SIEMENS
Ingenuity for life

MOM will play a critical role in Industry 4.0

Solution brief

Siemens Digital Industries Software

A guide to manufacturing systems in future factories

We are now mobile, connected and more automated than ever before. So what does that mean to manufacturers?

While each company will answer that for themselves, Germany's Industry 4.0 is one effort to outline what manufacturers can do to compete successfully. Industry 4.0 is a public-private initiative that is gaining interest worldwide and support from other governments.

Industry 4.0 paints a vision of smart factories using smart machines and materials to make smart products.

Challenges

- Control communication when migrating to smart devices
- Maintain a complex value chain of suppliers, partners and distributors whose data is globally traceable
- Normalize, synchronize and make all information available
- Address information gaps to realize the future vision
- Build the business case to justify investment in MES and its many integration points

Solutions

- Simplify, standardize and automate
- Support speed, visibility, agility and higher quality and consistency
- Add to rather than replace data-rich applications
- Build and evolve core systems while implementing missing functions
- Prioritize which platforms to implement and connect both vertically and horizontally

Solution focus

Leveraging the Industrial Internet of Things (IIoT), certain parts of the physical and digital value chains can merge in a connected world.

By its nature, an Industry 4.0 implementation will be incremental, not big bang. Manufacturing will still need people and centralized information applications in addition to the new IIoT data for the next several decades. That's where the systems that manage all that data, and the people, processes, products and machines that generate it – manufacturing operations management (MOM), or the next evolution of manufacturing execution systems (MES) – will play a critical role.

MES and MOM will continue to be critical

This is particularly true for innovation industries that have rapidly changing and complex products and production processes. Examples include automotive, aerospace, semiconductors, electronics, medical devices, electrical and transportation equipment. They must comply with requirements from demanding customers and regulators.

In the short term, even those aggressively pursuing Industry 4.0 will have a mix of smart devices and equipment with traditional products and machines that need MOM to guide the process. For industries that do not migrate to 100 percent smart products and materials, MOM will act as the conduit or proxy, delivering product data to smart devices and machines.

Much of what's new in Industry 4.0 is contained in the process, control and automation layers. As IIoT data from smart materials, machines, devices and products begin to flow, companies may logically prefer to transform the flood of new big data into usable information inside the plant. This is when MOM must play a role: it will be used to leverage this data in plants and to prepare and send data from the plant and IIoT to other systems.

MOM is needed to:

- Store, aggregate, correlate and transmit production and IIoT data
- Share information for rapid order and new product cycles
- Ensure and enforce quality processes and analysis
- Automate track, trace and genealogy for compliance
- Monitor performance with manufacturing intelligence
- Keep plants nimble for change
- Act as a proxy for smart products and ensure data flow for devices and machines that are not smart

This is not simply a matter of big-data storage and analytics. Leveraging the data to make sense of it and drive value is what is important. Those huge volumes of data must be used to assist in decisions about new products and services, orders for customers and jobs in the factories. This is the realm of existing enterprise applications.

What is typically missing are robust and rapid information flows to allow a common view and collaboration across all of the major aspects of the enterprise. So while companies investigate new technologies, they must shore up their infrastructure to support these new data streams.

The deep functional capabilities of MOM across production, quality and process enforcement combined with genealogy, planning and scheduling and manufacturing intelligence are well suited for creating a useful context for this new influx of data into the enterprise.

So will MOM have a role in future factories? Yes. Our analysis shows that companies in innovation industries will need it more than ever.

Industry 4.0: A big vision of the future

What will your manufacturing plants, company and industry look like in the future? No one knows for sure. Yet without a doubt, someone in your company is thinking about this. The answer will be unique to each company and possibly each plant. As has always been the case, there will be many common elements among companies and industries.

One theme you can count on is adding automation to production. This is not new, but emerging technologies point to some new angles. For years we have been talking about mobile, cloud, social and big data. By adding the IoT, intelligence and communication can be built into nearly everything, no matter where it is. These types of automation are propelling new opportunities for how, what and where to manufacture.

Their application to production is also igniting new vision-setting activities around the world. Manufacturing matters greatly to the economy. As the World Trade Organization (WTO) measures it, nearly 80 percent of global trade involves merchandise rather than commercial services.

Governments want to seize the opportunity to grow their economies and develop manufacturing industries within their borders. Governments and industry around the world are working together in public-private partnerships (PPPs) to modernize and transform manufacturing through advanced technology.

Industry 4.0 will be a revolution

"It will be a totally different infrastructure for manufacturing management; concepts will be very different from today."

Dr. Jonathan Chang
Senior Director, Factory Integration, Backend
Infineon

One widely discussed PPP is Germany's Industry 4.0 (see box to the right). Industry 4.0 provides a vision for how companies will thrive in 2030. In this vision, information and communication technologies such as the IIoT will enable automated high-volume and high-variety quick response manufacturing. Materials, equipment and products will communicate and coordinate with each other and humans in real time (figure 1). Using smart machines and materials to make smart products will result in smart factories that can coordinate through a value chain.

In addition to PPPs, other efforts involve consortia of manufacturers, academics and technology companies. Examples of this are the Smart Manufacturing Leadership Coalition (SMLC) in the United States and the Frauenhoefer Institute in Germany.

In these types of projects, collaborating organizations can make larger research investments than a single company. They develop frameworks and approaches to spur individual company investments and strategy. In addition, they help ensure the vision and capabilities that are developed are not too narrowly focused on the needs of a single industry or company.

There is a debate among those investing in Industry 4.0: Is there a role for MOM, or will all intelligence reside in individual smart products and machines?

