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Rolls-Royce embraces product lifecycle management as a means to lean

With more than 4,000 employees, **Rolls-Royce Corp**.'s Indianapolis plant is the aircraft-engine maker's largest production site in North America. Here, jet turbine engines are designed, developed, and manufactured for aircrafts as diverse as the F-35 Lightning II or Joint Strike Fighter; the V-22 'Osprey' tilt-rotor; the Cessna Citation X corporate jet; and the Lockheed Martin C-130J Hercules tactical aircraft.

Rolls-Royce is a world-leading provider of power systems and services in the civil and defense aerospace, marine, and ener-

gy markets. The company has more than 54,000 gas turbines in service worldwide, with more than 600 airline customers.

Underpinning the design, development, and manufacturing processes involved, says Matt Thomas, Rolls-Royce CAPP program manager, is product lifecycle management (PLM) software from **UGS PLM Software**, a division of Siemens Automation & Drives. The software solution allows the Indianapolis plant to start thinking in terms of lean well before actual plant-floor production ensues.
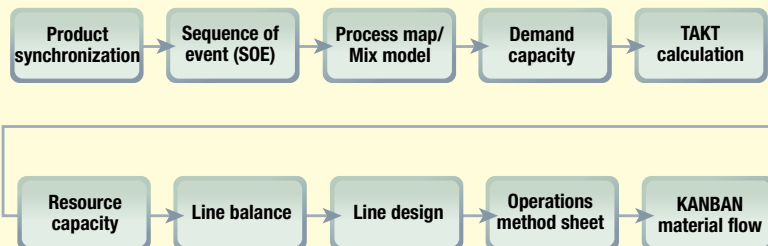
Typical lean capturing events

An accepted "best practice" method for implementing Lean production

A business strategy integrating tools and techniques to act synchronously, driven by customer demand

Reduces time and cost associated with new product introduction

Increases customer satisfaction

Product synchronization → Sequence of event (SOE) → Process map/ Mix model → Demand capacity → TAKT calculation

Resource capacity → Line balance → Line design → Operations method sheet → KANBAN material flow

Source: UGS

UGS Tecnomatix includes digital tools to model and simulate products and processes for accuracy and efficiency, and eliminating repeated trial-and-error methods associated with lean.

The power of digital tools to achieve lean

Alcatel Shanghai Bell uses digital manufacturing solutions to streamline multi-plant production

At telecommunications manufacturer **Alcatel Shanghai Bell**, headquartered in Shanghai, China, building lean principles into products and processes is critical to the way the company wants to do business.

Alcatel Shanghai Bell is a pioneer in China's telecommunications industry. It was born through the integration of the former Shanghai Bell and Alcatel's key business units in China. It delivers end-to-end telecommunications solutions covering fixed, mobile, and private communications markets.

As is well known, lean production aims at defining value, creating flow, and eliminating waste in every stage of the manufacturing enterprise, and most especially based on production tied to actual product demand.

"Getting it right the first time is very much part of our lean strategy—and also fundamental to driving down time-to-market metrics," says Manufacturing Director Zhu Jian, a multiyear veteran of the 6,500-employee business, and chairman of the China chapter of iNEMI, the International Electronics Manufacturing Initiative.

Jian says advanced digital manufacturing solutions from **UGS PLM Software**—as integral parts of Alcatel's global manufacturing system—contribute to both lean and time-

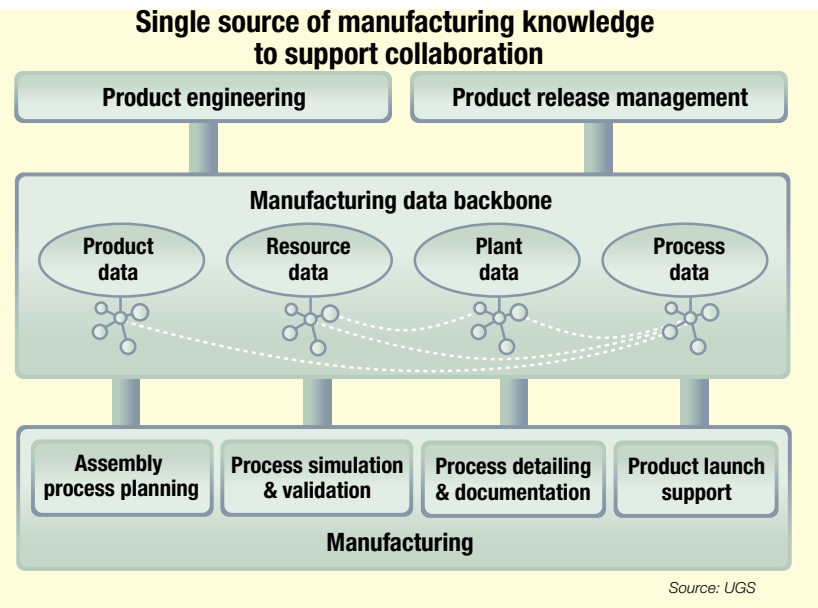# Rolls-Royce embraces product lifecycle management as a means to lean

Take component inspection, for example. "*How* you inspect an item is closely related to *where* you inspect it, and *which* items of tooling you use to undertake the inspection," says Thomas.

