



The Next Wave of Manufacturing Relies on Plant Operations Transformation

To enable deeply ingrained agility, predictability, responsiveness and efficiency, manufacturers must think holistically about their factories and develop integrated and harmonized capabilities that connect the end-to-end supply chain with a new product introduction value stream.

Executive Summary

Today's manufacturers are at an inflection point. On the one hand, they need to become more agile and respond more quickly to changing customer demand amid increased supply chain complexity. On the other hand, they need to embrace new technologies and process/product innovation to continuously adapt to competitive pressures, worldwide.

Plant operations stands at the center of this strategic change and is a critical lever for addressing growing business-technology challenges. While plants must collaborate seamlessly and efficiently with other facilities, as well as supply chain and innovation partners, many manufacturers still operate as disconnected plants, with non-harmonized operations management processes, non-standardized operations technology and legacy applications. Moreover, they have limited appetite and budget to adopt new technologies. The situation calls for a comprehensive approach to transforming plant operations management to enable ingrained agility, predictability, responsiveness and efficiency.

This white paper describes our approach to overcoming these issues, built on our ONEPlant transformation framework and services. It describes a well-defined maturity framework to draw a blueprint, methodologies to implement strategic actions, and end-to-end IT services that can help manufacturers transform their plant operations incrementally and cost-effectively.

Today's Environment: Challenges and Opportunities

Today's global economy presents manufacturers with a host of new challenges, as well as opportunities. Complex value chains, continuing economic uncertainty and changing customer demographics are forcing manufacturers to continuously adapt to dynamic business conditions. Meanwhile, the next industry revolution is taking hold (i.e., Industry 4.0¹), as new technologies and process innovations present opportunities for manufacturers to take advantage of the changing environment.

Challenges for Manufacturers

Manufacturers must simultaneously contend with the changing nature of the manufacturing model



by applying new technologies and respond to customers' highly demanding fulfillment targets. At their core, these challenges include:

- Addressing demanding customers by creating agile fulfillment capabilities.
- Remaining relevant amid market volatility.
- Meeting demand for more personalized products by bringing customer intelligence to the production floor, adding a higher level of complexity to the configuration and fulfillment cycle.
- Attracting employees amid radical changes in workforce demographics (i.e., millennials and employees with millennial mindsets).
- Understanding complex business models (i.e., a complex supply chain, contract manufacturing, global operations, volatile demands and higher product variants) that can reduce efficiency.
- Staying on top of increased merger and acquisition activity, adding heterogeneity to business processes as well as the technology stack.
- Driving real-time and predictive intelligence from the huge data sets that are collected throughout the supply chain, including production processes (i.e., plants).

To address these challenges, manufacturers must re-examine their operating models and priorities related to sourcing materials, production, fulfillment, new product introduction, supply chain efficiency, resource utilization, etc.

Emerging Opportunities

Manufacturing has generally been seen as a laggard in adopting new technology, but the emergence of social, mobile, analytics and cloud technologies (the SMAC Stack™) and the Internet of Things (IoT) is opening new vistas for manufacturers to explore.

The SMAC Stack provides the technological underpinning to help manufacturers support more intuitive, engaging, personalized and contextually-aware ways to design, build and deliver products and services to customers. For example, mobile technologies can greatly improve the productivity of maintenance operators by removing paper-based inspection sheets and allowing them to view equipment health history and enter condition information while on maintenance rounds. Mobility also helps quality inspectors

and warehouse operators perform transactions on-the-go by enabling real-time access to business-critical information.²

In today's digitally connected world, no product or offering is complete without a connection to the SMAC Stack or the IoT. The rapidly changing mobile landscape and onslaught of IP-addressable and IP-aware devices can enable manufacturers to gather accurate information, turn processing speed into a competitive advantage, and capitalize on the intelligence gained from every interaction and transaction across the value chain.

