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# AEROSPACE ENGINEERING

## Shop Floor Information Solutions



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# WORKING the floor

*Automated data-capture technologies can obtain, validate, and process time, labor, and other information for improved productivity and efficiency in aerospace manufacturing.*

Over the last two decades, the deregulation of the commercial airline industry, rising military procurement costs, and declining military sales have combined to shake up the world of aerospace manufacturing. Low margins, production delays on new aircraft, and poor returns on investment signaled the need to implement dramatic improvements in manufacturing efficiencies.

A key early milestone in addressing this challenge was the formation of the Lean Aerospace Initiative (LAI) at the **Massachusetts Institute of Technology (MIT)** in 1993 to begin applying the principals of “lean manufacturing” to the aerospace industry. Lean manufacturing in North America was launched by James Womack, Daniel Jones, Daniel Roos, and others at MIT through the International Motor Vehicle Program (IMVP), a five-year, \$5 million research project directed at identifying production factors leading to success in the global automobile manufacturing industry.

The LAI, sponsored by a consortium of large aerospace manufacturers, developed models to help implement lean practices throughout the aerospace supply chain. Over the past decade, the LAI and its corporate supporters have started to implement lean production models in aerospace and see productivity gains in the process.

**Lockheed Martin Aeronautics (LMA)**, an LAI member, was able to reduce the production cycle times of its Atlas III booster from 48 months to 24, and reduced the parts required for each rocket by 11,000. In effect, it was able to double its production capacity and reduce its cycle time and cost without doubling the facility size. Another LAI member, the **Boeing Commercial Airplane Group** in Wichita, was facing a significant jump in demand for its planes and needed to improve production speed

and efficiencies in the costs involved in its 737-fuselage production line. In this particular initiative, the company achieved a 50% reduction in labor hours per unit and a 25% decrease in unit cost.

“Given the competitive pressure in the aerospace markets for price reductions and ongoing operational cost controls, the application of lean techniques by manufacturers is essential for their margins and profits to improve,” said Jacek Lipowski, Chief Technology Officer, **Epic Data**, a global provider of lean data-capture software and technologies for companies such as Lockheed Martin, **Raytheon**, Boeing, and **Bell Helicopter**.

## Paperwork and forms

Data capture is any kind of information-gathering—time and attendance, tool tracking, inventory, receiving, materials, vendors, or the supply chain—needed to manage the value-production process. In the past, much of this has been done by way of handwritten notes and paper forms that are later entered into the ERP system manually.

According to Lipowski, data capture’s involvement in lean manufacturing is comprised of two aspects. It first helps the organization to understand its production weaknesses by quantifying the inefficiencies and waste in each business process by pinpointing where wasteful transactions might be bundled or eliminated. The second benefit is gained by applying data-capture technologies within the process to wring out the non-value-added paper shuffling that often delays production and adds expense.

Automated data-capture technologies include the use of bar code or magnetic-stripe identifiers for each part, inventory piece, employee, workstation, process, and

supplier—essentially anything that needs to be identified and tracked. It also includes the development of software to manage this information and make it accessible to decision-makers at various levels of the company by connecting it directly to the ERP system. Handheld units or fixed stations that scan the bar codes comprise the system’s hardware. If the system is wireless and allows the employee to roam about the factory floor with handheld scanners, RFID antennae will typically be stationed throughout the plant to acquire the signals from the portable units.

Apart from being used to speed up a wide variety of warehouse and manufacture transactions including receiving, picking, materials transfer, replenishment, tool tracking, warehouse management, and vendors/supply chain management, these systems can reduce the extra transaction costs accompanying the regulatory and military procurement “paperwork” requirements that aerospace manufacturers must fulfill.

## Audit control

Data-capture systems are well established with larger manufacturers. Such systems have been in use since the 1980s at Bell Helicopter, where meeting both external and internal requirements for the tracking of labor and materials now involves the electronic management of some 60 different kinds of transactions, including time and attendance clocking, inventory management, tool tracking, material time tracking of perishable composite material, and labor project tracking.

