

JUMPSTART DIGITAL TRANSFORMATION WITH MES

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The Road to Manufacturing Operations Maturity in the IIoT Age

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TABLE OF CONTENTS

SECTION 1: Executive Summary	<u>3</u>
SECTION 2: Benchmarking Manufacturing Operations Management	<u>6</u>
SECTION 3: The Road to MOM 4.0	<u>10</u>
SECTION 4: Digital Transformation is a Vehicle, Not a Destination	<u>19</u>
SECTION 5: Recommendations	<u>24</u>





SECTION 1

Executive Summary

Executive Summary

Smart Manufacturing, Industry 4.0, Digital Transformation and the Industrial Internet of Things (IIoT): we are bombarded by new terms and hype that remind us daily of the rapidly changing world for manufacturers. Everyone can find an excuse for ignoring them but, be assured, it is not all hype. The world is changing faster than ever and manufacturers cannot afford to be left behind.

LNS Research has been studying the industrial software market for years and its researchers talk with hundreds of practitioners every year; there is one common theme – find a starting point for Digital Transformation. This eBook will show how manufacturing operations management (MOM) can be a low risk, high-value entry point for manufacturers that see manufacturing as a key part of Digital Transformation.

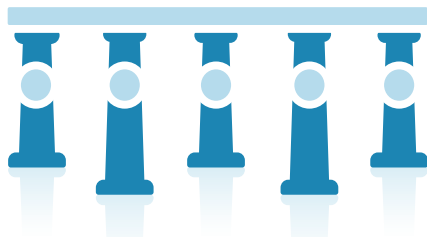
The definition of MOM systems has been given a lot of attention

due to the efforts of The International Society of Automation (ISA) and other organizations that have clearly delineated the various levels of software and systems in use in the industrial environment. Indeed, the ISA-95 standard goes so far as to define individual messages required between functions in a MOM system. However, few (if any) vendors religiously follow these definitions – not that this is important as we move into a digital world.

This eBook will explain that a clear strategy for first steps towards Digital Transformation is required. We will also show how for many manufacturing companies that first step can be implementing a common MOM layer to collect, share and disseminate information. However, MOM is not the main driver – corporate strategic objectives lead to programs that will enable operational maturity, and operational excellence, and ultimately digital excellence.

OPERATIONAL EXCELLENCE PLATFORM

by LNS Research is the alignment of people, process and technology capabilities to create a culture of continuous improvement; supported by metrics and organized in the functional pillars required for full stability. Measured in terms of maturity, shortfall in one pillar causes vulnerability; shortfall in more pillars risks catastrophic failure.



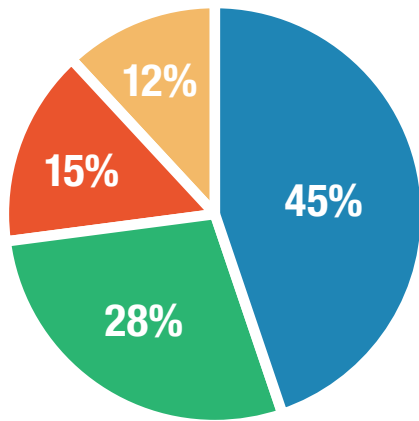
[Click to learn more about the Operational Excellence Platform](#)



Research Demographics

The data presented in this eBook represents over 300 survey responses through 2016. LNS Research employs a social research model where our online format English language surveys are open to the general public. Companies participate in LNS Research surveys to gain access to the LNS Research library, meaning survey participants are research consumers as well. An LNS Research analyst follows up with each respondent by email and phone and the analyst reviews each response for accuracy.

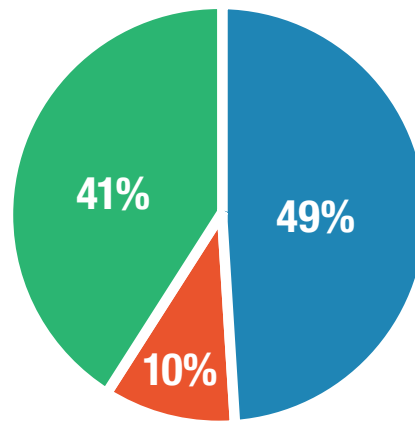
The industry demographics of the survey largely match the broader demographics of the industrial landscape, with discrete being the largest segment, followed by process and batch industries. Our research also has a broad split across industries and company sizes.



GEOGRAPHY

COLOR BY HQ LOCATION

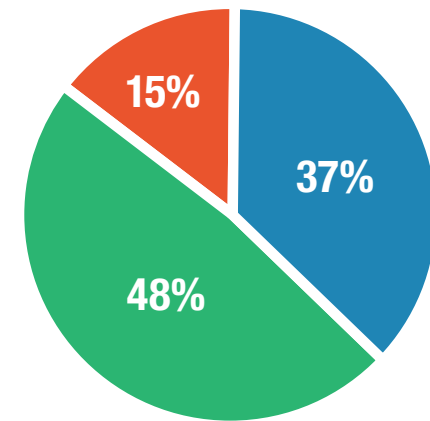
- North America
- Europe
- Asia/Pacific
- Rest of World