IT/OT Convergence

Amid the rapid advancement in digital technologies, underlying operational technologies (OT) on the plant floor have converged with enterprise information systems, forming one technical architecture that spans the manufacturing enterprise.³ As these technologies blur, the convergence of IT/OT will help manufacturers significantly reduce their technology footprints and improve the overall information flow between the plant and the rest of the enterprise, thereby facilitating new operational efficiencies.

In a perfect world, manufacturers would tightly align enterprise and operational systems to blend corporate run-the-business data with process information. For example, process data from legacy systems would be more tightly integrated not only with plant analytics but also with enterprise analytics. Better alignment between IT and OT systems would also consolidate enterprise architecture, thereby helping manufacturers provide event-based capabilities to more effectively respond to adverse events within the plant or across the supply chain.

Industry 4.0 and the Internet of Things

With the ongoing Industry 4.0 revolution, the boundaries between the physical and virtual worlds will increasingly cease to exist, particularly as IP-addressable/aware devices define the connected, smart factory. New operating models will emerge as physical material and information merge into one, since the digital bits and bytes contained in both will be tightly linked as more and more digital data is embedded into the supply chain.

Manufacturers will have more SMAC technologies on hand to power smart sensors, smart machines and smart wearables, which will take

manufacturing to the next level of agility and productivity. Smart sensors with IoT platforms will generate numerous “Code Halos,” or the digital code surrounding people, process, organizations and devices, throughout the manufacturing space.³ A plant Code Halo™, for instance, could be harnessed by using big data analytics to obtain real-time predictive and actionable intelligence for the plant. Actionable machine (or device) Code Halos could be built by collecting process data, machine data and alarm logs during machine failure conditions.

Using these data collections, manufacturers could detect failure patterns to warn maintenance operators about a possible breakdown well ahead of its occurrence. Such predictive alarms and information can help save costly breakdowns. Similarly, batch production information – with detailed meta data on process conditions – can help create product Code Halos that, in turn, can help manufacturers analyze and improve batch yields.

Factories (and small plants) are already emerging in which all employees – from supervisors to plant managers to senior leaders – share real-time information and access plant analytics to improve operational efficiency and productivity. As a result, essential elements of manufacturing are converging like never before, creating what we call “informed manufacturing.”⁴

Imperatives for Plants

As the focus on agility, responsiveness and personalized manufacturing increases, plants need to prioritize their efforts to seamlessly and efficiently collaborate with other manufacturing operations – from contractor manufacturers, through supply chain and innovation partners. This necessitates plants to work as a “one-plant” ecosystem to achieve plant operations management that is more integrated, predictive, lean (efficient), agile (adaptive and flexible) and enabled by new technology.

Indeed, according to IDC,⁵ 30% of manufacturers by 2016 will invest substantially in increasing the visibility and analysis of information exchange and business processes, both within the company and with partners. Further, IDC also estimates that this year, 65% of companies with more than 10 plants will enable the factory floor to make

better decisions through investments in operational intelligence.

Key capabilities include:

- Integrated supply chain and innovation capabilities that help to improve agility, reduce manufacturing and innovation cycle time, and improve resource utilization.
- Real-time and predictive capabilities to reduce response time, improve planning and boost resource utilization via dynamic planning; improve visibility; and achieve predictable performance.
- Collaborative operations management to improve knowledge-sharing and best practices within and across the plant.
- Standardized and future-proofed OT to rationalize the operations technology footprint and improve productivity by adopting new technologies. General Motors already sees Google Glass technology as a tool to improve assembly line productivity to deliver real-time images and videos, as well as on-the-job training/work instruction.⁶

Goals include:

- Higher customer satisfaction by delivering the right product at the right time and at the right price.
- More efficient plant operations by cutting waste and reducing input material and operations costs (including energy and utility expenses) and improving inventory turns.
- Improved regulatory compliance by adopting total quality management (TQM) discipline from design to delivery. This will help to improve customer satisfaction, as well as reduce overall manufacturing cycle time.