“Aerospace regulatory requirements greatly increase the amount of record-keeping that must be conducted by manufacturers,” said Lipowski. “Automating these data-capture processes reduces the

overhead costs involved in acquiring and storing this information.”

In Bell's system, which the company recently upgraded, employees must swipe their employee cards through a scanning unit whenever they work on a different project during the workday. This step enables the automatic assignment of the labor costs to a particular project's accounting stream, allowing the internal audit team to review up-to-date project cost statistics in real time. It also gives project supervisors the ability to set limits on how much time a particular employee



*Bar code scanning reduces the workload involved in data-intensive tasks such as tracking inbound inventory and managing material, vehicles, and equipment. Shown is the PDT 7200 portable data terminal from Symbol Technologies, which was designed to withstand the extreme environments found in heavy manufacturing. (Photo courtesy Symbol Technologies.)*

can spend on any one project, creating a significant cost-management structure.

The data-collection system's detailed reporting of all work performed is essential for the company to meet the stringent reporting and audit records required of **Department of Defense** contractors. In addition, it helps the company comply with **FAA** regulations on tracking the manufacturing, distribution, and usage of aviation parts. For example, to capture this information automatically on the manufacturing side, each part has a traveler part number on it that matches up with a bar code for each task performed on the part, allowing the regulator and manufacturer to track the origin of any particular part. After the manufacturing process is completed, the information is then stored and available to help analyze the cost structure of the manufacturing process, or to perform vital cost and performance analyses. These can include evaluating vendor performance and delivery times, or other applications mandated by management.

#### **Radio frequency identification**

The rationale for instituting a data-capture system is quite simple: automating the capture and transmission of data information reduces the cost of moving



*In warehouse and distribution environments, some bar code scanners (like the RS 1 Ring Scanner from Symbol pictured here) are suitable for shipping and receiving, order picking, and inventories/cycle counts. Applications for data capture include tracking work in process and managing cross-dock transfers. (Photo courtesy Symbol Technologies.)*

that information around. LMA has been using magnetic-stripe cards to control access to computer workstations and high-tech equipment on the shop floor for some time. However, the company recently decided to upgrade to RFID (radio frequency identification) and Epic's Java-based eXpresso data collection platform at its plants in Dallas-Fort Worth; Marietta, GA; and Palmdale, CA. One benefit of the eXpresso platform is that it enables the customization of the company's applications to fit its unique business processes, instead of the other way around.

“The enabling technology will allow customers to develop custom applications that will drive information to those who need it, further enhancing the speed and quality of work on the production line,” said Lipowski. Another benefit is that it

## **Two-way information transmission**

eXpresso is Epic Data's latest development in data-capture software, now being rolled out to long-time customers such as Lockheed Martin and **CAE**.

“To improve productivity, an enterprise needs greatly expanded access to current information for decision-makers and staff at all levels of the company, so that they can make better decisions about how to become more productive,” said Lipowski. “That's a step forward for companies interested in improving productivity.”

Basically, eXpresso is a Java-based software platform that enables synchronization of data, real-time

links, and the smooth flow of corporate information to any device or system within the organization. The product can be customized by Epic or “the customer has the ability to adapt the software to fit his or her business processes, not the other way around,” said Lipowski. “It provides significant flexibility and the ability to distribute information anywhere in the company and to any device in real time without problems crossing software systems.”

Epic's rugged new shop-floor RFID readers have a large screen that allows employees to access corporate intranet information such as policy

and procedures, safety regulations, and the corporate phone book—essentially, any information the organization believes is needed on the shop floor. The end result is that the company's library of knowledge and experience is made more readily available to all employees.

“Given the critical importance to the corporation of its knowledge management system, two-way information transmission is where data-capture technologies are headed,” said Lipowski.

