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# FROM COST CENTER TO REVENUE GENERATOR: LEAN WORKS AT DELTA AIR LINES ENGINE MAINTENANCE

**I**n a time when airline travel has declined, Delta's Engine Maintenance is growing instead of cutting back. The new customer base they are developing not only provides income, but also job security for those working in engine maintenance.

Within a two-year period, Delta's Engine Maintenance in Atlanta, Georgia has begun the journey from one of the airline's highest cost centers to generating revenue for the company, servicing Delta as well as other airlines. A team from The University of Tennessee, headed by Dr. Tom Greenwood, founder of the Lean Enterprise Forum and President of Lean Works Consulting Firm, worked together with the team at Delta's Engine Maintenance to create a flexible lean system for engine repair and overhaul.

Beginning in the Fall of 2000, Delta followed a structured process called the *Lean Implementation System*, which has certainly paid off. Delta's Engine Maintenance has successfully grown their business by taking in nearly 100 engines from additional new customers. In the last year, the new business model has reduced their turnaround on some engines by half while reducing unnecessary inventory.

## ENGINE MAINTENANCE AS A COST CENTER

Engine Maintenance used to work exclusively for Delta Air Lines, servicing engines, APUs, landing gear, and thrust reversers. With the expense of purchasing and storing the machined parts required to have on hand, their costs were high and the work they performed was very time sensitive or under strict demand for turn around times.


Even though their operational performance and productivity were equal to or better than their peers in the industry, Delta was not producing at the rates and at the level of consistency that they desired.

Operating with a centralized machine shop, plating shop, and cleaning shops caused part of the problem, because all of the parts were funneled through these departments creating bottlenecks in productivity flow. Even though most of their schedules were being met, they were falling behind on too many orders. Production was sporadic and turn times were inconsistent, forcing maintenance to keep excess inventory and spares on hand.

## NEW CUSTOMERS—NEW BUSINESS MODEL

Because of Delta's reputation for quality and safety, they had been approached by other airlines for engine maintenance. Delta saw this as a great opportunity to generate income and to grow the business.

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The time was right to take on new customers. Delta was in the process of retiring its three-engine planes and building a fleet of two-engine planes. This would decrease the overall volume of Delta engines coming into the shops, offering space and manpower to handle the new workload. However, they knew that they could not successfully grow the business to accommodate new customers while under their existing model.

In the past, Delta's Engine Maintenance had tried several manufacturing systems (JIT, etc.) but nothing had produced the level of desired results. They needed a new system that would ensure more consistent turn times, offer lower costs, decrease excess inventory, and uphold the quality of the products. In their search for a system, Lean was brought to the table and appeared to be a good fit for their process.

## LEAN TRAINING

Once the decision was made to pursue a lean system, Delta sent their people to the lean program at the University of Tennessee, Knoxville. "We knew that this system would not be a 'flavor of the day'. We knew it would deliver," recalled Ron Cherry, Director of Engine Maintenance, "We are very pleased with the training we received there."

They immediately noticed a difference in this approach to lean. The Lean Implementation System encompasses the entire business, not just operations. This was especially appealing to Delta, because they wanted to take lean to the enterprise level by incorporating their customers and suppliers—to make them part of the success.

## ON-SITE IMPLEMENTATION

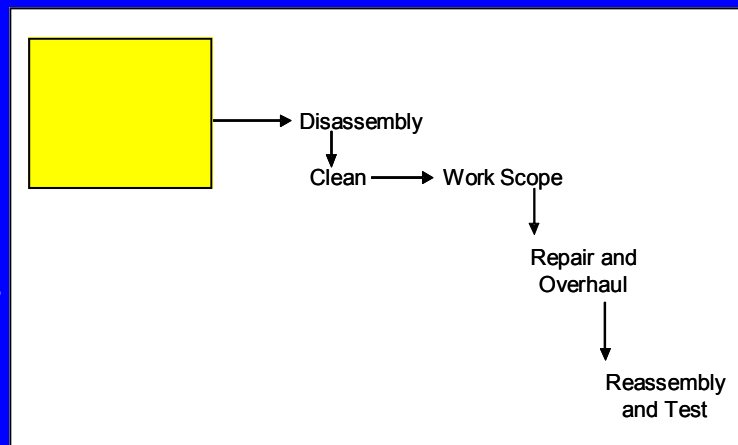
After completing the coursework at the university, Greenwood and his team of Lean Facilitators made trips to Atlanta to assist in the on-site implementation of Lean. "The support has been wonderful. The team came to Atlanta to help us adapt lean to overhaul and repair, as well as help with on-site implementation," states Cherry.

