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**Delphi's Lean Enterprise: Progressing Along the Journey**

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# Delphi's Lean Enterprise: Progressing Along the Journey

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## About Delphi

Delphi is a world leader in mobile electronics and transportation components and systems technology. Approximately 190,000 people are employed at Delphi. There are 172 wholly owned manufacturing sites, forty-two joint ventures, fifty-three customer centers and sales offices, and thirty-four technical centers in forty-one countries. Since 1998, Delphi has received 298 quality and excellence awards, including 235 awards from its customers and twenty Shingo Prizes.

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## Delphi's approach to quality

At the time of its spin-off from General Motors, Delphi's PPM rate was higher than was typically acceptable in the industry. In the first three quarters of 2003, we were much improved and now have over 100 facilities throughout the world running at single-digit PPM.

Delphi has surpassed the industry benchmarks on being best-in-class, and I attribute that to Lean implementation. We find that more and more quality improvements basically "fall in our lap" just by doing Lean implementation.

To truly be customer centered, we have to think that the only acceptable level of quality is zero defects. Here's why: We ship eight million parts a day to customers. A ten parts-per-million defect rate isn't good enough because that means eighty customers are getting a defective part every day. Zero defects are, of course, very hard to achieve but that has to be the attitude of the organization. Our industry's expectation and objective is zero parts-per-million defects to our customers.

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## Integrating business philosophy with tools and techniques

We have spent years paying attention to management tools and techniques. We learned the seven forms of waste. We had many forms of Six Sigma. We had thirty-eight action strategies. It was all good stuff, but at the end of the day, they're just tools and techniques. Are we using them to do the right things? To answer that question, to get beyond tools and techniques, we asked ourselves, "Are we effectively combining our corporate business priorities (faster to market, expanding markets, and more diverse markets) with our management tools and techniques?"

We also asked ourselves, "Are we clear on our business philosophy? Do we all know what our business strategy is? How are we using our business philosophy and business strategy to drive our business?"

As we investigated this, our CEO found that the material in the book, *Lean Thinking*, by James Womack and Daniel Jones was helpful, and this book became mandatory reading at Delphi.

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## Integrating business philosophy with tools and techniques, continued

In addition to *Lean Thinking*, my personal favorite is Taiichi Ohno's book, *The Toyota Production System*. It's a short book, and as I read it for the first time I thought, "Oh, that's easy." But it really isn't all that easy because until you get some real hands-on experience with Lean, it's unlikely that you will understand it all that well. I now try to re-read the book at least once every two years. The last time I read it—probably for the fourth time—I found myself thinking, "Oh, man, I didn't know he meant *that!*"

## Eyes for waste, eyes for flow

After devoting quite a bit of effort to successfully working on the seven areas of waste, we felt there was something important missing. We realized that while waste elimination is important, it basically represents only "blocking and tackling," to use a football metaphor, and not "scoring points." In essence, it doesn't deal with a full flow of value to the customer.

So we decided to document how waste reduction flows value to the customer. That got us into value-stream mapping. We were trying to develop an internal mind-set that *work processes are all about flow, and that includes how we flow value to the customer.*

## Kaizen events

We have three levels of kaizen (improvement) that we teach:

1. What can we do to reduce cost without moving anything?
2. What can we do to reduce cost with very minimal expense (e.g., no capital appropriation, plan or engineering budget)? This might be small tooling, quick unload.
3. A useful rearrangement. We were rearrangement-happy ten years ago. Managers felt good and went in and rearranged things. Employees were disappointed. They had a different workplace. And managers found out that they were not nearly as smart as they thought we were. Many times they had just rearranged the waste instead of taking the root-cause of the waste out. We now have two admonitions when starting kaizen blitzes:
  - (1) Please be sure you're not just rearranging your waste.
  - (2) Please be sure you're not automating your waste.

