions do not meet expectations, which creates competency gaps for the former employer.

These concerns cross industries, geographies, and company size. Thirty-two percent of chemical manufacturers plan to invest most in knowledge management, just behind Mergers and acquisitions and automation systems, each at 36%. Fifty percent of mining firms and 40% of forestry companies cite skilled labor shortages as the top challenge to achieving operational objectives.

However, many organizations struggle with training management and competency development challenges; the market's technology adoption is critically lagging. Training processes are not automated with software by 64% of the market. This deficiency is increasingly coming into focus for leaders — a full 21% of the market plans to adopt a mobile or augmented reality (AR)-based training system for targeted training in-context with job execution. While that's great news for leaders, much of the market has significant challenges in this area and needs to address them to meet core operational, financial, and digital objectives.

This research focuses on employee training technology, and provides a guide to address quality leaders' top challenges regarding training technology, namely:

- High-level trends driving the need for improved training and competencies;
- Today's state of the market in training management;
- How to take a transformation-first approach that leads to improved operational outcomes;
- Adoption of Quality 4.0 training technology initiatives;
- Training management's impact on top objectives; and
- How to define transformed employee competency.

Training management has been a part of compliance for decades, but today, more than ever, developing, retaining, scaling, and enforcing competencies is critical to manufacturing, supply chain, and service operations. The technology needed to transform employee competency is



WHAT IS COMPETENCY?

According to the University of Nebraska-Lincoln, competency is, "The combination of observable and measurable knowledge, skills, abilities, and personal attributes that contribute to enhanced employee performance and ultimately result in organizational success." Competence is broadly referenced and required by various standards and regulations, such as ISO 9001:2015 and the US Code of Federal Regulation. However, the UNL definition points to the fact that competency is observable and measurable, and also leads to success. Therefore, it is more than a compliance requirement. It is also a role-based consideration, and one of significant concern to operations.

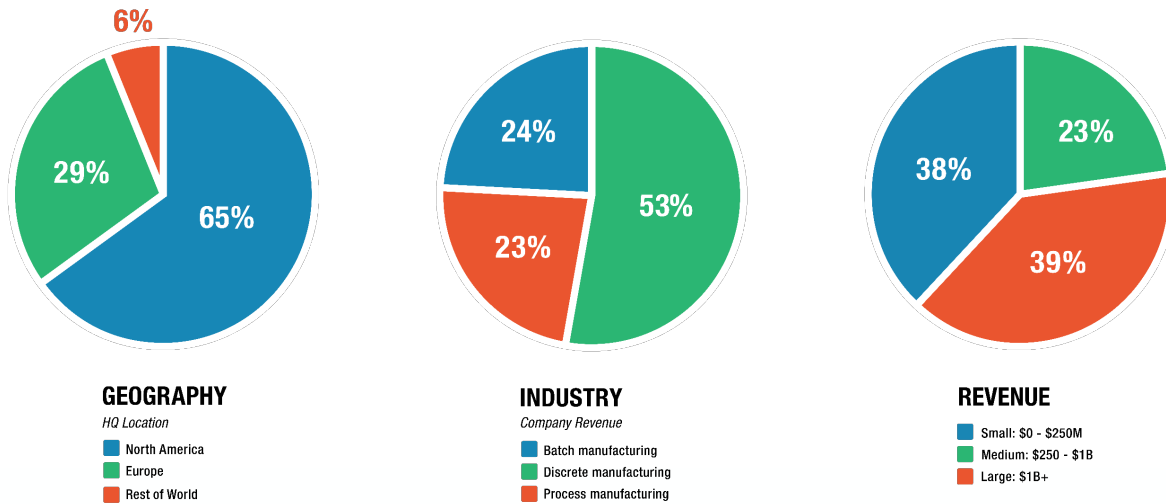
—DAN JACOB

Principal Analyst and Research Director

increasingly an off-the-shelf investment. Organizations that will thrive in today's market are those that can properly leverage this tech.

Demographics

The research data presented in this report is from the LNS Research quality management survey with responses from over 250 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, best practices and technology adoption, and business results and metrics. Slightly more than half of the companies operate in discrete manufacturing industries, with the remainder nearly equally split between process and batch manufacturing. LNS Research primarily serves industrial companies in North America and English-speaking Europe. The survey data represents that tendency, with over half of respondents in North America.