To make the transition to lean go more smoothly, Delta, established a Lean Implementation Team and appointed a local driver to put the team in place and began taking the steps toward implementation.

## HOW DID DELTA USE LEAN TO CREATE A NEW BUSINESS MODEL?

### LET'S TAKE A LOOK...

In Delta's traditional repair and overhaul, each engine was disassembled and the individual parts moved through the system for cleaning, work scope and repair. Component parts were scheduled into dedicated repair shops for repair or overhaul and returned to the engine. Then all of the parts were reassembled, tested, and the engine was ready after an average of 50 to 70 days.



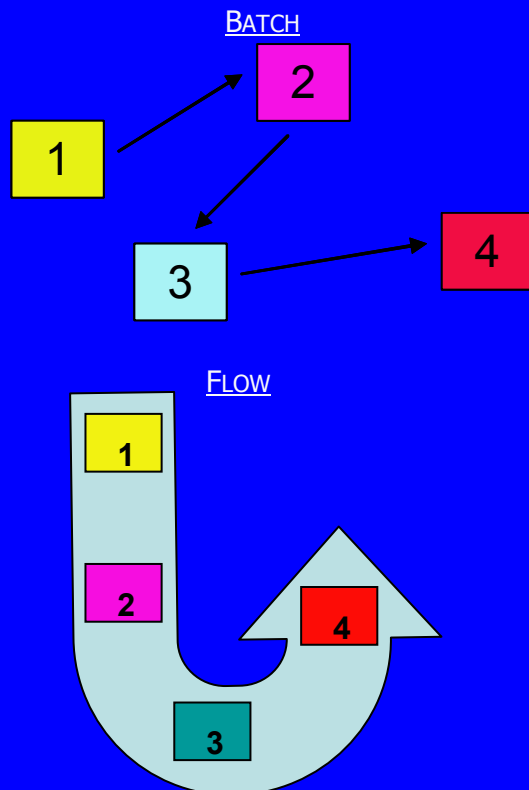
WE WILL NOW DISCUSS HOW DELTA'S NEW BUSINESS MODEL USED THE KEY PRINCIPLES OF LEAN:

## #1. FLOW

Once you pick up a part, do not set it down again until you hand it to your customer...

In this case, Delta wanted to ensure they enabled flow in all segments of the repair and overhaul process. This meant physical flow cells were established for Disassembly and Assembly functions for each engine type. Flow times were reviewed at each area instead of watching only due dates.

### FROM BATCH TO FLOW



## PUTTING LEAN TO THE TEST

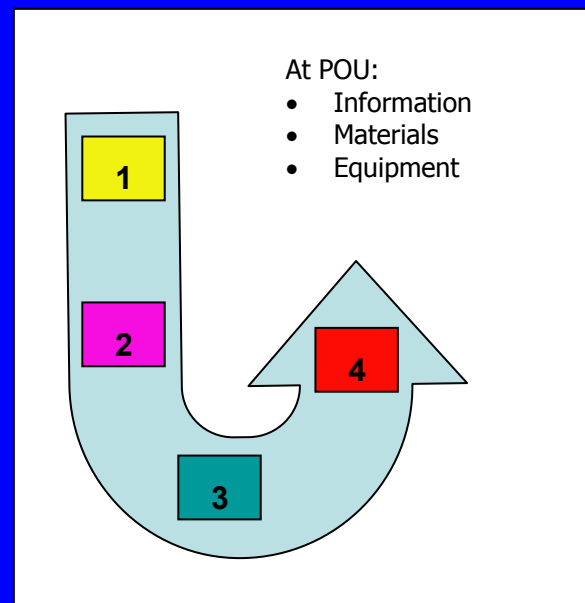
Now, it was time to put lean to the test. Engine Maintenance took their toughest engine and decided to attack it first—the Pratt Whitney 2037. Before implementing lean, they were having trouble with long turn-times for the repair of this engine.

Delta was pleased with the results. Cherry recalls, “We addressed that shop first. It showed significant success in a short time frame—within 90 days.” Delta drastically reduced the turn-time for the 2037. What once took more than 70 days, now takes between 28 and 40 days, depending on the amount of capacity in the shop.

## #2. POINT OF USE

Place everything you need at POU...

In order to support Flow, Delta made sure that all necessary “things” (parts, information, equipment, fixtures, etc.) were provided at the Point Of Use (POU) along the flow path.



## THE SPREAD OF SUCCESS

Originally there was reluctance from those on the shop floor because they had been a part of other systems that did not work. The operators had a “how long will this one last” attitude. Then, with the success of the 2037 and the long-term potential of lean, the buy in actually came easier than anticipated.