## From "batch and queue" to "small lot, high frequency"

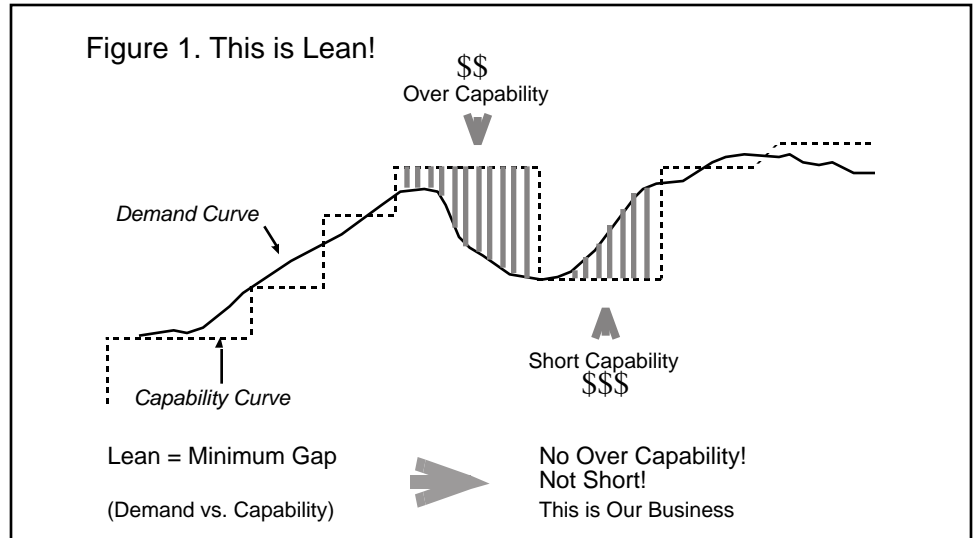
A big part of Lean for us was to go from a "batch and queue" system to a "small lot, high frequency" system. I won't go into any detail on this because it's beyond the scope of this article. I just want to emphasize that this has to be a corporate strategy and not a project. This just doesn't happen overnight.

## What is Lean?

Figure 1 on the next page shows how I describe Lean in our manufacturing production world, where we ship so many different pieces every day.

The dotted line is our manufacturing capacity or capability in some period of time. It shows what we are capable of producing and delivering in a given time

## What is Lean? continued



period. If the operating system is based on a batch and queue (economic order quantity) philosophy, you'll be doing large increments. As our major customers trend towards assembly plants that can build mixed models, Delphi had to re-think its capacity and its investment levels. That's one issue.

The other issue is the demand curve. The solid line on Figure 1 is the demand curve. It is very hard to predict. We think the winner in our industry is the company that can most closely match their capacity and cost to the demand curve. In Figure 1 you can see that there is too much capacity at one point (Over Capability, where we "burn" a lot of money and don't have the market). At another point in time, "Short Capability," we fell short in capacity and missed some profitable market opportunity.

## Organizational Structure

### Six operating divisions

Delphi has six operating divisions, with a division president in charge of each. Each division would typically have about \$4 billion in annual sales. Each division has a manufacturing director. Each division has twenty to thirty plants.

### Change agents

In 1997, when we got very serious about making the transformation to Lean, we added a senior-level divisional change agent to our structure. Just one per division. And that person has a small core support team that supports the plants in their division.

I do not have a large corporate staff. On the manufacturing side my staff is only six people. We support the groups within the division and we expect each plant to be building and breeding their own internal capability.

We have also basically divorced ourselves from the many Lean consultants we've had all over the world, because we're so big and complex. We have honed it down to about eight to ten people who have worked for and have implemented Lean

## Change agents, continued

at Toyota. The Delphi strategy is to model our manufacturing system on the principles of the Toyota Production System. That's our foundation. That's where we're going. That's the mindset we want all of our employees to have.

## We initially used a "functional" structure

Structurally, we've basically been a traditional "functional" organization. We trained people within functions. Everyone came up through functions at Delphi. That's where you're promoted, and basically that's where your career is. If someone wanted to be a general manager he or she would skip around between functions. But as we became more proficient with Lean, we felt functionalism wasn't getting the job done well enough in a global marketplace. We wanted our leaders to be more entrepreneurial, and a functional structure didn't facilitate that.

## Business Line Executives and Product Line Managers

In 2000 we created a cross-functional position of Business Line Executive at the very highest level of the corporation, reporting directly to the president. We also created the position of Product Line Manager. They are responsible for a particular product line within that business, and they report to the Business Line Executive. Business Line Executives may have several Product Line Managers reporting to them.

We currently have twenty-six Business Line Executives at Delphi and they average \$1 billion in sales with a variety of different product lines. These executives are responsible for growth and profitability throughout their respective value streams.

This is hard work. These executives are responsible for the flow in the value streams, and for ensuring that the functions are aligned and cooperative. It takes a certain kind of individual who can manage by influence instead of by budget and control of resources.