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Intersecting Competencies and Operations

LNS Research's discussions with the market reveal even more about these challenges and highlight manufacturers' varied technology-based initiatives to solve them.

- **A PRIMARY TOPIC AT A SMALL AND MEDIUM-SIZED** manufacturer's forum is growth (great news) and difficulties scaling to meet production (big challenge). Employee retention and competencies are common concerns, with the most successful companies using approaches that transform culture, teams, and technology. While augmented reality (AR) and hands-free technologies are

viewed as futures for most in this segment, these firms are deploying initiatives to leverage mobility to provide workers with role-based and in-context information, including data, standard operating procedures, and in-context training and competency development.

- **AN AEROSPACE COMPONENT MANUFACTURER** historically manufactured components in dedicated sites. Each facility had strong expertise on specific products and site-specific processes, which created bottlenecks and reduced agility when customer demand varied for given products. For example, one site was an expert, but its knowledge was in a silo. As the firm pivots to fungible, agile production, it needs to harmonize processes and competencies across the corporation. It conducted a major initiative to centralize management system data and competencies and leverage this common data to scale processes and competencies globally. Competencies were critical to this initiative — the organization needs fungibility and harmonization at the process and team level. Furthermore, the company needed to convert knowledge from expert sites into explicit and scalable knowledge.
- **THE PRESIDENT OF A NUTRACEUTICAL FIRM** found that its paper-based processes, while compliant, were creating quality, personnel, and operational issues. After investing in a mobile-enabled system to automate batch records, quality, and training management, the company found that employees were freed to focus on quality and production rather than paper. This improved worker satisfaction, reduced employee turnover, reduced time to ship and thus inventory on hand, and improved change management on the shop floor.
- **A MANUFACTURER OF LARGE ASSETS** had operated successfully for generations at established sites, supported by a workforce that had passed on competencies via mentorship. Cracks appeared in this tacit knowledge transfer as the company scaled operations, leveraged new operational technology, and faced a wave of retirement in its most seasoned workforce. The firm's new chief digital officer (CDO) started investing in training management to convert tacit knowledge into explicit knowledge. One part of this investment was in core IT systems, but it also included investment in augmented reality (AR) to document work by recording previously undocumented tasks through AR in context

of the task being performed, and converting tacit knowledge into explicit knowledge.

- **DIGITAL COLLABORATION AND DIGITALLY-ENABLED REMOTE** operations centers are becoming increasingly important tools to scale rare resources. While some highly publicized use cases include remotely operating construction equipment, these concepts also are being used to scale rare subject matter expertise in areas with high degrees of undocumented (tacit) knowledge, such as troubleshooting and audits. One firm with hundreds of manufacturing sites leveraged remote operations centers to provide rare expertise and address knowledge gaps caused by site-level turnover.

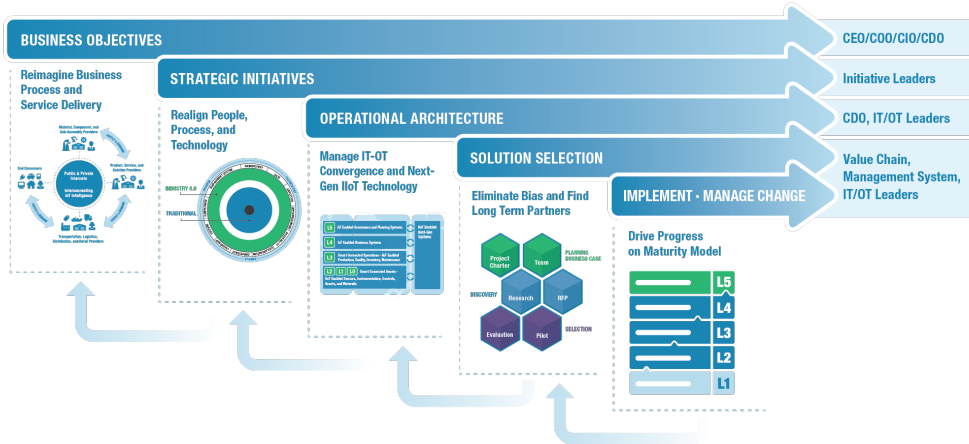
These use cases illustrate that for many, training management is critical to manufacturing operations, particularly with today's market dynamics. There are innumerable varieties of initiatives that the market is deploying to solve these problems, but the most successful are focused on ironing out core business challenges rather than compliance concerns.