Current State of Plant Operations Management

While manufacturers prepare for the connected enterprise enabled by SMAC and the IoT (and wearables in particular), many are still struggling to integrate and harmonize plant operations with the end-to-end value stream (order-to-cash, new product introduction, or NPI). According to Gartner,⁷ 70% of plant floor data is still not used for enterprise decisions. As a result, many plants are unable to capitalize on the power of new technologies.

Today's Manufacturing Enterprise

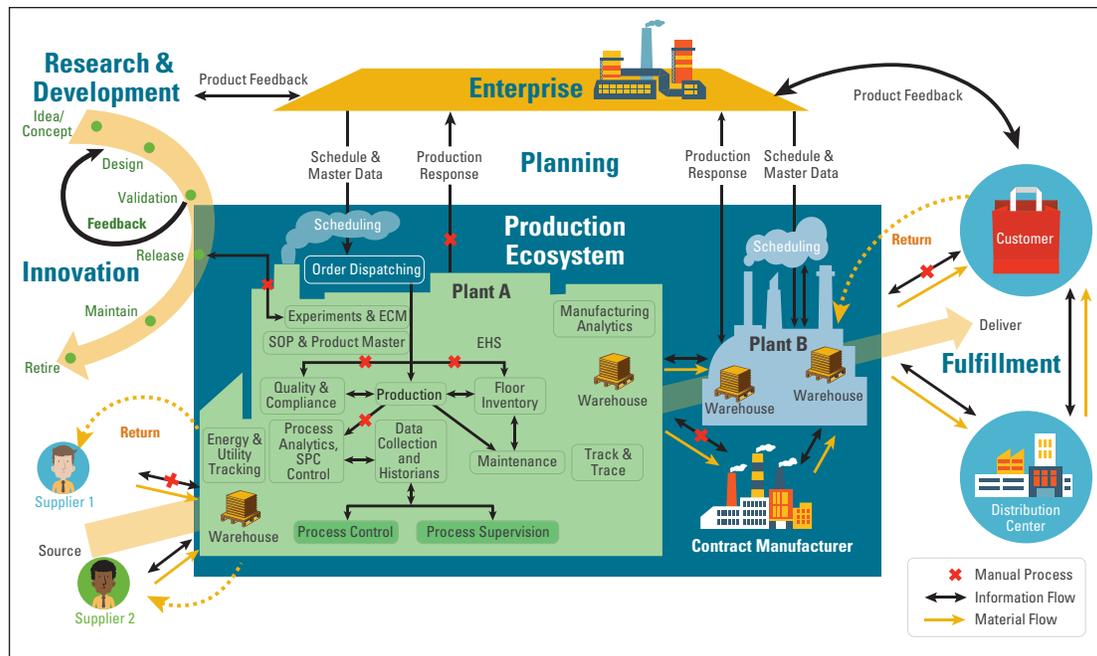


Figure 1

Manufacturing plants need to be viewed as strategic investments that help to develop and expand business. As such, plants need to operate in sync with the overarching business vision. Even some manufacturers with high levels of technology implementations fail to derive maximum value from their plant investments because of a plant vision and system integration that is misaligned with the enterprise.

Existing plants pose unique challenges for achieving enterprise transformation (see Figure 1). The following scenarios must be addressed by manufacturers to achieve such business objectives:

- Multi-discipline, non-standardized, non-integrated plant operation management processes.
- Non-integrated processes (within the plant as well as within the supply chain).
- Lack of real-time visibility of plant operations due to sub-optimal plant resource utilization.
- Challenges in getting end-to-end traceability (material/process) information.
- Lower levels of collaboration within the supply chain and innovation value stream.
- Legacy systems with disparate application stacks, leading to greater technology variance within and across plants. Obsolete technologies also add to the plant's operation risk.

