
# Industrial Connectivity Buyer's Guide

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# Table of Contents



# Introduction

What are many manufacturers missing to succeed in digital transformation, smart manufacturing, and successful artificial intelligence (AI) initiatives? A common foundation for reliably getting the right data and information to the right place at the right time. In short, what's often missing is enterprise-grade industrial connectivity.

Normalizing, organizing, and making available the massive amounts of data from both automation and information systems is not straightforward. Discerning which systems can deliver it is crucial to a manufacturer's short- and long-term success. In this Buyer's Guide, we'll discuss essential evaluation criteria for an industrial connectivity foundation that's flexible and future-ready.

# Why Connectivity Matters

### Leveraging Data to Compete

Manufacturers have learned they need to leverage their data, turning it into information and intelligence to compete. Getting the right data to the right place at the right time is essential. Moving operations technology (OT) data to other OT elements in real time is often required to run processes efficiently and effectively. Beyond that, sharing data between OT and IT for offline analysis, improvement, and optimization is essential for successful line, plant, and enterprise decision-making.

### Connecting Diverse Industrial Data

Industrial connectivity is unique – it's a more heterogeneous environment and more time-sensitive than many others. Data may be structured, semi-structured, or unstructured, time-series, parametric, and more. To create operational and business context, or meaning, all of those data types need to be normalized, harmonized, and secured. Compounding this issue are the many generations of equipment, automation, and devices in most production facilities. For one more layer of complexity, information technology (IT) now wants to connect with automation or OT, leveraging traditional IT data ops principles.

### Connectivity is the Foundation

Connectivity is a foundation for any approach to the industrial data infrastructure. It is the way data comes in reliably and in an organized fashion for any of these initiatives:

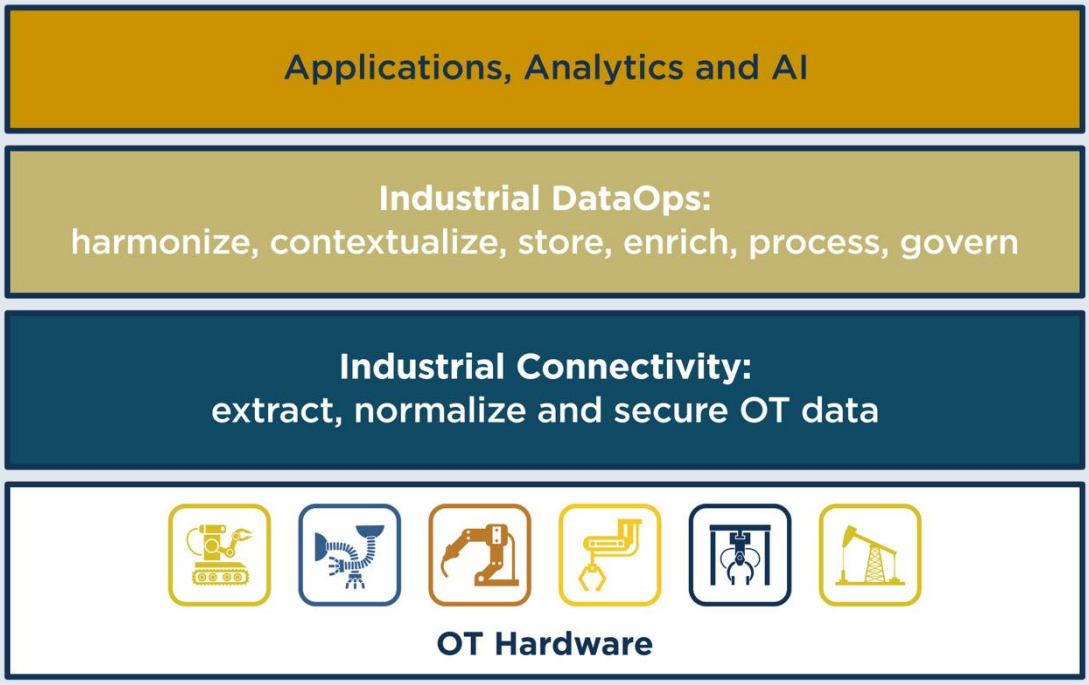
- Industrial DataOps (IDO)
- Industrial data management (IDM)
- Unified namespace (UNS)
- Model-based data and model-based enterprise (MBE)
- Digital transformation (DX) and Industrial transformation (IX)
- Continuous Improvement (CI)
- Digital Twins of processes, plants, and as-built products
- Simulation, analysis, and optimization
- Industrial analytics and artificial intelligence (AI)

Thus, it needs to be an early consideration in any of these programs. Like building a house, the foundation comes first.