We got off to a very rocky start with this change and, quite frankly, a lot of the individuals we placed in that position didn't feel very comfortable with it; and that's okay. We now have a generation of people coming up in Delphi that are looking at that as their career path.

At this time, we don't have enough slots for these positions to fill the growing demand. People now come in and ask, "How do I get into product line management, business line executive?" They want to be able to look across functions and run businesses holistically instead of just coming up through functions. The reality is that we need both—functional and business-line management—at Delphi. And the ratio is probably 95:5.

As a company, we have great strengths in engineering and manufacturing, for example, and need to maintain strong functional components. But we are also cutting goals across functions with these Product Line Managers and Business Line Executives.

During our annual reviews, especially in the budget review, the Business Line Executives provide value-stream updates to the chairman and vice chairmen and identify the profit opportunities and business issues. Functional leaders then present their business plan and budgetary needs to support that value stream.

## Lean leadership team

Delphi's board of directors, in November of 2002, created the position of Vice Chairman, Lean Enterprise and Delphi Technologies. That means the number two person in Delphi is overseeing Lean Enterprise.

As we began our work in Lean, we conducted an evaluation of our leadership. Everyone was put into one of three categories:

- A leader who knows what to do (i.e., has the knowledge and thinks), or
- A leader who is willing to learn (i.e., thinks and will get the knowledge), or
- Neither of the above.

We had 171 plants around the world and if any of our leaders didn't fit into one of the first two categories we basically had a business decision to make about them. I will tell you that we worked with our people and we actually had very little fallout, because we're trying to implement a culture that's a learning environment. Most of our people fell into the category that they didn't know a lot about Lean but wanted to learn and wanted to implement it.

## Lean leader development questions

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What should a Lean leader ask first in a problem situation?

1. Who is responsible?
2. What happened?
3. How do we fix this?
4. Why did this happen?

The answer we want is #4. Lean leaders want to know why a problem happened. They'll get to the who's, what's, and how's later. Here's another question. What do you think is the common ingredient in successful Lean leaders in manufacturing? In our hard, cold, environment of get the products out the door every day, what do you think the important ingredient is here?

- Deep experience?
- Proven ability to implement change?
- Appetite to learn and teach?
- Driven by accomplishments?

We found that with the amount of opportunity and challenge that's out there—like climb one mountain only to see the top of the next one—we really needed to try to develop a culture of constant learning and teaching. Of course experience, ability to implement change, and a motivation to achieve is important, but an attitude of being open to learning and teaching has to come first.

Another question: When a new engineer is given a task that she or he knows nothing about, what should the supervisor do?

- A. Tell the employee to do the best he or she can.
- B. Perform the task with the employee observing.
- C. As the employee to go observe what is going on and come back to discuss his or her findings.
- D. Assign the task to someone else.

## Lean leader development questions, continued

We've found that the best answer for learning and development is "C," ask the employee to go observe and come back to discuss his or her findings. Now some common sense is needed here. We are running a business. If the place is burning down, don't do C.

Okay, true or false?

1. Lean manufacturing may hinder ergonomics and health and safety.

False. We frequently found that people who think Lean manufacturing is making ergonomics or health and safety worse are misunderstanding Lean or that the wrong industrial engineers are on the job. When one does good "motion kaizen," people's jobs get better. And it turns into better productivity, too. We've found that no matter what their culture is, or where one is around the world, our people want to *do* a better job and they want to *have* a better job.

2. Faster-to-Market is achieved by selecting a single design early in the new product development cycle.

False. This is a big issue. We had to change our mindset. I'm a mechanical engineer, educated in North America with a linear mindset that says pick a design really early so you have plenty of time to work on it before you have to put it into production—versus set-based concurrent engineering. Run as late as you can.

3. The primary reason for reducing changeover time is to increase our available productivity time.

False. Our data shows that changeover time has been reduced from four hours to fifteen or twenty minutes. So is the main benefit that I gained an additional three hours and fifteen minutes of production time? Is that the reason I did it? No! What I really wanted is the ability to get sixteen changeovers in four hours, not three hours and forty-five minutes more production time. The goal is to create small-lot capability and that means lots of changeovers. We don't reduce changeover time to get more production time.