These initiatives also share some common themes. They rely on centralized and scalable training management as a foundation and often build on this foundation with new technologies that companies are deploying as a part of an Industrial Transformation (IX) initiative. The following sections of this report explain IX, Quality 4.0, and specific Quality 4.0 use cases that support an enhanced approach to training management and competency development.

What is Industrial Transformation?

While technology provides powerful opportunities for transformation, technology does not guarantee transformation. **Industrial Transformation (IX) is a proactive and coordinated approach** to leverage digital technologies to create step-change improvement in industrial operations. The IX initiative must align with business objectives, and change and converge people, processes, and technology across the enterprise and sites through effective solution selection and implementation.

INDUSTRIAL TRANSFORMATION FRAMEWORK

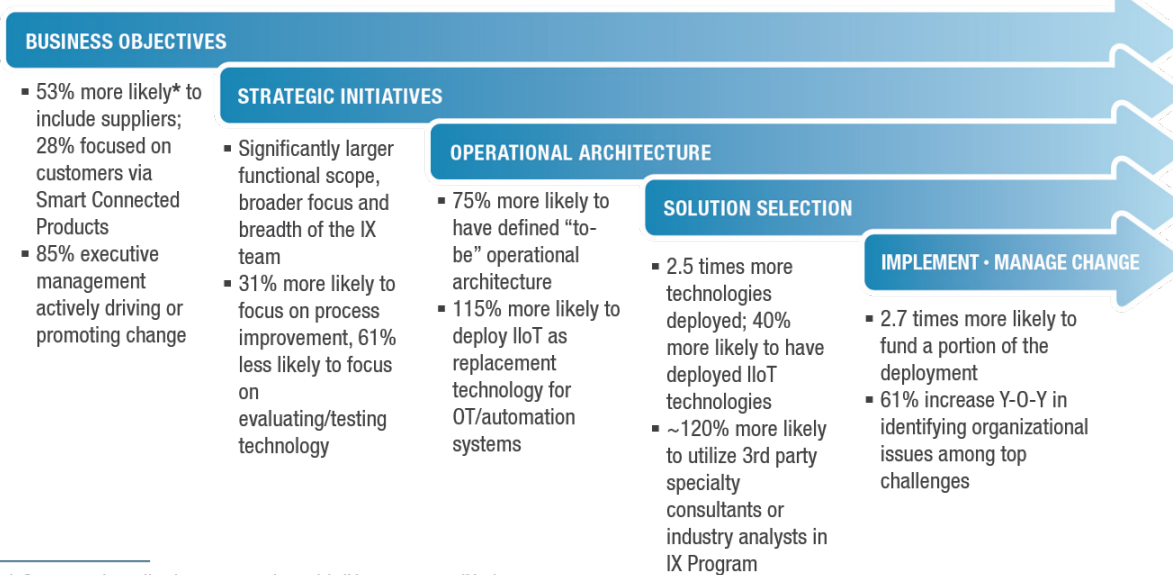


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Just as competency management is critical to today’s workforce needs, people are a crucial part of a successful IX initiative. IX is implemented and scaled by organizations – the initiative’s organization, the broader corporate organizational structure, and site-level organizations. The initiative organization is the change agency, but to be an effective change agent, it must properly align the initiative structure. Our recent research on digital readiness showed that IX leaders have "the power of more." Leaders do more at every stage of the IX framework. They adopt more technologies, and they include more functional and disciplinary teams in their IX initiative.

This backdrop is quite important for leaders of quality, EHS, regulatory compliance, and training, since these organizations overlay many other organizations. Leading companies have more cross-functional teams working together to eliminate silos, whereas lagging organizations tend to adopt technology but make little progress towards merging digital silos.

IX Leaders Operate Differently Across the IX Framework



* Compared to all other companies with IX program or IX plans

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Of course, while corporations may have IX goals, the larger the organization, the more challenging it can be to deploy across business units, regions, and sites, all of which often have different targets. It may be that the sites and business units are substantially more powerful than corporate functions, and control the implementation of technology and transformation under their purview. For situations like this, one strategy is for initiative teams to identify and implement first at the most aligned and ready sites, and leverage successes to gain credibility and build appetite among other facilities.