REVENUE

COLOR BY COMPANY REVENUE

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



INDUSTRY

COLOR BY INDUSTRY

- Process Manufacturing
- Discrete Manufacturing
- Batch Manufacturing

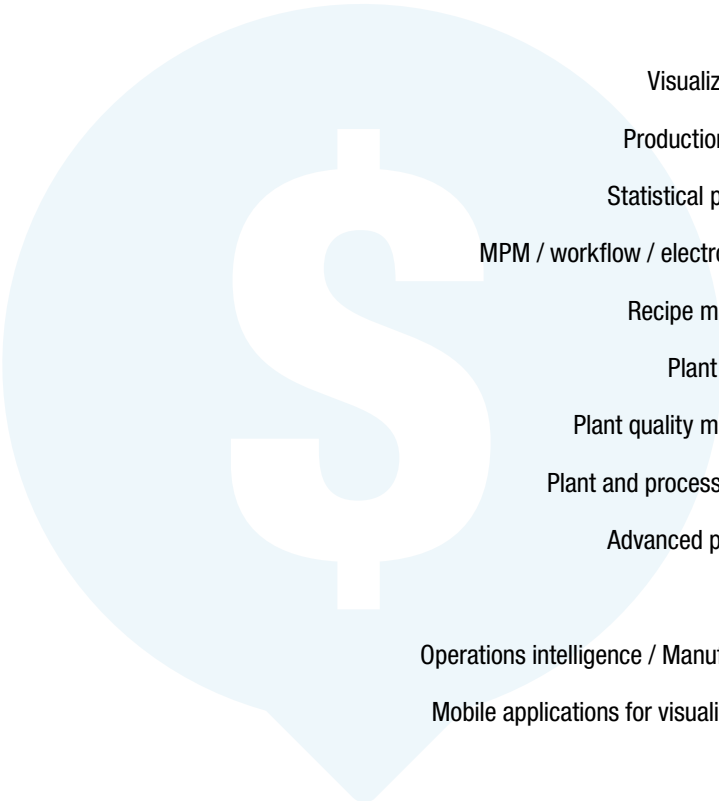


SECTION 2

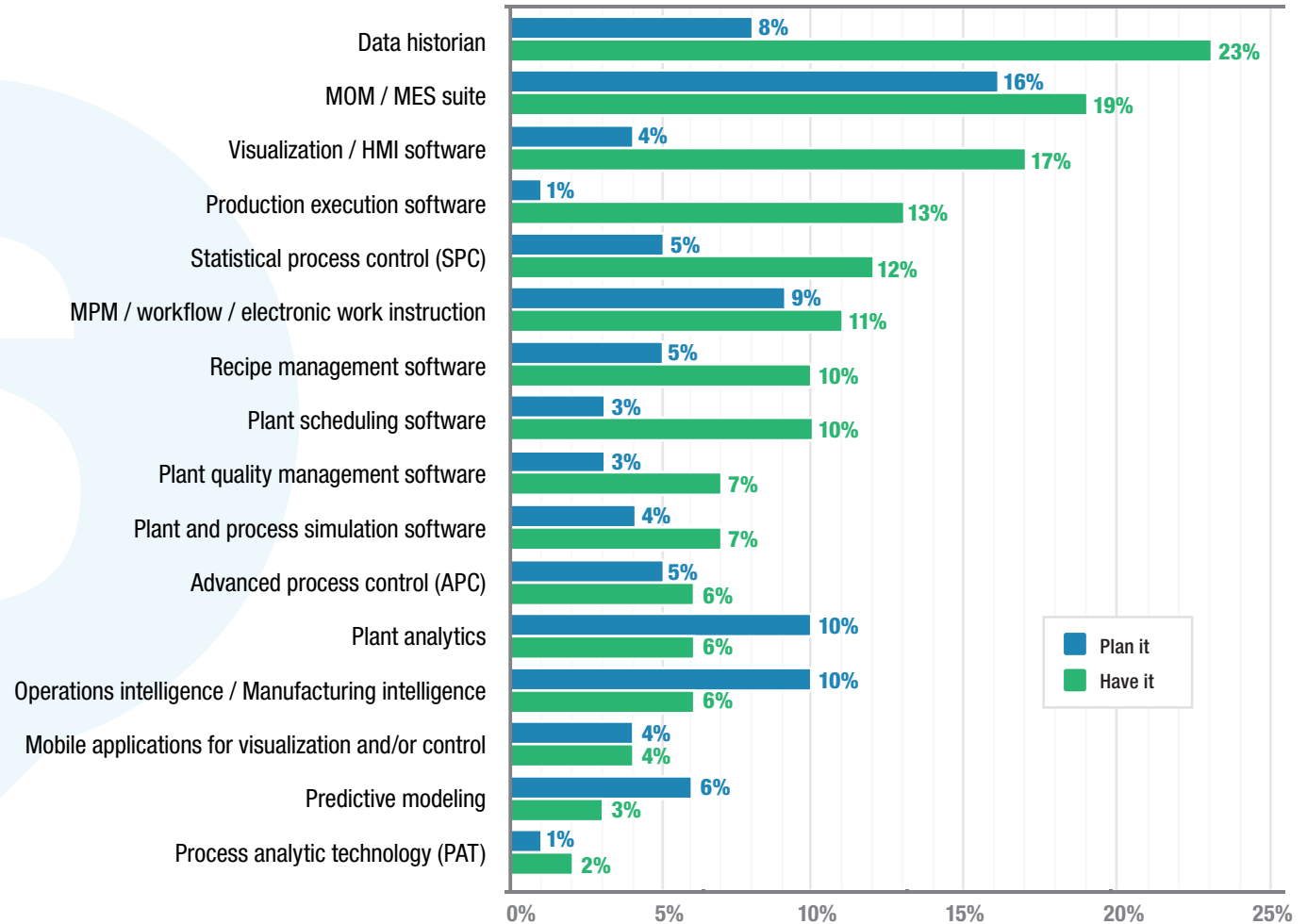
Benchmarking Manufacturing Operations Management

Software Investments

Over the last three decades or more, there has been substantial investment in many kinds of plant software. Research data shows that integrated MOM solutions are still seen as an investment opportunity. Other areas of growth are in analytics and Enterprise Manufacturing Intelligence (EMI), essential parts of a digital manufacturing world.



Actual and Planned Software Implementation

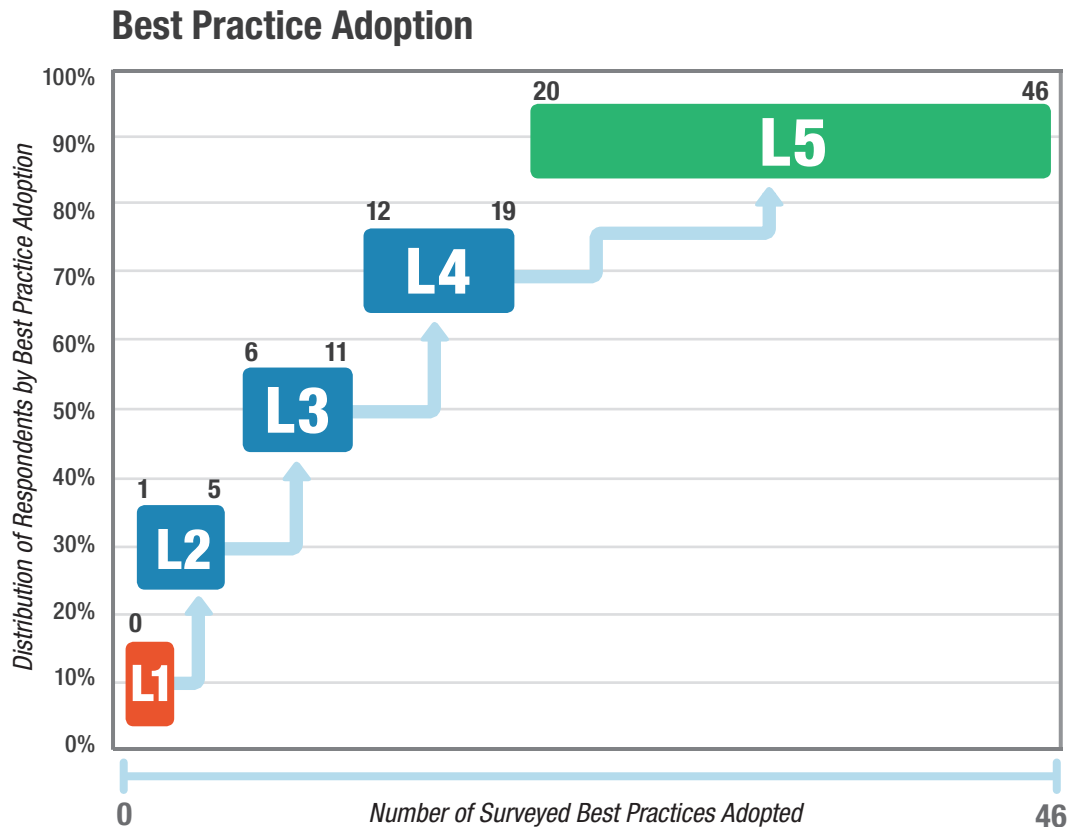


Maturity in Manufacturing Operations

The LNS Research MOM maturity model spans 46 best practices taken from the responses to our manufacturing operations survey. This model is part of LNS Research's Operational Excellence maturity model which focuses on best practices for the MOM pillar across people, process and technology capabilities. These best practices truly are "best;" in most cases, we look for respondents who have implemented particular business processes and that support those processes with integrated software solutions. It is not enough to just have a process in place, so the bar is set high.

The maturity model looks at manufacturing operations – it is a bit early to benchmark only IIoT capabilities for technology, so the discussion today spans both next gen and traditional technology capabilities. Some companies might make it out of the Ad Hoc level when measuring digital maturity but probably no manufacturers reach a Harmonized state today.