## RFID and the future of manufacturing

RFID is a generic term for technologies that use radio waves to automatically identify individual items. An RFID tag (containing a microchip and antenna to transmit information to the ERP system) is attached to an individual product or item. Information is transmitted via low-frequency radio waves to a "reader" and then converted to digital data.

RFID technology is not necessarily better than using bar codes to identify products, but there are some advantages to RFID tags. The big difference between the two is that bar codes are a line-of-sight

technology that a scanner has to "see" to read. RFID tags, on the other hand, can be read as long as they are within range of a reader. Bar codes can be damaged, making scanning impossible. RFID tags can be read through plastic, and so can be encased in a protective covering for weatherproofing and greater durability. And tags have microchips that can store a unique serial number so that individual items can be tracked and located.

Kodak has been using RFID for a number of years to track reusable containers in its manufacturing facilities.

In addition to helping in the location of units, the technology can help improve supply-chain efficiency. The key factor in extending RFIDs' usage will be in reducing the cost of tags and expanding their applications. The expanded take-up of wireless data-capture technologies (untethered scanning units) that is occurring now will pave the way for the new RFID technologies. "We foresee RFID technologies and bar codes being used together widely as technological applications are developed over time," said Lipowski.

will allow the organization to unify its various standalone systems.

"In producing advanced aircraft, it's essential to record and validate details of all work performed, as it occurs," said Jack Guthrie, Program Manager, Lockheed. "We need to do this without creating additional overhead. The move to eXpresso will bring our various standalone systems under a unified and much more efficient communications umbrella."

Epic Data is installing its MPT 9100 advanced data collection terminal throughout a number of LMA plants. The MPT 9100 features a full-screen color 10 by 6 inch VGA display with built-in touch screen capability. The MPT 9100 enables companies to make "corporate knowledge" directly available to shop floor operators. Information such as due-date sequenced work order and graphical work instructions are displayed right at the factory cell.

Epic's eXpresso software platform requires shop-floor workers to use their card to obtain authorization to operate the equipment—then it automatically records the processes that are performed. The sys-



*Epic Data's MPT 9100 terminal system implemented at Lockheed Martin features a full-color, 10- x 6-in VGA touchscreen able to present information such as graphical work procedures and CAD drawings to employees on the shop floor. Previous systems offered no inbound information and no access to the corporate intranet.*

tem can track more than 3500 simultaneous users and record labor against work instructions in real time using the fixed-mount data-collection terminals and RFID proximity readers. It will also support more than 60 other transaction applications, including tracking of thousands of tools in LMA's production plants.

Employees are being offered new ID badges with a low-frequency (125 kHz) RFID chip embedded in them. Instead of swiping the card through a reader, users now have only to wave the card near the reader. RFID is useful for controlling physical access to the building. Another issue is expanding lean manufacturing concepts.

"One of the goals in lean manufacturing is the focus on removing any actions that don't add value," said Russ Beinder, Director of Product Management, Epic Data, in an

interview with *RFID Journal*. "Every time you have to pick up a gun and scan a bar code to record a part, you have just done a non-value-added job. We're looking for ways to avoid those kinds of activities, and I see RFID tags being pivotal in that process."

Tracking work in progress is not just critical to high-tech airplane manufacturers like Lockheed. Knowing when steps were performed, by whom, and when gives managers the ability to monitor, evaluate, and improve the efficiency of any factory. "Other types of manufacturers might not need the same level of detail (as Lockheed)," says Beinder. "But as soon as you want to understand the performance of your factory, this kind of information becomes critical."

Giving employees immediate access to more and better information empowers them to get involved in developing more efficient and logical ways of doing things—and ultimately that means an even leaner operation.

This article was written for *Aerospace Engineering* by Steve Campbell.



*The use of bar code scanners or employee card readers such as Symbol's PDT 6800 can help simplify the labor-intensive exercise of tracking project costs by requiring staff to check in and out when they work on a specific project, making it easier for the accounting department and internal and external auditors to review. (Photo courtesy Symbol Technologies.)*