



*Aircraft structural components are assembled in lean assembly cells.*

# LEAN MACHINING — INTEGRATING THE SUPPLY CHAIN

*Cox Machine demonstrates the benefits of a tightly-managed supply chain, from customer to materials to finishing to end product*

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In the aviation cluster of Wichita, Kansas, Cox Machine has been producing aerospace machined components for almost 60 years. Founded by Ernest “Bud” Cox in his garage, the company has grown to 180 employees and roughly \$28M in revenue. Cox’s primary products are structural components and assemblies, and it produces products through machining or sheetmetal fabrication.

Cox Machine has always embraced lean principles, but after joining the Supplier Excellence Alliance (SEA) in 2007 it began to standardize and measure its lean manufacturing system. Cox developed repeatable processes for strategic planning, workforce development, and leadership communication. One particular focus, operational excellence, includes traditional lean initiatives like 5S, Kaizen events, and cellular manu-

## Lean Manufacturing

facturing. All of these things can be used to reduce cycle time, improve flow through, reduce inventory levels, and build cash.

At Cox, inventory turns have increased from under four in 2007 to around seven today. This has generated cash to upgrade or replace existing equipment, expand the company's footprint, and generally increase investments in our capabilities.

### Starting at the Beginning

One of the most important aspects of inventory reduction is the transactional relationship with the customer. If a customer is issuing traditional purchase orders for exact quantities, reducing lot sizes becomes much less powerful. With customers that have moved to min-max, ship trigger, or Kanban systems, Cox has the flexibility to set its own run sizes and adjust lead times internally to best support their inventory levels.

For this to be successful, a high level of integration is required between the local MRP system and the customer's



**Parts are inspected against a solid model on the manufacturing floor.**

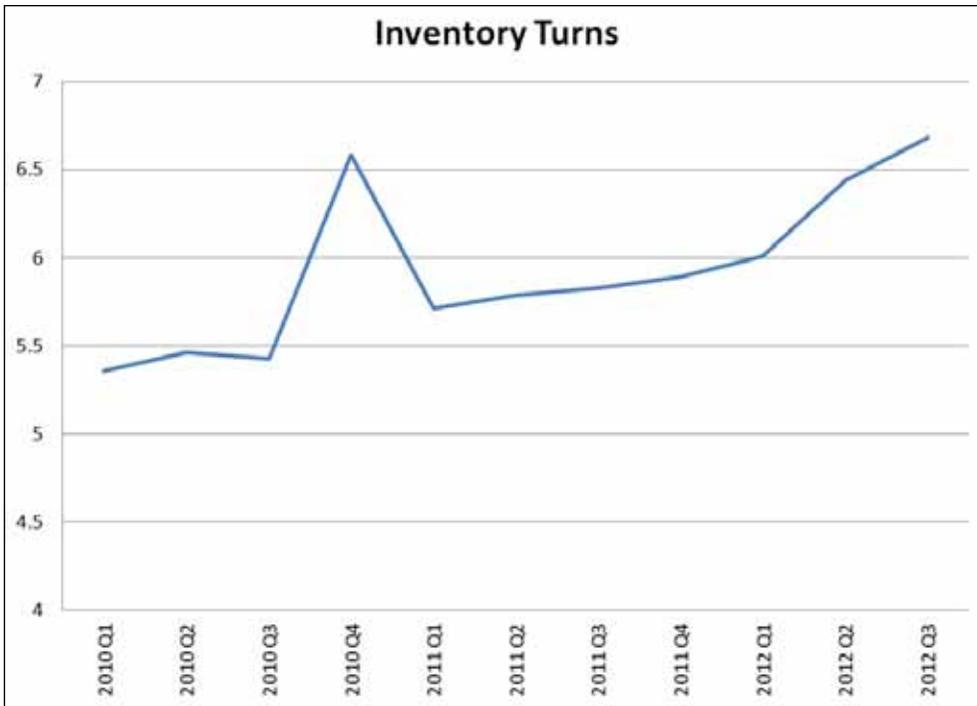
forecasts and inventory levels, and of course, the result of the process is only as good as the data going into it.

Once the customer's transactional relationship has been established, the supply-chain process begins with the raw material supplier. The goal at Cox is to have the material delivered three days before the machining operation, which can be a constantly moving target due to fluctuations in forecast and inventory levels.

### Just-in-Time Materials

Cox has had the most success with suppliers that are able to utilize a forecast that Cox provides, which is derived from the forecast that the customer provides. Bringing in the material Just-In-Time reduces the work-in-process inventory which reduces the cash required to operate. After the material arrives and is inspected, Cox delivers it directly to the machine cell, avoiding a non-value-added stop in a storage warehouse.

At the machine cell, Cox uses two or three machines in a one-piece-flow



**Inventory turns have increased since 2010.**

methodology. Since multiple spindles are cutting on the same job at the same time, overall lead time for the job is shortened. It is shortened even further by having the cell operator deburr and inspect his parts, avoiding a second or third staging location and process. This takes several days out of each job, again reducing work-in-process inventory.

**Integrated Communications**

Once the machining or fabrication operation has been completed, Cox sends most of its products outside for some type of coating process. This typically involves a chemical conversion coating or anodizing, followed by primer. Many of the parts also require some type of inspection, like fluorescent dye penetrant inspection. To reduce lead times outside their facility, Cox has entered into long-term agreements that help processors know what to expect, and when

many lead times in the past were based on a worst-case scheduling scenario.

**A Successful Supply Chain**

Finally, the lean supply chain that begins with the customer also ends with the customer. By utilizing mutually beneficial shipping methods, advance ship notices, and barcoding, Cox can help its customer reduce their “dock-to-stock” times, which lowers the inventory of finished goods. Overall, Cox has reduced its average quoted lead

to expect it. The processors Cox selects are also following the SEA Roadmap to reduce their cycle time and improve flow-through as well.

Cox also provides forecasts, again derived from its customer’s forecast. The forecast includes special notation for parts that have not been run before, which allows the processor to work on their internal planning ahead of time. When the processors understand what is coming, they can quote and meet consistent lead times that are shorter than previously possible, since



**The production floor at Cox Machine’s plant in Wichita, Kansas.**

time from sixteen weeks to four, and in many cases Cox can produce parts within a two-week lead time. Using lean transactional processes, Just-In-Time material, one-piece-flow cells, and long-term agreements, Cox has realized a significant and meaningful increase in inventory turns and available cash.

In conclusion, reducing inventory involves every single stage of the supply chain, and without support and partnership on all levels, the process can fail. Bad forecasts can cause a company to build the wrong components. Disruption in internal manufacturing processes, such as unplanned maintenance, must be addressed immediately. Outside processors must perform with a high level

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of consistency in quality and delivery. The benefit to the supply chain, when all of these issues are addressed by various stakeholders, can be enormous. Over the long term, customers are rewarded with more flexible suppliers and better pricing, making their products more competitive, increasing their sales, and nourishing the entire supply chain. **ME**

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*SEA is an aerospace & defense non-profit alliance founded in 2003 by prime and tier-one companies and led by sub-tier suppliers committed to accelerating supply chain performance. SEA customers benefit from increased performance and supply chain*

*transparency. SEA provides a lean management system and a voluntary supplier certification program for enhanced visibility, performance, and collaboration. SEA is funded by supplier memberships and sponsorships.*