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# ADAPTIVE MANUFACTURING

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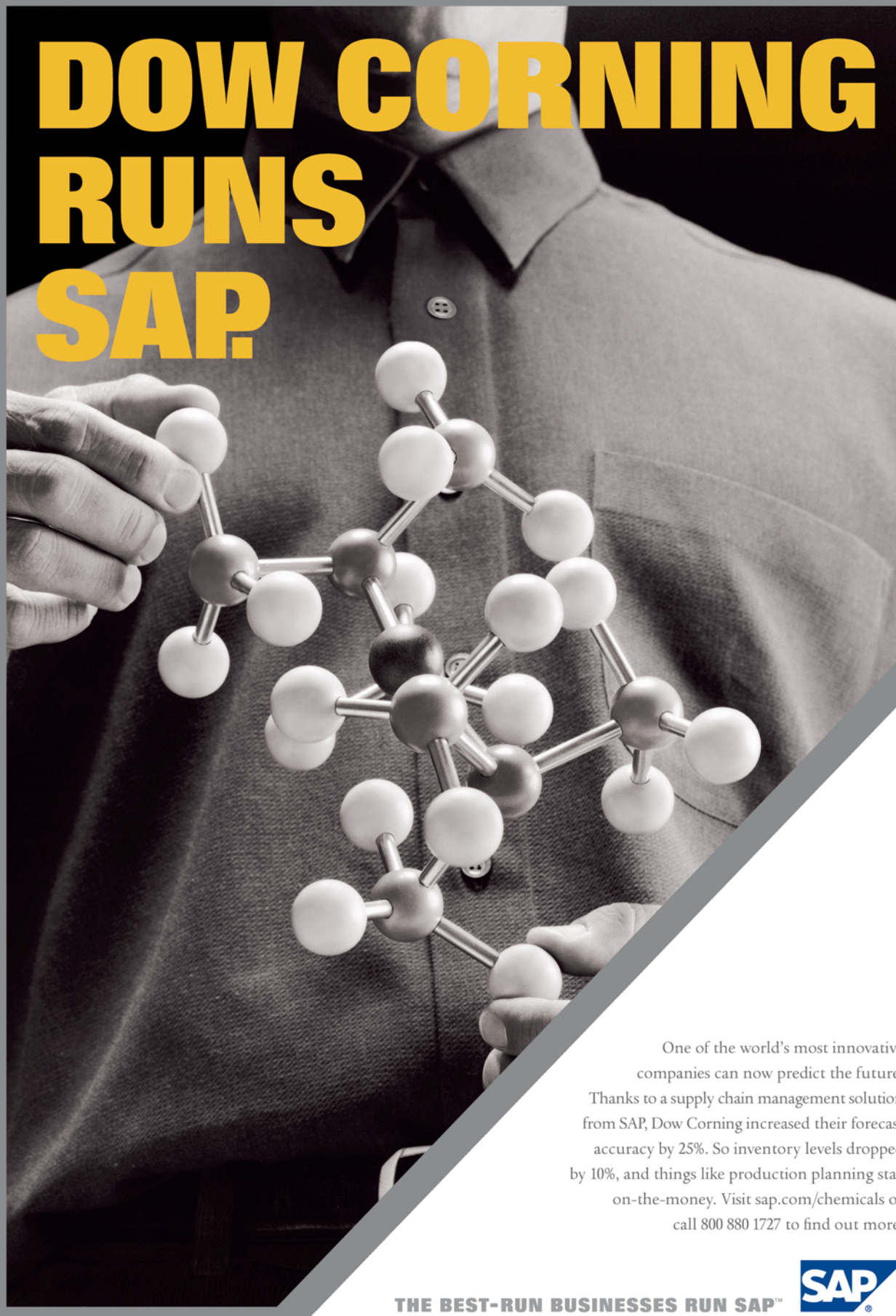

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# ADAPTIVE MANUFACTURING
## A NEW MODEL FOR DYNAMIC RESPONSE

Among the many lessons that history teaches about life is the notion that size, strength or speed alone will not guarantee continuation. The key to surviving and thriving is the ability to adapt – to adjust to new conditions.

Today as never before manufacturers face a set of global structural, competitive and technological conditions that demands an effective, coordinated response encompassing all phases of the enterprise from demand, to product design, to supply chain management, to production and beyond.

In short, what's required is transformational thinking and a new business model that will equip manufacturers with that crucial ability to adapt. That model is called Adaptive Manufacturing.

In this special supplement, you will learn not only the concepts underpinning Adaptive Manufacturing, but also how manufacturers in such diverse industries as electricity generation, dairy products and consumer products are employing this idea today to dramatically improve their businesses.


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# CRAFTING AN ADAPTIVE ECOSYSTEM

**Linking the shop floor, the supply chain, external partners and the executive suite is a core discipline.**

Surviving, and even thriving, as a manufacturer has never been more of a challenge. Competitive pressures abound, while the forces of globalization wreak havoc on manufacturing planning and execution. Time-to-market windows are shrinking, regulatory requirements are growing and the ability to maximize asset and workforce utilization and effectiveness continues to be a growing burden. Meanwhile, a highly-efficient supply chain – from raw materials to finished goods – has never been more essential and never more elusive for a majority of manufacturers across a wide range of industries.

While the problems besetting manufacturing may seem daunting, a growing number of manufacturers are rising to the challenge with a combination of new software, new technology and new business processes. These leading-edge companies, in industries as diverse as electricity generation, dairy products and consumer products, among others, are discovering and implementing a next generation of solutions that help them not only meet their competitive challenges, but plan and execute for new markets and new customers.

Central to many of these companies' renewed focus on success are offerings from enterprise software market leader SAP, and its partners, that provide support for what SAP terms "adaptive manufacturing." SAP's definition of adaptive manufacturing is straightforward: "The ability to profitably replenish the supply chain while dynamically responding to unpredictable change." This leads, SAP maintains, to the ability to "run manufacturing at the speed of business and deliver superior performance through higher visibility and responsiveness."