> "For us, 'Industrial Data Connectivity' is the communication and data transport link that makes the connected factory and Industry 4.0 possible, uniting the operational world (OT) with the information world (IT)."

**José G. Pichel**
Automation, IIoT, & Industry 4.0 Specialist
**FINANCIERA MADERERA S.A. (FINSA)**

**CONNECTIVITY IS THE FOUNDATION FOR INDUSTRIAL DATAOPS, APPLICATIONS, AND AI**




# Modernizing Industrial Connectivity

### Smart Manufacturing Mandate

Manufacturers are striving to make good, rapid decisions reliably in increasingly volatile and uncertain business environments. This desire to improve visibility, understanding, and, ultimately, their ability to decide and act often drives the initiatives listed above, such as IDM, IDO, UNS, MBE, AI, and IX. Profitability and long-term success will be determined by a company's ability to embrace these smart manufacturing principles, which all require access to relevant data in context through a proven, dependable connectivity foundation.

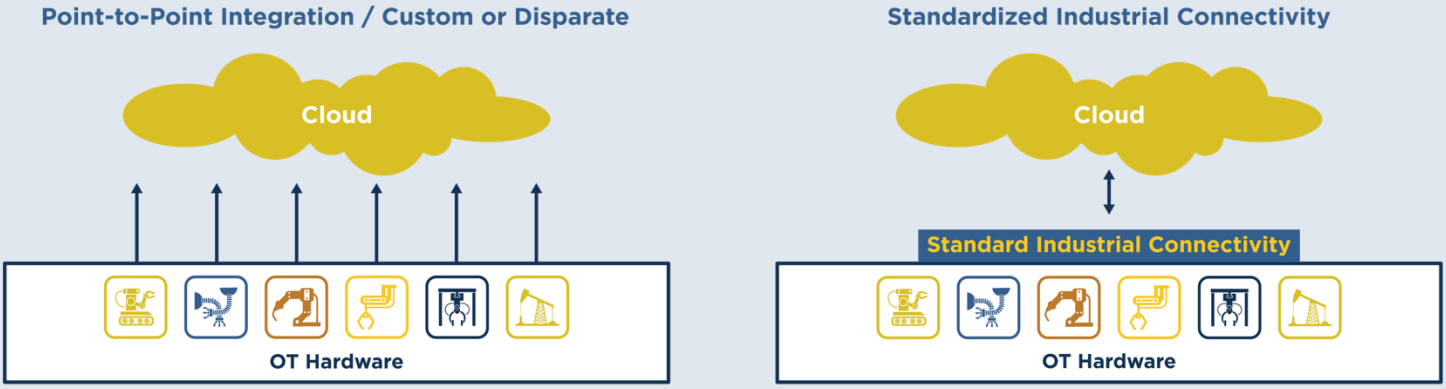
### Downsides to Old Approaches

Manufacturers must do more with less – they can't afford to collect data manually and risk the inaccuracies, inconsistencies, data gaps, and delays. Existing plants have a wide variety of OT systems, and standardizing at this layer is not feasible. Nor does it make sense to create new connection approaches for every project, plant, or initiative. The technical debt of point-to-point connections shows up as slow time-to-value, high downtime risk, and integration that requires significant effort.

### Standardize to Survive

Today's best practice has moved beyond project-by-project point-to-point connectivity to a consistent layer that both OT and IT can feed and trust. To meet their business objectives, manufacturers now realize they need to standardize connectivity to thrive or even survive. The connectivity approach must reliably convert diverse and often-changing industrial OT and IT data into usable formats for analytics, AI, and use by plant and enterprise software – with the ability to access data quickly when the business requires it.

**COMPARISON OF DISCONNECTED VS. STANDARDIZED INDUSTRIAL CONNECTIVITY**




# Standardize Connectivity Benefits

### Why a Standard Approach

Standard approaches ensure the correct data with reliable quality at the core. By standardizing the connectivity approach, a manufacturer frees its project teams to focus on specific operations and business value. It requires modernization and the rollout of company standards across lines, and ideally, across sites and divisions as well.

### Measurable Benefits

The benefits of standard vs. disjointed industrial connectivity you can measure include:

- Faster project completion and scaling
- Easier, more reliable integrations
- Lower total cost of ownership (TCO)
- Reduced administrative burden
- Streamlined staff training time

Each of these can improve your progress toward industrial data ops success.


### Intangible Benefits

Beyond those specific, measurable benefits, a standard approach delivers some bonuses that are more difficult to measure:

- Lower risk from a single solution
- Leveraging learning as more is connected, and the team learns
- A strong foundation for AI implementations with less energy expended
- More confident and timely decision-making

Naturally, decisions based on reliable, complete, and accurate data lead to improvements in operational metrics. Better operating performance typically also leads to better business performance.

