Celestica's Shooting for World-Class Performance

Their "lean zealots" are learning how.

Bob Yenkner

"High mix, low volume — that’s what our customers are looking for," according to Steve Delaney, Celestica’s Chief Executive Officer. "The economic conditions that the electronics manufacturing services (EMS) industry faces today demand a wider variety of product, more often than ever before, and naturally, the cost has to be reduced. Competition is brutal. If we don’t meet those challenges, then somebody else will." So what is Celestica doing to meet these challenges? The answer is simple. We are becoming lean.

How We Started Our Lean Journey

Celestica began its journey to a lean environment in late 1999 with the creation of a corporate lean experts team consisting of a process engineer, a person from manufacturing operations, and an industrial engineer. The team was a combination of three lean-savvy people from inside Celestica and a senior leader with multi-company experience from the outside. Their primary focus was the execution of a three-part strategy: 1) Raise awareness about lean principles and the resulting benefits; 2) create and nurture a foundation of lean skills, a general knowledge base, and support at all levels of the corporation; and 3) assist the corporation with the applica-

In Brief

Faced with market demands for a wider variety of product, more frequent deliveries, and cost reductions, high mix/low volume EMS provider Celestica is going lean. Celestica’s Bob Yenkner explains how corporate lean experts, site operations personnel, and others continue their lean implementation efforts using a three-part strategy.

Celestica, based in Toronto, ON, Canada is a global leader in the electronics manufacturing services (EMS) industry. With over 20,000 employees worldwide, Celestica operates 31 manufacturing and design facilities in the United States, Canada, Mexico, the United Kingdom, Ireland, the Czech Republic, Thailand, Hong Kong, and China. The company provides a broad range of services including design, prototyping, assembly, testing, product assurance, supply chain management, worldwide distribution, and after-sales service. Its customers include industry-leading original equipment manufacturers (OEMs), primarily in the computer and communications sectors.
tion and implementation of the five key principles of lean (Womack/Jones, Lean Thinking). (See the accompanying box, “Five Principles of Lean Thinking.”) These five principles are the foundation of the Celestica Production System (CPS), a variation of the Toyota Production System, being deployed to the sites in North America to drive a lean transformation.

Beginning in late 1999, much of the next two years was spent executing parts 1 and 2 of the three-part strategy. Today, Celestica is executing part 3 by using the CPS, which is the manufacturing system that constantly pursues streamlining the entire system through complete elimination of waste and non-value-added (NVA) activities. It aims to build quality into the manufacturing process while recognizing the principle of cost reduction.

This team is dedicated to getting each site fully skilled in how to implement and utilize lean concepts as part of their daily operations. They work with the designated world-class manufacturing (WCM) site leaders — catalysts to deploy lean concepts. Director of WCM Americas Bob Yenkner said, “We all have somebody in a leadership role in our sites for engineering, quality, HR, IT, and supply chain. It makes sense to have a person with the right expertise and focus to make sure we achieve our lean objectives. Experience tells us that without support, people in these roles have an uphill battle. A dedicated team of four to six people works directly for the WCM site leader, either on extended assignment or permanently. Traditional thinking holds that this is quite an expense for indirect labor, but when we consider that we get a 10:1 (or more) return in the form of cost savings, the payback far outweighs the cost.”

**Site Core Teams**

Cross-functional core teams at each site are trained in lean concepts. They learn to view the manufacturing process as a value stream. The preferred backgrounds of the core team members include one each of the following: process engineer, materials planner, and supervisor/shop floor leader. The core team completes a variety of formal instruction in the understanding and deployment of a lean system and supporting tools such as value stream mapping (VSM), MS Project software, Kanban calculator (a home-made spreadsheet tool), and Savings calculator (a home-made spreadsheet tool) as well as a significant amount
of "on the job" training where "learn by doing" is a great teacher. The formal instruction includes training/teaching about Celestica’s 24 modules of lean (such as 5S, setup reductions, cellular manufacturing, and pull systems). Also key to their formal learning is reading four books: The Goal by Eli Goldratt; Lean Thinking by James Womack and Daniel Jones; Lean Six Sigma by Michael George; and the Celestica Production System Guidebook.

Under the combined watchful eye of the WCM site leader and a WCM regional team, the core team looks at each product from kitting of raw material through packing. Each process is rigorously dissected using VSM tools to identify waste in the system. Key to managing the system is a deep understanding of how and when to use the lean improvement tools to eliminate the waste. Lean manufacturing is a system that is supported by a substantial tool kit; a typical system solution will include:

- Setup reduction for smaller lot sizes
- Pull systems for material replenishment
- Cross-training of the workforce for workforce flexibility
- Cellular layout to reduce material handling
- Line stop/escalation processes to reduce defects
- Six Sigma projects to decrease process variation
- Visual management for improved communication
- Ownership and program support by the site Leadership team.

