1

THE BASIC FLAWS AND MISCONCEPTIONS ABOUT LEAN

Batch manufacturing has been both the principle factor for success and the nemesis for a decline in the dominance of American manufacturing. Growing out of the techniques employed by Henry Ford when he strove to make an affordable automobile for the masses, batch manufacturing became the principle reason the United States was viewed worldwide as a model for industry. But as time prodded on, it was to become the chief reason the United States lost the leadership role it held in manufacturing for well over six decades.

During World War II, batch production was refined to as a science; it helped establish a “more is better” mindset. But that alone probably would not have made this system of production the waste generator it is today. Starting in the mid-1970s, the average consumer was exposed to an ever greater offering of styles, functions, and designs. Today a high level of product diversification is fully expected. The downside was this approach significantly increased the need for more on-hand inventory, added more equipment that had to be maintained, and created substantial variations in pro-

cessing — all of which served to grow the wastes noted to monster proportions.

But it wasn't until the late-1980s, when Toyota and other Japanese manufacturers began to invade the scene that U.S. manufacturers came to discover they were facing an opponent who went about the task of manufacturing in a totally different manner. Out of arrogance on one hand and a serious miscalculation on the other, the need for change was principally ignored, until it could no longer be denied that the United States was starting to lose its manufacturing base.

What made matters worse was even though most firms came to confirm the need for Lean Manufacturing in the mid-1990s, we haven't done an adequate job of fully and effectively implementing the process across a broad spectrum of industry. Thus, the purpose of this book is aimed at how to go about *completely destroying batch manufacturing* and replacing it with a world class system of production, in a reasonably fast and effective manner.

A question that comes to mind is: Are we looking at setting aside everything we're learned about Lean and starting over again? The answer to that is contained within the content of this work. I can assure the reader, however, that developing a world class system of production doesn't require setting aside what has been learned in the past. Nor does it require starting over again. What it boils down to is revising our implementation strategy, especially where the sole focus has for the most part been a shotgun approach to continuous improvement. But in making changes, nothing has to be undone. The best way to view the effort required is greatly enhancing the work that's been accomplished thus far.

IMPLEMENTATION STRATEGIES

Meaningful ideas aren't created in a flash of brilliance. They're born as a result of first-hand experience, a sense of dedication to the process, and a willingness to step forward, even when it goes against the grain of traditional thinking. As we move forward, let's consider some common perceptions that have been formed with respect to implementation strategy.

Perception #1

The mission of Lean Manufacturing should be to make steady, incremental improvements that result in an immediate savings to the company.

Counter Argument

Making Lean a success requires a focus on changing a factory's entire approach to manufacturing. If done correctly, this change requires spending money on the front end; this investment most often will not result in an immediate payback.

Perception #2

Implementing Lean does not require additional staffing, outside of perhaps hiring an experienced Lean Coordinator to oversee the process, perform training, and track overall results.

Counter Argument

While efforts are being directed at implementing Lean, the factory is still working to meet customer requirements under the rules and operating guidelines of the existing system of production. As a result, the ability to shift roles and responsibilities within the current ranks

is extremely limited, and usually provides less-than-adequate support for Lean.

Perception #3

Factory participants with no real experience and background in engineering can be trained to successfully conduct work measurement and to effectively apply the sciences of setup reduction and mistake proofing.

Counter Argument

Performing dependable work measurement — critical to operating decisions pertaining to manpower, taking on added business, and the like — requires expertise in performance rating and methods evaluation. This expertise is inherent to the science of Industrial Engineering. In addition, conducting meaningful setup reduction and working to make production processes mistake proof, which is critical to the fundamentals of Lean Manufacturing, cannot be effectively accomplished without the skill and expertise of Manufacturing Engineering.

Other Perceptions

There are other misconceptions about implementing Lean that will be addressed as we move along. One of the principle factors, however, has been the unerring belief that Lean Manufacturing is a never-ending process. Therefore, if it took Toyota four decades, it's perceived that the United States will need a similar portion of time to gain the same competitive level of expertise. As a result, the overall expec-

tations of management and stockholders alike have been minimized. The pressure to find a means of implementing Lean in a quick and effective fashion has fallen by the wayside.

There is a very serious flaw in this type of thinking. Fully implementing Lean Manufacturing is *in no way* a never-ending process. What is never ending about it is the continuous improvement aspect, which can best be done when a plant has made a full and absolute change to its existing system of production.

A very frustrated hourly worker pulled me aside once to complain, "It shouldn't take years to do this. If they can move a factory to Mexico and have it up and running in nine months, we should be able to make the same kind of change we need here, in order to help keep our jobs." When I passed the comment on to his direct supervisor, his reply was, "Freddie's a good guy, but he doesn't understand we've got other things to do as well." I proceeded to ask why Lean wasn't being more aggressively applied in the factory. He summed his answer in one word, "Equipment." When I pointed out I'd been informed the equipment involved had setup reduction and mistake proofing applied, he responded with a sly smile, before adding "For all the good that's done! They really shouldn't have wasted their time."

I've since come to believe what he really meant to say was that it was impossible for him to be enthused about Lean when everything he had to work with was geared to accommodate a totally different style of production. We have to understand that the best intentions of our production man-

agers and supervisors cannot be readily applied if we're asking them to fight a battle with one arm tied behind their back.