In manufacturing operations, we observe an interesting result in the Level 1 quintile. All those in the Level 1, Ad Hoc quintile have precisely zero best practices. The numbers increase very slowly, and at Level 5,



MOM Maturity Levels

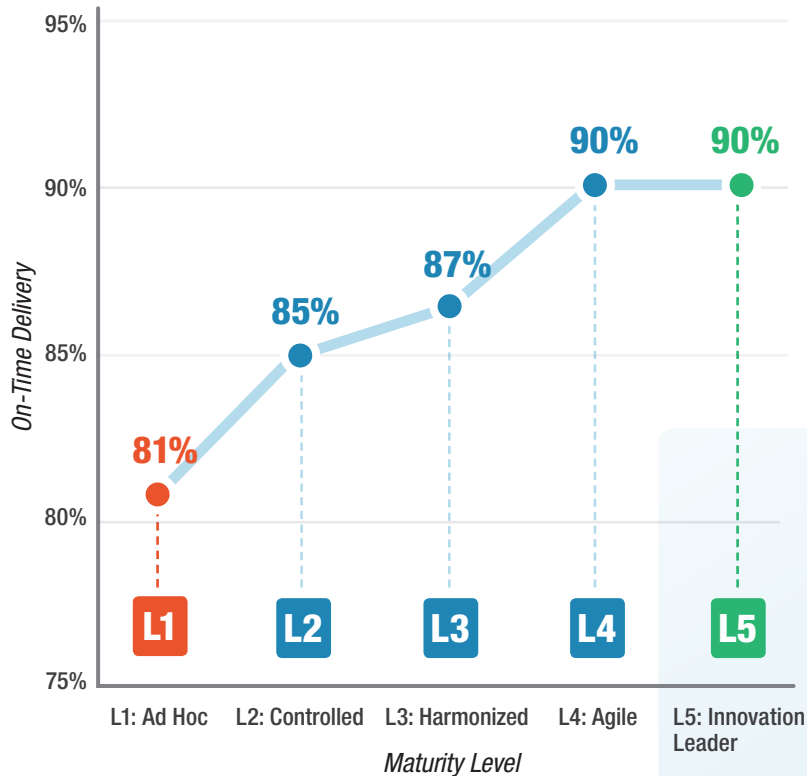
INNOVATION LEADER Drives standards and expectations	L5
AGILE Evolved people, process, and technology across the enterprise	L4
HARMONIZED Flexibly unified at the organizational level	L3
CONTROLLED Repeatable within organizational, process, and/or technology boundaries	L2
AD HOC Unstandardized with significant variation	L1

Maturity in Manufacturing Operations (Cont.)

Innovation Leader respondents have implemented 20 to 46 best practices. The majority fall in the 20-30 range. Given the requirements to meet the best practices, we know with certainty that Innovation Leaders are well integrated, automated and managed manufacturers.

Manufacturing companies can evaluate their own maturity with LNS Research and learn how quick wins can bring them up the maturity scale. An integrated MOM system is a prerequisite for higher levels; making the right choices will further improve maturity.

On-Time Delivery by MOM Maturity Level





SECTION 3

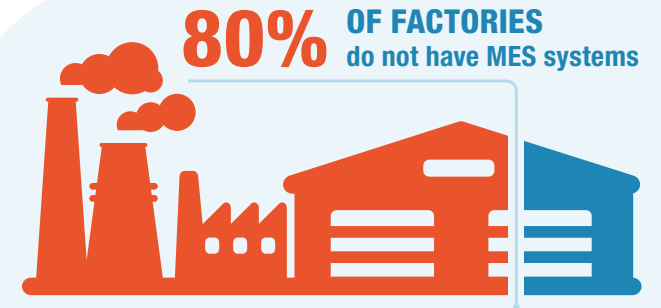
The Road to MOM 4.0

No Such Thing as “Standard” MOM System

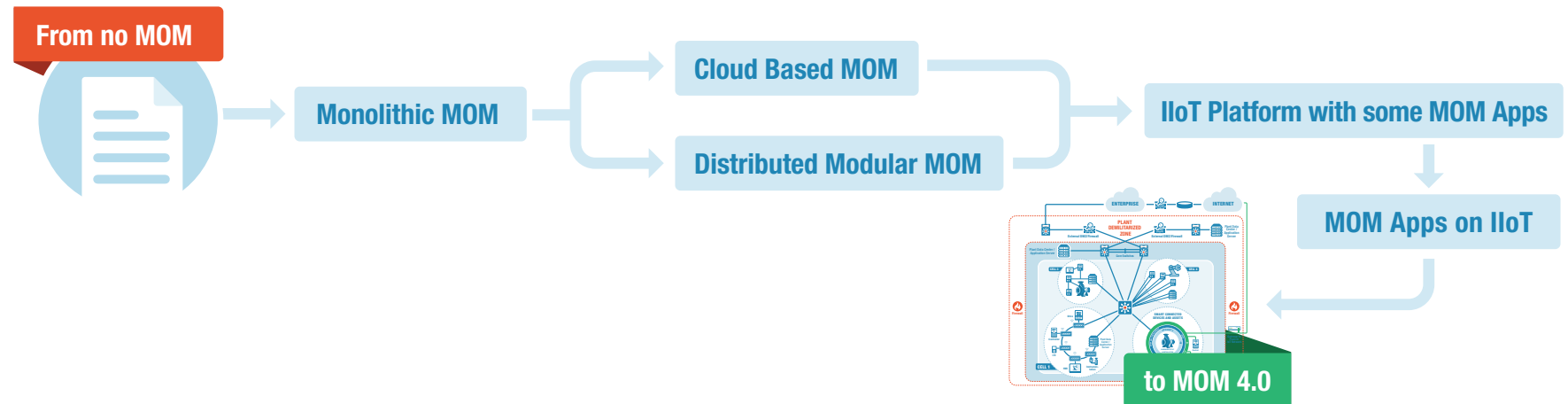
One could almost argue that everyone knows what a MOM system does. However, the variety of solutions on the market and the huge differences between process and discrete manufacturing (and other industries) shows that one size does not fill all.

Dozens of software vendors have addressed the differing needs with a wide range of MOM solutions, but manufacturing companies are all at different stages of implementing MOM and they have, particularly in the past, had differing goals for MOM. The advent of Digital Transformation has boosted interest in MOM since it can be a starting point for integrating factories into Industrial Internet of Things (IIoT) platforms. IIoT initiatives encourage manufacturing leaders to examine their current state of automation and MOM deployment so that they can make plans for Digital Transformation. To help leaders consider where they are with MOM and where they need to go to, we offer the seven lives of MOM, from nothing to everything.