Quality 4.0 and Current State of the Market

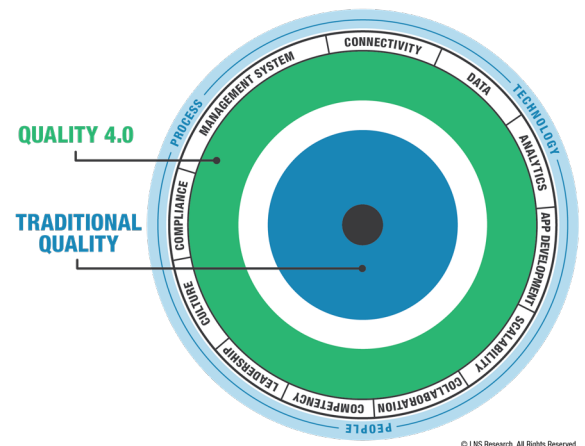
LNS Research coined the term **Quality 4.0** and published definitive research in early 2017. In early 2019, we took a deep dive into the state of the market to identify focus, current adoption, and lessons learned.

First, what is Quality 4.0? 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 enabled entirely new business models. While Industry 3.0 digitized data and records in business and operational systems, Industry 4.0 extends this through inexpensive sensors, mobility, augmented reality and virtual reality (AR/VR), and new collaborative technologies such as social media and blockchain. Advancement and democratization of

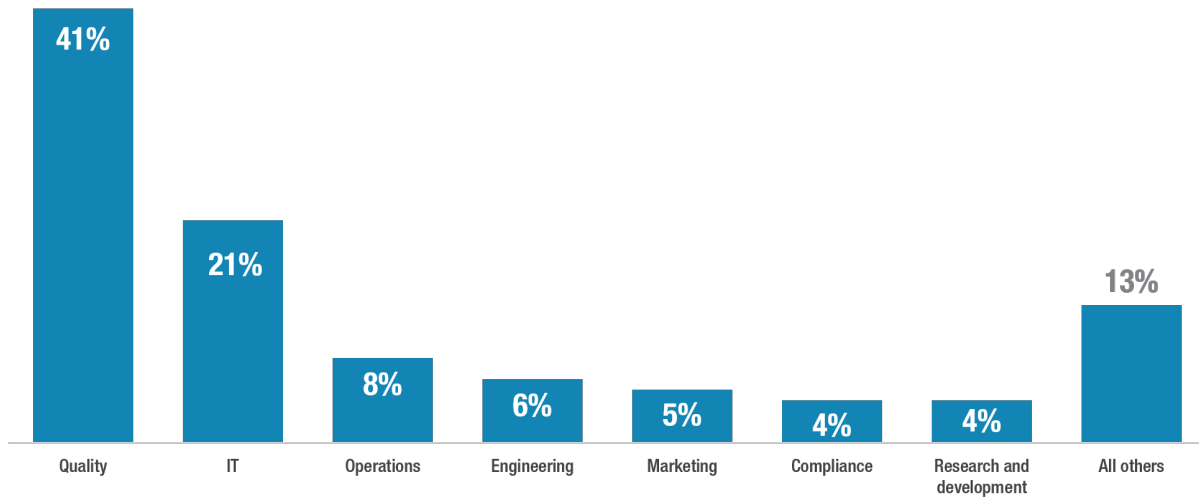
analytics, simulation, autonomous control, material science, and additive manufacturing merged the physical and digital worlds and opened new frontiers in innovation.

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

Quality 4.0 is an overlay to broader IX and Industry 4.0 initiatives, as well as many other corporate initiatives. Interestingly, the teams engaged in Quality 4.0, and with traditional quality technology such as training management and EQMS, are not aligned to successful transformation. On the one hand, traditional quality technology selection teams are siloed, quality-heavy teams with light cross-functional engagement. These teams are effectively picking "quality technology" for the quality team, in stark contrast with inclusionary goals like "culture of quality" and "quality is a cross-functional responsibility, not a department." Conversely, Quality 4.0 teams have light quality engagement. In fact, in 2017, for every quality person involved, there were 19 others in the organization. These numbers have improved, but those in the quality discipline are still much less likely to be aware of Quality 4.0 initiatives than peer groups. In fact, in early 2019, 85% of quality teams are not involved in Quality 4.0 initiatives, which have much greater participation from IT, operations, and engineering.