- Lack of a common IT program at a corporate level. IT strategy is still largely driven by local plant or enterprise integration needs.
- Higher risk and substantial time involved in changing processes/systems at the plant level.

A Comprehensive Plant Operations Transformation Strategy

To prepare for the next wave of industry revolution, manufacturers will quickly need to close gaps between plant and enterprise operations, as well as between operations technologies and new information technologies. To achieve this, manufacturers must adopt a comprehensive approach to transforming plant operations management.

Most of our leading global manufacturing clients realize these challenges and have already initiated a comprehensive approach or are in the process of adopting one. The aim of such a program is to harmonize operations management and operations technology to align the plant(s) with the enterprise.

Key Considerations

A successful transformation initiative requires the following:

- The understanding that transformation is a journey, not a sprint, that requires buy-in from all stakeholders (corporate business users,

Implementing a ONEPlant Approach



Figure 2

corporate IT, plant IT, plant users, owners of various strategic initiatives, such as Lean Six Sigma, etc.).

- A phased approach to align plant(s) with the enterprise vision and a defined roadmap to reach a future state.
- The ability to identify strategic actions that address current plant challenges and align with the overall vision.
- And, perhaps most importantly, the wherewithal to choose a credible partner that can help in realizing overall transformation goals.

Cognizant's ONEPlant Services Help Transform Plant Operations

Our ONEPlant transformation framework and services offer a unified approach to transform plant operations. Importantly, they enable manufacturers to achieve an integrated enterprise by strategically aligning technology, processes and people toward a common vision and goal (see Figure 2).

Key components of our ONEPlant services include:

- A maturity framework to assess the current state and define the transformation roadmap.
- Strategic actions that are part of the transformation road map. These actions focus

on addressing current plant situations, as described in this document.

- Technology services and agile methodology to help transform plant operations management in alignment with the transformation roadmap.

Plant(s) of the Future

Plants of the future will need to be seamlessly integrated with the extended supply chain and innovation cycle, operating with greater agility and efficiency (see Figure 3, next page). All plants, including contract manufacturers, will need to work as a single ecosystem to fulfill customer demands, thereby improving customer satisfaction across the board. Role-based and secure plant information/transactions will be available anytime, anywhere and in real-time, on any device (mobile, laptop or desktop computer, wearable, etc.). Plant operations will automatically adjust or respond to adverse events within the supply chain.

Plant, product and machine Code Halos will aid in predictive intelligence and drive proactive actions. As such, new SMAC Stack technologies will become an integral part of operations technologies. Experts will be able to remotely work with floor operators in a collaborative manner to improve efficiency, with remote experts able to not only view the real-time health of plants but also identify machine failure locations through video and photo sharing.