- LIFE #1:** No MOM
- LIFE #2:** Monolithic MOM
- LIFE #3:** Cloud-Based MOM
- LIFE #4:** Distributed Modular MOM
- LIFE #5:** IIoT Platform with Some MOM Apps
- LIFE #6:** MOM Apps on IIoT Platform
- LIFE #7:** MOM 4.0



THE SEVEN LIVES OF MOM



Life #1: No MOM

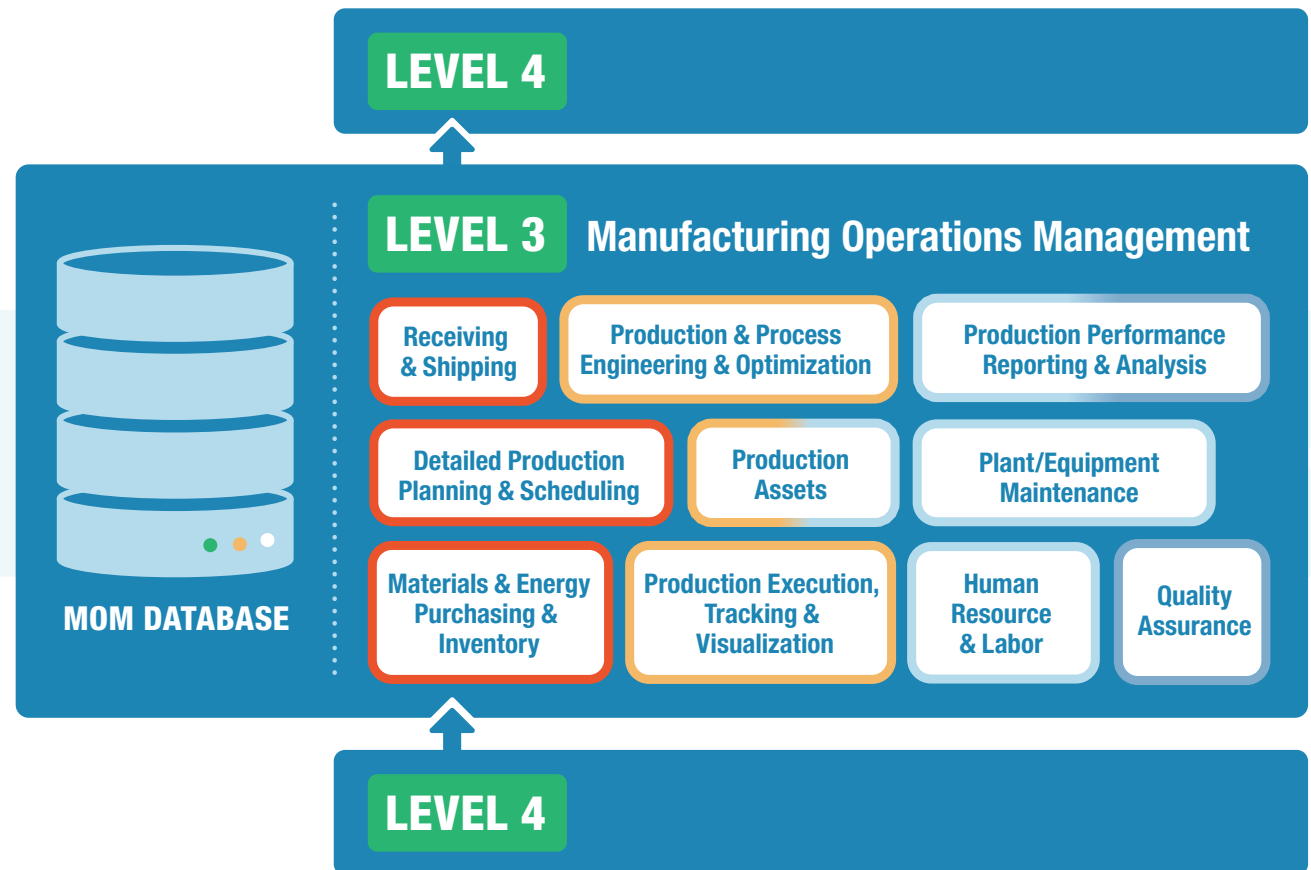
We start with no MOM where plants may have automation, but no central management system is in place. Usually, the management functions happen with paper. This group is still by far the largest. LNS Research shows that close to 80% of factories do not have a MOM system.

Organizations with no MOM system in place need to make a strategic decision about the size of the first step into MOM. Since the move into MOM is part of the Digital Transformation process, manufacturers should consider a partial move to IIoT solutions. At minimum, a cloud-based or modular solution will be a small start to get the ball rolling; work with solution providers to ensure that the MOM selection requirements clearly describe the intended paths and outcomes – that it's part of Digital Transformation, not just an isolated MOM project.



Life #2: Monolithic MOM

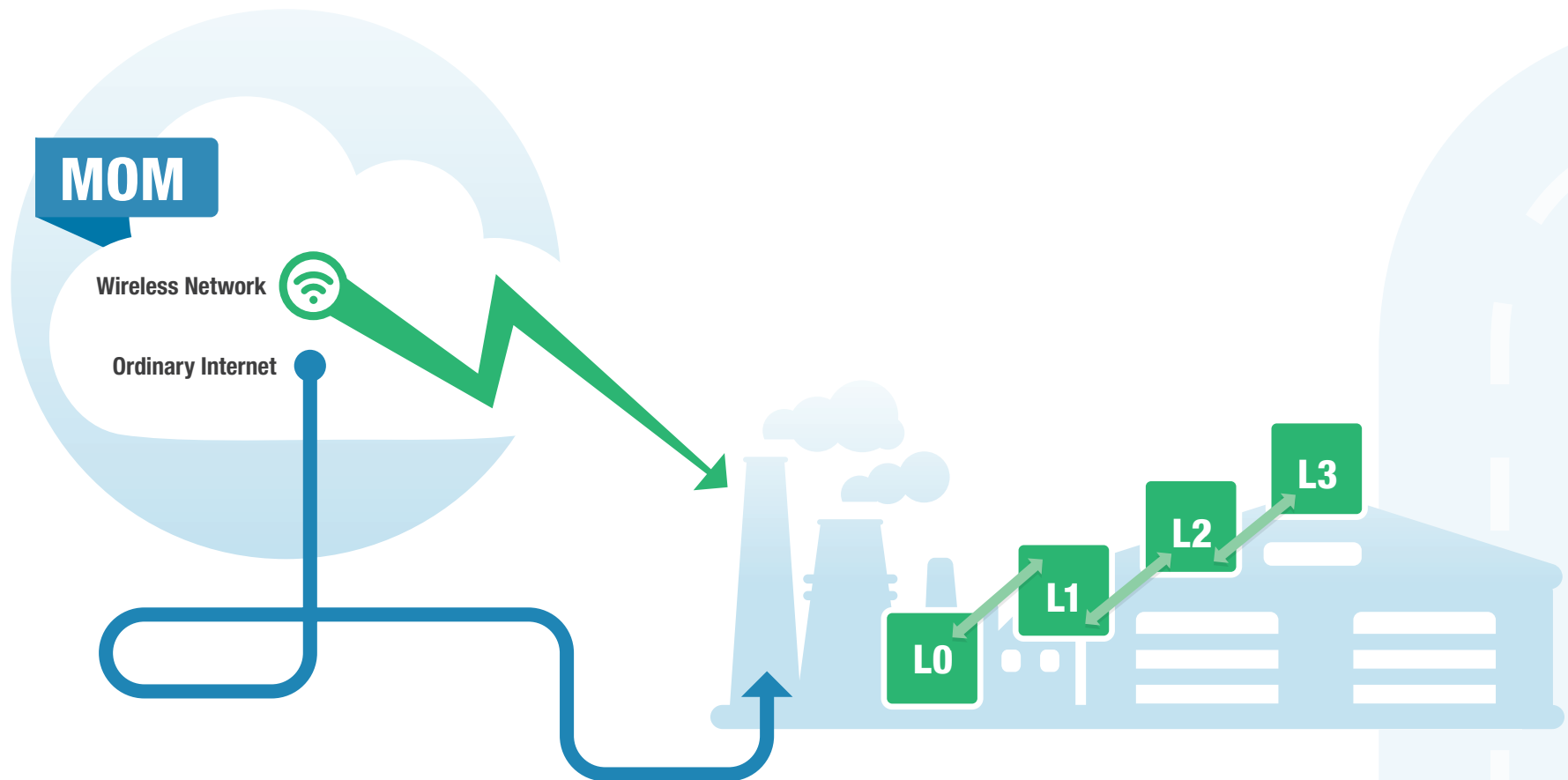
Monolithic MOM is the typical big software solution that includes most ISA-95 functionality bundled together, and usually managed through a proprietary database in the plant. The clear majority of MOM solutions today include a monolithic MOM system running in the plant (often one per plant). Small manufacturers with only a few plants might find monolithic MOM a low risk, but most will want to understand potential vendors' plans for the future of their MOM architecture.



