Lean manufacturing processes are often credited in improving operational efficiency. However, in the challenging, multi-customer environment of electronics contract manufacturing, can significant savings really be achieved? This article will profile lean initiatives with several of EPIC Technologies' clients in its factories in the U.S. and Mexico. It will look at changes made in outsourcing practices in terms of forecasting and identify areas of savings related to working capital, increased flexibility in meeting schedule changes and customer goals for cost reduction.

**Introduction**

Much has been written on the value of lean manufacturing processes in improving operational efficiency, but can significant savings really be achieved using lean manufacturing processes in electronics contract manufacturing? This article profiles lean initiatives with three of this EMS provider's clients in its factories in the U.S. and Mexico.

**A phased cost reduction approach**

In EPIC Technologies' Synchronous Flow Manufacturing (SFM) model, lean initiatives are in place across the entire product realization process. In some cases, cost savings may be immediate. In other cases, cost savings may roll up over time in a given project as joint improvement initiatives are pursued.

A good example of the immediate cost savings phenomenon involves a client who began production with EPIC Technologies in 2006. This OEM was a manufacturer of power systems. Previously they had outsourced all their production in Asia. Their product mix included both high volume assemblies and low volume parts. The challenge was that their Asian outsourcing partners saw the lower volume product as a drag on optimum equipment utilization. They would schedule short runs infrequently. The end result was that lack of availability of relatively low-dollar parts was delaying the deployment of multi-million dollar systems. The OEM solved this problem by changing their sourcing strategy for parts with lower annual quantities. The business was transferred to one of EPIC’s Juarez, Mexico, facilities. Using the SFM system, demand swings of up to 50% can be addressed within 3 days of a customer pull signal. The window for firm orders is 1-2 days with raw material coverage of 4-6 weeks. With their Asian supplier, lead time on low volume assemblies could be weeks or even months. In addition, because the factory is on the U.S.-Mexico border, product that leaves the factory at noon has generally cleared Customs and is in U.S. transit to the customer by 6 p.m. the same day. Customers get the cost advantage of a Mexican build site with none of the added logistics transport or time costs associated with shipments from farther in the interior of Mexico.

Longer term cost savings are driven by joint continuous improvement focus in the areas of supply base management and design for manufacturability/testability (DFM/DFT). The speed at which these savings are realized is dependent upon the level of responsiveness of the supply base and the customer.

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**Figure 1. The Kanban pull system.**

- **Start—Both Bins are Full**
  - Bin 1 is the “Active” bin
- **Bin 1 is consumed by production**
- **Bin 2 is now the “active” bin**
- **Card signals “Order Required”**
- **Customer Planner**
  - E-mail “Pull Signal”
  - EPIC Acknowledgement
  - EPIC Inside Sales

**BIN Sizes Based on:**
- Manufacturing cycle time (estimated at same day based on finished goods leveling)
- Transit time (estimated at 2 days from El Paso to customer)
- Desired upside flexibility

Sends next “Pull” Qty per release EPIC ships within 2 days from the finished goods leveling system
From a supply base standpoint, the SFM philosophy incorporates the following principles:

- Strong focus must be placed on developing and qualifying suppliers that embrace lean manufacturing principles of short cycle times, flexible batch sizes and high quality.
- Suppliers must be responsible for managing production to forecast, yet deliver to ‘pull signals’ vs. requiring firm release dates over an extended lead-time.
- Appropriate buffer sizes for current production rates must be established, maintained, and continuously monitored for adequacy.
- Material buffers should be maintained in close proximity to the manufacturing facilities to allow frequent release of small batches to the production floor and maximum flexibility in responding to changing demands.
- The material pipeline must be proactively and regularly monitored over the medium-to-long-term horizon through bond reports to identify and resolve potential supply disruptions.

EPIC Technologies has addressed this focus with a Kanban ‘pull’ system, postponement of commitments, and utilization of Electronic Data Interchange (EDI) (Figure 1). Strategic suppliers produce to the MRP forecast and ship to EDI release signals. Buffers are established at key locations in the pipeline and are regularly reviewed and revised as market and demand conditions vary.

Consignment, in-house stores and vendor managed inventory (VMI) programs are used with strategic suppliers to maintain buffers closest to the point of use.

Pipeline status or ‘bond’ reports are regularly reviewed with supplier teams to ensure buffers and replenishment streams are able to support planned production within a range of variation levels based on past historical demand, current forecasts, customer service lead-time guarantees to their end market, manufacturing lead-times and transit lead-times.

On the factory floor, a two-bin system and color-coded cards identify raw material and WIP status. Material shortages are easily visible on a walk-through of the material area. In EPIC Technologies’s Juarez, Mexico, operation, an ‘E-Kanban’ system allows employees to electronically view status of inbound material in-transit from suppliers as well as en-route from the U.S.-based receiving operation.