Therefore, even at the component design stage, Rolls-Royce has UGS Teamcenter, the world's most widely used product lifecycle management (PLM) solution, create tight linkages between the different data structures of three type bills—for materials, process, and plant—used by Rolls-Royce.

UGS Teamcenter not only creates and maintains those links it also publishes them to the factory floor in a ready-to-use, operator-friendly format that is error-free and up-to-date.

"Without waste or duplication, we deliver the right work instructions, at the right time, direct to the point of use, and with full flexibility to refine and change them," says Thomas. "We're entering data just once, and then reusing it many times."

By capturing, integrating, and controlling all product, process, manufacturing, and service knowledge in a single

Single source of manufacturing knowledge to support collaboration

Product engineering	Product release management

Manufacturing data backbone

Product data	Resource data	Plant data	Process data

Assembly process planning	Process simulation & validation	Process detailing & documentation	Product launch support

Manufacturing

Source: UGS

Product lifecycle management is a single source for product knowledge, and an integral part of efforts to eliminate waste, error, and duplication.

environment, UGS Teamcenter expands product knowledge management and process automation capabilities across an extended enterprise of departmental and divisional operations, partners, and suppliers.

Computer-based efficiency

Computer-aided design (CAD) technology has long been a

The power of digital tools to achieve lean

to-market improvement efforts.

UGS Tecnomatix links product engineering with the manufacturing disciplines, including process layout and design; process simulation/engineering; and production management. Tecnomatix bridges the gap between product design and product delivery by managing both manufacturing process design and execution in a fully associative data model.

The UGS Tecnomatix toolset is an open software platform that enables continuous process improvement and plant visibility based on a unified plant and process model. It also provides connectivity to a wide variety of shop floor devices, scanners, automated controllers, and OPC-compatible systems.

Alcatel Shanghai Bell will need capabilities like these to meet its objective of becoming the leading supplier to both the Chinese domestic market and the rest of the world with broadband, wireless, and mobile convergence telephony products.

Given a constant stream of real-time information, manufacturing systems produce masses of data. Synchronizing and reusing this knowledge reduces waste across manufacturing process domains and ensures the right data is available at the right time, contributing significantly to any company's lean efforts.

A trusted confirmation

"Concurrent engineering—with research & development [R&D], manufacturing, logistics, and procurement working closely together across the product life cycle—underpins much of what we do," says Jian.

While similar strategies are pursued by many electronic manufacturers, Jian says Alcatel Shanghai Bell takes it further than most, and does so in a way that neatly dovetails with the business' lean strategy.

"Even at the very earliest design stages—and across the extended enterprise, if necessary—R&D engineers and manufacturing engineers collaborate closely using the UGS Tecnomatix digital manufacturing toolset to take account of design-for-manufacturing and design-for-test considerations," says Jian.

At Alcatel Shanghai Bell, says Jian, "design-for-manufacturing and design-for-test aren't 'bolt-on' extras—they're key parts of a truly lean process. Instead of doing things several times over to get them right, wasting time and consuming resources, we avoid a lot of potential mistakes by trapping them before we launch into production. We do this not sequentially and inefficiently after the design process, but in parallel and efficiently."

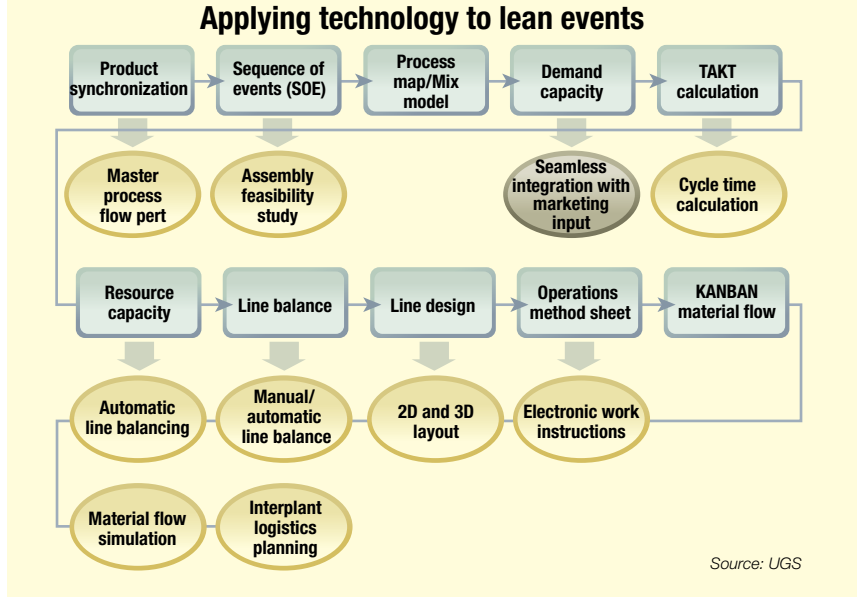UGS Tecnomatix includes digital tools to model and simu-