Behind these concepts is a wide range of applications, technologies and business processes that together enable manufacturers to both survive and thrive. Central to SAP's view of adaptive manufacturing is visibility and responsiveness and a direct and powerful linkage between the manufacturing shop floor, the supply chain, external partners and the executive suite. Adaptive manufacturing is also highly focused on enabling and supporting business processes that operate in real time, and in optimizing these processes to the mutual benefit of all stakeholders. The result is that adaptive manufacturing can be applied to a broad range of manufacturing companies and yield an equally broad range of results, from better resource allocation to improved shop floor yields to a more productive workforce. And adaptive manufacturing allows companies to set goals and milestones based on an accurate, real-time and comprehensive view of the plant floor and its interactions with the supply chain, and then execute, modify and rework those goals and milestones in response to rapidly changing market dynamics.

The issues that are driving the adoption of adaptive manufacturing are familiar to manufacturers everywhere. The main, overarching issue revolves around meeting the challenge of competition and enabling a company to plan for and execute a strategy for meeting customer needs, growing corporate revenues and succeeding in new markets.

Beneath these macro-issues lies a particular set of challenges that is peculiar to manufacturing in the 21st century. Primary among them is the need to improve the overall information architecture so that information, and processes, can effectively flow between the manufacturing shop floor and the rest of the enterprise. While the shop floor and the back office have been well-automated by manufacturing execution systems and/or shop floor automation systems and enterprise resource planning systems, respectively, there has been little progress toward integrating these two domains. The result is that information and process flow between the shop floor and the rest of the enterprise is inadequate and represents a huge untapped potential for efficiency and effectiveness. Tapping that potential, and leveraging it for efficiency and profitability while responding to unpredictable change, is the hallmark of the adaptive manufacturer.

## The Need for Supply Chain Coordination

This lack of integration and coordination between the shop floor and the rest of the enterprise is mirrored in a relative lack of coordination and collaboration between the different stakeholders in the overall manufacturing supply chain. Those stakeholders can be internal employees – machine operators, plant or production managers, and executives, for example – or they can be suppliers in an extended supply chain. The ability to empower plant floor personnel is a particularly important aspect of adaptive manufacturing: by providing these employees with a host of business intelligence, analytics, and exception management functions, adaptive manufacturers are able to further enhance their productivity and the efficiency of the entire supply chain.

Building in closer collaboration and cooperation enables another key capability of the adaptive manufacturer: the ability to respond dynamically to rapid changes in demand and supply. When the lines of communication and collaboration are well-established and well-supported, the ability to manage according to current demand, and real-time exceptions or changes in that demand or supply, can have extraordinary benefits to all members of the supply chain, including customers.

The ability to better manage assets – from machinery to inventory to personnel – is another characteristic of the adaptive manufacturer. Thriving in highly dynamic and interconnected business environments requires a deep understanding of, and control over,

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the assets that support manufacturing operations. This isn't just about ensuring the greatest possible output, but about managing maintenance and support for equipment that is highly valuable and strategic to manufacturing operations.

Being an adaptive manufacturer also means being able to more closely manage and leverage human resources. With many manufacturers facing a diminishing and aging workforce, the risk that attrition will result in a loss of not just personnel, but expertise, is a main impetus behind adaptive manufacturing. Much of the valuable expertise in coordinating shop floor processes and overall business goals all too often resides in the heads of a few key individuals. Adaptive manufacturing can allow that expertise to be built into business processes that can be shared throughout the enterprise.

Finally, the need to improve information access for decision-makers and stakeholders is a key driver behind adaptive manufacturing. Managing by exception cannot take place in an information vacuum or in an IT environment that depends on untimely or inadequate information. If real-time information, delivered in a useable format, cannot be delivered to the right stakeholder at the right time, then responsiveness and competitiveness are bound to suffer. An adaptive manufacturer must be able to reap the benefits of improved integration and efficiency, and that can only be accomplished by improving the quantity of information available and the quality of the individual stakeholder's access to that information.

There are three basic means by which a company can become an adaptive manufacturer: adopt an adaptive manufacturing architecture; define, monitor, analyze and control the key performance indicators (KPIs) needed to measure success and prevent failure; and ensure that the manufacturing software solution supporting the underlying business processes is robust, comprehensive and highly industry-specific.

### The Importance of Role-Based Functions

For many prospective adaptive manufacturers, the adopted architecture – SAP's NetWeaver and the SAP xApp Manufacturing Integration and Intelligence (xMII) being prime examples – must be able to support a comprehensive manufacturing solution that provides planning, execution, quality, maintenance and environmental health and safety functionality from the shop floor to the executive suite. This solution must also support role-based functionality, which uses a Web browser to provide users with tasks, alerts, KPIs, reports, workflows and information specific to their jobs. Software tools for analysis and decision support are also a requirement.

Having the platform is only half the battle, however. The analytical and decision-support tools needed to gauge and measure and analyze the actions of the end-users must also be in place. An information architecture without the ability to guage and track important measures of success and failure would be unable to support adaptive manufacturing. That analytical/decision-support framework must also support the role-based display of the KPIs that drive the business. Too much information, or information that is fundamentally inaccessible or cannot be acted upon, is as bad as not enough information, and just as useless.

Finally, adaptive manufacturing must be based on top-flight manufacturing software that is able to support industry-specific business processes. That software must also come with a strong set of partner products that can be used to extend manufacturing capabilities and provide further support for adaptive manufacturing. mySAP ERP, mySAP Business Suite, SAP xMII and SAP NetWeaver enterprise services architecture precisely fit these requirements.

The remainder of this report highlights three successful examples of adaptive manufacturers and how they have achieved significant improvements in operations, supply chain efficiency and customer satisfaction through the use of adaptive manufacturing techniques. As the following sections indicate, adaptive manufacturing isn't just a good idea, it's a practical set of goals that can be achieved today by manufacturers in a wide variety of industries. Surviving and thriving as a manufacturer have never been more of a challenge, but adaptive manufacturing makes them possible as never before.

## THE KEY CONCEPTS FOR TOP MANAGEMENT

*In many ways, the concept of adaptive manufacturing is as much a business philosophy as it is a marriage of technology requirements and operational processes. Peter J. Kirschbauer, general manager of applications and a corporate officer of SAP, discusses the key questions facing manufacturing business leaders seeking greater agility and flexibility for their companies.*

*Peter J. Kirschbauer*

Q: Is the adaptive concept an IT strategy or a business strategy?

