



# Recession-Proof your Shop the Lean Way

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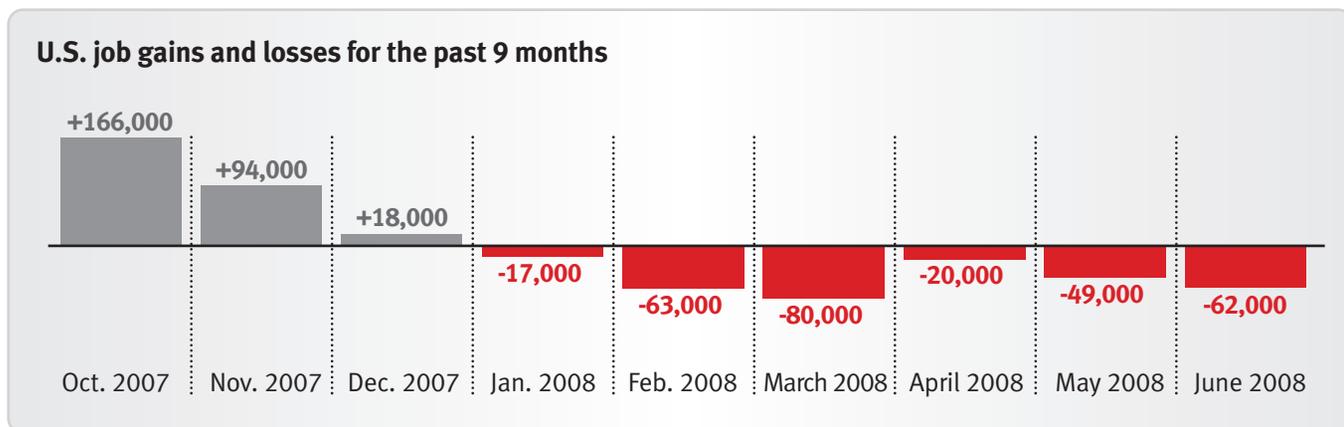
## The mortgage crisis, record high oil prices, and a lackluster stock market are hitting the U.S. economy like a perfect storm.

Rising material and labor costs, weak consumer spending, and the collapsing housing market are hammering job shops nationwide. Many are looking for ways to re-engineer themselves to compensate for flattening growth. Lean manufacturing has emerged as a viable method for ensuring continued prosperity. This e-book discusses new lean methodology geared specifically to job shops, as they attempt to recession-proof their businesses.

### The U.S. is slipping into recession.

It may not be official, but it is increasingly obvious. A group of academics at the National Bureau of Economic Research (NBER), the official judges of downturns in America, define a recession as “a significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, unemployment, industrial production and wholesale-retail sales.”

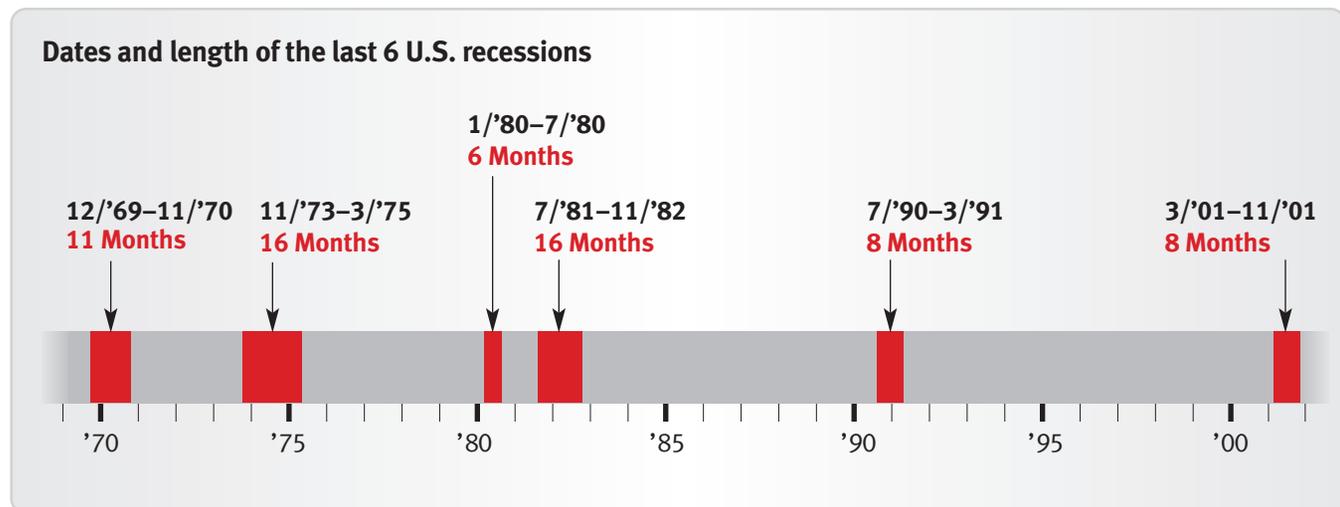
According to NBER, we are not officially there yet, though December through June 2008, the U.S. economy shed an average of 48,500 jobs per month.