major part of the Rolls-Royce Indianapolis operation. But UGS Teamcenter allows Rolls-Royce to take advantage of CAD-derived digital design data in new and innovative ways, linking drawings with routing information, work instructions, plant details, and relevant resource information regarding fixtures, gauges, and tooling.

"UGS Teamcenter delivers the process plan to the factory floor," adds Thomas. "At each stage in the manufacturing process, it helps us specify what's to be done, how it's to be done, and where it's to be undertaken."

Manufacturers today see the major software platforms as being an integral part of their lean initiatives. No one switching to lean-based production, for example, would do so without taking into account how they will record transactions to the ERP system. Even more importantly, PLM is the single source for product knowledge, and it can—and must be—an integral part of efforts to eliminate waste, error, and duplication.

Use and reuse

At Rolls-Royce, UGS Teamcenter is the means to plan and manage production processes, resources, operations, and facilities to eliminate waste, error, and

Applying technology to lean events

Product synchronization → Sequence of events (SOE) → Process map/Mix model → Demand capacity → TAKT calculation

Master process flow pert | Assembly feasibility study | Seamless integration with marketing input | Cycle time calculation

Resource capacity → Line balance → Line design → Operations method sheet → KANBAN material flow

Automatic line balancing | Manual/automatic line balance | 2D and 3D layout | Electronic work instructions

Material flow simulation | Interplant logistics planning

Source: UGS

By capturing, integrating, and controlling all product, process, and production knowledge, UGS TeamCenter expands knowledge across an extended enterprise.

duplication. It also is the means to reconcile what's planned and what actually happens, as that too is part of the linkages PLM makes possible.

In this manner, and by means of the central process repository for design, planning, and process data, UGS Teamcenter not only makes knowledge available for new line and workstation design, but also allows standardized pro-

cesses and best practices to be both reused and further leveraged to deliver lean thinking across departments and the extended enterprise.

In other words, lean best practices, once defined, is not only readily repeatable, but repeatable in a manner that is both lean and efficient.

"Think of it as value-engineering the

The Powers you gain to exploit lean production

The *enterprise bill* of process at the heart of the **UGS Tecnomatix** digital manufacturing solution helps manufacturers achieve lean production—within the context of the all-important new product introduction (NPI) process—in two very different ways.

First, there's the opportunity to embed lean thinking and best practices into the manufacturing process right from the start—when a new production facility, production line, or assembly cell is first designed.

Then, once the cell, facility, or line is running, the *enterprise bill of structure* and *enterprise bill of material*—both core parts, along with the enterprise bill of process, of UGS Tecnomatix—can ensure that the products being manufactured use as many lean constructs as possible.

To start, it's the role of the enterprise bill of process to ensure the production facility itself is as lean as possible. This is done by means of a central repository for line and workstation design, including design, planning, and process data. This **single source of Manufacturing Knowledge** allows for standard processes and best practices to be reused and reincorporated in fresh ways, and potentially focuses on lean manufacturing as standard. It gives companies **Greater Control** to harness knowledge, thus giving them a competitive advantage in the global landscape.

This central process repository includes "what-if" scenarios—to test alternative kaizen proposals, for example—but also production

scenarios applicable to different geographies and economic conditions. In addition, it provides the ability to view and collaborate on all levels of the organization—**Top-floor-to-shop-floor Collaboration**—so as to adapt to customer demands faster due to decisions based on facts.

A global manufacturer, for instance, might elect to have a more labor-intensive assembly method on file within the enterprise bill of process—for use in countries such as India and China—and a more capital-intensive one for use in more developed economies. Each, of course, would be proven best practice for the particular economic conditions, providing **Greater Insight** to facilitate the decision-making process.

The second way UGS Tecnomatix helps manufacturers achieve lean production, in the context of new product introductions, is through its **proven solutions for process optimization**—which facilitate new product introductions onto existing production lines and achieve **Greater Speed**.