A: It is the second. The two key events involved are the lean philosophy and the idea of the demand-driven supply chain. The business must leverage all of the advantages of lean and get much closer to customers and react quickly to demand. Then match IT strategy accordingly. You can only manage well if you have all the information.

Q: What is the role of senior business executives in creating the adaptive business model?

A: The chief executive, and his or her strategy council; the chief operating officer; and the chief information officer all have to be thinking about this concept. A recent survey by the Economist Intelligence Unit asked global CEOs what their greatest sources of competitive advantage would be in 2010. Almost 60% said it was most important to focus on adaptive models versus new products and service development.

But the problem is current spending is not aligned with this view. To support the adaptive strategy, the executive team needs to be aligned around the concept. And IT needs to be at the table with a true understanding of business processes.

Q: What is the role of partners and suppliers in the adaptive enterprise?

A: What we must move toward is more automated collaboration. To do this, partners must play a role in standardizing the paradigm, and not just in the software, but also in processes and communication protocols. It's about how companies collaborate, the semantics of exchanging information. It's much more of a business network than a sequence of events.

Q: Does the adoption of the adaptive idea require a shift in IT architecture, such as to SAP's ESA?

A: I think so. It's not the only thing, but it is key to the realization of the business network model. Much IT integration has been done today, but most is point to point. The issue is that there are proprietary connections. SAP's Enterprise Services Architecture (ESA) will help to improve and accelerate standardization, provide more flexibility at the shop floor and enable better decisions for customers.

An adaptive network can only be successful if connections are standardized. IT can go on the offensive here by, for example, consolidating resources to free up budget for establishing adaptive business models. The adaptive concept requires a proactive IT organization, and this is where ESA can help.

CASE STUDY: WHIRLPOOL

# Standardizing IT Assets

**The consumer products giant uses SAP's ERP as its corporate backbone coupled with SAP xMII to transform and link the shop floor.**

For Whirlpool, a $13 billion manufacturer and marketer of home appliances, being a major global brand brings with it global responsibilities. At the corporate level, the company's focus on brand excellence and customer loyalty means that Whirlpool must continually respond to customer demand with new products and innovative processes for bringing them to market. At the plant level, translating those corporate goals into reality requires an adaptive manufacturing operation that is highly efficient and cost-effective and tightly integrates ERP, shop floor and other key functions.

When Whirlpool's leadership conducted a review of its technology assets four years ago, the results signaled the need for major change. A history of mergers, acquisitions and decentralized decision-making had left Whirlpool with over 120 legacy systems that performed the functions handled by today's ERP systems spread across the company's global enterprise. Over 100 different ERP legacy systems made up the company's IT landscape in North America alone.

The complexity of managing Whirlpool's myriad systems was an impediment to the company's strategic goals, and the cost of maintaining those 100-plus systems and the silos of information they represented was a significant impediment to success. A major change in strategy needed to be executed, and it had to start with reducing Whirlpool's infrastructure costs, says Jim Shimp, Whirlpool's senior director for Global Application Development. "We had to get our costs in line," Shimp recalls. "We had to start by simplifying."

Simplifying meant throwing out the old and bringing in the new, in the form of a corporate ERP standard based on SAP's ERP, which was one of the major systems already running at Whirlpool. The company's experience with SAP's ERP had shown it to be ideal for the task ahead. Moreover, while SAP was an under-leveraged asset within Whirlpool, "SAP's ERP was built on best business practices and already had 20,000 users," says Shimp. "Our past experience showed us that it was flexible enough to meet Whirlpool's needs."

That realization started a major shift in Whirlpool's global IT operations toward an adaptive manufacturing infrastructure: SAP's ERP became the company's global standard; SAP's supply chain management, plant maintenance, and CRM software, among others, were installed in Whirlpool plants worldwide; and a new organizational structure to support SAP's ERP standard was defined for the company's IT group.

Whirlpool's shift from dozens of systems to standardization on SAP's ERP, however, was only the beginning. Whirlpool also needed to simplify and improve its shop floor operations, which suffered similarly from a surfeit of systems and a paucity of integrated functionality. But whereas Whirlpool was willing to replace its legacy ERP systems with SAP, it was reluctant to make a similar standardization effort on the shop floor. "They had lots of custom code and a plant database that captured data in a standard way," Shimp says. "They weren't ready to make the shift to SAP."

And yet the shop floor needed as much change as the rest of the enterprise. The ability to track orders, move them into production, measure defect and quality data, provide key links from the shop floor to SAP, and otherwise manage by exception, were largely lacking. But without those capabilities, Whirlpool's ability to meet its short-term efficiency needs and its longer-term strategic brand and customer loyalty needs would be severely limited.

Whirlpool's solution was to turn to Lighthammer, which is now owned by SAP but at the time was an independent vendor of manufacturing intelligence software. Lighthammer's Illuminator prod-

Photograph by Vittoriano Rastelli/CORBIS

uct, Shimp realized, would be able to link up to SAP's ERP and support his shop floor users "without upsetting their infrastructure," Shimp reports. "SAP xMII became the leverage point for transforming the shop floor."

The savings for Whirlpool started rolling in even before Illuminator – which was re-branded as the SAP xApp Manufacturing Integration and Intelligence (xMII) after SAP's acquisition of Lighthammer – was hooked up to SAP's ERP system. SAP xMII gave the company's plant operations greater visibility into shop floor operations, and the ability to track defects and quality issues yielded significant savings for the company.

*Jim Shimp*

Part of the benefit came from being able to define and track key production processes using SAP xMII; data from PLCs and other shop floor systems were used to monitor over 45 individual processes tracked by SAP xMII.

The results gave a significant boost to Whirlpool's efficiency and cost-cutting efforts. "Our people could see the defects and react to quality issues while a production run was going on," says Shimp. "They could start dissecting the problems in past runs and figure out what to fix before they ran the project the next time." In short, the visibility that SAP xMII provided into line operations and quality issues provided Whirlpool with a relatively rapid payback that, Shimp reports, reached well into the millions of dollars.

But that was really only the beginning for Whirlpool. Even more savings and value were to come from using SAP xMII as an interface into SAP's ERP. The main design goal was to provide shop floor users with access to key ERP data without requiring them to become experts in SAP's ERP functionality.