Notice that figure 1 to the right shows the things communicating, but no systems to help normalize, contextualize, analyze and make sense of the data they generate. This is a role that MOM and other enterprise applications, such as product lifecycle management (PLM) and enterprise data search, can and should play. While migrating to smart equipment and devices, there will be an urgent need to control communication. This means there will be an even more important role for MOM in coordinating information across one or more production facilities.

Those in innovation industries particularly need manufacturing information to flow effectively across all sites so they can make rapid decisions. For innovation industries embarking on Industry 4.0, MOM must be modern. This means it is not just used plant wide; it's an enterprise multi-function system. (See box on next page entitled: What does MOM encompass?)

We have seen cases in which a modern MOM can replace several dozen silos or independent narrow-function systems. Moving beyond isolated plant systems to a more unified MOM will allow a company to streamline the manufacturing applications to ensure the flood of new industrial Internet of Things data is managed uniformly.

Then data becomes useful because it is provided consistently, reliably and in context and can be quickly accessed. That is the only way to truly guide flexible production.

Public-private partnership for future manufacturing

Industry 4.0 is a project that is part of the German Federal Government's high-tech strategy, focusing on information and communication technology (informatics). The vision is to create decentralized, autonomous real-time production. From the beginning, it included academic and industry luminaries. Nearly every company based in Germany has Industry 4.0 projects and many have government funds to support them. The chief executive officer (CEO) of Germany Trade & Invest, Dr. Benno Bunse, says it will "effectively reinvent industrial production as we know it."

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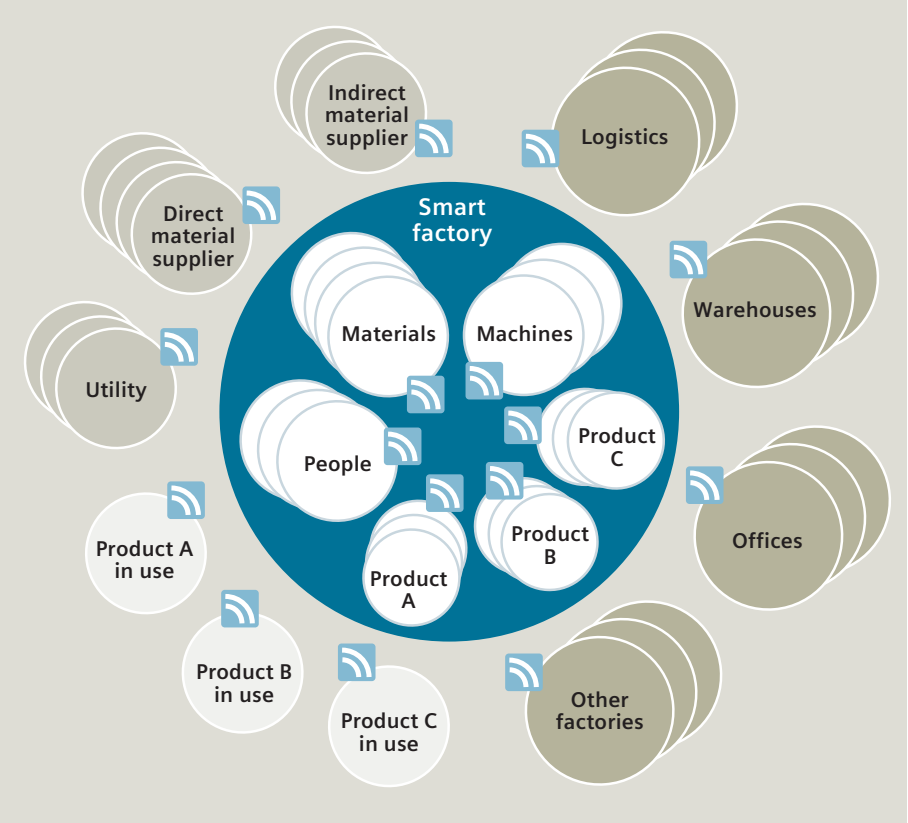

Figure 1: Industry 4.0 vision of the future: Smart materials, machines and products will be used to leverage the Internet of Things across the internal and external supply chain.

Varied needs continue

Manufacturing is not a single industry. Even segments such as electronics and automotive involves hundreds of different types of companies with thousands of varied manufacturing processes and business priorities. Beyond manufacturing, there is also a complex value chain of suppliers, partners and distributors whose data must be globally traceable end-to-end. This variety means that for each company, both the present and the future value chain will have unique and evolving needs for specific software functions.

Innovation industries with complex products and production processes that change frequently and require full traceability will be affected most in the future. Examples of innovation industries are semiconductors, computers and electronics, medical equipment, automotive, aerospace, electrical machinery and transportation equipment.

In these industries, the ratio of traditional manufacturing employees to other employees is relatively low. In part that's because they have intensive research, development, supply chain and regulatory requirements, which require more office-style knowledge workers. Their demanding customers often play a major role in these companies' need to respond quickly and effectively. They also typically have complex and automated production processes.

What does MOM encompass?

The plant applications called manufacturing execution systems or manufacturing operations management include a variety of functions that support each other. MES is the core MOM platform, and typically includes manufacturing execution and intelligence and at least parts of quality execution and compliance. Quality planning, scheduling and maintenance are typically not part of MES, but are in manufacturing operations. Note that each of the major categories listed below includes many more functions than we can list.

Quality planning: Advanced product quality planning (APQP) is a formal and documented undertaking to ensure contractors build quality into the design of the program, product and process. The formal steps of definition, verification and validation are captured and reported on in software.