Source: United States Dept. of Labor Bureau of Labor Statistics

Though the numbers may seem large, in past recessions, a far worse rate of 150,000 – 200,000 job losses per month was normal. Then too, recent orders to U.S. factories for big-ticket items, excluding autos and airplanes, showed surprising strength, with April numbers signaling that demand from abroad may be helping manufacturing ride out the slowdown.

When and if a recession is officially announced, the Fed predicts it will be short, though many economists forecast otherwise. Mr. Bernanke told Congress that growth will strengthen in the second half of the year, nourished by lower interest rates and the fiscal stimulus package. If the Fed is right, the 2008 recession could last just a few months. However, that would be remarkable given the depth of the housing bust and credit turmoil. According to *The U.S. Economy, A Historical Encyclopedia*, the average recession lasts one to two years, though the past six recessions lasted an average of 10.8 months each.



Source: The U.S. Economy, A Historical Encyclopedia

Whenever the recession officially begins and whether it persists or ends quickly, the country's job shops are already feeling its pinch and making changes to ensure continued profitability. Many of those changes relate to lean manufacturing.

Few shops operate an assembly line like Toyota, Ford, Boeing or John Deere. Thus, a job shop requires its own lean toolkit, its own flexible approach or application of those tools.

## Re-Thinking Lean for Job Shops

Most shop owners have read the revised and updated version of James P. Womack and Daniel T. Jones' bestselling business classic, *Lean Thinking—Banish Waste and Create Wealth in your Corporation*, based on Toyota's mastery of productivity, quality, low inventories and reduced lead times. Almost everyone in manufacturing agrees that the lean precepts of Womack and Jones have exceptional merit. But when it comes to contract manufacturing, shops are finding they apply only on a partial level, because few shops operate an assembly line like Toyota, Ford, Boeing or John Deere.

Thus, a job shop requires its own lean toolkit, its own flexible approach or application of those tools in order to benefit its customer base, organizational culture and bottom line. Because of this, progressive shops succeeding today are re-thinking Lean in key areas such as plant layout, information technology and culture. Hybrid cellular layouts and part matrix clustering, integrating ERP with Lean, Kaizens and a cross-trained, IT-savvy workforce power today's lean shop.

## Benefits of Lean

Though Lean is a journey requiring dedication, persistence and resourcefulness, its benefits are immense. According to Gary McGregor, Manufacturing Specialist with the Chicago Manufacturing Center, a shop embarking on Lean will spend two to five years learning and improving before realizing full advantage. But the return on investment is nothing short of dramatic: major improvement in productivity, quality, cost and service. Over the course of a comprehensive lean implementation, McGregor says profits increase gradually, then exponentially, though costs and cash flow are positively affected from day one.