In addition to the success of the 2037, lean offered something that the other systems did not—a level of ownership by those working on the shop floor. The operators were an active part of the process; it was their shop where they were the owners.

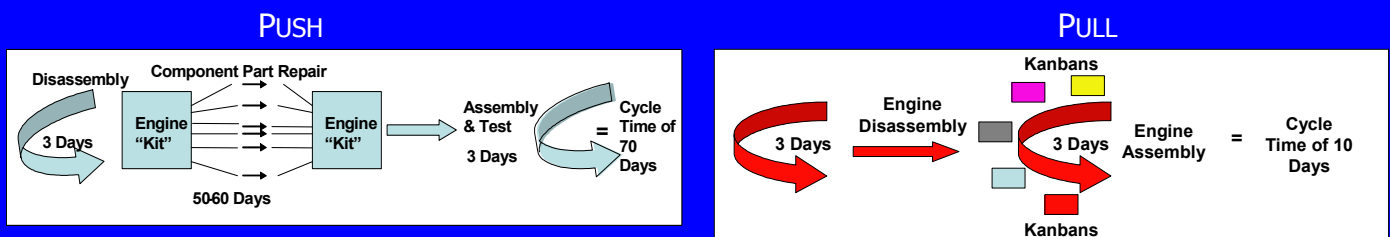
“Lean always left the technicians with a high level of awareness. They have pride in their work and what they have done, especially when we bring visitors in to tour the shops. We turn it over to those who run the shop. The visitors are impressed by the level of knowledge and involvement of those in the shop, and they have great pride in that,” Cherry explains.

### #3. PULL

Take one, make one...

The use of Pull represented a fundamentally new capability that changed the business from Repair and Overhaul more towards the concept of re-manufacturing. What this means is a dramatic reduction in lead time by moving from push to pull for specific engine components.

The idea is this: instead of disassembling each engine and scheduling the piece parts to return to that engine, there is a new process. Kanbans (a set quantity of serviceable, repaired engine components) are established in advance. Then, when unserviceable parts are identified, replacement parts are simply pulled from the Kanban at the point of use in the assembly cell. The engine is then reassembled, tested, and ready to go. There is no lengthy wait for components to be repaired. This is because the component parts are later repaired to replace the Kanban part that was used but without holding up the engine. The impact on customer wait time (engine turnaround time) is dramatic!



## ENGINE MAINTENANCE TODAY

**E**ngine Maintenance is still in the process of implementing lean across its site. Several shops have fully implemented lean, while others are more than half way there.

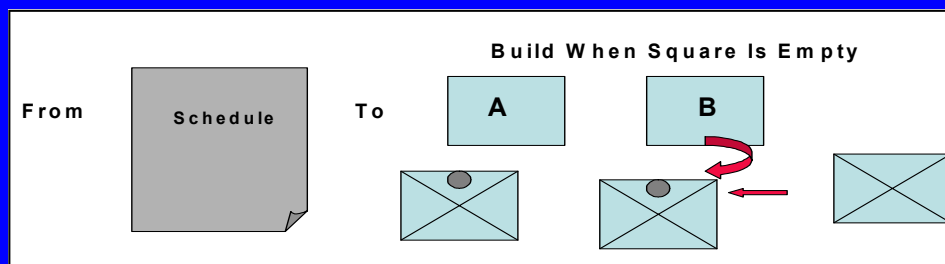
Delta nearly doubled the number of customer engines serviced last year. Cherry attributes their success to their new lean system, “Lean has given us a great competitive advantage. This has helped to draw people to our business.”

Now, “we only use what is needed and we manage our manpower more efficiently. Because the necessary parts are in the system, we work only what is needed, so we move them faster and we utilize our manpower and our equipment more efficiently. They have not reached the point where they are completely off setting their costs across the board, but some shops are near this goal,” Cherry explains, “We are in a good position now to grow the business with full support. We have gone from one of the highest leaders in cost to generating revenue and we are not done yet. Within the next year, we still expect to keep growing.”

### #4. VISUAL CONTROL AND QUALITY

In Lean, there is a significant emphasis placed on moving all quality tests to the Point Of Use (POU) and never allowing a defective unit to be passed down stream. We also want to use physical signals to communicate activity, not schedules and reports. In traditional businesses, synchronous schedules are sent to several departments and the modules or sub-assemblies are married together down stream. The problem with the traditional system is that different modules have different takt times and/or complexity variations, as well as normal problems in the plant (i.e. downtime) that cause the modules to rarely be married up at the correct times. In a Pull system, in-process Kanbans or work-in-process are put in place throughout the process and used as a signal for production.

#### FROM SCHEDULE DRIVEN PRODUCTION TO VISUAL PULL SIGNALS



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