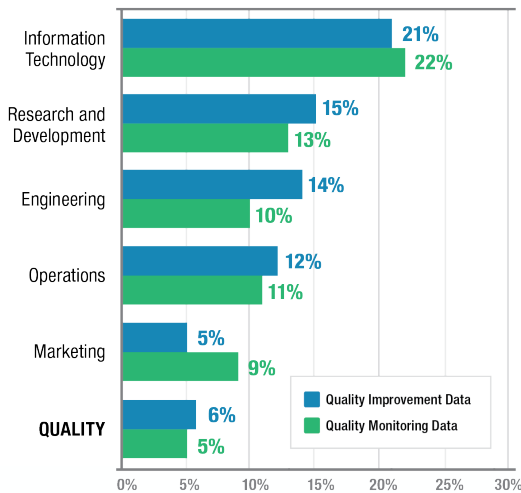


Roles Involved in EQMS



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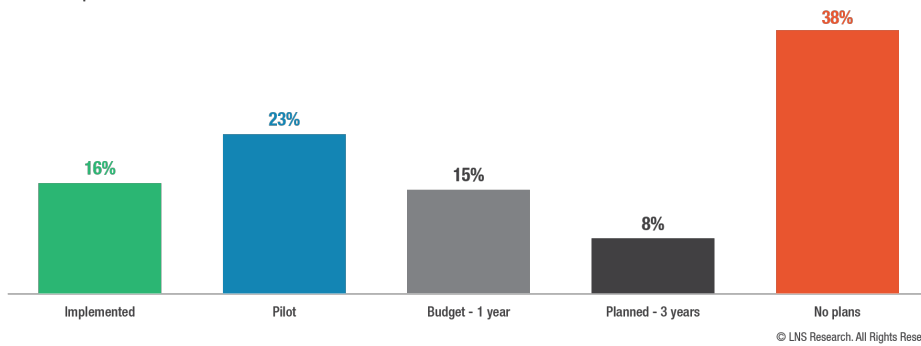
Which roles are planning to use IIoT to monitor and improve quality?



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The market’s adoption of Quality 4.0 is accelerating, which is reflected by our conversations with manufacturing companies. Quality leaders and technology teams are changing their perspective on Quality 4.0, and are working to assess, build, and execute strategies, often planning to begin execution within six months.

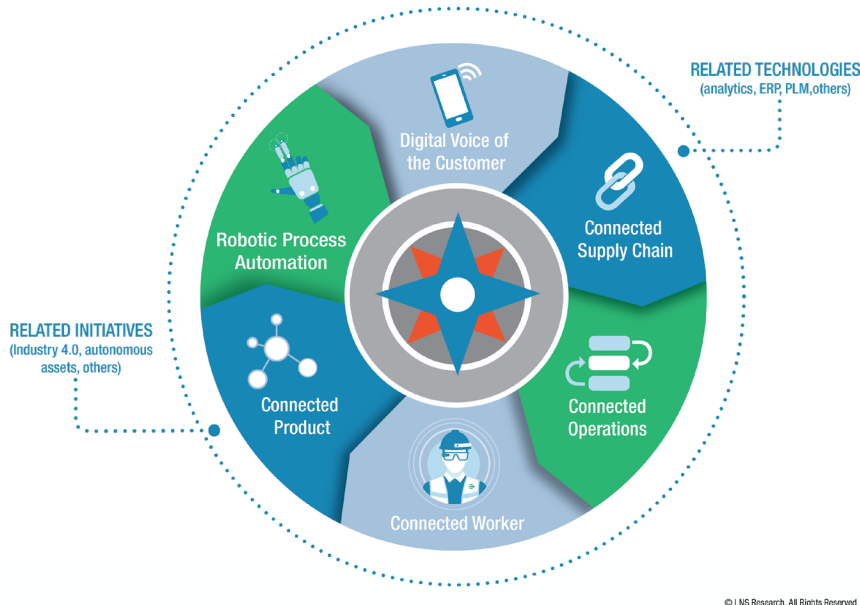
Market Adoption of EQMS



Quality 4.0 and Transforming Competencies

LNS has identified 33 Quality 4.0 use cases that the market is repeatedly adopting, which we organize into six groups using the Quality 4.0 Use Case Navigator.