> "Honestly, describing the value is a challenge. Yet it enables us to track what we're producing, see machine up or down and reasons, see assembly progress, and gain genealogy for parts, all with a standardized way to normalize tags."

**Kwabena Hobbs**
IIoT & Equipment Connectivity Lead N.A.
**ELECTROLUX GROUP**

# AI Accelerates Urgency to Build Data Foundation

### Data for Analysis

Manufacturers have long analyzed their data to operate effectively, optimize operations, and gain insights into problems. AI takes that to the next level. Data must be defensible for operations, improvements, and AI. This means data should be deterministic, have integrity and traceability end-to-end, and be durable.

### AI Requires High-Quality Data

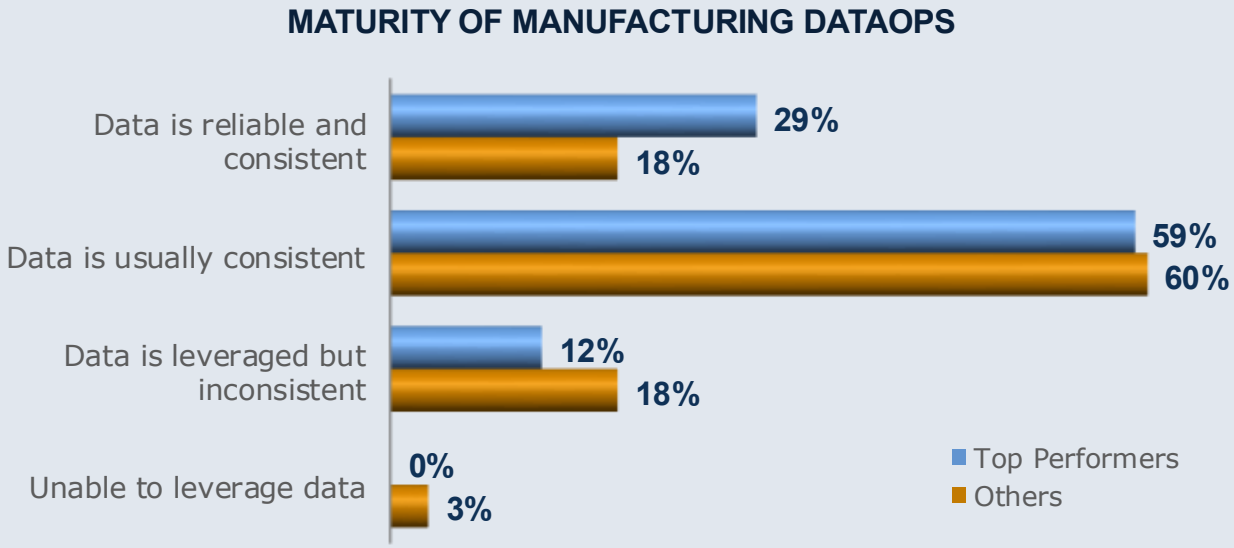
Accurate, complete, and contextualized data sets are a foundation for AI success and value. This is true of all forms of AI: agents, generative AI (genAI), machine learning (ML), and deterministic algorithms. Traceability of the data to original sources supports observability and trust in AI. When AI spots a pattern, it makes inferences; these will be incorrect if the data is not timely, clean, and in context. Unfortunately, most manufacturers, even top performers, don't feel their data is reliable and consistent.[1]

### Many Lack Adequate Data

The top challenge manufacturers face when using predictive analytics, one of the more established forms of industrial AI, is inadequate data (see the graphic later in the eBook). The data often exists but is not connected or harmonized to become useful. An inability to scale AI from pilot to broader use often points to a lack of standardized connectivity for extracting and normalizing diverse data.

### Standard Connectivity to Meet AI Needs

In fact, AI adds urgency, weight, and long-term consequences to connectivity decisions. Standard connectivity delivers traceability and a view of data lineage and provenance. Putting data into context as close to its origin as possible also helps ensure the full meaning is easier for AI to see and harder to misinterpret.



# Evaluating Industrial Connectivity Software Solutions

### Aspects to Consider

Manufacturers have many aspects to consider for long-term success with industrial connectivity. These include technology, functionality, the provider, and specific considerations to ensure long-term ability to meet business needs, recognizing that needs will change.

### Technology

Industrial connectivity is a crucial element of today's manufacturing technology infrastructure, so extensible, secure technology matters. As described, it's best to adopt a standard enterprise approach that supports a wide variety of current and legacy OT and IT interfaces and protocols. It must also meet security, scalability, and edge-deployment requirements.