Manufacturing planning and scheduling: To create realistic and feasible schedules for each production plant, companies typically need software that considers the finite capacity of every line, machine and resource, including the people, tooling and materials, in generating a detailed schedule.

Manufacturing execution: These functions – typically described as core MES – deliver visibility, track-and-trace and full genealogy for production operations as they happen. These systems also dispatch materials and jobs, allocate resources, collect data, enforce process steps and operator certification, deliver work instructions, print labels and enable paperless plant floors.

Quality management: During manufacturing, these functions ensure acceptable quality levels (AQL) with statistical process control (SPC), nonconformance and event management, corrective and preventative actions (CAPAs), containment, incoming quality, sampling and testing. They also include analytical functions to support root-cause analysis as well as lean and Six Sigma efforts.

Compliance management: Included are multilevel electronic signoffs, traceability and process enforcement to ensure materials are handled according to standard operating procedures to satisfy regulatory and customer compliance. Detailed automatic records with signatures streamline regulatory reporting and audits.

Equipment maintenance: Tracking equipment usage is typically inherent in MES, and in some systems, additional capabilities for preventive and corrective actions for keeping equipment up and running are included. In a broad definition of MOM, all of the maintenance activities such as materials and spares management may also be included.

Manufacturing intelligence: Performance dashboards for overall plant key performance indicators (KPIs) as well as status and performance by line, operator, or product deliver an enterprise view into the plant. Manufacturing audit trails, root-cause analysis, exception monitoring and alarming, and aggregation across multiple plants for enterprise views are all possible.

Business reason must rule

"Automation is not the holy grail to fix problems. You still have to identify what the business problem is you are trying to solve. You have to make sure that you are automating good processes."

Mark Remson
Vice President, Information Technology, Applications NXP Semiconductors

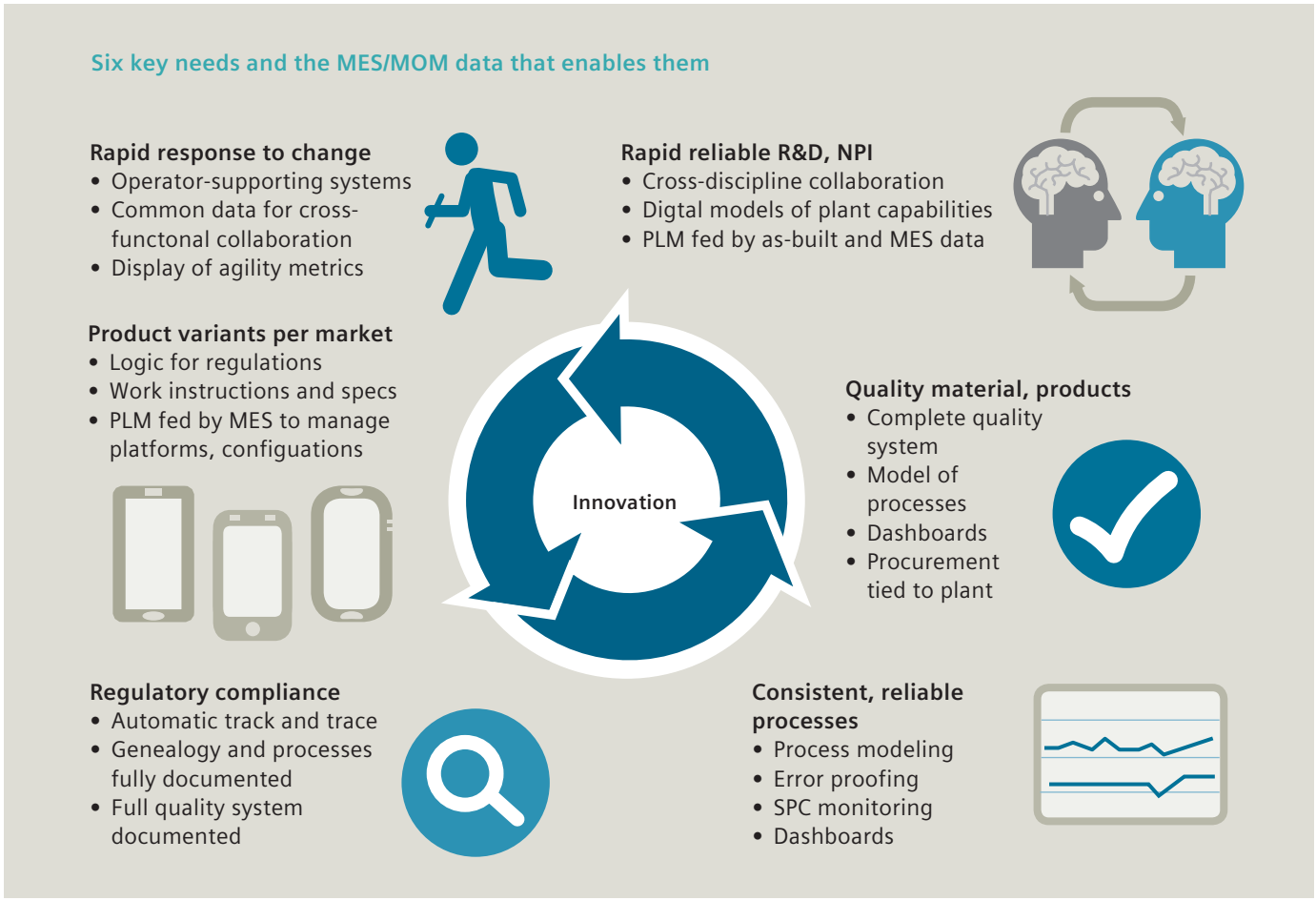

Figure 2: Innovation industry companies require comprehensive, high-quality, aggregated plant data to feed knowledge workers on and beyond the manufacturing floor. MES/MOM is the system that provides the capabilities shown above.