Tomorrow's Manufacturing Enterprise

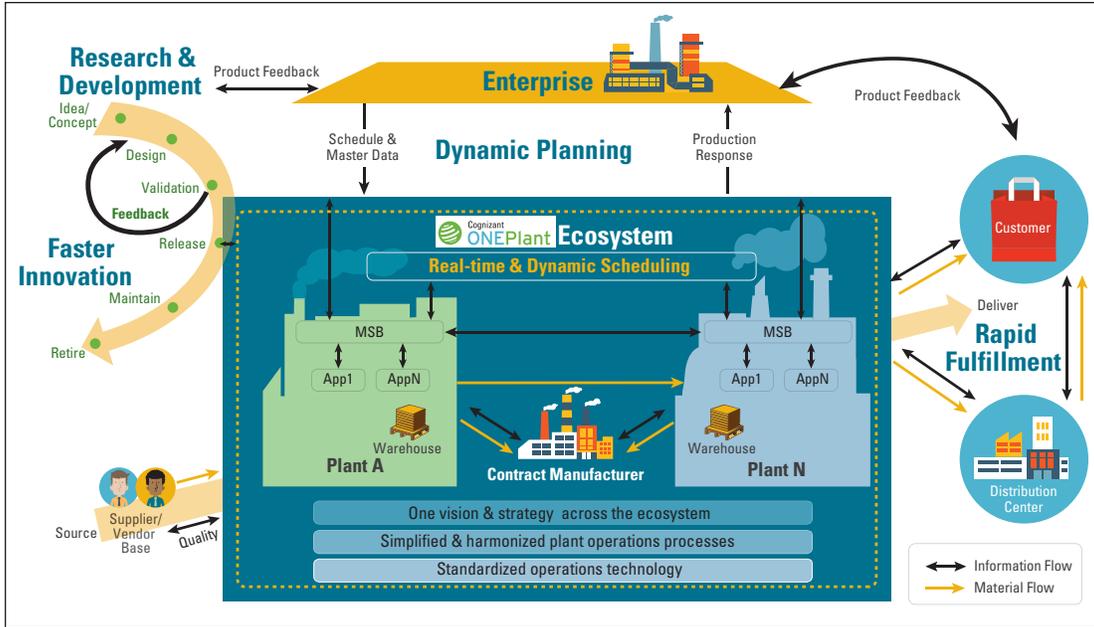


Figure 3

Maturity Framework

Our proprietary ONEPlant maturity framework provides a systematic way to define maturity, along with a specific focus on plant operations management processes. It can be used to align vision/KPIs and process capabilities, as well as define the transformation roadmap.

Process View

Considering various interactions and the impact of plant operations on the value stream, the framework focuses on key plant operation processes that are key to achieving business

objectives. Key processes that ONEPlant addresses include detailed scheduling, experiments and change management, production execution, inventory management, quality management, plant maintenance, energy and utility management, track and trace, QMS and compliance, plant performance, EHS, etc.

Figure 4 illustrates the various levels of maturity and capabilities required at each level.

The ONEPlant maturity framework defines maturity across five levels, from the initial level, at which plants are more reactive, to the top level,

Measuring Process Maturity

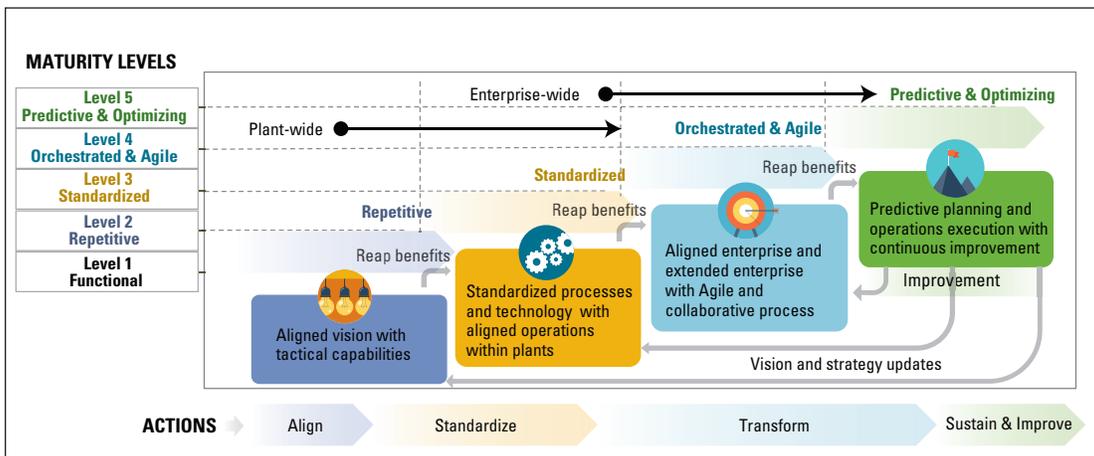


Figure 4

at which plants are agile and predictive. Progress toward the highest maturity level typically happens step-by-step, where at each level, certain capabilities generate tangible business benefits. The initial maturity level focuses on improving efficiency by boosting production yield, productivity and real-time plant visibility to the planner. By delivering improved maturity, plants move toward more flexibility, responsiveness and predictive planning.