### Functionality

The functionality for industrial connectivity is also worth careful evaluation. It must be comprehensive to serve both OT (automation) and IT needs. Ideally, it does more than connect; transforming data into useful information at this level can significantly improve the timeliness of usable results.

### Provider

The provider should have a proven track record in industrial connectivity. Look for case studies and reference accounts you can contact. It's important to seek out a company with employee experts to support needs before, during, and after implementation. An ecosystem of partners can boost this support.

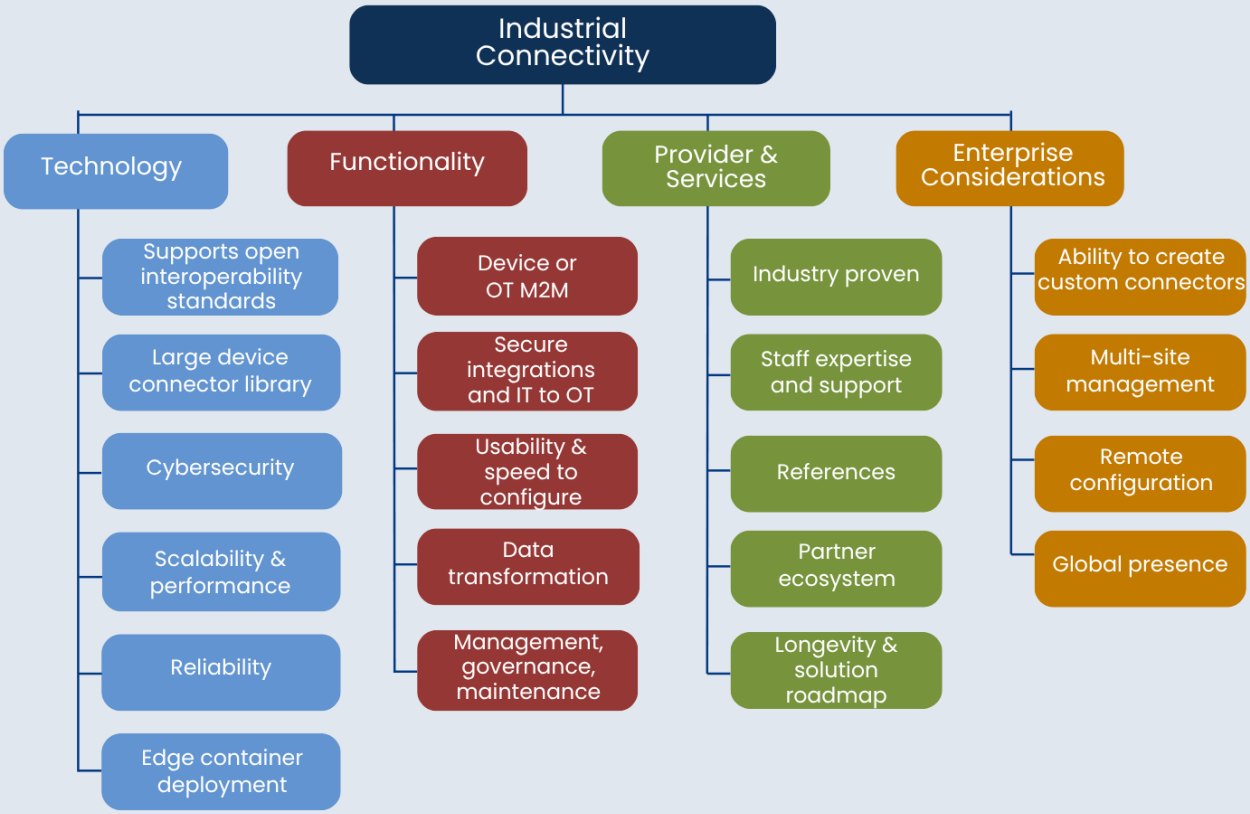
### Enterprise Considerations

Many companies also have specialized industrial connectivity needs, such as older or specialized equipment that lacks native standard data output protocols. Many companies also have multiple sites and a desire for enterprise-level control and governance of their industrial connectivity.

> "After testing other suppliers of this type of software, we considered the standardization at the PLC level and the ease of creating asset databases to manage the entire system. In addition to the main supplier, we have a local trusted partner who supports us."

**José G. Pichel**
Automation, IioT, And Industry 4.0 Specialist
**FINANCIERA MADERERA S.A. (FINSA)**

## INDUSTRIAL CONNECTIVITY EVALUATION FRAMEWORK




# Technology Basics

### Open Interoperability Standards

Manufacturers have many aspects to consider for long-term success with industrial connectivity. These include technology, functionality, the provider, and specific considerations to ensure long-term ability to meet business needs, recognizing that needs will change.