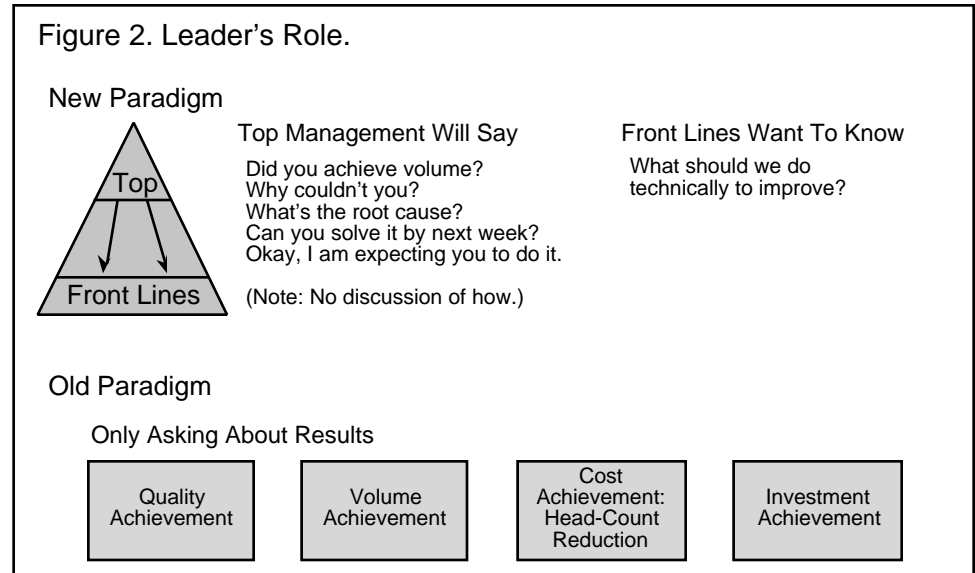
4. A "U-cell" is the optimal arrangement for cell layout design.

False. Watch out for that word "optimal." The important objective is to create a design that will achieve man-material-machine balance, and not just try to optimize some particular preconceived shape. The right shape might be a straight line. It might be a "U" shape. It might be some other shape.

## Leader's role

There has been a paradigm shift in what we think of as the leadership role in Delphi. We have a new paradigm that's being taught in our Leadership College. The old leadership paradigm was to basically ask subordinates about their results. Leaders would say, "Tell me your quality results, your quantity results, your cost and head-count reduction results. Tell me your investment. The new approach goes to understanding, and making sure subordinates understand why things are happening and that they know how to improve things (see Figure 2).

## Leader's role, continued



## Manufacturing leaders assessment

As a part of the new leadership model, we designed an assessment process to inform ourselves about where we all stand. We started with our 171 plant managers throughout the world. We decided that there would be three attributes we would score in everyone's annual appraisal: 1. Are you making the results (e.g., parts per million, budget, and expense)? Do you demonstrate leadership abilities? Do you demonstrate Delphi Manufacturing System/Lean knowledge? There are four possible scores one can get on the assessment: (a) has none, (b) has the knowledge, (c) has shown that he/she can implement the knowledge, and (d) can be trusted as a teacher.

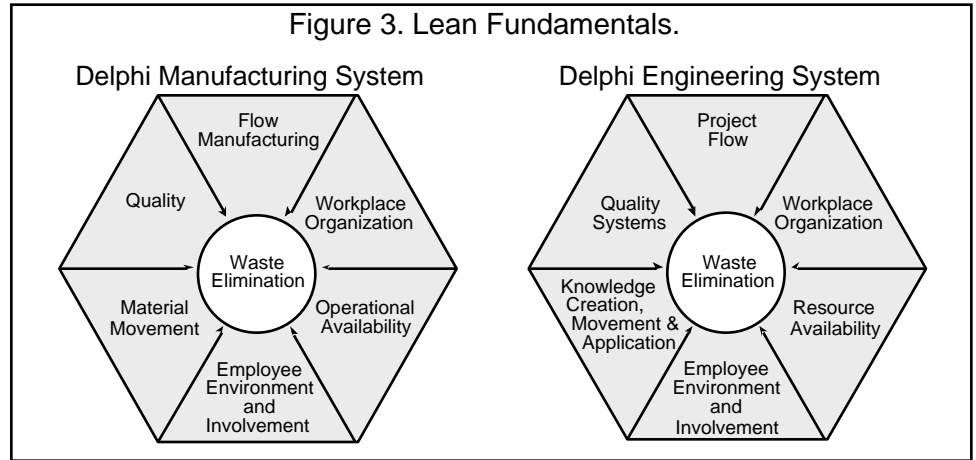
We were concerned that there would be a lot of backlash when we introduced this evaluation. That didn't happen. Instead, we found that most of our managers liked it. In fact, managers started using it at different levels of their organization. So instead of it being a "plant manager's assessment," plant managers started using it down to supervisor levels.