Strategic Actions: Addressing Unique Plant Challenges

Our ONEPlant roadmap recommends a phased approach, with strategic actions that align with the overall vision and simultaneously offer ways to address existing plant operations challenges. These include:

- **Simplify and standardize plant operations management processes.** This is one of the key aspects of transformation and needs to be aligned with enterprise strategic initiatives such as Lean Six Sigma, TQM, etc. Individual plants typically have different ways of handling planning, execution, production reporting, performance management, material handling, quality assurance and control, etc. Moreover, many plant operations processes span multiple departments. For example, order execution processes typically cut across enterprise planning, plant production, quality and materials handling departments. To standardize these processes, it is important that multiple stakeholders from various plants, as well as the corporate business/IT team, are strategically aligned.
- **Improve user experience.** With millennial workers, organizations need to take a new look at the user experience with respect to operations technology. The user interface should be more personalized and responsive to the preferences of individual users. Such an approach is emerging in the SCADA space, as well as other operations technology environments (MES, EAM, WMS, LIMS, QMS, EMI, etc.).
- **Standardize operations technology.** While simplifying processes is important, standardization of operations technology (system) is equally so. Key elements that need to be considered are clear separation of responsibilities for systems with business capabilities with minimum overlap, a minimal number of technologies and interfaces, plant needs for higher availability, and multiple deployment options (central vs. local) to address reliability needs.
- **Adopt new technology.** New and powerful technologies, such as mobility, social media, big data analytics, virtualization, cloud, wearables, etc., provide real-time actionable intelligence that can elevate plant operational performance by improving flexibility, responsiveness and quality. Vendors that provide automation technology to manufacturers already offer historians, supported with big data technologies. This can help manufacturing enterprises analyze long-duration process data with transactional MES/lab data, gaining new process insights.
- **Integrate processes and enable plants with manufacturing SOA.** Current plants use multiple systems (including legacy environments) to achieve various manufacturing capabilities. While plant transformation and standardization of operation technology will reduce the application footprint, plants need more flexible and faster ways to integrate disparate and legacy plant systems while the transformation is in progress. A manufacturing service-oriented architecture (SoA)⁸ can help by addressing specific needs for plant integration. This approach can also enable the development of cross-platform applications, improving agility and responsiveness.
- **Enable remote operations management.** Remote operations management for performing asset diagnostics and abnormal event analysis can help reduce the overall TCO of maintaining operations, as well as improve overall organizational responsiveness.
- **Improve collaboration and best practices utilization.** As advancement in each technology/process increases, it is important to take inputs from all experts before incorporating best practices in process improvement. Such collaboration can be improved through the adoption of new technologies. Integrated knowledge management and remote expert support using screen-share and camera-share capabilities offer organizations ways to take collaboration from concept to reality.
- **Build predictive and real-time operations intelligence.** Creating closed-loop predictive operations intelligence is one cornerstone of plant transformation. Harnessing plant, product and machine Code Halos – and layering these with predictive intelligence – can help plants take proactive actions aimed at improving overall customer satisfaction, efficiency, agility and responsiveness.