However, achieving optimum bin sizing for every purchased part generally takes time. For instance, each customer typically has an approved vendor list (AVL). The bulk of suppliers on that list may be common with other customers and therefore already supporting Kanban min/max planning systems. However, suppliers of custom and/or mechanical components may not be existing suppliers and may be reluctant to change their lot sizes or production frequency to accommodate the SFM system. In some cases, the customer’s pricing may be based on annual or quarterly builds of these components. In other cases, a sole-sourced supplier may feel they have the leverage to set delivery terms. In those situations, the total cost of non-compliance must be analyzed and discussed with the customer and supplier. In some cases, the supply base complies and in other cases there are some holdouts who may require less than optimum inventory buffers. Noncompliant suppliers may be designed out over time, providing some incentive for eventual compliance.

The end results of an optimized Kanban strategy are reduced working capital, a high percentage of on-time delivery performance, optimum flexibility in meeting unanticipated demand and high inventory turns.

One of EPIC Technologies’ long-term customers provides the best example of the cumulative savings achievable through joint focus on optimizing supply base performance. This client is a manufacturer of home care medical equipment. The program has 79 different assemblies. In 2000 inventory turns were 4 per year. A joint goal was set to increase turns to over 45 (Figure 2). By 2004, turns actually increased beyond 60, but the customer found that that level of inventory minimization was too lean to support their internal factory variation. The program has settled in the 45 turns per year range. The high turns are attributed to two factors. First, optimized min/max bin planning minimizes overall inventory requirements and work-in-process (WIP). Second, suppliers are providing bonded inventory. It isn’t ‘purchased’ until it is pulled. For the customer, this has translated to a $US10 million reduction in working capital. Additionally, this customer has seen 100% on-time delivery for over 60 months. Initially this program had an on-time delivery rate in the mid-90 percent range.

Shorter term customers see incremental savings in this area. For instance, a manufacturer of medical imaging equipment began production with EPIC Technologies in mid-2005. They have 59 different assemblies in their program. Initially, 10% of their suppliers were on Kanban. Today, the majority of their suppliers have optimized min/max Kanbans defined. On-time delivery is near 100%. A working capital reduction of $US2 million has been achieved because the improved responsiveness of the SFM process has allowed them to eliminate a full two months of inventory buffer.

The final area of continuous improvement focus relates to DFM/DFT. Optimized design contributes to higher quality and may also reduce manufacturing cost. The basic SFM philosophy focuses on increasing throughput through the factory by optimizing and standardizing production processes. This philosophy focuses on minimizing waste, including:

- Minimizing travel time of inputs, WIP and finished goods.
- Eliminating excess WIP or finished goods through smaller lot sizes.
- Eliminating underutilized equipment by standardizing processes, minimizing changeover time and ‘right sizing’ production capability.

The bulk of the focus is on standardization of equipment and processes to enable a wide range of product to be run with minimal changeover time. EPIC Technologies has a standardized facility layout which utilizes the same equipment and processes in every factory. Vapor phase reflow is used in SMT...
manufacturing because it offers a broader process window. Specialized wave solder equipment which reads bar codes on each assembly and then changes profile based on the bar code allows as many as 12 separate through-hole lines to feed in a single wave solder machine.

The focus on DFM/DFT adds to this by further minimizing wasted activity. In the project launch phase, the customer data package is analyzed, and advanced product quality planning (APQP) techniques are used to identify potential areas for improvement. Improvement focus can include pad spacing, mixed technology conversion, double-sided to single-sided redesign, component orientation, component availability considerations and test coverage. As with supply base optimization, this process can take time because often a customer must analyze and qualify recommended changes.

In the medical imaging OEM example, the first year of DFM/DFT focus combined with identified material cost savings has resulted in a $US450,000 savings. Comparatively, the longer term program for the home care equipment manufacturer has generated significantly greater savings. DFM/DFT efforts started with making redesign recommendations to existing products and have migrated to complete collaboration on design of new products. In 2004, $US3.4 million in cost savings were identified, which then grew to $US5.45 million in 2005. In 2006, the savings from the joint redesign effort of the next generation of product started to be realized, generating what is projected to be an $US8-9 million cost reduction for the year (Figure 3). Improvements in quality were also achieved. In 2002, PPM defects were reduced by 68%, the reduction was 64% in 2003 and 48% in 2004, as the available opportunities for improvements began to shrink. In 2005, the reduction was 25%. The next generation of product was introduced in 2006 and the joint collaboration on DFM/DFT in the design phase has resulted in an additional 50% reduction in PPMs.

Conclusion
Cost savings in lean initiatives are not achieved through a single kaizen event or by the EMS provider alone. Instead they are driven best by clearly defined company-wide processes and joint teaming with suppliers and the OEM customer on desired results. Cumulatively these improvements can result in measurable savings in working capital and material/manufacturing cost reduction. It can also result in less measurable improvements in very real opportunity costs such as reduced time to market, greater flexibility in supporting end market demand and increases in overall product quality.

References

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Figure 3. Savings from the joint redesign effort of the next generation of product.