QUALITY 4.0 USE CASE NAVIGATOR

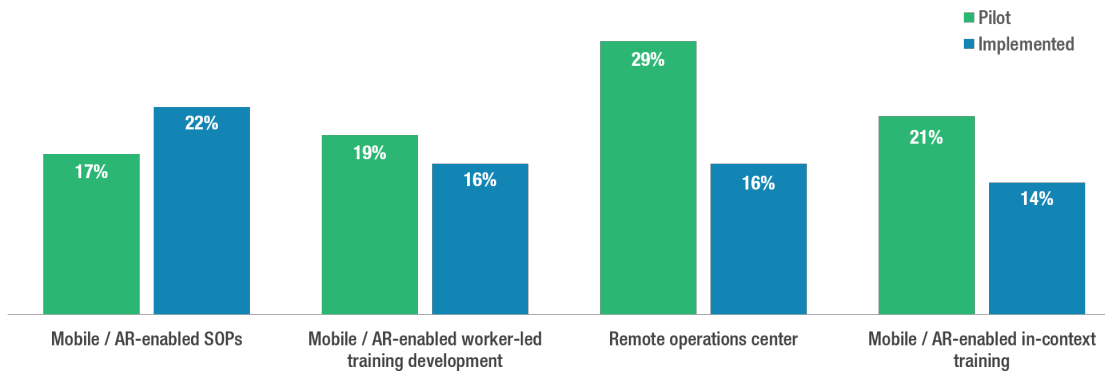


- **DIGITAL VOICE OF THE CUSTOMER** | Use cases related to social media, online marketplaces, warranty, and customer complaints
- **CONNECTED SUPPLY CHAIN** | Use cases related to supply chain quality, predictive supplied goods, and testing/inspections
- **CONNECTED OPERATIONS** | Use cases related to predictive analytics in process and final product quality
- **CONNECTED WORKER** | Use cases related to connected audits, customer complaints, training, and remote operations
- **CONNECTED PRODUCT** | Use cases related to smart connected products, predictive diagnostics, and maintenance

- **ROBOTIC PROCESS AUTOMATION** | Use cases related to artificial intelligence targeted at next-generation process automation and insights within IT systems

While worker competencies impact many of these areas, the use cases that most closely align with training and competencies are in the connected worker use case group; let's examine four of these use cases.

Quality 4.0 Training Use Cases



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Mobile / AR-enabled standard operating procedures (SoPs) replace document-based SoPs and procedures with responsive mobile-ready content, which can include multi-media content, in-context SoPs, and/or interactive data. Rather than reading a document or other file, the mobile/AR-enabled SoPs provide structured data, which can connect to other data within the system, or to devices outside the system, to provide context and streamline the worker's access to needed information. The intended outcome for this use case is increased efficiency and ease of use, leading to higher competency and worker retention.

Mobile / AR-enabled in-context training provides workers with training specific to the task that they're currently performing. The training system might also link to existing training records to see if training is needed. Early case studies show that in-context training reduces time to competency, resulting in improved production ramp up.

Mobile / AR-enabled worker-led training development allows workers to record work instructions and procedures as they perform them, in context of specific tasks. This use case is expected to improve the conversion of tacit knowledge to explicit knowledge, and to promote agility when deploying new processes and technologies. Various approaches exist. Some technologies include the use of beacons to capture location, sensor readings to capture current operating data, data from wearables or voice-activated systems to include operator activity and

inputs. However, this technology is evolving, and systems may take more straightforward approaches, such as using a mobile device to record activities within a structured framework. This approach divides the data in structured steps purposefully by the worker and/or as a post-processing step so that the company can develop it into future competencies and procedures.

Remote operations centers allow firms to scale rare skills and subject matter expertise that is difficult to deploy. Use of AR, video, and other data allows experts to more fully participate with knowledge seekers. Remote operations centers may include data capture and lessons learned as well as other technologies to convert tacit knowledge to explicit knowledge.