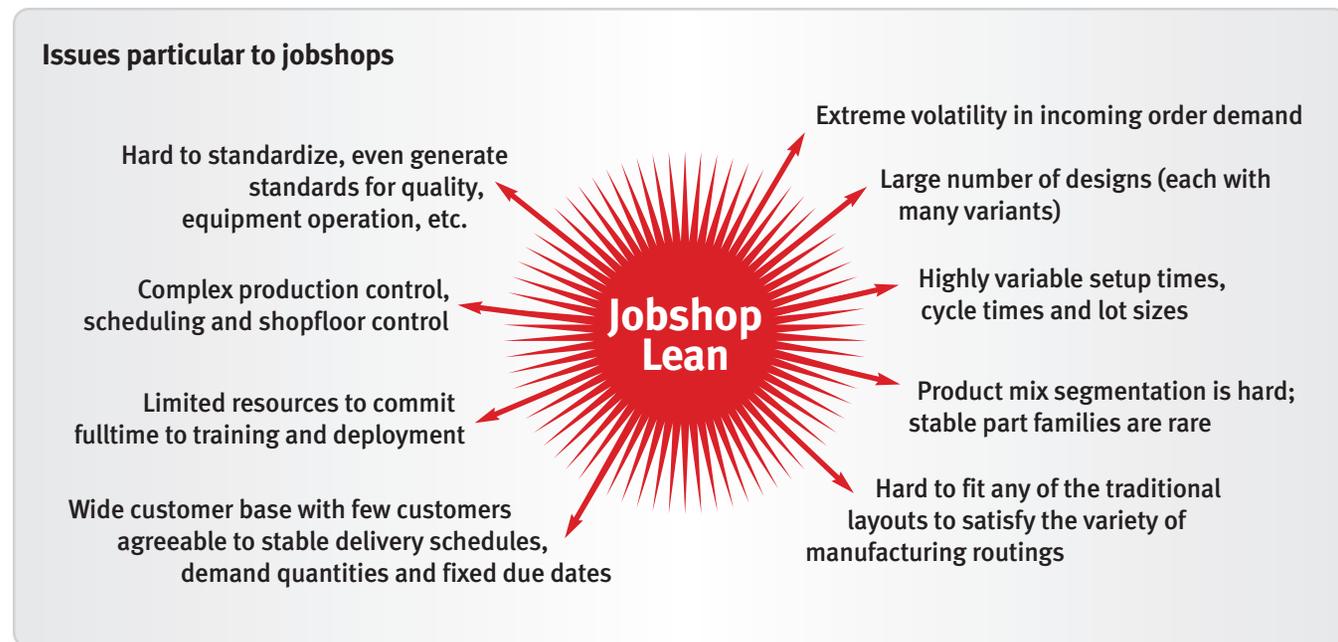
■ **At first**, metrics indicate creeping advances in profitability as workers and managers get used to lean terms and techniques.

■ **Halfway through** the implementation, working with data from their business management system to schedule the shop, incorporating lean production techniques and behaviors, improvement accelerates and significant ROI is apparent.

■ **In most cases**, shop profits and productivity increase an average of 50 percent within a few years.

## Step I: Planning before Execution

Lean manufacturing is difficult in a job shop, because short- and long-term planning is tricky. Quantities, delivery dates, and jobs continually change. Just-in-time requires continuous flow—unrealistic in most shops. And new types of work can flood the shop floor with the next set of purchase orders.



Source: Shahrukh A. Irani, Department of Industrial, Welding and Systems Engineering, The Ohio State University

Nevertheless, today's custom manufacturers must engage in critical thinking and planning before executing Lean on the shop floor. They should think about:

- Their business type
- The competition
- Employee roles and responsibilities
- Shop resources
- Key milestones
- Desired outcomes

Continued critical decision making will be required along the way as management adjusts its business and marketing plans to target business into families of parts. When one part doesn't belong, they may discuss the viability of going into a new business.