SAP xMII's use in support of plant maintenance is a good example. Maintenance engineers use SAP xMII to not only flag a maintenance problem but also query what replacement parts – managed in SAP's ERP system – are available. That data, Shimp explains, isn't necessarily easy for an engineer inexperienced in SAP's ERP to find. "The information in SAP's ERP can come from seven different screens. SAP xMII can put it into one screen."

That capability allows Whirlpool to extend the value of SAP's ERP without having to train personnel in its use. And the flexibility of the interactions between SAP's ERP and SAP xMII made it easy to use one or the other system as the preferred interface for Whirlpool's users, depending on their needs and level of experience. "We wanted to be able to control how the user interacted with SAP," says Shimp.

The use of SAP xMII as an alternative interface to SAP's ERP transaction data also allows Whirlpool to provide a degree of redundancy for SAP's ERP system on the shop floor. By driving important ERP data into SAP xMII, and using xMII as the main interface for end-user interactions on the shop floor, Whirlpool is able to manage key transactions from the shop floor using SAP xMII even if SAP's ERP system is down. This fail-safe capability is a key value-add for Whirlpool, Shimp explains. "Our plants need to operate 100 percent of the time. If something happens on the ERP side, we still need to make product. SAP xMII can pick up the transactions and be the back-up system if SAP's ERP is down."

SAP xMII can also play a role in the executive suite as well. Whirlpool executives plan to use SAP xMII to track plant operations by displaying key performance indicators (KPIs) in the form of dashboards and reports that draw directly on shop floor and SAP's ERP transaction and Business Warehouse data.

Moving forward, Whirlpool sees great possibilities for SAP xMII and SAP's ERP. Understanding the relationship between work in progress (WIP) and inventory is a key capability that the two products can have a significant impact on: SAP xMII can track work in progress on the shop floor and synchronize it in real time with inventory data stored in SAP's ERP. This will allow Whirlpool to understand its precise inventory levels as a job progresses down the assembly line, rather than just when the individual product is ready to ship.

This capability to leverage WIP data will have another important impact as well. One key area that Whirlpool sees as ripe for change in the near future is the relationship between work in progress and the disposition of working capital. Manufacturers like Whirlpool can reap enormous benefits by using knowledge about WIP to better manage finished goods inventory and link that directly to customer demand. "SAP xMII can let us look at working capital differently," says Shimp.

Whirlpool also sees opportunities to use its SAP xMII and SAP's ERP systems to better integrate engineering and design with marketing and production, and use the two systems to improve Whirlpool's product pricing strategy.

In sum, Shimp concludes, the combination of SAP xMII and SAP's ERP provides Whirlpool with the ability to take its "mountains of data" and turn them into information. It's an important step in the on-going process to becoming, and remaining, an adaptive manufacturer, and an important one for a major global competitor with a strong global brand. "To drive customer loyalty we need to get closer to what the customer desires," say Shimp. "This partnership between Whirlpool, Lighthammer, and SAP lets us use our different data sources to meet these needs."

## HOW XMII TIES IN THE SHOP FLOOR

The goal of SAP xMII is to provide real-time information, in the form of a wide range of analytics, that can support the management of shop floor processes in conjunction with enterprise-wide processes and business goals. SAP xMII, which came to SAP in June 2005 as part of the acquisition of Lighthammer, has a manufacturing services layer that can draw real-time data from plant automation and MES systems and use that data to drive a broad range of KPIs, alerts and other analytics. SAP xMII also includes visualization and workflow tools that allow users to develop and manage best practices based on SAP xMII's analytics.

Connectivity to SAP's ERP and mySAP Business Suite product family as well as SAP's NetWeaver enterprise services architecture is an essential part of the functionality provided by SAP xMII. SAP customers can use SAP xMII out of the box to connect their shop floor systems to their SAP environments without deploying a third-party middleware product. Support for key standards such as S95 is built into SAP xMII.

The analytics offered by SAP xMII allow manufacturers to track essential KPIs such as order status, charge rates, yields, completions and usage, start and stop times, and rework scrap rates. Users can drill down into any analytic in order to perform root-cause analysis, and SAP xMII can also allow users to spot exceptions to established best practices and track overall efficiency. This means that SAP xMII can be used to support Six Sigma and other quality management programs. Direct visualization of shop floor assets is a key feature of SAP xMII, allowing users to visually track and manage specific machinery and its performance against business requirements. Role-based analytics are also supported, meaning that supervisors can see "rolled up" versions of the analytics delivered to shop floor managers.

The linkage to SAP's ERP and mySAP Business Suite also means that individual plants and their assets can be closely managed according to plans established in the SAP system. A common set of metrics can then be deployed across a plant or plants that can be used from the shop floor all the way up to the office of the vice president of operations, thus ensuring that all stakeholders are functioning based on a single version of the truth.

CASE STUDY: ARLA FOODS

# Achieving Consistent Quality

**The dairy company integrates its supply chain with SAP's NetWeaver and Invensys's ArchestrA technology.**

When Arla Foods, a global producer of dairy products based in Denmark, looked at its dozens of plants, its multiple SAP implementations and the many process control systems at the plant floor, one major problem kept surfacing. There was no way to create, implement and measure a set of standard business practices across the company's far-flung operations.

The company's vision of the future was of "One Arla," but the lack of standard business practices didn't just mean that Arla wasn't being as efficient as it could be, according to Arne Svendsen, Arla's production IT manager. It meant that material consumption and production were hard to measure, and it also meant that ensuring a consistently high-quality product was harder than the company wanted. This, Svendsen points out, meant that Arla was going to have trouble competing, particularly in a European market suddenly made all the more competitive by the entry of lower-cost East European companies. "We were under extreme pricing pressure in our markets," Svendsen explains. "We really needed to rationalize our business."

That rationalization meant one thing on the technology side: connect Arla's shop floor operations and processes through SAP's NetWeaver to SAP's ERP systems and enterprise business processes. This would allow information from the shop floor and SAP's ERP to improve operations and enable business decisions to be made based on as complete a view of the company's operations as possible. "We needed to extend our SAP system. We were working heavily on our supply chain and needed to get the supply chain better linked" to the company's plant floor systems, says Svendsen.