We run an internal Lean College. Each month fifteen to twenty people come in for a full week of learning. The curriculum covers the three leadership assessment categories of performance results, leadership abilities, and the Delphi Manufacturing System/Lean Knowledge. Our Chairman of the Board teaches five sections on leadership abilities. He spends two hours with the group and teaches what he requires as the first five elements of leadership.

## Lean fundamentals

The focus of product development at Delphi is the creation of profitable future value streams by developing a seamless linkage between engineering, manufacturing, purchasing, and the extended value streams. We've used a wheel to picture our manufacturing system and engineering system, as shown in Figure 3, which you'll find on the next page.

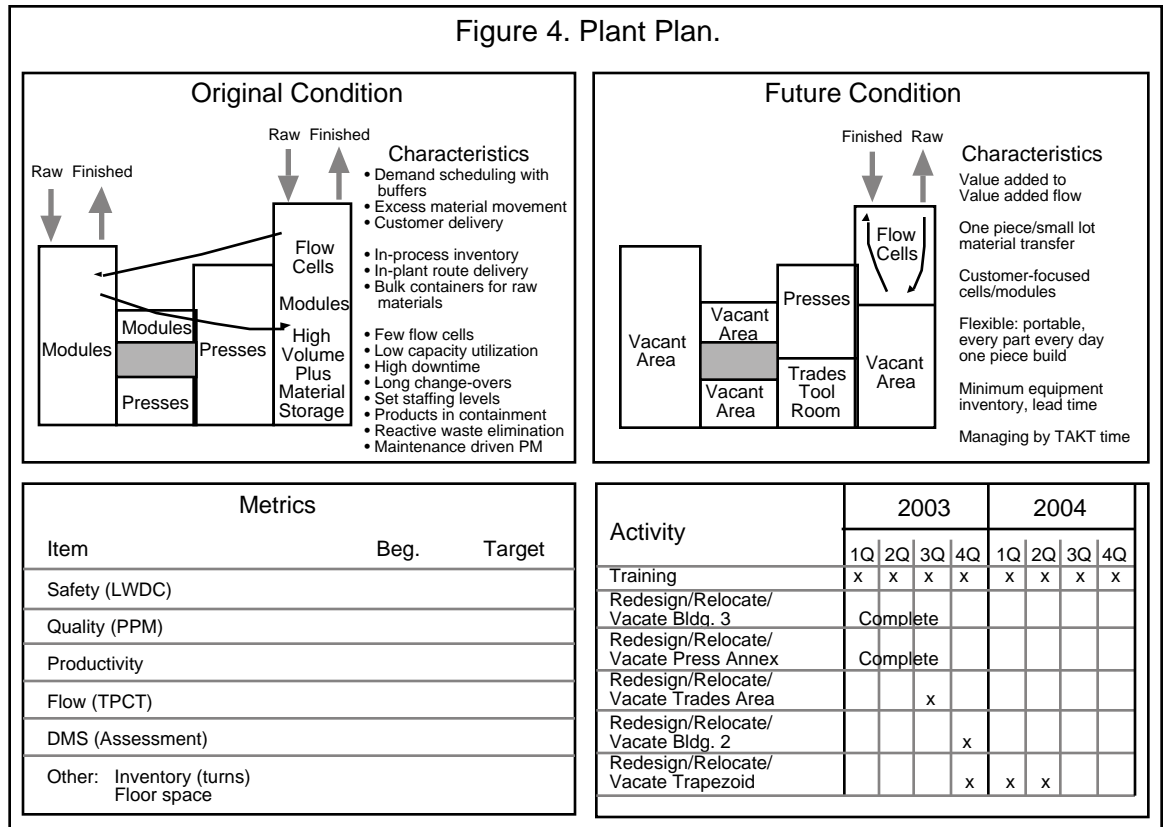
**Lean fundamentals, continued**



**Lean manufacturing planning process**

People generally ask, “Where do I start?” We suggest a four-step process.

1. Choose a specific product line or process from your site or program.
2. Establish the product cycle time, and document the critical path in hours.
3. Map the value stream, showing material flow and information flow.
4. Develop a one-page plant plan (Figure 4).