Getting “From Here to There”

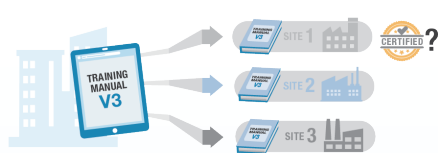
The market is at many stages on its training technology journey. While some manufacturers still use paper, it is increasingly common for companies to use an enterprise IT system that maintains a training schedule, delivers training via document or e-training, and assesses competency by employee and task (a "competency table" of sorts). A more advanced implementation of these systems connects this competency table to operations to ensure only certified, competent employees can perform a given task. Finally, as shown above, teams may be investing in Quality 4.0 training use cases.

HOW SCALABLE IS THE TRAINING MANAGEMENT SYSTEM?

1 PAPER BASED MANAGEMENT SYSTEM



2 TRAINING MANAGEMENT SYSTEM



3 CENTRALIZED IT – OT



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Quality 4.0 is based on traditional quality technology. How mature is the market on its training journey? Recent surveys by LNS Research characterize the market's training management process maturity. For companies looking to develop a robust training management program, we recommend they adopt these capabilities:

- **46%** of companies have a **training management process**
- **43%** of companies have **formal training established** on the training management process

- **36%** of companies have **automated training management** with software
- **34%** of companies have **harmonized training management** across all sites
- **30%** of companies have developed **robust, standardized training management processes**

Manufacturers should also assess training technology capabilities against this list:

1. Centralized, scalable training content
2. Revision-controlled training content
3. Embedded eLearning
4. Automated assessment and certification
5. Competencies synchronized to assets
6. Training change management across IT and OT
7. Mobile / AR-enabled in-context training
8. Mobile / AR-enabled SoPs
9. Mobile / AR-enable worker-led training development
10. IX insight-derived competencies

The final capability, IX insight-derived competencies, is new to our discussion. These competencies can include lessons learned from data and analytics (including ML/AI) that require new or changed SoPs. This includes scenarios where:

- Current SoPs result in excessive data variance and must be changed;
- New insights change operating parameters, from maintenance to settings to steps; and
- Entirely new SoPs are necessary, such as the adoption of smart connected products.

One Possible Future State for Training Management

It can be beneficial to envision a future state to put the current state in context and identify a roadmap. The current state is often compliance-oriented and fairly slow-moving, with limited visibility into how workers consume training, and where workers have tacit knowledge that is

difficult to share or scale. Additionally, training management systems tend to not capture or scale new insights from ML/AI, which can change SoPs and worker activities.

One possible future state would provide a view of deep insights from site-level operations and corporate enterprise technologies. This two-way street demands deep thinking and planning and has historically been challenging. Much of the industry has faced roadblocks with connecting these two arenas — management systems and execution systems.

Industrial Internet of Things (IIoT) technologies like data collection and analytics at the Edge (device controllers and automation), IIoT gateways, broad integrations, data lakes that collect business system, time series and unstructured data, advanced analytics applied to enterprise data, and mobility and augmented reality, are enabling the shift to a more connected, integrated management and execution systems. Together, they are the technology to connect sites and the enterprise. This paves the way for better insights and decisions to optimize risk control at all levels throughout the organization, incorporating granular lessons learned from operations with corporate functions.