To accomplish that linkage, Arla turned to SAP partner Wonderware, a business unit of Invensys plc, and its ArchestrA industrial automation and information software architecture. The goal was to use ArchestrA, along with Won-

derware's components for production and performance management, including analytical tools like DT Analyst™ and QI Analyst™, to connect shop floor operations to SAP's production and quality management systems. Once connected, the goal of a single analytical environment for driving better management and decision-making – and thereby enabling the One Arla strategy – would now be possible.

Also key to this connectivity between the shop floor and Arla's SAP environment was the SAP NetWeaver enterprise services architecture platform. SAP NetWeaver, Svendsen explains, was a key element in linking the many different plant floor systems in the company's 50-plus sites, as well as a number of legacy ERP systems also running in Arla's far-flung empire, to its SAP systems. With over 150 different integration points, NetWeaver was essential to Arla becoming an adaptive manufacturer, says Svendsen. "NetWeaver lets us fairly easily do the mapping from one system to the other."

Also key to the One Arla effort was the role ArchestrA could play in providing a single infrastructure for integrating the shop floor and supporting the ISA-S95 standard for control system data. This use of the S95 standard further simplified Arla's ability to capture data from its production systems and use that data – in SAP's ERP and the production systems – to help improve product efficiency and quality.

Currently, Arla is executing parallel rollouts of NetWeaver and ArchestrA, which is now Arla Foods' global standard MES platform. This allows Arla to use the bill of materials in SAP and the shop floor production data from ArchestrA and related Wonderware components to measure precisely what materials are being used to produce what quantity of product. That real-time production data can then be rolled up into SAP's ERP so that Arla's planners can manage costs and fine-tune the plant's production schedule.

While Arla had been able to look at these issues in the past, the lack of direct connectivity between the shop floor and SAP's ERP system meant that there were too many rekeying errors and not enough real-time information with which to make decisions. "We were duplicating errors and duplicating problems," says Svendsen.

More important is the fact that Arla can now "work as one enterprise," adds Svendsen. "This is the only way we can start describing all the standard business processes from production, human resources, project management, IT and others and begin to implement them in the SAP system."

Arla's next goal, once the current rollouts of SAP's ERP and Wonderware are complete, is to use its newly-integrated environment to improve production quality. With SAP's Quality Management (QM) module as the driver, Arla will use the ArchestrA system to capture "in-line" quality data from the production environment and send it directly to the SAP QM system.

The result will be a significant improvement in customer satisfaction, predicts Svendsen. "If a customer wants to buy a batch of a certain product at a specific quality, we'll be able to do it."

The direct payback in customer satisfaction won't be the only way in which Arla will be able to leverage the connectivity between SAP's ERP and the shop floor. Having this infrastructure in place is so fundamental to managing the business that it's almost priceless, Svendsen maintains. "How do you calculate a payback on infrastructure? If you don't have it, you're almost not in business."

The payback will also come from better traceability of raw materials and better regulatory compliance. The new system, utilizing Wonderware's new Production Events Module, will allow Arla to replace a tracing system that often took an entire day to trace the ingredients that went into a specific batch. The new system can do the same task in a few hours. This isn't just a customer requirement, Svendsen points out. "We have to have this information for regulatory requirements as well."

Further payback will come from having a standard integration between SAP's ERP and the plant floor systems. This leverages the S95 standards and lowers Arla's total cost of ownership significantly, allowing the company to roll out the integration across multiple plants rapidly and cost-effectively.

In the end, perhaps the most important part of the SAP/Wonderware combination at Arla is that it's a system designed to help Arla be an adaptive manufacturer for a long time to come. "We hope to be able to look back in 2010 and say we're still on top of it," says Svendsen. With a tight and flexible connection between SAP's ERP, NetWeaver and Wonderware's ArchestrA, One Arla looks to be a success for at least that long.

## HOW ARCHESTRA LINKS THE SHOP FLOOR

Wonderware's ArchestrA software architecture is a framework for a variety of infrastructure services that enable the integration of a multitude of shop floor systems, such as Supervisory Control and Data Acquisition Systems, (SCADA) , supervisory HMI systems or manufacturing execution systems, to ERP systems such as SAP's ERP. The main functional component of ArchestrA is the Industrial Applications Server, or IAS. The IAS allows a manufacturer to define the logical structure of a plant in terms of its functions and resources. This logical structure can then be used to support the integration of different shop floor systems to SAP as well as analytics and other key functions.

ArchestrA also includes a set of key services for managing an integrated shop floor environment: messaging, security, events and alerts, among others. And it supports a wide variety of industry standards for industrial and enterprise software integration. The result is that ArchestrA can provide a fully-formed abstraction infrastructure that can model the functionality in the plant environment and use that model to drive analytical and other applications.

Down Time Analyst, or DTA, is one of the key analytical applications used by Arla in conjunction with the ArchestrA framework. DTA uses the plant model in IAS to drive analytics relating to the performance of a given plant, line or piece of equipment. DTA can track a number of different quality measurements, including overall equipment effectiveness and availability, and real output relative to planned output. This allows manufacturers to closely track quality-related issues and link them not just to shop floor functionality, but the overall business plan as defined within SAP.

Wonderware's QI Analyst™ is a statistical process control application that allows a manufacturer to define the statistical measures necessary to analyze shop floor productivity, take measurements based on those statistics and then analyze the results against a specification or plan. QI Analyst also makes use of real-time data from ArchestrA and IAS, as well as human data input, and can generate different statistical graphics that can be shared by work teams or across the enterprise. The real-time, statistical sampling nature of QI Analyst means that it can detect slight deviations in product line functionality that may be invisible to a human operator.

*"Wonderware's Industrial Application Server gave us the ability to deploy a production and performance solution across our many different plants and helped us optimize processes and get our products faster to market."*

Arne Svendsen, Corporate Production IT Manager

# How Wonderware helped Arla Foods tie a corporate strategy for operational excellence to the plant floor.

With 70 plants across Europe, Arla Foods is one of the largest dairy companies in the world. But they had big challenges. Arla needed to quickly optimize production by standardizing and duplicating their multiple-product processes across all their plants. Each plant was using its own local MES solution and the incompatibility was causing delays and soaring costs.