### Connector Library

Industrial connectivity is a crucial element of today's manufacturing technology infrastructure, so extensible, secure technology matters. As described, it's best to adopt a standard enterprise approach that supports a wide variety of current and legacy OT and IT interfaces and protocols. It must also meet security, scalability, and edge-deployment requirements.

> "Normally, most of the data comes from the PLCs; it is essential to have the data well organized at this stage so that it is easy to access. Good data formatting and organization into intermediate tables is essential for the future."

**José G. Pichel**
Automation, IIoT, & Industry 4.0 Specialist
**FINANCIERA MADERERA S.A. (FINSA)**

### Security

Cybersecurity is fundamental to connectivity – manufacturers cannot afford data breaches, yet they occur regularly.[2] In fact, they are growing in both OT and IT. In 2025, the average cost of a data breach in manufacturing was $5M.[3] They frequently cause lost production time and even plant shutdowns. The platform needs encryption, security by design, and tunnelling based on ID, not location. Ideally, security is implemented at multiple levels (servers, data sources, values, etc.), since threats take many forms. Ask the provider about their security posture, their response to vulnerability disclosures, how often upgrades are offered, and their response time to confirmed security issues.

> "Connectivity is now easy and simple; our top challenge is bringing IT and OT together to meet IT's desire for governance and OT's need to optimize regularly."

**Kwabena Hobbs**
IIoT & Equipment Connectivity Lead N.A.
**ELECTROLUX GROUP**

**CYBERSECURITY IS A PREVALENT RISK FOR MANUFACTURERS**

**Companies Reporting Breach in Previous 12 months**

**77%**

**Average Time to Recover from a Breach**

**7 months**

**Likely or Very Likely to Suffer Attack in Next 12 Months**

**52%**

**Cyberattack likely to result in plant shutdown**

**46%**

Source: How energy and manufacturing can stay ahead of cyber threats and protect their tech

# Enterprise-Grade Technology

### Scalability and Performance

While industrial data connectivity projects often start small, ideally, the connectivity can support continued growth and new initiatives over time. Scalability for industrial connectivity is about how easy it is to replicate and extend a solution. As connectivity scales, the performance and availability of normalized, secure data are also crucial. OT systems rely on real-time data, often mixing data from other systems.

### Reliability

For all of this to be useful, the system and the contextualized data it makes available must be reliable. Look for a connectivity solution that can confidently handle a high volume of fast-moving data. Connectivity might extend from a line to a site, multiple sites, or an enterprise. Digital transformation needs to get the right in-context industrial data to everyone in the plant and throughout the company – think supply chain, design, finance, sales – every time.

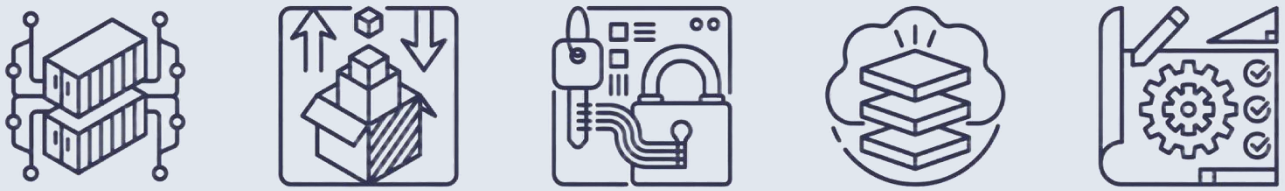
### Ease of Management

Standardizing on industrial connectivity across an enterprise also requires options for using and managing it at the enterprise level. Increasingly, manufacturers are using the industrial edge to ensure data capture and processing close to the devices. This approach helps keep latency low for high-performance operations, data, and intelligence. Containers at the edge also simplify deployment and re-deployment.

> "Thankfully, the connectivity platform and provider's support helped us ramp up our efforts as quickly as possible. The training was extremely hands-on and simulated our factory conditions. And the results speak for themselves. Our earliest connection took weeks of testing and configuration; what used to take us a month now takes seconds."

**Kwabena Hobbs**
IIoT & Equipment Connectivity Lead N.A.
**ELECTROLUX GROUP**

## CONTAINERIZATION



# Functionality

### Device Connectivity

Connecting to devices for OT and machine-to-machine (M2M) purposes requires both protocol conversion and data normalization. Ideally, the standard platform includes out-of-the-box (OOB) device drivers to handle most common needs. For any company that has specialty, non-standard, or very old equipment in any facility, the ability to create custom drivers is an important factor in the review.