It is important to note here that while the same tool set is available to all the sites, not all tools will be used to the same extent or in the same manner. Based on an extensive up-front analysis (the "Define/Measure" of DMAIC (Define, Measure, Analyze, Improve, Control) and the proposed solutions, the tools are adapted to deliver the lean concepts and ensure a sustainable system.

We implement the lean system by value stream in a relatively fast manner. Many projects of this magnitude may suffer from "paralysis by analysis," so Celestica’s lean transformations typically are completed (or at least 90 percent complete) for each value stream within a 12-week window. As the core team members increase their "leaning" skills and the related financial benefits begin to appear, the culture becomes, "Think lean." Projects pick up momentum. The site employees learn how to deploy lean skills faster to maximize the key measures of customer satisfaction, return on investment (ROI), and cash flow.

**Fort Collins Experience**

A lean manufacturing transformation of high mix/low volume (HMLV) operation is occurring at the Fort Collins, CO site, where over 400 printed circuit assemblies (PCAs) for two customer accounts are now produced within three lean work centers. Cross-functional teams, trained in WCM and CPS concepts, designed and implemented an integrated process to cover the full customer value stream, from SMT (surface mount technology) through to final test and pack. (See Figure 1).

"The challenge of designing lean work centers in HMLV operations lies with finding the optimum configuration of equipment and processes for a diverse range of products," observed Dave Halter, the VP/general manager of the Fort Collins site. The Fort Collins team, led by WCM Site Leader Bill Palazzi, has accomplished this through rigorous value stream mapping of the current state and similar mapping of the desired future state for the entire site. Fort Collins suffered with recurring production delays due to large-batch manufacturing methods that were incompatible with the HMLV demands of the marketplace. Long setup times, inconsistent material availability, and low yields at constrained resources were a never-ending battle. The process began with selection of one value stream process as a pilot area and eventually migrated to the rest of the site.

The mapping process has been adapted to HMLV situations by the selection of a few products, which represent the majority of the value stream portfolio. The small sample (approximately 60 PCAs from the over 400 PCAs) is then mapped in detail for inventory, quality, yields, resources availability, cycle time, and staffing for each...
Future state development begins with the establishment of the customer demand takt time. Takt time is the pace at which we need to produce units to meet the customer demand expressed in very small units of time, such as seconds or minutes per piece. Using takt time and process times, the number of work centers is calculated, and the process capabilities within each work center are then based on the process steps needed to build each product. The future state layout of each work center is brainstormed and modeled by a cross-functional team (members typically include a process engineer, a materials planner, a supervisor/shop floor leader, a direct labor employee, and some part-time help from IT and finance). Team members become change agents to lead the new work center setup and implementation.

Kanban and heijunka (heijunka is a sequencing board to help determine priority) process tools are used to maintain continuous flow and product sequencing within the lean work centers. This is essential to balance the production load across diverse products and multiple test sets, thus minimizing work in process (WIP) inventory and maximizing productivity.

Production balancing is also achieved by staffing the work centers with cross-trained teams of people, many of whom can perform multiple tasks within the work center to minimize constraints at any single work station and increase overall flexibility.

Another important element of work center design for production flexibility and
smaller lot sizes is quick setup. Tooling and material stocked at the point of use enable short setup time. A two-bin process is used to supply material at workstations and then is replenished from line-side material libraries on the production floor.

The last element of the lean transformation process is quality improvement. The cross-functional team identifies quality yield constraints and NVA process steps. The lean work centers associates at Fort Collins instituted a sample process audit in place of 100 percent final inspection. In turn, this change drives root cause corrective actions on processes, rather than relying on visual inspection.

These lean manufacturing practices have had a major impact on the Fort Collins operations. Some examples of the effects are: 25 percent reduction of production cycle time; 45 percent decrease in WIP inventory; 25 percent increase in productivity; $500,000/year reduction of excess equipment expenses; and a 45 percent decrease in factory floor space requirements.