Enter Wonderware. Using Wonderware's Industrial Application Server built on the ArchestrA software architecture, Arla rapidly standardized production and performance management applications across their multiple sites. Enabling a common set of standards, Wonderware helped Arla significantly improve real-time visibility throughout their entire enterprise—from equipment, to manufacturing processes, right up to the ERP system. All with an elegant, fast integration on top of existing infrastructures. So instead of a collection of incompatible systems, Arla can now develop MES solutions in parallel, reusing slices of one solution to build others. In just weeks—not months—Arla deployed a corporate standard with the lowest lifecycle costs, and is now harvesting measurable improvements in their pursuit of operational excellence. Got manufacturing challenges? Then contact Wonderware to see what we can do for you. Visit us at wonderware.com/ad/success.

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CASE STUDY: CONECTIV ENERGY

# Optimizing Power Output

**The electricity producer uses SAP's ERP and NRX's asset management software to optimize operations.**

Building and running electricity generation plants in an era of deregulated energy represented major opportunities, and some challenges, for Conectiv Energy. Competing in a deregulated, or competitive energy market meant that Conectiv Energy had the opportunity to increase its profitability by providing electricity in direct response to market dynamics. One of the challenges lay in ensuring that its different generation plants were able to operate at maximum efficiency and throughput in order to meet the needs of a highly-dynamic market.

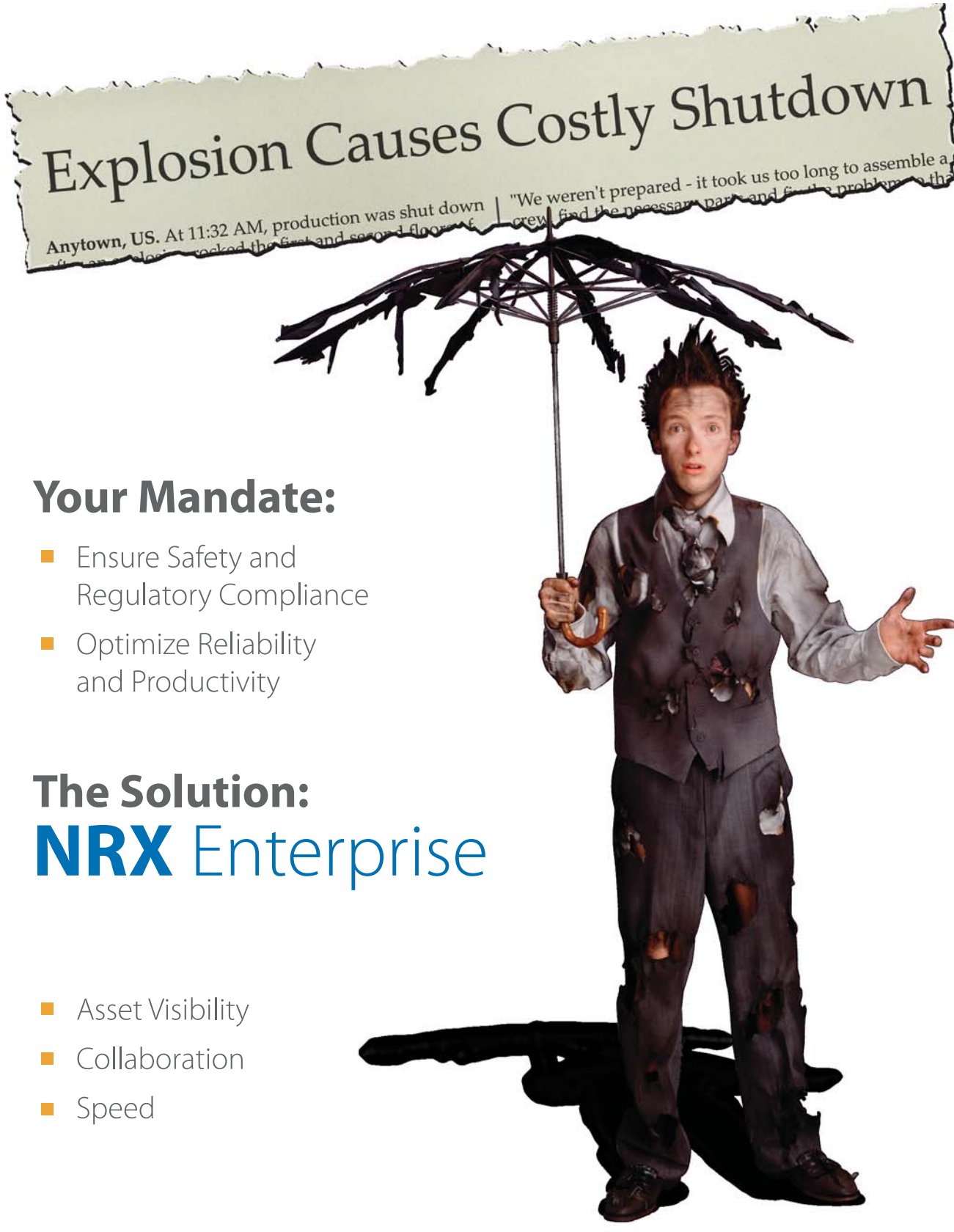
Conectiv Energy manages a portfolio of highly-flexible wholesale energy related assets, which requires the company to focus its efforts on proactively managing these assets. The combination of operational experience and market knowledge has created an asset optimization model that allows Conectiv Energy to achieve these goals.

"In the regulated days we were a vertically-integrated company. We purchased fuel, generated, transmitted and delivered power, metered and billed customers," says George Muller, an IT manager at Conectiv Energy. A deregulated market means that the Conectiv generation company had to run a leaner and more intelligent operation. "Now we have to bid generation into tomorrow's market and compete there against other suppliers. It's caused us to look much harder at efficiency."

Conectiv's efficiency requirements are further complicated by the different types of plants that it operates. While some of Conectiv's plants are traditional generation plants that are run on a more continuous basis, Conectiv also operates certain plants, called "mid-merit" plants, that are rapidly brought on- and off-line in order to respond to daily, and sometimes hourly, changes in electricity demand. Conectiv has also begun building plants with a radically different culture and operational profile, where self-directed teams perform a wide range of functions that would otherwise be handled by a larger number of highly-specialized personnel.