### Secure Integrations

Bridging the divide between systems managed separately, with different priorities and data formats, requires robust connectivity. It is only more complex when ensuring that operational data is accessible to and from both OT and IT systems in a secure manner. Look for data translation into open standards, including OPC UA, MQTT, JSON, XML, SQL, and custom plaintext formats.

### Usability and Speed to Configure

Look for an industrial connectivity solution that your team can learn and configure rapidly. You will create a structured asset database for what you're connecting. Given that equipment and processes change frequently, your team should be able to become reasonably self-sufficient.

### Data Transformation

For many applications, the data is most useful when processed, and doing so at the connectivity layer, close to data capture, can be both efficient and effective. It requires an ability to handle all types of industrial data – time-series, batch, structured, unstructured, semi-structured. Ideally, it can also perform:

- Contextualization or conditioning and organizing diverse OT and IT data
- Calculations & unit of measure (UOM) additions or translations

Performing contextualization at the data source, rather than where data is consumed or distributed, is an emerging best practice, and the connectivity solution must be ready to enable that approach.

### Management

Connectivity must be carefully managed for confidence in the data. Governance of connectivity is crucial for clear provenance and lineage, traceability and compliance, and understanding data integrity. Particularly as AI evolves, trust in the data is crucial to unlock its value and limit the risk of incorrect or misleading results.

# Provider & Services

### Industry Proven

Be sure you consider not just the product, but the company offering it. Ask: Is this solution proven for industry? Established solution providers have seen many situations and have had to ensure the product and project approach are ready. The company needs to have delivered successful solutions spanning both OT and IT across enterprises like yours.

### Staff Expertise and Support

Look for a company whose people have sold, implemented, and evolved industrial connectivity programs many times. Ask questions to probe for deep subject-matter expertise and years of experience company employees have with industrial connectivity. In addition to self-service portals for knowledge, look for support from someone in your local language and time zone whenever you need it to match your shift schedules.

> "Some of our injection molding machines did not support OPC-UA, so we had to rely on OPC-DA instead. After receiving the tag matrix and driver details from the equipment vendor, I coordinated with our connectivity software provider to obtain the appropriate OPC-DA drivers, and we were able to get everything integrated and running correctly."
>
> **Kwabena Hobbs**
> IIoT & Equipment Connectivity Lead N.A.
> **ELECTROLUX GROUP**

### References

Are current customers happy? Look for specific instances with similar data volumes, formats, and flows to yours now and in the likely future. Ask to speak to at least a couple of customers 1:1 without the supplier "chaperone." Note that other solution providers may serve as a reference if they "white-label" industrial connectivity. This is typically a strong endorsement, as they have built it into products they stand behind.

### Ecosystem

Does this connectivity platform have strong support from both solution provider and system integrator partners? Other companies with a strong background and experience using the connectivity solution can be hugely beneficial, including a user community.

### Longevity and Roadmap

Choosing a platform for industrial connectivity should be a long-term decision. Look at the vendor's history of supporting industry's needs as they have changed. Review what the latest releases of the solution have added. Ask about the roadmap for the connectivity solution – be sure it reflects the trends you see and expect.

# Enterprise Considerations

### Company-Wide Needs

Several aspects of scaling are not strictly technical or functional yet are common in enterprise-level standardization decisions for industrial connectivity. To ensure one connectivity platform will work across the enterprise, consider these additional capabilities.

### Multi-Site

Since connectivity is a foundation for the industrial data architecture, it must support business initiatives for larger or growing organizations. This might include enabling smoother onboarding for acquired companies or sites, and consistent management of large and small sites. An enterprise-level capability to create and manage connectivity across multiple production sites requires central configuration management and change control.

### Create Custom Connectors

This ability to connect when there is no API or standard interface is often crucial. This could be to legacy, specialized, or customized equipment. Some companies also have special needs to optimize latency beyond default settings. Ideally, all of this comes out of the box, designed to enable customization, not a paid one-off custom development that defeats the purpose of standardization

### Remote Configuration

Central management ideally also enables someone not on that site to address pressing connectivity needs. Remote configuration capabilities enable a central team, in one or many locations, to ensure standard approaches and reuse, thereby streamlining effort. Given the workforce skill challenges manufacturers face, this may be crucial in enabling a more experienced person to support another site.