As the lean implementation progresses, analysis of the business should be renewed periodically when bringing in a new machine or new business segment to ascertain how effectively it fits into the whole. An enterprise that tries to be everything to everybody compromises its ability to serve its current customer base. Sometimes it makes sense to farm out parts to competitors, or to swap work in order to remain efficient.

Critical thinking at the start, and at crucial junctures, will provide answers.

### **Step II: Shop Layout**

According to a 2008 survey by *Modern Machine Shop* magazine of 1000 OEMs, job shops, contract manufacturers and distributors, 50 percent of respondents said their company had undergone significant changes in the past few years. The most commonly reported process changes included reorganizing shop layout and incorporating faster equipment.

This is no surprise. Fast equipment increases a shop's competitiveness. Even more important, layout of the shop floor drives Lean. If a shop lacks an efficient layout, difficulties arise with cross training, optimal material handling and communication. Lead times lengthen and waste increases.

To determine shop floor layout, author James. P. Womack suggests finding families of parts. However, the typical shop makes thousands of different parts annually. The shop foreman may know offhand how many small round parts with surface grind features, or how many long big parts they manufacture per year. But to look at all its parts and see the holistic picture in terms of families presents a challenge for any machine shop.

A shop's mix of parts moves through the same group of machines every day. The organization sells similar types of work to its range of customers. Patterns do exist and shops can identify them manually or using software.

Value stream mapping also poses difficulties. Value stream mapping analyzes the steps, delays and information flows required to deliver a product or service, to identify opportunities for improvement in lead time. But shops make thousands of different parts, each with their own distinct routing. For jobs running 30 to 50 weeks a year and requiring 1,000-2,000 hours of machine time, value stream mapping works well. Long running, always-on jobs require employees and machines and Kaizens dedicated to them for single piece flow. But for jobs that are merely repeaters—those running four to six times a year and requiring about 200 hours of machine time—finding the optimal cellular layout to expedite the job is like finding your way out of the jungle. Then, too, there are infrequent jobs, the “strangers” that float in once or twice a year.

To the shop foreman or plant manager overseeing so many disconnected processes, it may seem that jobs seldom flow the same way twice. Deciding how to change the shop layout to move disparate parts through quickly can appear impossible.

Nevertheless, there are patterns and consistencies in what a job shop does. A shop's mix of parts moves through the same group of machines every day. The organization sells similar types of work to its range of customers. Patterns do exist and shops can identify them manually or using software.

To achieve identification of part families, look at similarities in routings, materials, and geometries to ascertain which parts move through the same types of machines. Use ERP data to look at volume/revenue blocks. At first, this will seem an insurmountable task—how can anyone look at a thousand or more routings and see which are similar?

But with time, with the advice of engineers or foremen who have gone through thousands of outputs, the insight of a consultant, your ERP system's routing information, or the help of a lean analytical software tool such as PFAST ([www.leanavenue.com](http://www.leanavenue.com)), a shop can analyze its routings, group its machines into cells, and achieve a lean shop floor layout.

Certain physical routings require the same machines, which forms the basis for a manufacturing cell.

## Quick-Start Approach to Jobshop Lean

### Steps necessary to create an efficient flexible flow cell, the key to optimal layout.

- Collect sales data from the past fiscal year—revenue, quantity, etc.
- Obtain all routings
- Create part families
- Pick a part family with highest contribution. From this family, find parts with same routing
- Obtain a layout of your facility, locate:
  - Receiving
  - Shipping
  - Value-added workcenters featured in the routing
- Generate a flow diagram for the part(s)
- Evaluate the flow diagram to identify:
  - Flow delays
  - Eight types of waste
  - Violations of the principles of design for flow
  - Crossflows and backtracking in flow paths
  - Large (+10 ft.) travel distances between consecutive operations
- Create a flow process chart to identify flow delays and types of waste
- Analyze material handling and shop floor control
- Create a value stream map for detailed evaluation of the flow diagram
- Compute the value-added ratio (defined on the next page)
  - Do a timeline analysis and cash flow diagram based on past orders for the part(s)
- Identify and then analyze any bottlenecks
- Identify and prioritize strategies for improvements
- Implement improvements in order of priority

Through the above process, you will find that certain physical routings require the same machines, which forms the basis for a manufacturing cell. Once part families are identified and a product/process matrix or spreadsheet is generated, cells can be identified and Lean is underway.