While Conectiv's operational requirements may look complex, all the plants share a similar over-arching objective: maintain the different plants in a high state of readiness in order to run at optimal efficiency. "The technologies are different, and the staffing models are different," says Muller. "But in the end you want to maximize the use of maintenance dollars so that you are ready to run when called to."

Meeting Conectiv's complex maintenance and performance goals sent the company on a quest to find ways to extend the




## Your Mandate:

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# NRX Enterprise

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plant maintenance functionality in SAP's ERP system. While SAP's ERP Plant Maintenance was able to perform many of the functions needed by Conectiv to keep its plants operational, Conectiv was looking for a tool that would further improve plant maintenance while providing increased functionality that could be readily accessed by its casual and non-technical users.

Conectiv's goal was to improve overall intelligence about plant operations and maintenance, and use that information to empower its users. That goal in turn led the company to SAP partner NRX and its Asset Content Management (ACM) and Visual Information for Plants (VIP) products. ACM was used to build a catalog of physical assets and then link each piece of equipment to its relevant engineering, maintenance, parts and repair information, including what NRX calls a visual bill of materials. VIP, which is an SAP NetWeaver-certified composite application, provides the ability to directly link SAP's ERP Plant Maintenance module with the ACM and other real-time data regarding plant operations and maintenance.

"These tools allow companies such as Conectiv to use plant intelligence to achieve more output and get more electricity out the door," says Glenn Morell, chief technology officer at NRX. "There are a lot of dollars to be saved and earned from keeping these plants running."

Conectiv initially deployed the two NRX solutions at a newly-commissioned plant. ACM was used to catalog the plant's assets, build master data records for equipment and materials and build content and the visual BOMs. "Traditionally, capturing equipment information such as make, model and other characteristics was a manual process," says Muller. "Then you would sit down with SAP and create all the equipment records. It took a lot of manual effort.

"With ACM, our people mapped all the equipment on a laptop and plugged it into the ACM system," adds Muller. "That made them very efficient. We could do the plant walk down for less money and get more information. That was a sweet deal for us."

But the real payback came from leveraging the information in ACM and SAP PM with the other maintenance and operations information that VIP could make available to plant personnel. This link between VIP, SAP's ERP and other real-time plant systems meant that Conectiv could effectively provide information to plant personnel, extending the reach of the ERP investment and empowering users. This supports the small, self-directed work team culture. This new work culture requires that systems solutions deliver significantly more business and technical intelligence to Conectiv's staff to ensure that the plant operates at optimal capacity. "We need to give the teams the information and the freedom to perform their jobs," says Muller. "For them, information is an important tool."

*George Muller*

Conectiv uses NRX's VIP as an interface into the information stored in SAP's ERP system and in the NRX ACM system. The plant's users can see ACM manuals and parts diagrams, pick up SAP's ERP assignments and make reports without having to be experts in the details of SAP's ERP.

Leveraging this connection to SAP's ERP and its NetWeaver enterprise services architecture platform is what makes VIP so valuable, adds Muller. "This ability to have a common workplace that integrates across the different applications is essential," says Muller. "The power of what we're doing comes from NetWeaver."

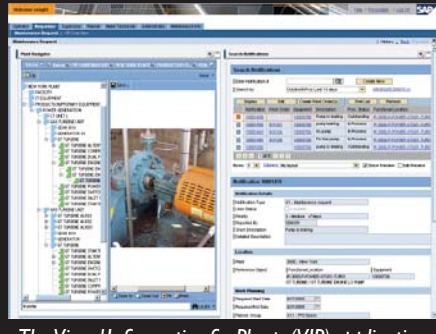
Conectiv is currently in the process of expanding its use of VIP and NetWeaver. One of the measures of the value of NRX and SAP is the endorsement that the new functionality has received from the individual plant managers, who are empowered, if necessary, to reject any technology that they feel doesn't suit their needs. "We went back after a year and asked them if they would still choose this method, and they said 'yes,'" Muller reports.

The bottom line for Conectiv is that it is now able to better use information to empower its users and render the company more efficient and, therefore, more competitive. "People are very good integrators of information," adds Muller. "You just need to get the right information in front of them." With NRX, SAP's ERP and NetWeaver, that need has finally been met.

## NRX'S TOOLS CREATE A VISUAL BOM

ACM is based on patent-pending technology that allows customers to build a complete library of visual bills of materials and technical documents – such as maintenance and operations manuals, engineering drawings, parts catalogs and training materials – for a given plant or set of plants and integrate it into the maintenance process. The product can sit on top of a standard document management system to leverage basic services such as shared storage and document lifecycle management, and can provide the knowledge management functionality necessary to link shop floor assets and spare parts to specific documentation.

ACM can have two major ramifications at a company. The first results from the audit that takes place as the technical library is constructed. Operations frequently find that the result of the ACM audit shows an important discrepancy between actual assets and what the company thinks is in its plants. Knowledge of the true content and value of plant assets can have an impact on maintenance and service costs as well as asset deployment.



*The Visual Information for Plants (VIP) application*

The more direct impact of ACM can come at the point of service or repair, when a field mechanic is confronted with a specific problem on a specific piece of equipment. ACM can provide that individual with equipment-specific information on operations and repairs, and find the exact replacement parts needed to complete a maintenance request. This can provide a significant savings in maintenance, repair and procurement costs, while improving the accuracy and efficiency of maintenance personnel. The end result is better quality of workmanship, shorter downtime and lower operating costs.

VIP, or Visual Information for Plants, is a composite application that integrates ACM and other plant-level information directly into SAP's ERP and mySAP Business Suite environment. VIP can link automation and control systems data to SAP and display that information in a portal using the SAP NetWeaver architecture. VIP can combine maintenance management and operational information for real-time diagnostics, as well as improve a company's ability to predict and prevent problems.

The use of a portal-based interface allows VIP to display information to a wide variety of users, depending on their roles and requirements. Planners can have a more integrated view of a work order, particularly one that includes information from SAP and non-SAP systems, using a single portal interface. Casual users that lack extensive SAP training and are unfamiliar with multiple shop floor systems can view aggregated information related to their specific functions without having to become experts in each system they need to access. This can improve system adoption and collaboration between plant management, operations, maintenance and supply chain teams.