Life #3: Cloud-Based MOM

Cloud-based MOM is starting to get traction in several industries. This approach makes a lot of sense for many MOM functions where business systems already run in the Cloud, and there is a natural tendency towards integration. For example, enterprise quality systems are often cloud based so it would seem logical to combine quality data from the plant and enterprise in the Cloud. There are, however, industries and functions that, to many people, simply demand that the apps reside in the plant and close to the automation and process. Issues with latency, communications reliability and even secu-

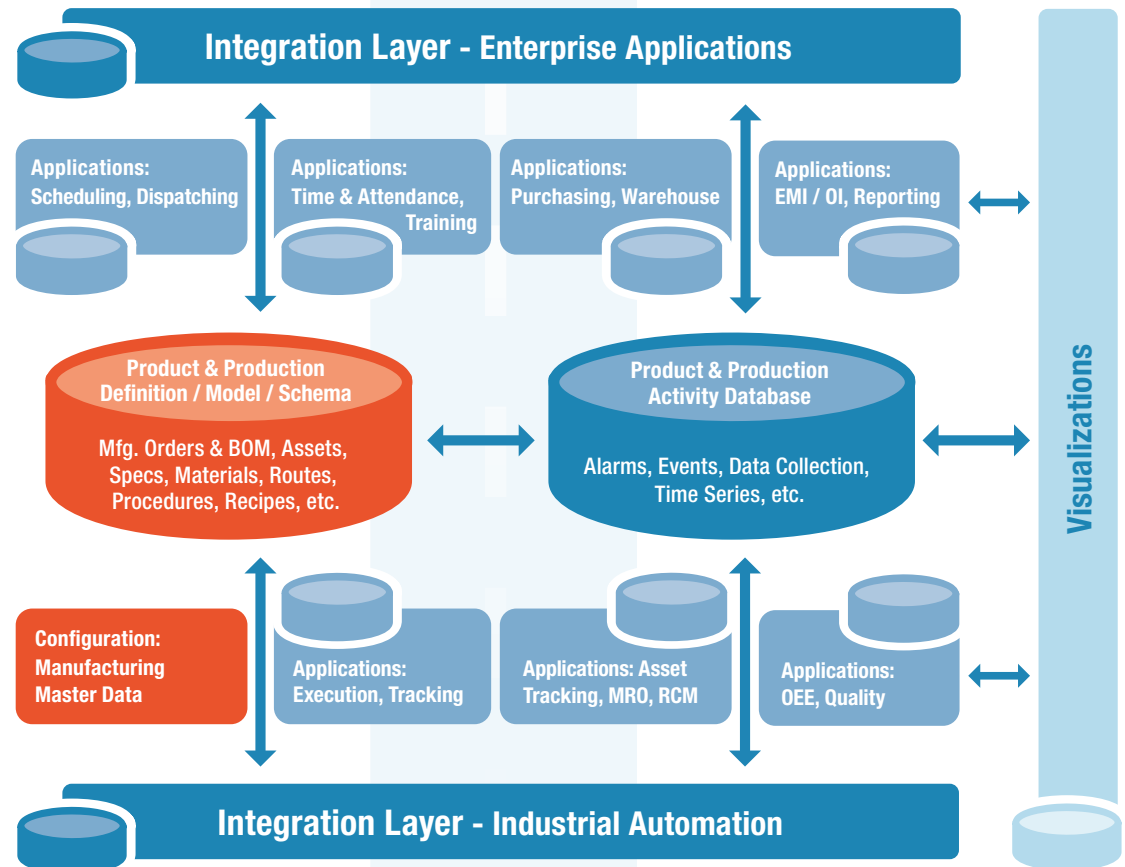
rity cause a lot of fear. In the past, these concerns were justified but with today's networking and computing technologies, the reality is much less worrying than that theory. The advent of edge computing in manufacturing plants will help alleviate most performance issues as direct connectivity, local storage and data processing will all be available on upcoming IIoT platforms. Cloud platforms are a definite step towards IoT enabled MOM and decision makers should consider where functionality meets today's requirements.



Life #4: Distributed Modular MOM

Many large vendors have had monolithic MOM systems for some years. The big automation and business system vendors are investing in IIoT platforms; they need to bridge the gap between old and new architectures. One approach has been to modularize their MOM solutions to make it easier to transition to a new IIoT platform. There are also a few pure-play MOM vendors who have stuck to a modular approach. Modular MOM will naturally move into IIoT or Cloud platforms. Going modular will probably involve choosing an IIoT based solution; many of the solutions in this category have rich functionality and a strong installed base.

MANUFACTURING OPERATIONS MANAGEMENT Traditional Database-Centric Architectures

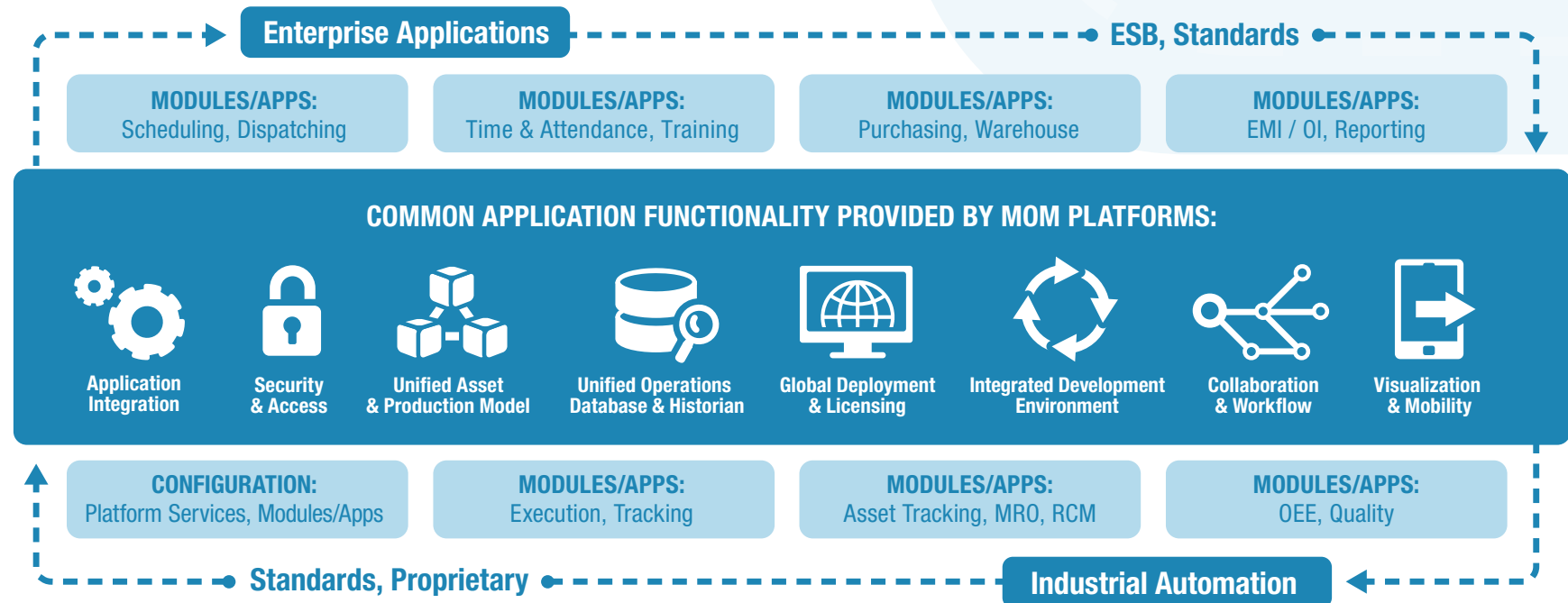


Life #5: IIoT Platform with Some MOM Apps

The transformational step is taking on an IIoT platform with some MOM apps. Our previous view of an integrated MOM solution paved the way for the move to integration and collaboration platforms. We now know that IIoT platforms will enable moving all types of functionality, including MOM, to the IIoT.