With well over 1000 routings, G & G had difficulty identifying true part families and process streams. In January of 2008, they jump started the process by implementing an analytical software tool called PFAST

### Step III: The Flexible Flow Cell

G & G Manufacturing Co. in Cincinnati, Ohio, delivers machining, finishing and assembly services on both metal and plastic components. This ISO-9002 certified, 50-person shop offers precision machining to fine tolerances and works in material of all types and shapes. The shop produces 1600 unique part numbers every year, in metals, alloys and plastics.

G & G comprises the classic high mix, low volume shop; their mix of jobs can change with their next set of purchase orders. In 2006, when G & G experienced increasing demand and material flows, they implemented flow cells for their highest volume parts in order to achieve unit cost efficiencies. Those initiatives launched them on the path to Lean. Along the way, they struggled to overcome the inherent inefficiencies of their traditional shop floor layout: all screw machines and screw machine operators together, all lathes together, etc. As with any job shop, those groupings had developed organically, over time, and proved to be barriers to effective communication and scheduling. At the same time, G & G's owner wanted lead times compressed *across the shop, not just in single-piece flow cells*, to expedite cash flow. Rising labor costs complicated matters. Part families and material flows remained unclear. Jobs piled up.

The shop embarked on a JobShop Lean program in late 2007. This time around, G & G was mindful of overcoming past issues when they had created failed cells in the 1990s. Cells during that era had been built for customers, or parts of the same name and feature set or material type, without respect to size. In some cases, part families only ran a portion of the year. The cells could not be sustained and inefficiency resulted.

With well over 1000 routings, G & G had difficulty identifying true part families and process streams. In January of 2008, they jump started the process by implementing an analytical software tool called PFAST ([www.leanavenue.com](http://www.leanavenue.com)) after learning about it at the annual JobShop Lean Conference, hosted at The Ohio State University in Columbus, Ohio.

Armed with PFAST, G & G redoubled their efforts. They identified turning and milling operations on a group of machines associated with a series of higher value parts. Parts ran through these machines four to six times a year and several followed a similar flow pattern. They plugged this group into their PFAST software, used it to crunch down the data, and identified a cell.

Physically, this new cell consisted of a group of machines, not jammed next to each other as in the high volume flow of classic Toyota Lean, but grouped very near each other in a square with openings to bring in materials. The flexible "cell" served a variety of parts with similar patterns, one part often reversing the path of the previous part but requiring the same machines.

### Goals were established for jobs moving through the cell:

- Monitor each job's value-added ratio—estimated hours divided by available shift time. Example—a job requiring 30 hours of machine time over five 10-hour shifts yielded the value-added ratio of 30/50 or .6, an indicator of the effectiveness of their shift time.
- Reduce labor costs per job by 10 percent and leverage operators across two machines, when feasible.
- Reduce dock-to-dock time by 20 percent.

Within two months, G & G's implementation of a flexible flow cell dramatically improved flow by solving wait time issues. Lead times were reduced an average of 50 percent, production hours cut 20-30 percent, and value-added ratios increased 136-171 percent.

Bigger yields per run and better use of their ERP scheduling tools also resulted. According to Jeff Gleich, G & G's Vice President of Manufacturing and Sales, success in this endeavor was supported by easy extraction of routing data from their ERP system, Exact JobBOSS.