Cognizant's Aligned Service Offerings Ready to Deliver Transformation

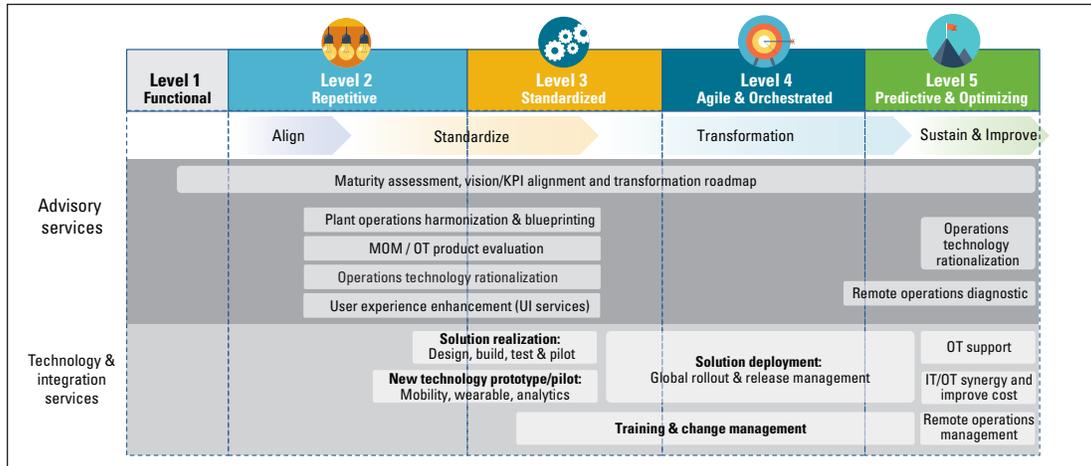


Figure 5

End-to-end Services to Transform Plant Operations

Figure 5 details our portfolio of advisory, technology and integration services to advance the transformation of plant operational management.

Quick Take

Advancing Plant Operations Transformation

Many of our clients already follow a comprehensive approach for plant operation transformation, although some are at the early stages of their transformation journey. Examples include:

- The world's largest research-based pharmaceuticals company has begun its transformational journey of converging electronic batch record system, quality management, inventory management and plant performance, along with an enterprise SAP initiative. We helped with solution realization and are deploying it across 70-plus sites.
- A global diversified manufacturer known for its innovative products across segments is starting its journey of transforming its manufacturing operations management, along with an SAP initiative. We helped define the operations management roadmap by blueprinting the production, quality and inventory processes, with a specific focus on functional segregation of processes between multiple systems.
- One of the world's leading consumer goods company in the healthcare space is in the process of enterprise transformation, which is driving change within plant operations management. We have been engaged in standardization and solution deployment for QMS and MES systems, with a focus on compliance management, device history records and quality management.

Benefits

A structured and comprehensive transformation initiative typically delivers multiple benefits:

- With improved maturity, plants will see improvements in various KPIs, such as manufacturing cycle time, time to change or experiment with new processes/products, flexibility for order variations, inventory turns, energy efficiency, scrap, overall equipment effectiveness, yield and quality compliance.
- With a step-by-step approach, the enterprise will see early benefits due to new business capabilities supported by IT capabilities.
- Business will be able to compare multiple plants and benchmarks in terms of capabilities and KPIs. This will help improve KPIs, adoption of best practices and collaboration.
- A framework approach helps to align IT transformation, informed by a Lean Six Sigma initiative.
- Simplification and standardization during solution design and build will help reduce rollout time for solutions within the enterprise. This, in turn, will help to reduce rollout costs and enable early business benefits.
- Operations technology rationalization will help reduce total cost of ownership by reducing support service costs, as well as software license costs.

These services are further supported by our solution accelerators and tools/templates, including:

- Cognizant ONEPlant framework.
- FloorTrack: Mobility for Shopfloor.
- APEx: Remote asset monitoring.
- PACE: Agile project execution framework.
- Process templates and tools aligned with various industry standards (ISA 95, ISA 88, PAS 55, ISO 22400, MIMOSA, SCOR, APQC, etc.).

Looking Ahead

Amid a new era of growth, manufacturing has a crucial role to play in moving both developed and developing economies forward. In this new era of manufacturing, businesses need to realign their strategy to address the challenges of agility, efficiency and volatility. We believe that to participate in a new growth phase, manufacturers must align their information and operations architectures and processes from the plant floor to the top floor. Powerful new technologies such as the SMAC Stack and IoT, powered by proactive Code

Halo thinking, will play a key role in this strategic realignment.