Each type of industry will have specific ways of working in the future. This will involve different needs. Figure 2 shows innovation industry business needs and the MOM capabilities that are required to support them.

For each company to create a unique vision that supports its desired position, the key questions are:

- Strategy: What will make our business successful in the future? Industry 4.0 can support speed, visibility, agility and higher quality and consistency
- Operations: What can we do now to be prepared to effectively fulfill that future vision?

Unfortunately, many conversations seem to get stuck in tactics. Tactics may focus on how to ensure security and power while using mobile, IIoT, smart machine progress, big-data analytics and cloud computing for use in cyber-physical systems (CPS). As some of the newer technologies come into play, these questions may be intriguing and exciting.

Nevertheless, a bigger question is: How will all of the information be normalized, synchronized and made available? The product designs, materials and the processes in innovation industries are all complex. As a result, many have adopted not only enterprise resources planning (ERP) systems, but also PLM, MOM plus an array of intelligence solutions.

In innovation industries, most plants will move to Industry 4.0-style automation. The exceptions are plants that are close to the end of life in which the likelihood of payback from such an investment is low, those that are able to compete even as labor costs rise, or those with a low product mix. These are a minority. Most production facilities will be able to justify Industry 4.0 investments with a solid business case centered on flexibility, error reduction and greater real-time awareness. It may become a matter of competitive survival to be this responsive.

Elements of Industry 4.0 for innovation industries

Most companies are not yet fully aware of what Industry 4.0 entails, so they cannot predict what it will mean for their business. To the degree that smart machines, materials and products become available, an enormous influx of new data into the system is likely to result. If the information infrastructure is ready, this data can add value and granularity to process understanding, root-cause analysis and decision making that is hard to envision today.

This is likely to elevate the need for six capabilities that enable the primary goal of faster response time.

1. Speed: Business needs such as those shown in figure 2 rely on speed. Whether it's new product introduction, engineering and component changes, customer requests, or process improvement for quality or cost, it must be done quickly and flawlessly. With the complexity of their products, processes and supply chains – not to mention regulatory compliance requirements – speed can be a real challenge.
2. Automated controls: Automation is one way innovative companies address speed and complexity challenges. This includes investing in smart, IIoT-enabled machines and controls that allow equipment to provide real-time information on the process and their condition. It may also include IIoT on devices, materials and products.
3. Connection: Even a brilliant machine needs to have a sound information structure to receive data if it is to benefit a company's performance. It would otherwise suffer as an island of automation, only delivering local benefit at best. Disconnected islands of automation that focus on optimizing the local plant can often hurt overall performance. For example, maximizing the throughput and speed of a machine that feeds a slower operation can simply generate additional work-in-process (WIP) inventory without increasing final production rates.

4. Insight: Ideally, each machine's data helps create an overall picture of plant health. It is this insight that delivers better business results. Decision makers in each area of the plant and the company gain not just data but understanding. Those aha moments are the foundation for effective innovation.
5. Effective action: Once decisions are made about how to respond, the company must take swift, coordinated and confident action. The vision of Industry 4.0 is that routine activity can occur by using IIoT for materials, machines and products with little human interaction. However, the unplanned and unexpected will require innovative responses that create a competitive advantage. This requires not only analytics, but will also involve plant-wide and enterprise-level decision makers.
6. Agility regardless of location: Many companies now strive to design, build and deliver products anywhere to enable faster local response with standardized and effective processes. Some companies are moving to local production. Others, such as medical device maker Stryker Corporation, are closing smaller plants to create highly flexible mega-plants to build a wider array of products with economies of scale. In this complex global undertaking, companies must control the flow of both products and information.

This requires strong systems for not only the design-and-build aspects, but also for supply chain and overall product data accessibility and analysis. As a result, companies in the innovation industries must automate information tasks with application software as well. In most innovation-oriented companies, each level of the International Society of Automation (ISA-95) and International Electrotechnical Commission (IEC 62264) models (figure 3) are already heavily populated with applications. Our experience suggests that most companies that have modern software will add to rather than replace these data-rich applications.