# KEY STEPS TO BECOMING AN ADAPTIVE ENTERPRISE

**Assessing supply chain, ERP and other systems will get you started, but look at best practices and key performance measures as well.**

1 Assess your applications infrastructure. Is your applications infrastructure robust enough to support tight integration and business process interoperability between your ERP systems and your shop floor systems? You'll want your infrastructure to be able to handle the bulk of the integration requirements for your adaptive manufacturing environment, and to do so in a highly-scalable and reusable fashion.

2 Assess your supply chain management, manufacturing and ERP systems. Do they have the functionality you need to be more responsive to dynamic changes in supply and demand? How easy is it to get key information from your ERP, manufacturing and SCM systems in order to drive adaptive manufacturing metrics? How easy is it for you to link your ERP and SCM systems to shop floor automation systems? Does your ERP system support a robust integration and analytical framework?

3 Assess your ability to standardize on a single shop floor integration infrastructure. While it can be difficult to accomplish, a single integration infrastructure for shop floor functionality can significantly lower the cost and complexity of becoming an adaptive manufacturer.

4 Look for industry best practices and see how they can be applied to your company, and then look at how you can improve on them. Being able to measure your company's performance against your industry – and your competitors – is a good start. But to really succeed as an adaptive manufacturer, you need to know how to excel beyond what your competitors are already capable of doing.

5 Look for the key performance indicators that you need in order to become an adaptive manufacturing enterprise. Once you know what the best practices are, and what you need to do in order to exceed them, you'll need to build a rich set of KPIs that you can use to drive your company toward its goals. You need a solution in place to aggregate data from the plant floor and compute these KPIs on a real-time basis, if needed, to monitor, measure and improve your performance continuously. Being able to measure and compare performance across your assets and plants will help you benchmark best practices and identify underperforming assets.

6 Implement a quality management program, if you don't have one already. But be sure that your ERP system and applications infrastructure can support the business processes needed to meet your quality requirements. Programs such as Six Sigma can't reach their potential if they can't be linked directly to the key enterprise processes in your software environment.

7 Confer with and include your major internal stakeholders (such as your plant floor personnel). Make sure that everyone understands their role in moving toward becoming an adaptive manufacturer, and their KPIs, and then make sure that the new software environment makes it easy for them to fulfill their new role by delivering information as needed for right time decision support and exception-based management. Integrating software and processes without integrating people will doom your project to failure.

8 Move forcefully, but incrementally. You can't become an adaptive manufacturer overnight, so don't try. It's a journey as much as a destination, so act accordingly.

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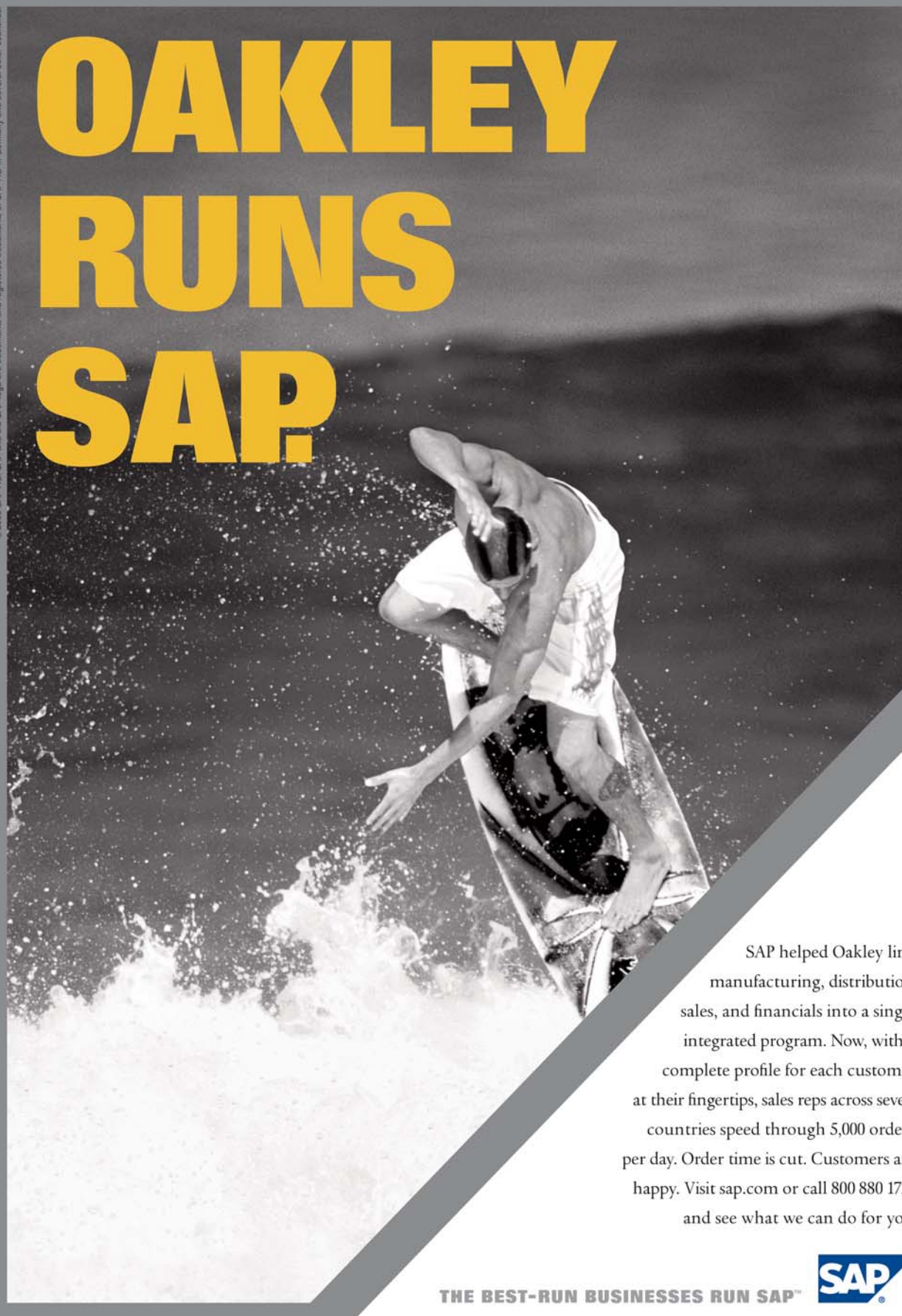

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