MANUFACTURING OPERATIONS MANAGEMENT

Future: Integration and Collaboration Platforms

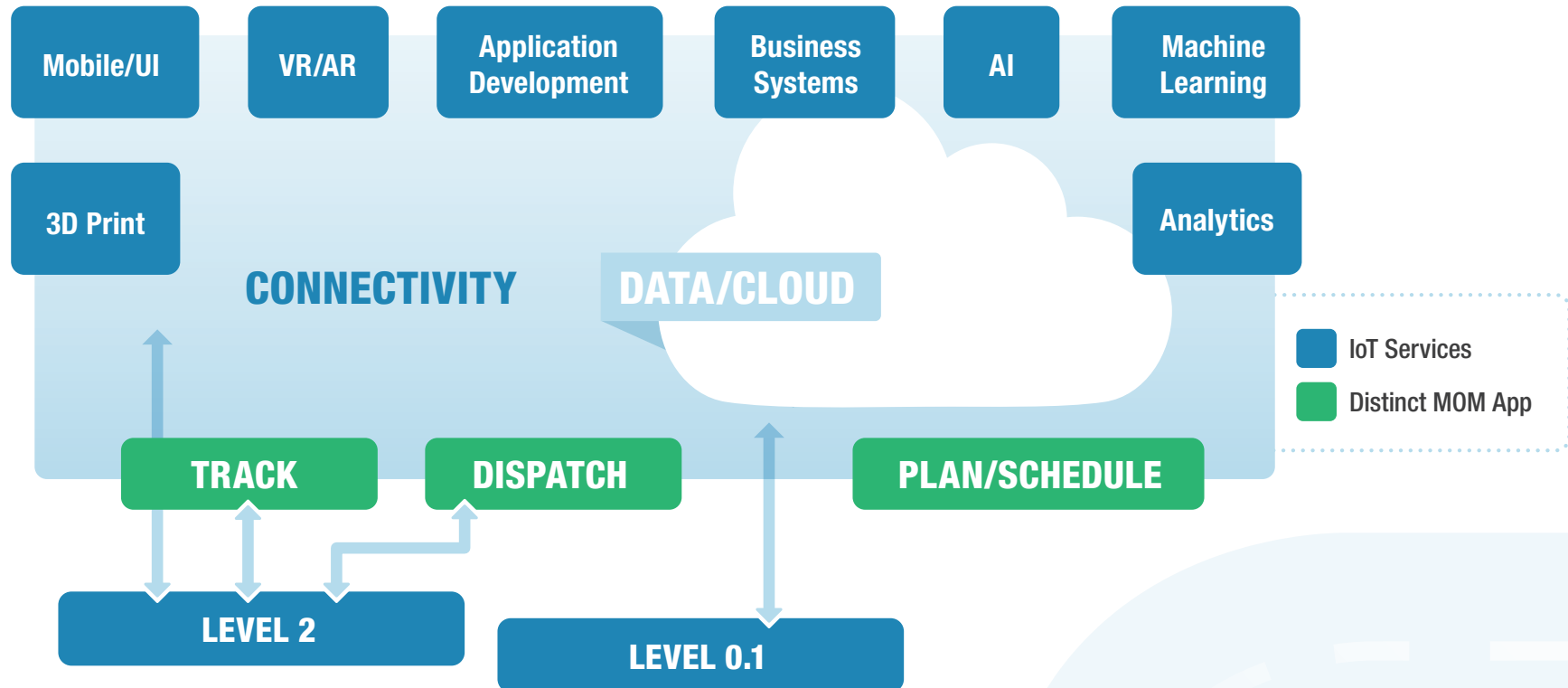


Life #6: MOM Apps on an IIoT Platform

Once a manufacturer has made the decision to its operational architecture on an IIoT platform, MOM apps should be the starting point for plant integration and optimization. Manufacturers that are this far down the road in their Digital Transformation journey may already have a monolithic MOM system in place. Today's IIoT based MOM solutions are not yet ready to completely replace all the functionality

of traditional MOM systems. LNS Research predicts that the choice of MOM apps is going to accelerate in 2018 and beyond as both platform vendors and third parties start to deliver real value.

This will gradually bring us to MOM apps on IIoT, a level of maturity in platform and plant integration that will start to enable real value from plant data and new business processes.



Life #7: MOM 4.0

MOM 4.0 is a life with "no MOM." What could life with "no MOM" possibly look like? It's a digital world. As we move into the more mature stages of running operations through an IIoT platform, we gradually become free of the burden of a standalone MOM system. Instead manufacturers will use MOM 4.0. MOM 4.0 offers flexibility of choice, process-specific functionality, and deep integration with business processes – it will deliver tremendous value through these characteristics and will support the business processes and people's roles that make up a digital manufacturing enterprise.





SECTION 4

Digital Transformation is a Vehicle, Not a Destination

Business Drivers for Digital Transformation

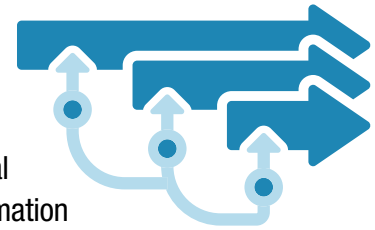
Given that MOM systems will evolve rapidly over the coming years, industrial firms need to look much wider than just connecting the shop floor to business operations. Collecting manufacturing data is not the *raison d'être* of a program, but rather a necessary step to achieve corporate strategic goals. Every company will have unique goals, and those with a clear path for Digital Transformation will need to define a starting point and a plan. Some will start with sales and operations planning (S&OP), supply chain or asset management. Others will view manufacturing operations as the place to be.

In a digital world, strategic objectives go beyond traditional operations objectives like productivity, quality, asset performance and costs. Companies leading the digital wave are today considering smart products, end user engagement, order of one, product as a service, design to order, increased automation and many other transformational goals. Many of these ambitions will require a much tighter integration between operations and the business than we typically see today. Ultimately, most businesses cannot achieve aspirational goals without accurate and timely manufacturing data.

To make the transition and ensure that the transformation delivers business value, manufacturers must map out an enterprise operational excellence program that defines success for specific business processes.

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.