Accepting the need for a holistic approach and transformation of plant operations management is a critical first step in enabling this evolution. Here are some additional steps that manufacturers can take to better prepare themselves for plant operations transformation:

- **Align and establish support from stakeholders for the transformation program**, both from the business (corporate business owners as well as plant operations owners) and IT.
- **Establish an understanding of the current state of plant operations management** and set common goals for the desired future state.
- **Develop a PMO and core team** to manage the transformation program.

Cognizant ONEPlant helps manufacturers prepare and transform plant operations management across the enterprise, adapt to new-age manufacturing and gain competitive advantage in the global manufacturing industry.

Footnotes

- ¹ Industry 4.0 is a project funded by the German government to promote the computerization of the manufacturing industry, <http://www.bmbf.de/de/9072.php>.
- ² "How Mobility on the Shop Floor Transforms Manufacturing Operations," Cognizant Technology Solutions, August 2013, <http://www.cognizant.ch/InsightsWhitepapers/How-Mobility-on-the-Shop-Floor-Transforms-Operations.pdf>.
- ³ For more on Code Halos, read "Code Rules: A Playbook for Managing at the Crossroads," Cognizant Technology Solutions, June 2013, <http://www.cognizant.com/Futureofwork/Documents/code-rules.pdf>, and the book, *Code Halos: How the Digital Lives of People, Things, and Organizations are Changing the Rules of Business*, by Malcolm Frank, Paul Roehrig and Ben Pring, published by John Wiley & Sons, April 2014, <http://www.wiley.com/WileyCDA/WileyTitle/productCd-1118862074.html>.
- ⁴ See "Informed Manufacturing: the Next Industrial Revolution," Cognizant Technology Solutions, April 2014, <http://www.cognizant.com/InsightsWhitepapers/Informed-Manufacturing-The-Next-Industrial-Revolution.pdf> and "Informed Manufacturing: Reaching for New Horizons," Cognizant Technology Solutions, September 2014, <http://www.cognizant.com/InsightsWhitepapers/informed-manufacturing-reaching-for-new-horizons-codex980.pdf>.
- ⁵ "IDC FutureScape: Worldwide Manufacturing 2015 Predictions," IDC, December 2014, http://www.idc.com/getdoc.jsp?containerId=IDC_P32121.
- ⁶ Jeff Bennett, "GM Takes Google Glass on a Test Drive," *Wall Street Journal*, Aug. 5, 2014, <http://blogs.wsj.com/digits/2014/08/05/gm-takes-google-glass-on-a-test-drive/>.
- ⁷ "Has MES Come of Age," Gartner/MESA joint presentation, December 2014, <https://services.mesa.org/ResourceLibrary/ShowResource/47eff093-b4f9-417e-9aa1-1ddb3e82757>.
- ⁸ "MESA White Paper 43: Applying Global MOM Systems in a Manufacturing 2.0 Approach," MESA International, April 2013, <https://services.mesa.org/ResourceLibrary/ShowResource/f00b70ce-5637-4027-a14d-4bf7c0209eee>.

Note: Code Halo, SMAC Stack, FloorTrack and ONEPlant are pending trademarks of Cognizant Technology Solutions.

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About Cognizant

Cognizant (NASDAQ: CTSH) is a leading provider of information technology, consulting, and business process outsourcing services, dedicated to helping the world's leading companies build stronger businesses. Headquartered in Teaneck, New Jersey (U.S.), Cognizant combines a passion for client satisfaction, technology innovation, deep industry and business process expertise, and a global, collaborative workforce that embodies the future of work. With over 75 development and delivery centers worldwide and approximately 211,500 employees as of December 31, 2014, Cognizant is a member of the NASDAQ-100, the S&P 500, the Forbes Global 2000, and the Fortune 500 and is ranked among the top performing and fastest growing companies in the world. Visit us online at www.cognizant.com or follow us on Twitter: Cognizant.



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