### Results for Part #1

- Production hours cut from 85 down to 60
- Mfg. lead time reduced from 12 work days to 5
- Value-added ratio went from .53 to 1.25 (136% gain)
- Profitability increased from -13% to 19.5%

### Results for Part #2

- Production hours cut from 82 down to 65
- Mfg. lead time reduced from 16 work days to 6
- Value-added ratio went from .45 to 1.22 (171% gain)
- Profitability increased from -11% to 32.6%

In the process, G & G expanded their thinking on layout. They realized Toyota's classic single-piece flow wasn't always the answer, and learned, due to exceptions, not to expect a cell to be 100 percent contained. They dealt with disagreement and learned to give honest feedback. Soon their Kaizen team achieved faster and more consistent lead times with an ability to run more operations in parallel. In some cases, this required changing cell layout more than once to find the optimal plan. The flexible flow cells that resulted improved quality, reduced lead times and sped cash flow.

Since 2007, G & G also implemented a 5 S system, grouped different processes together, reduced batching, and improved communication.

### Step IV: Exception Strategies

Implementing cells via a product/process analysis, assigning part families to machine groups, and redesigning your shop floor will undoubtedly lead to exception operations, as it did for G & G — thus the need for exception strategies.

#### **When looking at machines used by cells, your shop might group them into three types to deal with exception operations:**

- Your “red” machines are monuments, which are “problems” that can not be put inside the cells, i.e. heat treatment, in which a shop is forced to send parts outside. A shop must manage capacity to the monument, which creates set up changes and losses. Machine sharing between cells is also a monument.
- Your “yellow” machines may be based inside cells, but because the load is insufficient, one can't justify equipment of that expense for every cell. Lathes are an example. Expensive “yellow” machines must be held in a central area, and different cells will have to compete for their capacity. Red and yellow machines are potential bottlenecks.
- “Green” machines are those a shop has plenty of and would not hesitate to buy more of if needed.

An exception strategy for red, yellow and green machines strengthens a cell's speed and flexibility. Shops, with their variety of parts and products, will want to maximize mobility, agility and speed of set ups regardless of lot size and mix. Adaptability will rule. If cells create a machine sharing problem, focusing a Kaizen to remove those problems should yield a solution.

Once your shop achieves organization into cells and formulates exception strategies—no easy task—you will have laid a firm foundation for lean production. Nothing will work out totally smoothly, but focusing attention on key improvements via these cells moves the business closer to Lean.

Kaizen events typically last one to five days and can yield 50–90 percent reductions in waste, compared to the 1–5 percent level of improvement obtained in unstructured process improvement efforts.

### **Step V: Kaizens**

As you progress with your plant redesign and layout process, you will learn and use the Kaizen process. The Kaizen is a basic tool in lean manufacturing in which small, cross-functional teams analyze processes to identify and eliminate waste. Kaizen is supported by analysis and improvement tools such as 5S, visual factory, total productive maintenance, setup reduction, mistake-proofing, standard work, one-piece flow and kanban (Robinson, 1991).

No lean program can truly flourish without the support of an ERP environment, tailored to support lean planning, production, and metrics.

### **Step VI: Leverage Your ERP**

Along with an efficient layout, your shop will want to integrate Lean with your shop management software system. Your shop's ERP system ensures constant communication between office and shop floor, between upstream and downstream work centers, and with customers. Automated scheduling fosters production that remains fluid based on due dates, common set ups, and capacity constraints.

Fortunately, progressive software developers know Lean is here to stay and as a result, some are marrying lean techniques to their shop management systems with the common goal of driving waste out of business processes.

Connections between Lean and ERP initiatives do exist, though they are not always obvious. According to Lean Manufacturing Specialist H. Paul Hardy, "Historically ERP systems have been forecast driven or push systems, but Lean is about responding directly to customer orders, a pull system. Despite this, many shops have successfully adapted ERP with lean production."

G & G recognized the need for a creative integration of Lean with their ERP system, a key tool enabling them to analyze routings and look at performance and profit results. According to Gleich, Exact JobBOSS integrated well with Lean.