> "As of last March, we moved all of North America to a single global license for our Kepware connectivity platform. This was a big move to be sure we are all aligned globally."
>
> **Kwabena Hobbs**
> IIoT & Equipment Connectivity Lead
> **N.A., ELECTROLUX GROUP**

# Buying Team

### Roles to Engage

The buying team should typically include all of the following roles to ensure a well-rounded selection process that serves a variety of needs:

- Operational leaders at site, multi-site, and enterprise levels (ideally leaders representing all sites)
- OT/IT strategists, champions, or liaisons
- Influential representatives and/or leaders from OT (controls engineering or automation)
- Influential representatives and/or leaders from IT (CIO, enterprise architect, Manufacturing IT)
- Data integration specialists, data engineers, MES administrators, Continuous improvement/lean/six sigma, and others who may struggle with data quality, timeliness, completeness, or reliability in their jobs
- Cybersecurity specialists (again, at IT and OT levels)

Each of these can improve your progress toward industrial data ops success.

### Activities for Industrial Connectivity

As the team forms, it will also be important to identify the focus areas that will require action after the buying decision. For the connectivity and initiatives that rest on it to deliver full benefits, there must be an ongoing team, often a center of excellence (CoE). Change management, plus education and training on the connectivity platform, are at the top of the list to get the people on board. Someone must also define enterprise connectivity standards and enforce them.

> "The initial phase was very intense because you have to get a lot of people to agree, you have to find an asset structure that is acceptable to everyone, and that's always complicated. Once the initial phase is over, it's simply a matter of work; things almost fall into place on their own."
>
> **José G. Pichel**
> Automation, IIoT, & Industry 4.0 Specialist
> **FINANCIERA MADERERA S.A. (FINSA)**

## BUYING TEAM DEPARTMENTS, CONCERNS, AND ROLES

| DEPARTMENT OR TITLE | CONCERNS AND FOCUS | ROLES IN THE PROJECT |
|---|---|---|
| **Operations Leader** | Making sound decisions to improve performance daily | Represent users in buying, training, rolling out |
| **Factory simulation to support "lights out" assembly** | Keeping production processes on and in control for best results | Device, M2M, protocol, process performance requirements |
| **IT Leaders** | Gaining reliable access to all production data for apps and AI | Specifications for IT data formats and performance |
| **OT/IT Liaisons and Champions** | Advocating for all industrial data to be in-context and fully utilized | Define needs, drivers, protocols, and performance, make it work |
| **Data Specialists** | Ensuring the data they manage comes in and goes out reliably | Outline specifics, ensure the choice will work for their needs |
| **Continuous Improvement** | Require data quality, timeliness, completeness, reliability | Specify where better connectivity would streamline their work |
| **Cybersecurity Specialists** | Risks and surface of attack in both OT and IT | Explore security approaches, options, completeness as deploy |

# Connectivity Buying Process

### Enterprise Decision

Be sure this is a broader enterprise strategic decision, not only for a specific project or initiative. Consider reliability, longevity, performance, and scale of both the connectivity software and vendor. Select to create a company standard for this foundational infrastructure to gain all of the benefits available at a lower TCO and time to value (TTV). Plan to drive the adoption of your connectivity standard over time in every new project and pressing modernization projects.

### Initiative Foundation

One great way to drive to an enterprise connectivity standard is through a broader initiative. DX, IX, AI, SM, or Industry 4.0 or 5.0 initiatives often trigger a close examination of the solution provider landscape to ensure they can meet their needs. Clearly, this review should include connectivity, since it is the foundation for the industrial data infrastructure.