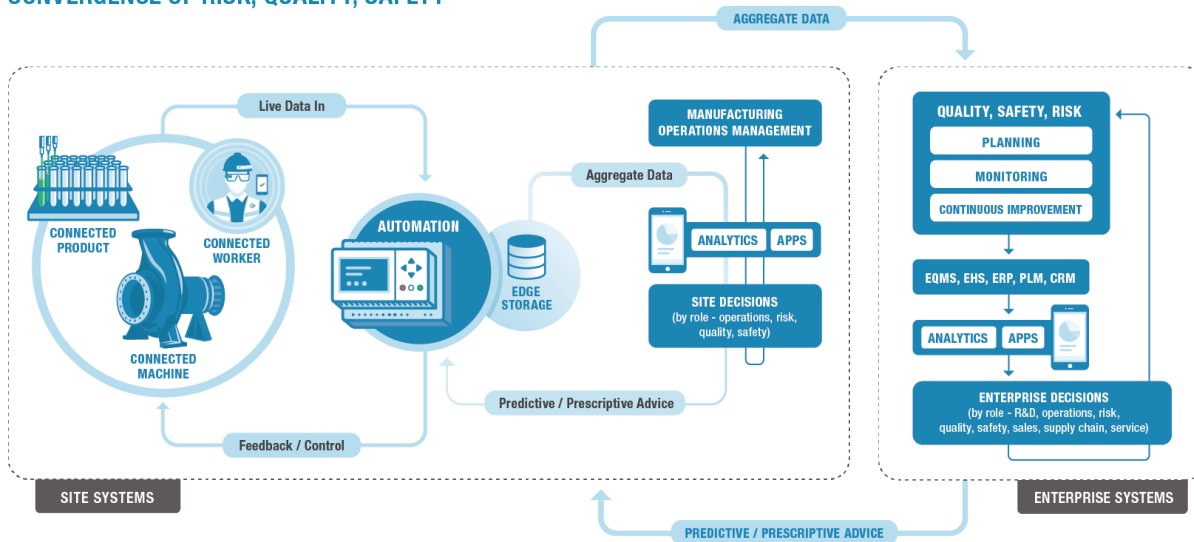
At the site level, production operations occur where machines and people interact to make products. Sensor-generated and human-generated data feed into automation systems which provide feedback to operators and equipment to better control the process. Operations management systems contain production settings such as speeds, feeds, and quality limits, as well as inventory, process flows, supplier data, and execution. Workers execute against explicitly defined SoPs and leverage tacit knowledge in operations. This data can be increasingly monitored through sensors, wearable devices, mobile devices, and augmented reality systems. The organization then aggregates data from automation systems, edge devices, and connected workers and makes it available for analysis in operations management systems to help site personnel make better decisions regarding operations, risk, safety, and quality. These decisions must be ultimately captured explicitly in defined SoPs and competencies.

Today, this information is mostly separate from enterprise systems that administer training management, quality, safety, and risk plans, in-service data and monitoring (e.g., customer complaints, warranty), and corporate analytics. However, by aggregating the site data, corporate functions can connect operation's site-by-site ability to execute and lessons learned with plans and continuous improvement. The result is the

ability to scale employee competencies, identify both positive and negative outliers, replicate innovation and success, and reduce the risk of non-conformance.

It's easy to think of this in the snapshot of an individual site or individual product, but with growing data velocity comes a constant flow of adaptation, with feedback loops continually providing advice cascading down to the people and systems on the plant floor. These feedback loops drive performance improvement through the availability of more and better information to make more informed decisions, and from faster improvement cycle times. Data and insights catch new products, new plans, new service, and support scenarios in flight, significantly speeding the rate of continual improvement.

CONVERGENCE OF RISK, QUALITY, SAFETY



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Recommendations

Today's market dynamics put a premium on competent and connected workers in operations, and effective training management is a critical component to operational success. While much of the market still struggles with siloed, incomplete, and poorly automated training management, leaders are improving their manufacturing operations through industrially transformed training management. It's time to recognize the strategic and operational value of worker competency and the role of digital technologies in unlocking new insights and value. Companies eager to transform training management to scale, develop, and retain workforce competencies should position themselves to meet core operational, financial, and digital objectives.

IDENTIFY OPERATIONAL CHALLENGES related to worker competencies due to current market dynamics.

INVEST IN CENTRALIZING AND SCALING TRAINING MANAGEMENT and competencies that replace paper and siloed systems with change- and revision-managed training management across the corporation.

PROVIDE ROLE-BASED AND MOBILE TECHNOLOGY to improve worker retention and competencies.

INTEGRATE TRAINING WITH INDUSTRIAL TRANSFORMATION INITIATIVES to drive Quality 4.0 use cases, namely mobile/AR-enabled SoPs, mobile / AR-enabled in-context training, and mobile / AR-enabled worker-led training development.

LEVERAGE THESE INSIGHTS to enhance competencies as the firm expands usage of ML/AI.

CONSIDER REMOTE OPERATIONS CENTERS as needed to scale rare competencies.

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](#) →

AUTOMOTIVE AND A&D RESEARCH | Manufacturing Performance: Automotive and A&D Gaining Momentum with Analytics

[View Research](#) →

LIFE SCIENCES 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](#) →

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