## Step VII: Encourage Lean Behavior

Experts have shown waste present in human behaviors eclipses the waste present in production. Finding and eliminating *behavioral* waste in your shop is vital to Lean success. This entails making sure that your company culture supports Lean, that leaders drive the process and that employees buy into it.

M.L. Emiliani, Managing Director of Lean Behaviors LLC, Wethersfield, CT. writes and teaches extensively on the topic of lean “hard” skills on the production floor supporting the daily use of lean “soft” skills throughout the organization.

As on the production floor, the focus in lean behavior is on understanding value as perceived by the customer. Therefore, behavior, activities and actions that fail to add value should be eliminated. (M.L. Emiliani, *Cracking the Code of Business, Management Decision* 38/2 [2000] 60-79)

### Emiliani adapts Lean’s five key concepts to employee behavior:

- **Specify value**—understand the wants and expectations of people you interact with.
- **Identify the value stream**—understand what people do and why they do it.
- **Flow**—behave in a manner that minimizes or eliminates delays or stoppages in the work performed by others.
- **Pull**—recognize that people operate under different mental models which require us to adjust our styles or approach often.
- **Perfection**—systematically identify and eliminate behavioral waste.

According to Emiliani, even Kaizens work in a behavioral context, as do many other lean process analysis and improvement tools such as 5S, visual/audio control and total productive maintenance. For example:

- **5S stand for:** sort, simplify, sustain, self-discipline, and spirit. A workplace, work habits and mind that are organized and energized eliminate the waste caused by inconsistent behavior.
- **Visual and audio controls** are visible and audible expressions indicating someone’s emotional state and willingness to engage in human interactions. Managers should be mindful of their facial expressions and tone of voice.
- **Total productive maintenance** is the maintenance of the mind and body, since our personal effectiveness is affected by how we think and feel.

He will praise his people’s successes, note their failures, talk about opportunities that exist, and communicate frequently. A culture founded on strong leadership elicits the elimination of waste in human behavior.

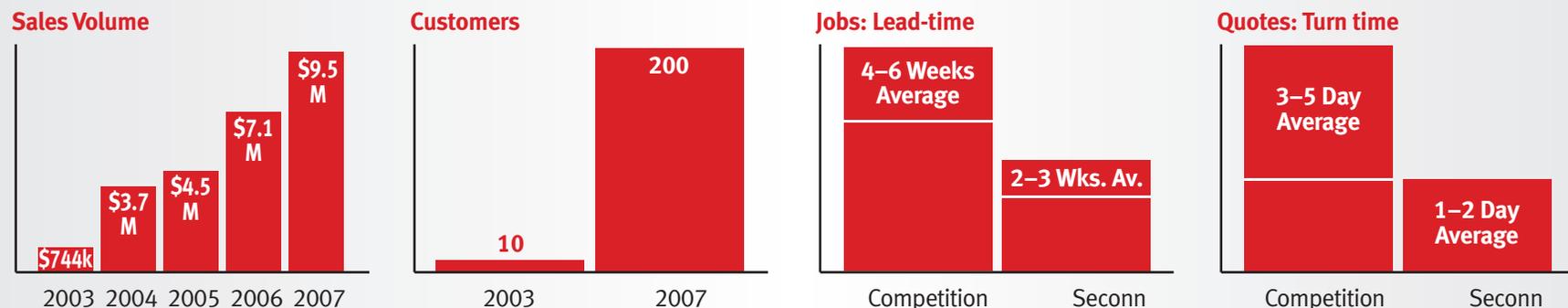
Perhaps the most important tool affecting lean behavior is a leader's ability to inspire his/her people. A skilled owner will walk the shop floor observing, encouraging and participating in the lean production process, rather than handing it over to a process engineer.

### A Culture as Lean as the Shop Floor

Seconn Fabrication in Waterford, Connecticut, exemplifies a shop with a lean culture. Seconn, founded in 2003, specializes in custom manufacturing: design, engineering, test development and prototyping. Its 70 cross-trained employees excel at both short and long production runs. The shop epitomizes lean production by promising the shortest lead times in the industry and delivering on it. But its leadership, communication and an atmosphere of trust comprise the heart of its success.