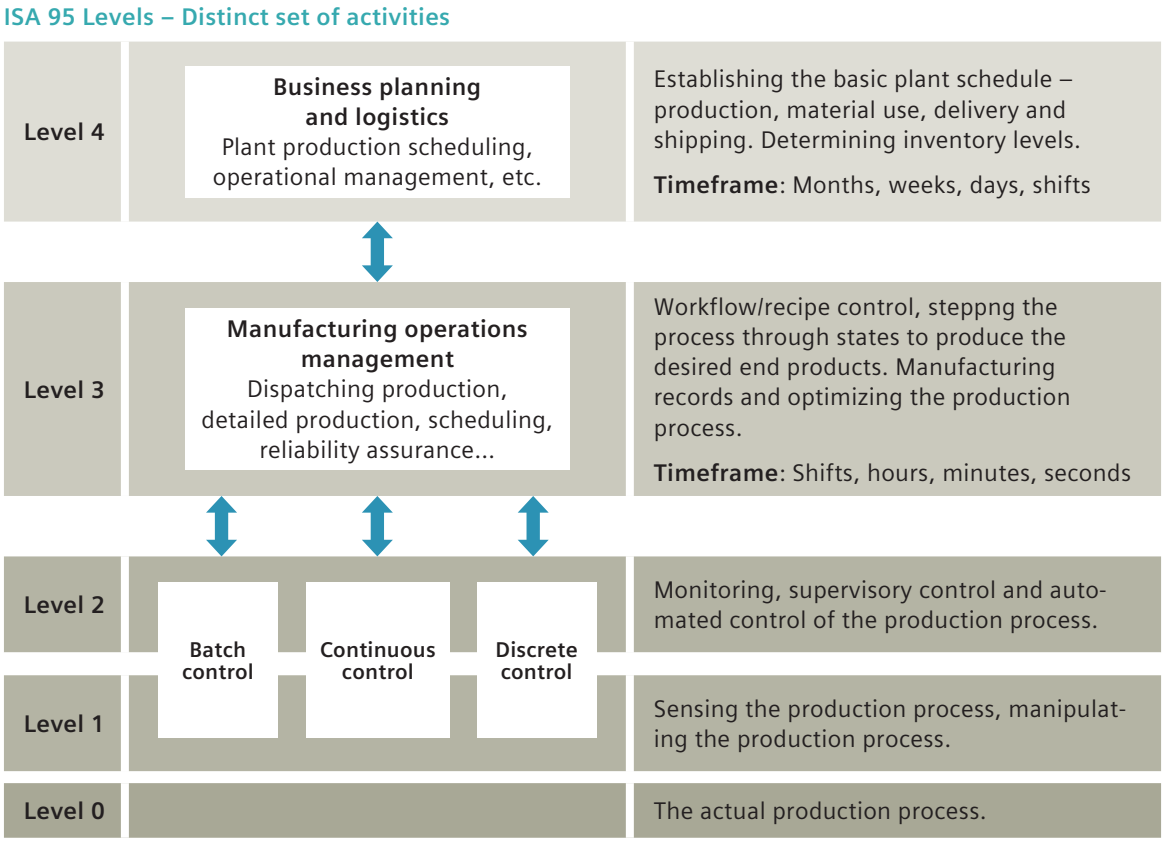

Figure 3: The ISA-95 IEC 62264:2013 four-layer stack. Industry 4.0 success rests not only on the new technologies flooding in at lower levels, but also on integration through layers 3 and 4 for manufacturing enterprise success.

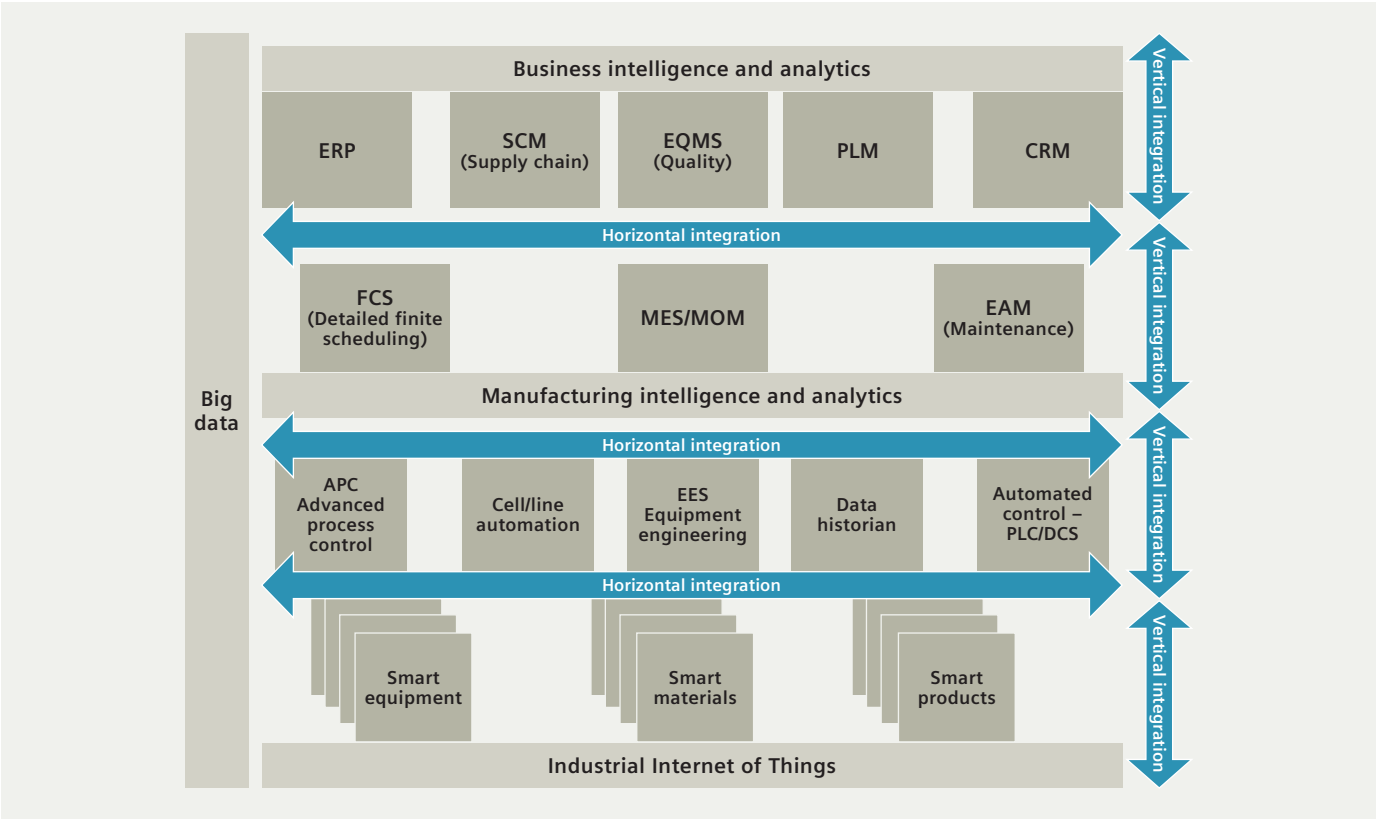

Figure 4: Horizontal and vertical integration between a wide array of applications and technologies will characterize most Industry 4.0 future factories. These applications are interdependent.