**Monterrey Breakthrough**

Another example of breakthrough performance resulting from a lean transformation is the Celestica site in Monterrey, Mexico, where a lean transformation yielded savings of more than $1.2 million a year in one of the four business units. The recipe was simple. Site personnel committed to dedicate a WCM core team of five cross-functional, high potential, high energy change agents. Direct labor employees representing each of the three shifts participated on the core team and were a tremendous part of designing the new system and making the culture changes necessary to implement lean concepts. The WCM Americas team of lean experts initially trained the core WCM team and guided them through the initial DMAIC process as outlined in the CPS guidebook.

Led by Monterrey WCM Site Leader Mario Gonzales, these five people became the zealots leading the site transformation in the other three business units. The WCM Americas Regional team continued to provide ongoing support, updated training materials, and coordinated forums for the site to learn best practices from each other. Meanwhile, the five-person site WCM core team continued lean transformations throughout the rest of the facility, addressing each business unit in turn, priority being based on a few simple measurements such as customer satisfaction, current profitability, and cycle time.

The VSM process highlighted a number of significant actions to reach the future state of lean. Action items taken were to reduce the number of SMT lines and arrange final assembly and test equipment in small, product specific, flexible cells, close enough for hand transport and job sharing. Production scheduling changed from "push" at SMT lines to schedule daily output of final assemblies only, and production driven by pull signals.

The team determined allowable maximum WIP in supermarkets (small buffer stock between circuit board assembly and final assembly) and libraries (line side raw material stocking) to minimize inventory but maximize material availability. Limits were set for maximum number of in-line repair units to drive line stop practices and minimize repair queues. When the space for the maximum number of in-line repairs is filled, this is the signal for the upstream process to stop working until the process causing the problem is identified and corrected.

A quick changeover/setup improvement program was implemented to allow smaller batch sizes and high mix production. Procedures and control plans for each process were enhanced and improved, and a "play book" was developed to identify necessary staffing and walk paths for the new work cell designs.

"The WCM transformation delighted the customer, especially when they received the $1.2 million savings as a cost reduction,' said Christy Mitchell, business unit director. 'Feedback we have received from our customer noted our 'impressive progress on WCM so far. New line layouts, efficiencies, and on-time deliveries have been noted. And thanks for the cost reductions.' That says we are doing something...
right for the customer and Celestica." The WCM core team moved on to the next area to implement WCM. The production team took ownership of the new changes with the commitment to sustain the changes and maintain the discipline to follow the new processes and practices.

Implementing the changes was hard work, but the results were amazing. The attached table (Figure 2) shows significant improvements realized within just three months at Monterrey. Savings site-wide reached approximately $4 million by the end of one year. Specific improvements included these reductions: changeover time 48 percent, leadtime 71 percent, distance traveled 29 percent, SMT equipment 33 percent, space 34 percent, consumables 25 percent, scrap 66 percent, direct labor 31 percent, and indirect labor 10 percent.

**Austin, TX Operation: Cultural Change**

Cultural change does not come easy. The single biggest challenge to lean implementation, according to James Armstrong, Celestica Austin (TX) general manager, "is the cultural change required at all levels of the company to not only drive the change but to make it part of the daily operating environment." He noted that the transformation of an organization to the lean way of thinking requires all of its leaders to possess three characteristics:

1. Long-term commitment to the business, providing stability and continuity
2. Deep knowledge of lean techniques and tools
3. Desire and ability to smash organizational barriers that inevitably arise when dramatic change is proposed.

Commitment at the senior-management level drives lasting, meaningful change. Among our "lessons learned:" Celestica has participated in a number of "improvement fads" over the past ten years, achieving related "pockets of excellence." However, in the glory days of a good economy that drove high volume, low mix environments, process improvements were not where the big money appeared.

**Tracking and Sustaining Performance**

Sustaining the changes will require the selection and linking of the correct measurements. While many of these improvements shown in Figure 3 are measured/tracked at the shop floor level, each value stream requires that the selected measurements will have a direct impact on the customer’s measurements of the site’s performance. Customers typically track on-time to commit/delivery, some type of parts per million defect rate, cycle time, cost, and a subjective responsiveness measurement.

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**Monterrey 3-month Improvements**

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<tr>
<th>Metrics</th>
<th>Improvement</th>
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<tr>
<td>Direct labor</td>
<td>- 31%</td>
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<tr>
<td>Indirect labor</td>
<td>- 10%</td>
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*Figure 2. Monterrey three-month improvements.*
If the right shop floor measures are in place, then the results will ultimately appear in the favorable column in our customer reviews.