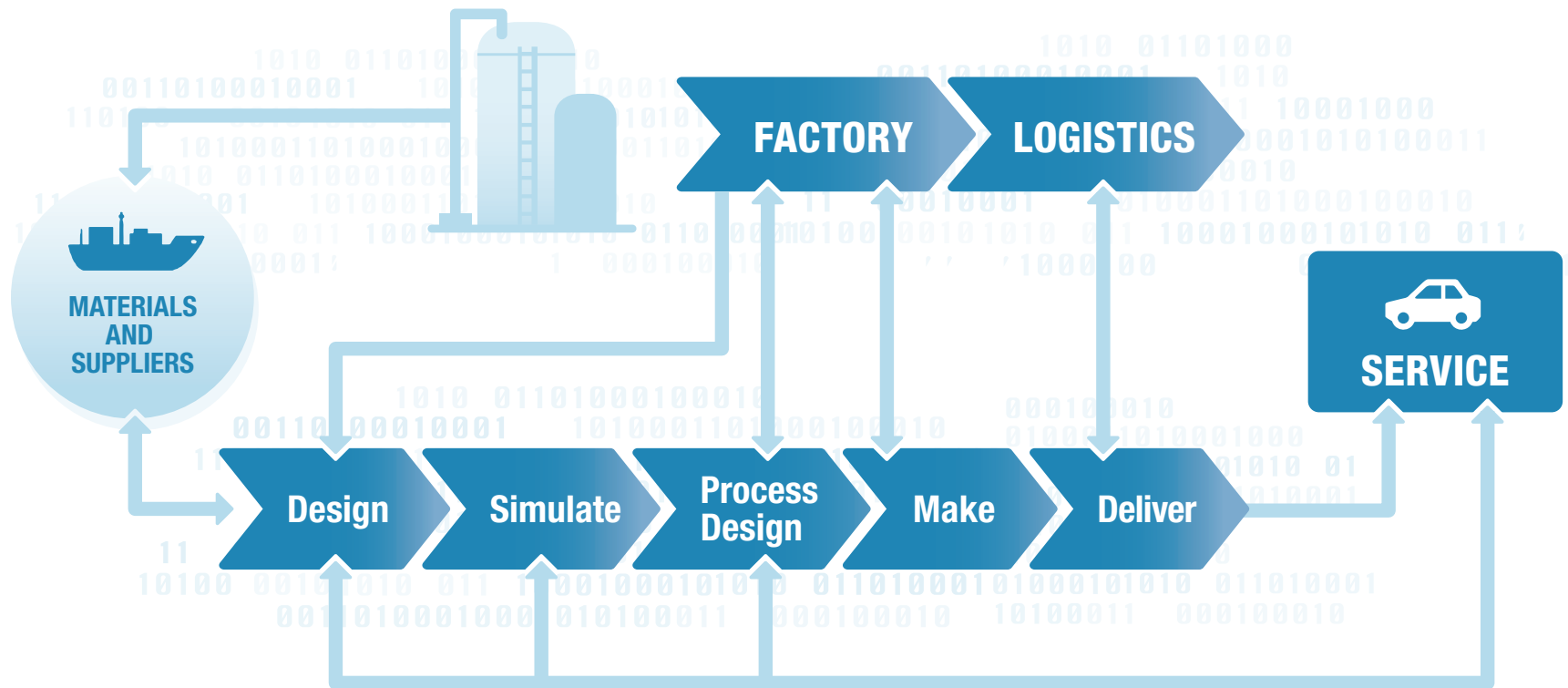


 [Click to learn more about the Digital Transformation Framework](#)

Business Processes in a Perfect World

The world in which organizations use assumptions about manufacturing for business purposes is disappearing – flexibility and accuracy are not possible by guessing how much has been made or from waiting until a complete order is finished to report its parameters to the business. The fact is, business processes like order-to-cash and design-to-delivery are not possible without manufacturing or manufacturing data. Becoming a master of not just business processes, but in reinventing business models requires Digital Transformation.

Of course, Digital Transformation is a massive undertaking and will not all happen overnight. The way to operational excellence is to think big and to start small – in this case start with MOM, possibly, but not necessarily, with IIoT platform support. Regardless of the starting point, having a process and technology path to the digital future is key. The digital thread and the real thread will live together as twins, hence the concept of the digital twin.

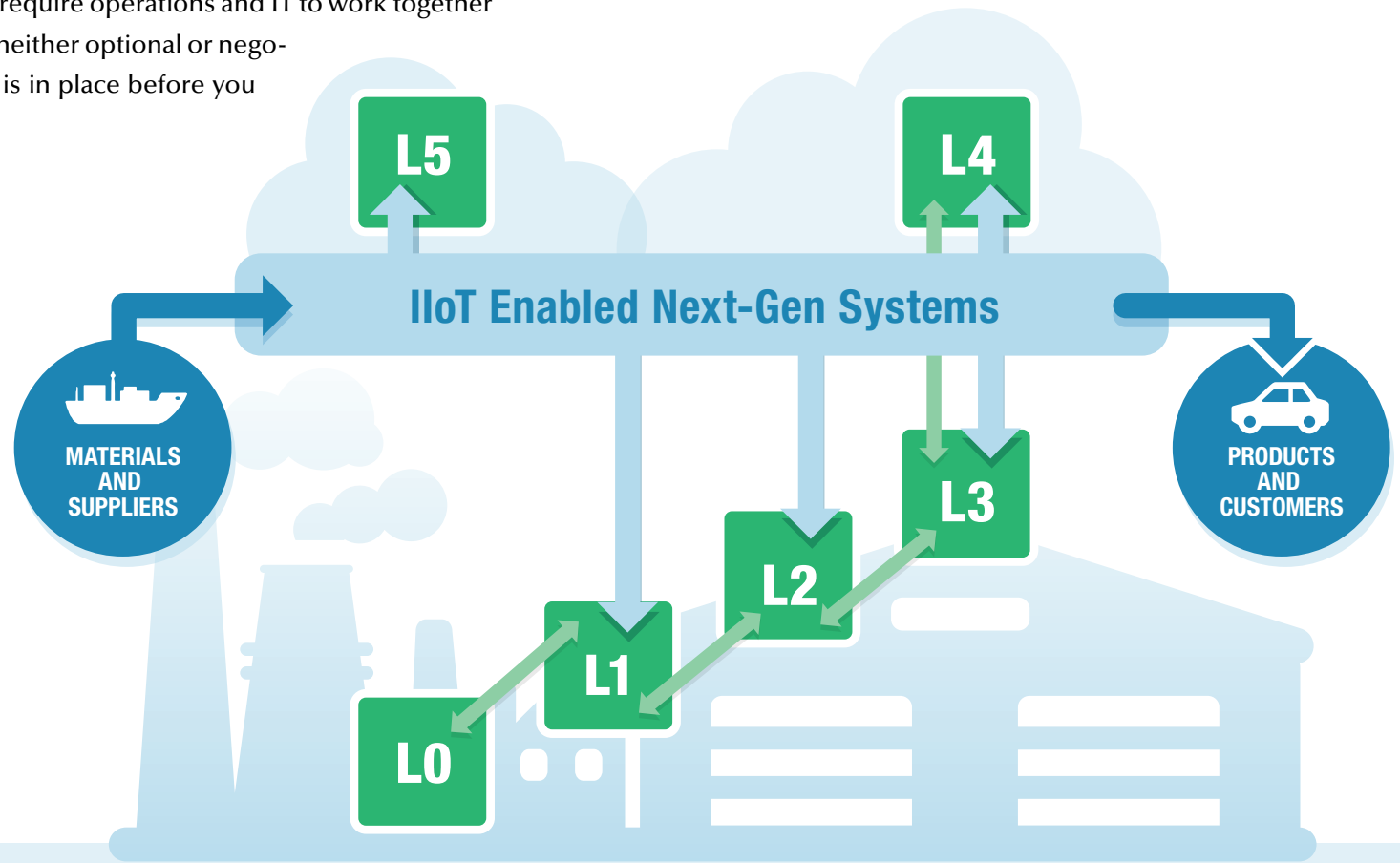


Leadership in Digital Transformation

LNS has conducted extensive examinations of process and technology points that help manufacturers achieve operational excellence and move towards Digital Transformation. Now we add the most important part – people. People are involved in every aspect of transformation but more importantly, that transformation impacts people.