Information architectures

There is no single solution for Industry 4.0, and it will not happen overnight. Building an Industry 4.0 road map does not necessarily mean eliminating the systems you have.

Many companies have already replaced older applications with modern systems. The logical approach is to build and evolve core systems while implementing functions that are missing.

As with previous innovations, current technologies will remain in place so new technologies will need to be integrated. As this happens, the various systems become interdependent. For each application in which logic resides, the data sources may vary. This will require data stores, conduits and ways to normalize and put disparate data into context.

Using this data intelligently will require a unified data cleansing and search platform. Fortunately, such software products are emerging to handle big data. Product lifecycle management can already deliver product data access, management and collaboration across the extended enterprise, though not everyone has implemented it this broadly.

The challenge is that even in the technologically savvy innovation industries, most companies' current application infrastructure has critical gaps. As a result, companies are not able to leverage all of the data available to generate new insights.

Companies must address information gaps to realize their future vision. Otherwise, adding vast quantities of distributed data from cyber-physical systems will simply overwhelm the information system's capabilities.

It would be like building more stories onto a building that has cracks in the foundation. In that case, performance of the system and the business could deteriorate. This is a risk companies cannot afford, particularly since there are so many systems tailored to innovation industries' needs, and competitors are sure to have them.

Figure 4 is a view of how all of the current and newer puzzle pieces may come together for Industry 4.0 success. Notice there is integration both vertically among layers and horizontally among applications within a layer.

Companies need a set of platforms for various information needs.

- A data governance platform must be used to rapidly cleanse, normalize and search for data from across the enterprise and its ecosystem
- An innovation backbone such as PLM will allow product and production process collaboration based on non-real-time data from across the ecosystem
- For delivering insight about production operations and IIoT data in that context, MES with manufacturing intelligence is an essential enterprise platform
- For procedural quality and quality documentation, the likely platform is enterprise quality management system (EQMS)
- Big data cleansing, search and analytics will act as a box around everything. This new system is critical in order to use all of the data across all of the applications, layers and business processes. Without this, the full implication of specific data sets may not be clear in the short timeframes that innovation industries have to decide and act
- Modern MOM will be the platform for production and smart machine, materials and process data aggregation and context. MOM may include a wide array of capabilities beyond traditional WIP and genealogy, such as scheduling, maintenance, quality planning and many others. Figure 5 illustrates that MOM is in the middle of all of the crucial processes for manufacturers

Although every company may need each of these platforms, that does not mean that every company will want or need every application and connection that we are showing in figures 4 and 5.

Companies will prioritize which platforms to implement and connect both vertically and horizontally.

As you can see, we don't believe the current suite of applications and their logic will disappear. Companies will still need PLM, MES, APS, EQMS, ERP and customer relationship management (CRM) systems. We have already seen these systems used to incorporate predictive analytics, cloud computing and social or collaboration tools. These become a foundation for companies that will add new technologies, such as IIoT (in machines and products) and big data cleansing, normalizing and analytics.

Logic from various technologies will pull data from others, and having data conduits between these technologies will be critical. For the vision of Industry 4.0 to become a reality, speedy and reliable information flows between applications and technologies will provide the required foundation. So integration and information flows among the current systems will matter.

Unfortunately, diagrams do not always show information flows. One exception is in the Industry 4.0 road map, which uses a version of the ARC Advisory Group model with MES at the convergence of four main processes. Figure 5 shows the Technology, factory, product and order progressions that all include one common element: production information or MOM.