Our one-page plant plan, shown in Figure 3, is pretty simple:

- Original condition: First, the plant manager and his work group draw a picture of their beginning condition, listing the major characteristics.

## Lean manufacturing planning process, continued

- Future condition: Next, document what the proposed future condition will be.
- Metrics: Show the measures that will be used, what the beginning and target metrics are.
- Activity: Show major activities and time lines.

We originally started out (big mistake) by asking our plant managers for a two-year plan. We have found that working with 30-day, 60-day, and 90-day plans are most effective. They might have some two-year plan on the shelf to make sure some long-term vision is being tracked.

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## Product system design

Product System Design (PSD) at Delphi is a flow that includes our Manufacturing System Design (MSD), and the Delphi Manufacturing System (DMS). PSD incorporates Set-Based Concurrent Engineering, Lean, Segmentation, and Standardization.

The Delphi Engineering System, in our business, is the highest-leverage technical resource in Lean. Engineers write every print and specification for everything we buy. I'm spending most of my time on the engineering supports for the main batching system.

Our mission is to have clear responsibility and tight linkage between product development, manufacturing engineering, and the daily activity in the company. We use the phrase, "hunt in a pack." It means that we work together to achieve high first-time quality at each stage, and high operational availability. Some of the results we've achieved among our facilities so far include:

- Productivity improvements range from 9% to 45%
  - Floor space improvements range from 8% to 100%
  - PPM improvements range from 44% to 100%
  - TPcT improvements range from 18% to 53%
  - Inventory turns improvements range from 9% to 100%
  - Model-to-model cost reductions in the range of 15% to 50%.
- 

## Lean supplier development

We hired a new vice president of purchasing about two years ago, someone who really understands Lean enterprise. We're basically doing a 180-degree turn-about with our supply base. We have some 4,000 suppliers. We don't know what the right number should be but we know 4,000 suppliers are too many. We have an organization now called Lean Supplier Development that is taking our DMS and putting the exact same process that we have in our plants into key suppliers that said they would like to do this with us.

Our vice-chairman's thinking is that "I don't have 171 plants. I have 4,171 because I've got 4,000 supply plants that I have to be concerned about, too. Our vision is that someday, long-term, our key suppliers will be part of the same Lean system, all working from the same information.

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## Delphi in transition

Our Lean journey has produced impressive results for us, yet we seek even greater results. In the area of quality, for example, we are working to go from inspection and containment to being capable at every station.

In the area of suppliers, our old system was basically an auction. We sent the prints out, ran the auction, found the best price, and they got the business. Now we're going on a term/cost basis and we're going with a few partners who want to be aligned with us in Lean Enterprise. There will still be a price auction. That's not going to go away on nuts and bolts—commodity products—that's a way of life. But on the key technologies and our desired state in the value stream, we are targeting and working with select suppliers.

This work is like a two-edged sword. Our Lean journey has produced impressive results for us and it offers us some solid hope so for our future in this highly competitive global marketplace. But also there is really no end to the journey. There might be a couple of plateaus but it's a very humbling environment to work in. When you think you know something, you soon find out how little you know as you keep going, and how much more there is to know.

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## Closing thoughts

In closing, I'd like to leave you with three thoughts:

- Lean is a philosophy of what you are and how you think. In the words of Teruyuki Minoura, “a living and constantly evolving system.”
- Pay attention to detail on continuous improvement and problem solving.
- A Lean enterprise is a business system, not a collection of the latest “lean” techniques.

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## Author information

*David J. Logozzo has thirty-three years experience with General Motors and Delphi Corporation. He began his career with New Departure-Hyatt Bearings where he held numerous manufacturing and engineering assignments. He later became the synchronous manufacturing leader and quality director for the New Departure-Hyatt Bearings Division.*

*During an eight-year period, Logozzo was the production manager and chief engineer for the AC Rochester Division, the international operations manager for Delphi Energy Division and the business line leader of Delphi's Exhaust Business. His P&L responsibilities in these positions included implementing Lean and flexible manufacturing modules in locations around the world. He is a strong proponent of mapping flow to achieve material and information improvements in the entire value stream.*

*Logozzo received his mechanical engineering degree from General Motors Institute (now Kettering University) and his MBA from Dartmouth College. He is a member of the Shingo Prize Board of Governors, and he is Delphi's liaison to the Lean Enterprise Institute. He also serves as a guest lecturer for various universities and professional organizations.*

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## About this article

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