With lean, multi-product assembly lines increasingly common, UGS Tecnomatix digital pre-assembly verification can provide assurance that multiple products can co-exist on the same line, without disrupting line performance.

According to UGS PLM Software, customers can verify that the manufacture of new products can be done within the constraints of existing products, and they accomplish all this digitally, without physically touching the line itself. ∎

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manufacturing process from a lean perspective," says Rolls-Royce's Thomas. "We get a double benefit: the drawings or instructions that manufacturing engineers are reusing are accurate, error-free, and known to be best practice; and the very act of reuse frees up engineers' time to do more valuable work."

At Rolls-Royce Indianapolis, UGS PLM Software supports design engineers, manufacturing engineers, and manufacturing factory-floor personnel working together as a virtual team, collaboratively drawing upon a common central process repository to define and refine manufacturing instructions—and in the process demonstrably eliminating waste, error, and duplication.

If that's not lean production, what is? ∎

The power of digital tools to achieve lean

late products and processes for accuracy and efficiency—eliminating the repeated trial-and-error improvement cycles associated with traditional lean methods.

The effect, according to UGS PLM Software, is to "lean-out" lean manufacturing itself. From simulating how kaizen team suggestions will work in practice, to delivering "a single source of the truth" to the factory floor; and from trapping performance metrics at the execution layer, to building a central repository of process knowledge for persistent value-stream mapping, UGS Tecnomatix has the power to turn lean aspirations into lean reality.

Using simulation and modeling driven by shop-floor data capture, kaizen-led improvements can hit the factory-floor on a first-time-right basis. The result is a true end-to-end lifecycle management solution, inherently lean because it closes the loop between intention and action.

Fed by real factory-floor data, the simulation and modeling capabilities of UGS Tecnomatix supports lean in ways that include the following:

• Analyze throughput and bottlenecks;
• Map and improve factory and line layout, and production flow;
• Reduce set-up times through better process analysis;
• Analyze workplace designs from a logistical and ergonomic perspective;
• Calculate and optimize Kanban sizes;
• Analyze drivers of process cost; and
• Optimize the movement and placement of resources.

For a large portion of the global manufacturing community, the challenge is to build lean thinking and practice into the bedrock of the business—not attempt to "fire-fight" lean into existence through dozens of disparate initiatives aimed at tackling symptoms, and not the underlying problems.

Lean in a digital framework

Alcatel Shanghai Bell leverages UGS Tecnomatix in its lean efforts as well.

While a wide range of technology vendors offer similar systems and functionality to UGS Tecnomatix, Jian says, "As a global business, Alcatel wants a global vendor that can support its operations worldwide."

Just as important, the UGS Tecnomatix solution covers a broad subset of Alcatel Shanghai Bell's manufacturing operations—not just surface-mount operations, or manual assembly, as some vendors' offerings do, but operations as diverse as functional-test and system-test as well.

The tight integration across the UGS Tecnomatix digital manufacturing toolset allows Alcatel Shanghai Bell to "close the loop" and transmit information about issues vital to the plant floor back to engineering where it can influence ongoing product design, as well as component assembly, manufacture, and test procedures.

Results across the board

First used in printed circuit-board assembly, UGS Tecnomatix tools collect and analyze test and inspection data, as well as data from pick-and-place machines. In addition to part-traceability and work-in-progress management, the solution allows materials verification—with obvious lean relevance—and reporting via both a management dashboard and drill-down engineering reports.

A broader rollout followed as Alcatel Shanghai Bell management recognized the scale of improvement they were experiencing.

"UGS Tecnomatix digital-manufacturing technology allowed us to optimize our shop-floor processes around lean principles by uniting 5-'S', Six Sigma, and just-in-time methods in a single software platform," says Jian. "As a result, manufacturing processes can be re-engineered for more effective quality control and greater production efficiency."

In addition, he points out, "Utilizing data collected from the shop floor provides useful information to both the management team and line operators with real-time key performance indices. That provides a single version of the truth to the staff and enables a Lean Six Sigma focus on performance improvement."

With the solutions now found across Alcatel Shanghai Bell's operations, the company has seen improvements in many key performance indicators. Production costs and product lead times have dropped while on-time delivery rates improved. The first-pass rate is higher, while inventory and scrap have been reduced.

While exact "before-and-after" comparisons are difficult, given substantial product-mix changes that have occurred since UGS Tecnomatix came on the scene, the return on investment has been considerable.

"We estimate that our return on investment took around 15 months—but that is likely a conservative estimate," says Jian, "and one that excludes all the 'soft' improvements that digital manufacturing and enhanced lean production enables."∎

To learn more, visit:
http://www.ugs.com/products/tecnomatix/