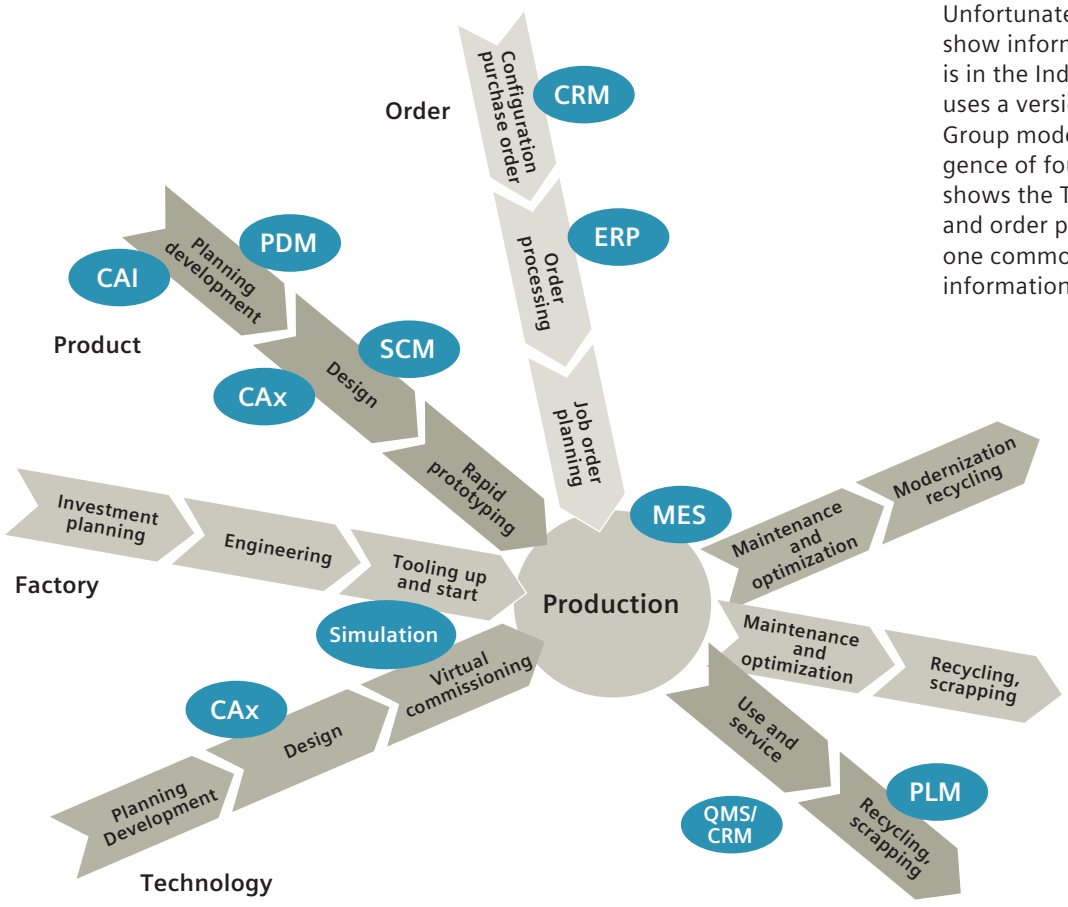

Figure 5: MES is central to the Industry 4.0 road map.

Source: The Industrie 4.0 Roadmap 2014

The business case: Why MOM matters

MOM systems help make sense of the data generated by those connected things in figure 1. Let's take a closer look at why MOM will matter in the highly automated Industry 4.0 world, the needs of which are illustrated in figure 2.

Rapid reliable research and development (R&D) and new product introduction (NPI): Moving rapidly from concept to product with low risk rests firmly on knowing how a design and materials perform in early production runs. This needs to be an end-to-end view, not just flagging a single material or production step that causes a problem. In that light, MOM holds the critical context for design improvements.

Quality materials and products: For example, a driverless car will only be safe if it has zero defects, and that is best performed with manufacturing intelligence and MOM. Although some companies have independent EQMS applications, MOM is typically used for product and process quality data, putting it into plant-wide context. Quality processes in MES build quality in proactively rather than react after the fact. Compliance is a by-product of the MOM type of quality process.

Consistent and reliable processes: MOM is also a system that can flag or even prevent errors by operators and detect overall process drifts that matter to business results, and not just to an individual step-in-the-process. Process monitoring and performance displays at an aggregate level are often the domain of MOM.

Regulatory compliance: Even basic MOM automatically tracks and traces materials and products through the plant, resulting in a genealogy record that has rich, deep Information. Integrating information into MOM enables the user to support quality systems and deliver automatic documentation for regulatory audits and compliance. All of this is critical to protect the brand.

Product variants per market: The number of specific options, features and versions of a product proliferate, and the types of products throughout the plant rises. People cannot be effective alone. The effects of this mix may not be clear when working only from automation. So having production systems across the plant is the right balance.

Rapid response to change: The most compelling part of Industry 4.0 is that change can be rapid and more seamless. When change happens – triggered either by market shifts, smart machines and products, or by order management or marketing – modern MOM, with its total view across factories, enables you to prepare and inform the rest of the enterprise so it can respond effectively.

Many companies will invest in smart machines and devices in the factory, which should be able to guide their individual activities pretty effectively. However, even in the long term, many companies will not be using 100 percent smart materials and making only smart products that know their work instructions, location and best path through the production process. In those instances, MOM is the system that provides that intelligence. For many years to come we expect MOM to act as a proxy for the products and equipment that are not smart or IIoT enabled. MOM will be used to coordinate the manufacturing process with smart machines and check the virtual factory model for the materials and processes.

As is true today, the specific MOM functions that are important may vary by industry, company and plant. The box entitled, "What does MOM Encompass?" is a high-level summary of modern MOM capabilities; each category may have dozens of functions.

As MOM plugs into data search and PLM, others in the enterprise can make full use of production information. Figure 6 shows the central role of MOM; this is from the Industry 4.0 road map in 2014.

In short, we believe (as do many in the Industry 4.0 community) that the role of MES may shift somewhat. New and different data from cyber-physical systems will flow in as production is more highly automated. Over a period of decades, fewer operators may be needed, and MOM may shift to providing comprehensive product data as well as context and intelligence to support decisions during the inevitable exceptions. MOM plays an important role in innovative businesses today and will do so in the decades to come.