Tracking and measuring progress of the lean activity at a regional level presents a challenge. Celestica has developed a simple but effective method that allows each site to monitor its lean progress at the site level as well as the cell or value stream level. The rallying cry is “Get the RED out” (no relation to the eye drop people). The leadership team at each site completes a comprehensive rating sheet by value stream based on generally accepted lean practices, ISO, and customer requirements each month. Each site tallies and reports their current score in a monthly “Radar Chart” for lean skills and sustaining skills; it is part of the monthly operating review. See Figure 4.

Each “spoke” of the “radar chart” represents a tool, skill, or culture aspect that is needed for the site to be considered lean. Celestica has selected 3.5 (on a scale of 1-5) as the point where lean skills have been acquired and lean culture is becoming the norm. Performance gaps become painfully obvious during the tracking process and corrective actions as well as any special support needs are specified for the next review. Regional WCM experts conduct periodic audits of the results to prevent confusion, ensure consistent reporting, and validate the results.

**A Few Missteps**

No story of lean efforts would be complete without admitting that there have been a few missteps and mistakes. Many of the mistakes are errors of omission such as forgetting to include a third-shift person on the transformation team or not adequately addressing long-service employees’ concerns about altered job requirements. By far the biggest mistake Celestica has made to date is not making sure the entire site management structure is truly part of the change process. Failure to have the lean concepts visibly and vocally supported by all levels of
Celestica measures progress of lean activity at the site level as well as the cell or value stream level. On the left side is the lean average score and on the right side are sustaining measures.

**Figure 4.** Celestica measures progress of lean activity at the site level as well as the cell or value stream level. On the left side is the lean average score and on the right side are sustaining measures.
site management will bring a lean transformation to a standstill very quickly.

"Everybody is learning as we go — the employees, the general managers and yes, even the ‘experts.’ The textbooks get us started, but there is no substitute for plain old experience. The risk of making a really big financial mistake is minimal, because when you remove waste on a low-cost or no-cost basis, you find you don't spend money to work smarter," noted Dave Halter, Fort Collins VP/general manager.

**The Lean Drive Continues**

Celestica continues to make gains in all of its facilities in the drive to become lean. There is a multitude of smaller scale successes that the various sites are quick to demonstrate: cycle time reductions from 12 days to six hours, setup time reduction from four hours to 35 minutes, and customer accolades in customer assessments for lean process improvements, for example. Many of our customers conduct a quarterly business review (QBR), which presents the opportunity for direct feedback at all levels. One customer, a global supplier of integrated circuits for communications and networking applications, after awarding a site customer satisfaction rating score of eight (out of ten), commented, "We are totally satisfied, delighted even, with Celestica's ability to produce product to support our customers' needs." The site's achievement? They had committed to delivering 25 units a week, but the application of lean methods provided the means to deliver 50+ units a week, exceeding customer expectations.

"These and other improvements have become a strategic tool in garnering additional work from existing customers and attracting new customers in the telecommunications industry. Equally important, the lean efforts have been crucial in moving into the defense and commercial industries where Celestica plans to grow," said Jim Matthews, director of Americas Business Office.

Steve Delaney referred to the need for "lean zealots" — individuals who carry the vision, spread the word, and generally wake up the dormant culture that supports the old way of doing business. Delaney asked, "Want to become lean? Get yourself a few zealots, place them in strategic positions within the company, and let them make some constructive noise. Dedicate some resources, involve the management of the sites, and watch the changes become the norm."

**Editor's note:** Lean ThinkingSM is an integrated set of industrial principles and methods first developed by James P. Womack and Daniel T. Jones and articulated in their landmark 1996 book, Lean Thinking (Simon and Schuster). It grew out of the authors' groundbreaking study of the Japanese automobile industry, The Machine That Changed the World (Simon and Schuster), and it continues to be refined and promulgated through the work of the Lean Enterprise Institute (www.lean.org). Lean Thinking enables companies to find the best way to specify value for the customer, to identify the value stream for each product, to cause the product to flow smoothly from concept to customer, to permit the customer to pull value as needed from the producer, and to make a lean leap toward perfection. The concept of value, value stream, flow, pull, and perfection are deployed by means of lean techniques for product development, production, purchasing, and customer support. Portions of this article referenced, paraphrased, or excerpted from the book Lean Thinking by James P. Womack and Daniel T. Jones, with permission (pp. 16, 19, 21, 67, and 94).

Bob Yenkner, Director, world class manufacturing Americas for Celestica, has more than 20 years' international lean experience in a variety of industries including electronics, aerospace, automotive, consumer goods, and electrical. He has extensive experience in the implementation of such productivity programs as setup reduction, kaizen, cellular manufacturing, Six Sigma, supply chain development, demand flow, and Total Productive Maintenance.

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