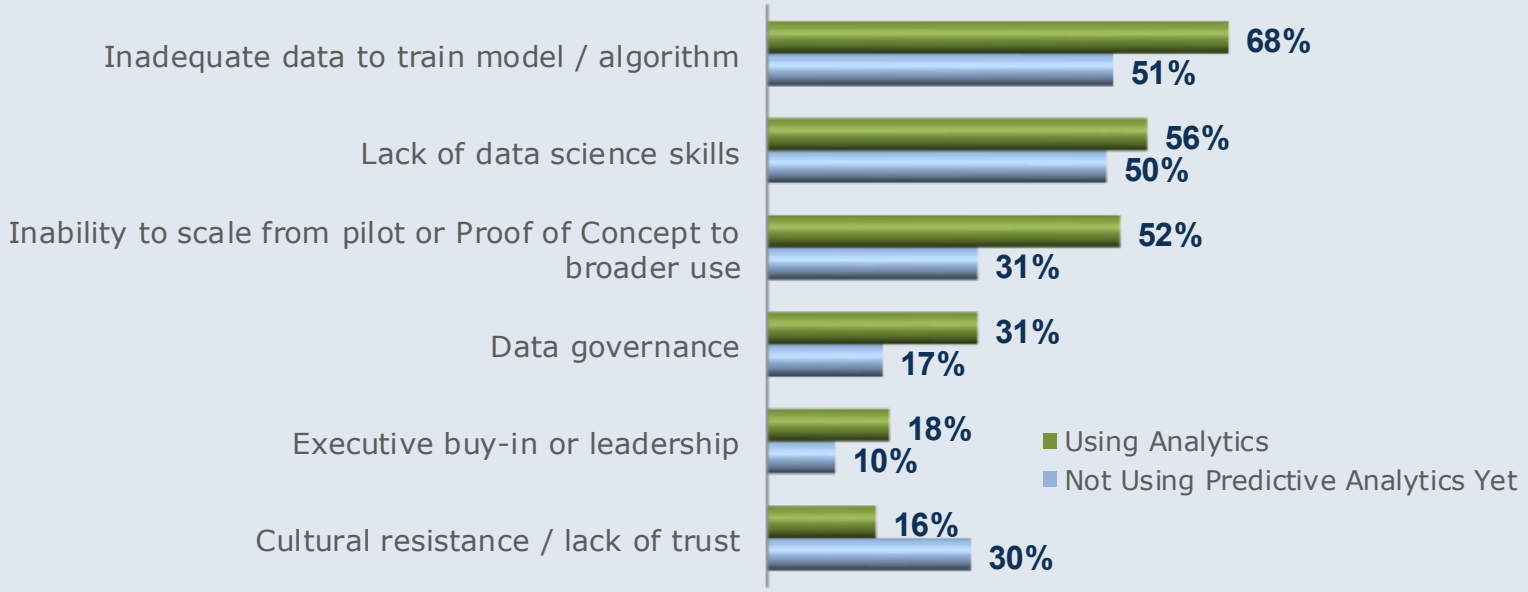
### Start of a Journey

Realize that selecting your industrial connectivity solution is the beginning of the journey, not the end. Plan for ongoing education, evangelizing, and organizational change management – people must get on board. You will need to establish owners for industrial connectivity governance, adoption, and cascading training. Creating documentation and aligning with established company standards is a starting point. Expect expansion as technology, your processes, people, and products change.

### Be Prepared for AI

Lack of data is the #1 most-cited challenge in predictive analytics. Usually, the company has the data, but it's not connected, normalized, harmonized, or available reliably and quickly enough to enable predictive insights that prevent problems. Standardized industrial connectivity can avoid that challenge.

**ADOPTION CHALLENGES – ACTUAL AND PREDICTED**



# Recommendations

- Selecting the best industrial connectivity solution matters. It is the foundation for both current success and forward-looking initiatives. Every aspect we discussed will matter over the long run: modern technology, deep functionality, a proven provider, and custom and enterprise capabilities.
- Explore whether you can find a single industrial connectivity solution to ease training, use, configuration, and management.
- Check technology aspects for current and future needs, including cybersecurity posture, capabilities, and track record.
- Look for a provider with a solid track record and market presence to meet your needs across the company now and in the future.
- Seek out a solution that provides comprehensive, reliable, and performant industrial connectivity and is evolving as OT and IT do.
- If you plan to use this as an enterprise standard, which we recommend, review scalability, management, configuration, and support, as well as specialized connectors or customization to meet every facility's needs.
- Ensure consistent industrial connectivity can be a foundation for your success with AI.

> "As you progress in the implementation, as you build your asset database, needs always arise that you didn't anticipate at the beginning. This is normal; it's a constantly evolving system. It's not a matter of finishing and letting it function; there are always optimizations and improvements."

**José G. Pichel**
Automation, IIoT, & Industry 4.0 Specialist
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# Acknowledgments

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

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# About the Author

Julie Fraser is the Vice President of Research for Operations and Manufacturing for research firm Tech-Clarity. She covers Industry 4.0, Smart Manufacturing, MES/MOM, QMS, APS, Supply Chain, APM/CMS, IIoT, AR/VR, and other technologies and solutions for manufacturing.

Julie has over 35 years as an industry analyst in addition to experience in marketing and strategy (Berclain/Baan, now Infor) and editorial roles for computer and technology publications. She worked as an assembler over college summers and that got her hooked on manufacturing.

She has a BA in German and French, Magna Cum Laude, Phi beta Kappa, from Lawrence University in Wisconsin. She is also a certified business change agent and conscious business ambassador.

Julie's current areas of research include the realities of moving Industry 4.0 from vision to reality; the role of MES/MOM in the new landscape; incremental vs. transformational change in manufacturing; approaches to empower plant workers and their leaders; IT/OT convergence; local and personalized manufacturing; managing supply chain resiliency, and more.

She is fascinated by the organizational, cultural and personal transformations required to drive success with new technology and approaches to manufacturing.

Julie is a certified yoga and meditation teacher. When she's in love with life, good things like the opportunity to work for Tech-Clarity come at the right time.

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