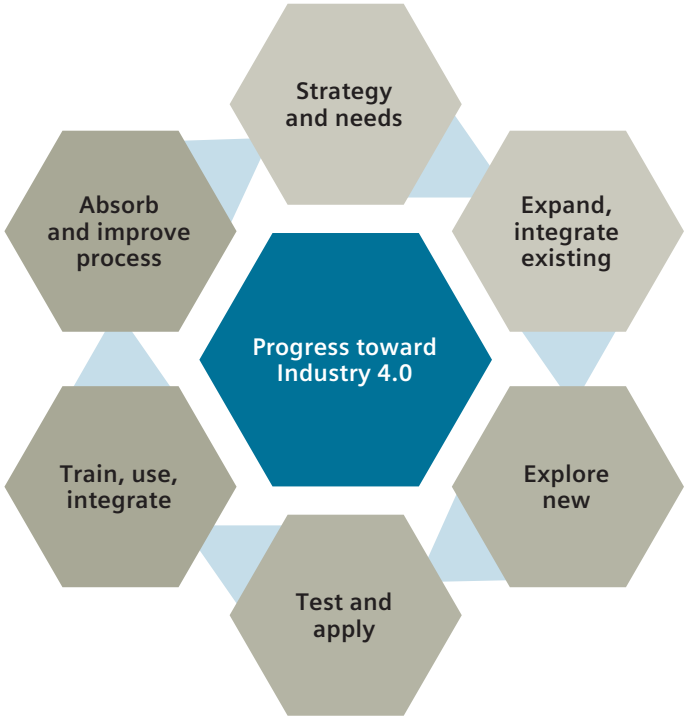

Figure 6: Starting at the top, this is a possible process for moving toward Industry 4.0. In practice, all occur at once, and the absorb step is a continuous process.

Timeline and priorities

Industry 4.0 is a vision. Many express it as a future state companies will achieve by 2030. The question to ask is: What can we do in the meantime to prepare?

Each company will craft a strategy, and figure 6 shows possible steps in an iterative process of improvement. The priorities will vary based on what you have already done, the specific way you compete, your product lines and mix, and your vision. However, you should ensure that the mature elements are well positioned for the future.

Core enterprise applications can be strengthened so they can be used more fully. For example, MES can be a complete system to manage production, but many companies only use a few elements to comply with regulations or solve a specific plant-floor problem. In mature implementations, MOM has a variety of capabilities that work together to optimize production.

MOM is also integrated at multiple points with ERP and supply chain management (SCM) for the order line (as shown in figure 5). This ensures order and materials information flows to the plant, and that production numbers are reported at the enterprise level. In some cases, customer service orders pull directly from MES as well.

The product line in figure 5 shows the product lifecycle and PLM applications feeding through production. Many more companies now perform design for manufacturability (DfM) and share digital manufacturing models with the plant floor. The next logical step is for designers to use MOM data for stronger design and simulation results.

As leading software providers figure this out, it is increasingly feasible to close the loop. Yet few companies have made the required process, culture and mindset changes to do so. In other cases, some key technical elements are not yet mature. For example, there are as yet no standards for integration among the cyber-physical systems using the IIoT. So at this stage you can align with the solution provider you prefer. In fact, there are still research projects ongoing to create those smart machines and products that will communicate across this as-yet nonstandard mechanism.

Logic suggests that you start with areas in which there are already examples of success. This includes both core capabilities and vertical and/or horizontal data flow.

For every technically possible way to make data flow, the main obstacles typically have to do with internal change management issues. This means it's important to build out a business case with all of the stakeholders who will feel an impact.

Multisystem, multidiscipline efforts to work through some of the areas that require changes in workflows or business processes will often lead to deeper cross-functional understanding. These can also open up new avenues for envisioning the future together.

MES for big data

"Future manufacturing will be fueled by IoT and robots – not by humans like today. With robots and IoT, the next generation of MES becomes a big data place."

Dr. Jonathan Chang
Senior Director, Factory Integration, Backend
Infineon

Conclusion

Given that manufacturing is central to the supply chain and product lifecycle, you will want a modern, fully functioning MES that enables you to share information early in your journey toward Industry 4.0. Even if its role shifts over time, this critical information infrastructure can deliver significant value now and into the future.

Now and for at least the next few decades, MES will be critical to ensure smooth integration of data from smart devices and equipment with older plant assets. In the longer term, most companies will not replace all applications nor include the production intelligence in every material and product. Thus, MES continues to be a mission-critical application.

Full-function MOM with modern extensible architecture supports all of the innovation industry requirements for success:

- Rapid reliable R&D and NPI
- Quality materials and products
- Consistent reliable processes
- Regulatory compliance
- Product variants per market
- Rapid response to change

Often the challenge can be building the business case to justify investment in MES and its many integration points. Historically, production and engineering teams have not been proficient at justifying their investment.

Fortunately, there are many other stakeholders who may also realize the benefits of MOM, and bringing them into the discussion is a best practice. Although people outside of manufacturing may prefer that funding go to their department's project, if your case includes the value non-production departments can gain from MOM, you are more likely to get the funding you need. Clearly, including the need not only for the system, but also for the technical, process and possibly even the organizational changes of integrating MOM vertically and horizontally into other systems, will show other departments how they will gain the full benefits.

Naturally the key to MOM playing a role in Industry 4.0 is that it be modern, highly functional and flexible enough to be extended to meet future needs. To justify implementing, upgrading or replacing an MES, the chosen system must also be capable of improving current operations.

This typically means implementing an enterprise-grade MOM system across all plants. Today MES is critical to support truly global operations. In addition to core track-and-trace, it will have many functional components not only for production, but also for quality, maintenance, scheduling and analytics. It will also be capable of swiftly and effectively implementing change across the enterprise.

Most visions of the future require companies to simplify, standardize and automate. For innovators, a modern MES/ MOM can be a core element for today as well as preparing for Industry 4.0.

Completing the move to comprehensive MOM is a strategic decision to help you gain a competitive edge. Those who do will streamline operations now, and will also be poised to embark aggressively on their Industry 4.0 plans. MOM can be a cornerstone for success in the Industry 4.0 future.

What's next?

"We are starting global expansion, looking at manufacturing supply chain strategy. There are two things we're focused on: Selling more of the right products and/or reducing costs of current products. For this, we are looking to implement MES around the world."

Mark Lincoln
Vice President, Global Operations Terumo Cardiovascular

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