Thanks to a highly dedicated workforce, Seconn offers a level of service most shops don't. Someone is always there to answer the phones. The shop hits its delivery dates 96 percent of the time. Sales reps visit customers every few weeks.

The results in numbers for this four-year-old business: 2003-2007



# The answer for the custom manufacturing industry is Lean, adjusted and attuned to the fluid, dynamic environment of a job shop.

From day one, Seconn's founder adopted an open door policy and empowered his workforce to be creative and continually make suggestions. Seconn still operates with little hierarchy and a big focus on continuous improvement and communication. Every new hire receives a mentor, plus 30, 60 and 90-day evaluations to ensure expectations are being met on both ends.

Many shops engage in interdepartmental cross training, but few train across the board as Seconn does. Upon hiring, its employees receive training in several areas. The goal is to boost productivity and meet delivery dates. Office personnel learn to weld. Customer service reps can handle shipping. In this way, various departments understand each other better and work toward the common good. Metrics in one functional area conflict less with metrics in another and production ramps up.

Seconn is a four-year-old shop working lean—2003 to 2007

### **Step VIII: Don't Delay**

Though it may not yet be official, America's economy is slipping into recession. The troubled state of the housing and financial industries, consecutive months of rising unemployment, and the decline in the U.S. auto industry with GM reporting an 18% drop in sales in June, indicate the downturn is very real.

Even so, not all the news is negative. Excluding the volatile transportation sector, orders for durable goods rose 2.5% in April, the largest gain since the previous July. Economists say the numbers indicate the economy may have some momentum in manufacturing, a sector critical to helping pull the nation out of recession.

America's custom manufacturers loom more important than ever. Fortunately, increasing numbers of shops around the country are taking action to implement lean manufacturing and to recession-proof their organizations. Today's unique challenges call for unique solutions. More and more, the answer for the custom manufacturing industry is Lean, adjusted and attuned to the fluid, dynamic environment of a job shop.

To learn more about Lean for Job Shops and to recession-proof your shop, go to [www.exactamerica.com/jobboss](http://www.exactamerica.com/jobboss) or call **888-201-6572**. To find out about or register for Dr. Shahrukh Irani's JobShop Lean 2008 Conference on Sept. 16-19, 2008, in Columbus, Ohio, go to [www.Leanavenue.com](http://www.Leanavenue.com).

## About Exact JobBOSS

JobBOSS is the most widely used shop management software designed specifically for job shops, custom manufacturers, and high-tech shops. Today over 4,300 shops and more than 23,000 users rely on JobBOSS shop management to give them the visibility and control they need to manage all the changes their businesses experience on a daily basis. Whether you are a high-volume production shop or a quantity one proto-type, machine builder, tool builder or assembly shop, JobBOSS can increase your productivity and profitability. It's a system that manages workflow from quote to cash—quoting, order processing, scheduling, purchasing, labor tracking, real time data collection, quality, shipping, job costing, and integrated accounting. Users know what jobs cost, can compare estimated to actual labor, material, and outside service costs, and isolate problem jobs while in process.

## About Exact Software

Established in 1984, Exact Software is one of the world's leading providers of business software solutions. Its integrated solutions comprise traditional Enterprise Resource Planning (ERP) as well as related software solutions such as Human Resource Management (HRM), Customer Relationship Management (CRM), Project Management, Business Intelligence/ Analytics (BI/BA), and Electronic Workflow. Exact is headquartered in Delft, the Netherlands and has offices in Europe, the Middle East, North and South America, Asia, Australia and Africa. With over 2,700 employees, subsidiaries in more than 40 countries, solutions available in 40 languages, Exact currently serves customers in more than 125 countries across all five continents. Exact Holding N.V. (EXACT) has been listed on Eurolist by Euronext Amsterdam since June 1999.

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