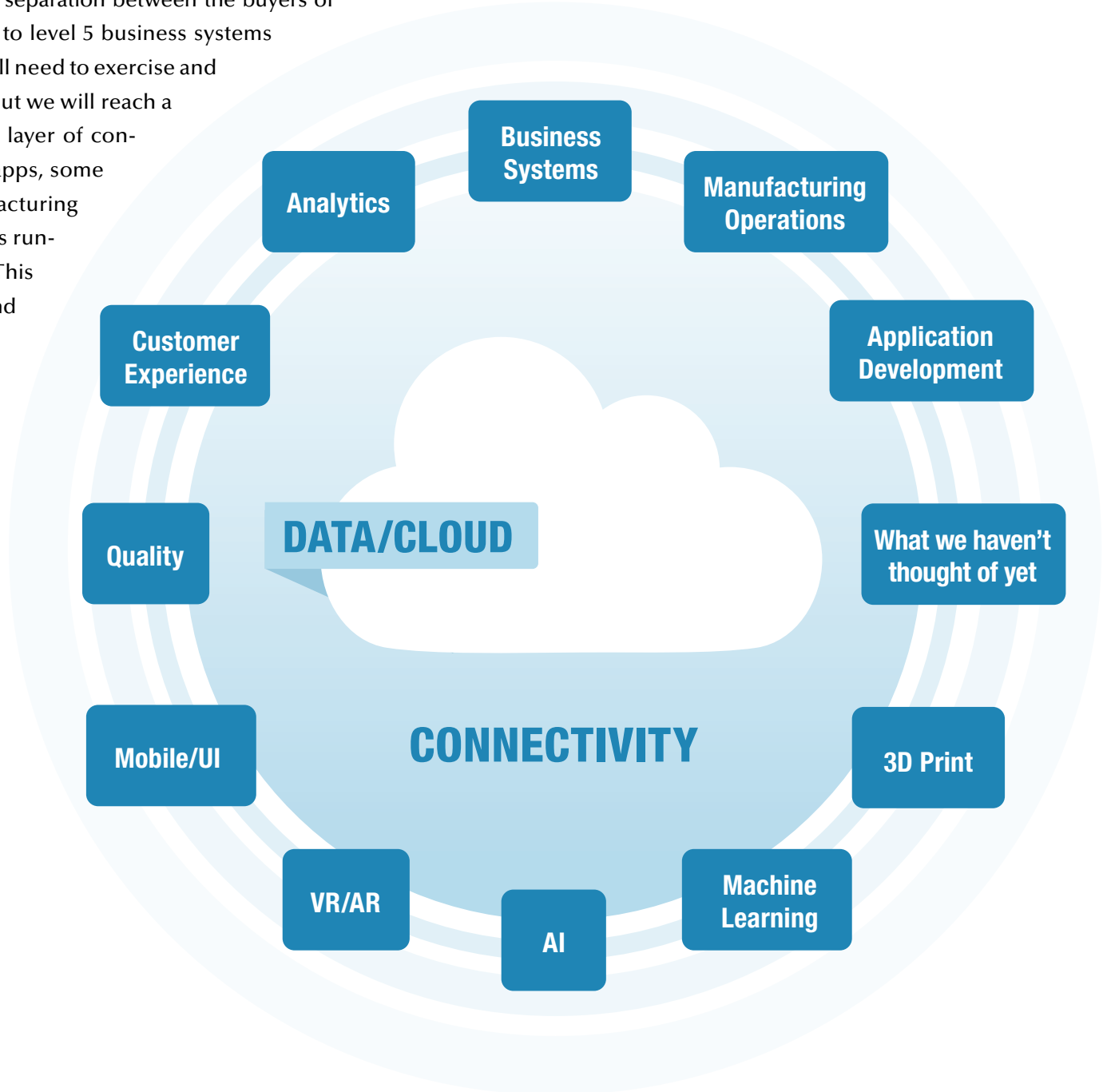
To ensure success, Digital Transformation must set down some critical goals. First on every list should be the concept of IT/OT convergence. LNS has written much on this topic; all successful Digital Transformation programs require operations and IT to work together to ensure success – this is neither optional or negotiable so ensure the team is in place before you spend a single dollar.

We have also explained that the entire transformation should be based on strategic objectives. These objectives are owned by top management so it is critical that C-level executives are on the team or at least actively engaged executive sponsors of the team's activities.



MOM 4.0, aka A Platform for Digital Excellence

As we move to a digital world the separation between the buyers of automation from Level 0 devices to level 5 business systems will rapidly blur. Organizations still need to exercise and maintain business process rigor but we will reach a point where MOM as a separate layer of control will be delivered by a set of apps, some of which are specific to manufacturing operations, but most are IIoT apps running on the corporate platform. This will be the world of MOM 4.0 and running in a digital enterprise.





SECTION 5

Recommendations

The Goal: Digital Excellence

We have considered a few of the key considerations on the way to Digital Transformation led by MOM . Manufacturing companies should formulate a plan based on the elements discussed. However, there is one more question that strategic thinkers in your organization should consider:

What does digital excellence mean to the enterprise?

We already see some great Digital Transformation stories from leading companies. The true winners in the long term will be those that become digitally excellent enterprises. LNS Research looks forward to continuing the journey with program members, and joining the journey with many more manufacturers.



Start the Journey to Operational and Digital Excellence

The road to Digital Transformation is a long one, and one that will not end. Manufacturers need to start now and follow a clear path from corporate strategic objectives through to successful program implementation.

If you choose the MOM route as a step towards the digital enterprise, ensure that you consider the big picture architecture, technology, process and the people needed to deliver on the business process changes you have planned.

Establish a transformation team led by a senior executive. The team should include staff from all levels and functions throughout the organization. Don't forget operators and other shop floor staff – they often have the most surprising and valuable insights.

Evaluate and understand operational maturity. This enables the organization to build a practical and effective plan from true current state to desired future state. Keep in mind, “future state” isn't a true “end state” because it will always be a moving target. By understanding where you are today allowing the team to address any major roadblocks to the initial Digital Transformation program.

Define the to-be business processes using MOM data. Agreeing on success criteria at the outset of Digital Transformation projects is key; the team should pick a project and define the to-be business process using MOM functions and data.



Start the Journey to Operational and Digital Excellence (Cont.)

Establish an operational architecture, followed by platform choices and solution selection. Many companies conduct the pilot, make platform decisions, and MOM solution selection in tandem, or at minimum in relation to each other. Despite future opportunities we do not expect support for other vendors' MOM solutions on today's IIoT platforms – the most likely scenario is choosing one vendor for both. An important proviso about IIoT platforms – these are still early days and although it is clearly possible to select a platform by following a rigorous solution selection process, companies should not view their platform choice as irreversible – things will continue to change and improve well into the future.

Prepare to conduct plenty of internal evangelizing during the pilot. Throughout the project, the team should continually evangelize program merits – top management must stay actively involved to demonstrate their support and show that the program is critical. Lastly, the enterprise should encourage a culture of experimentation and risk taking. Celebrate failure and move on fast to the next attempt. Everyone will learn to move quickly and embrace change.

Manufacturing operations management is often a low-risk, high-value Digital Transformation entry point for manufacturers. Those that wish to pursue this route have much work ahead. However, those that use proven strategies will pave the way for digital excellence and in turn operational excellence.

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