Lean Objectives

For every case of striving to introduce Lean and spread it across a factory, there are two objectives that always take priority. The first has to do with meeting established demand, by achieving a master schedule that is intended to reflect actual customer orders. The second objective is to achieve assigned budgets and forecasts, without incurring unfavorable variances.

Lean is touted as a process that shouldn't pose a significant interference in meeting customer demand, along with projected budgets and forecasts. But it frequently can and does. When implementing Lean seriously interferes with past practices, it can be perceived as more of a nuisance than a benefit. And when such a perception sets in, the process is doomed to become a secondary mission, with little heart and soul behind the effort.

What is simply amazing is the number of manufacturing leaders who believe that achieving a complete transition in production can be done on a part-time basis and with limited and less-than-qualified resources.

Equipment Engineering

Toyota created a substantially different approach to the mass production techniques used by American industry at the time. Their approach led to the *Toyota Production System,* which has since become the foundation for almost every initiative undertaken in the field of Lean Manufacturing. But

there is an important piece of the puzzle that's been lost: a plant's Key Production Equipment.

Any difficulty in moving a Lean initiative forward will almost always revert back to equipment that isn't geared to respond to the conduct required. I use the word *geared* in reference to the compliance of equipment to the highest levels of both reliable and repeatable performance. Equipment that can achieve these levels will lead to improved flexibility, substantially lower operating costs, and an often eye-opening reduction in factory lead-time.

The issue of equipment engineering seldom, if ever, is addressed seriously on the front end of most Lean initiatives. As a result, the process has been hampered. Consider if you will, the following questions:

1. Why do firms enter into Lean with nothing but good intentions, only to see it seriously falter before it becomes a way of life?
2. Why hasn't America's Lean transition become an answer to outsourcing hundreds of thousands of manufacturing jobs to foreign soil?
3. Why is it so hard for U.S. industry not only to buy into the concept of Lean Manufacturing, but also to use the nation's considerable ingenuity in making it a reality?

The United States has proven repeatedly we have the ability to deliver, if and when we put our heart into an effort. But for various reasons we haven't as yet established a universally accepted means of implementing Lean and effectively measuring progress. In turn, this failure has left many

organizations questioning where they stand and what they've truly accomplished.

Take the U.S. space program as an example. Everyone would agree that it too is a never-ending process. But a very narrow focus was placed initially on putting a man on the moon. That goal, in essence, became the United States' space program and the nation rallied around it with an uncommon fervor. However, meeting this objective was done with the expressed knowledge that while the program would not effectively *end* with that achievement, it could not truly *begin* without it.

The same holds true for Lean Manufacturing. We must have a recognized level of accomplishment, at some well-defined point in the process, in order for manufacturers to buy wholeheartedly into the concept and work to achieve a foundation from which the next solid commitment can be launched.

But first one has to acknowledge that if a factory can never look someone in the eye and say they've arrived, so to speak, there is little chance they will have the fortitude to push forward aggressively toward the next level of achievement. As a result, the overall mission requires a spot where an operation can pause, if only momentarily, to celebrate a clear and noteworthy accomplishment — not an end in itself, but rather an achievement that becomes the next launching pad for the future.

OBSTACLES TO PROGRESS

Before examining what can done to improve the thrust of implementation and more quickly gain the benefits across

a broad scale of U.S. manufacturing, it is important to summarize the flaws that have served to hamper progress:

1. The lack of an appropriate focus on a plant's key production equipment in setting the stage for an aggressive application of Lean across the entire operation.
2. A general failure in the utilization of the Industrial and Manufacturing Engineering functions in the process.
3. A growing trend away from a "just do it" mentality to establishing a proof-based comfort level before change of any kind is allowed.

After retiring, I was called on by various firms to assist in setting the foundation for a *Waste Free Manufacturing* environment. In every case, some very pronounced accomplishments were made. Work-in-process inventory levels were reduced as much as 90%. Productivity, in terms of the actual number of people required to perform the work, improved as much as 30%. Required floor space was reduced up to 50% and quality measurements, in the form of scrap, rework, and obsolescence, were lowered 50% and more.

Under any form of evaluation these would have to be classified as phenomenal accomplishments, especially considering the change was made over a very short period of time. On the other hand, there was more than one occasion where completing implementation on a plant-wide basis fell short of the goal. Although it would have been easy to say there simply wasn't strong enough management support, that wasn't the case. Management was more than willing to see

Lean become a success and to fully support it — up to a point. That point, of course, was when Lean began to seriously distract from achieving other factory obligations, such as dealing with expenses and meeting customer demand.

There are those, including myself, who would like to see plant management much more driven as to the need for Lean and more willing to step forward in defense of the process. Still, we have to face reality. In the vast majority of cases, this isn't something that can be depended on to keep a Lean initiative at the forefront of priorities. Consider the case of Avery Manufacturing (Case 1-1):

CASE 1-1 AVERY MANUFACTURING

Avery Manufacturing, which has been in business for well over two decades, produces plastic extruded components for the automotive industry. For much of its existence, it enjoyed steady growth and improved market share. But as competitive pressures grew, it slowly began to lose business to overseas competition. As a result, profits and share of market began to spiral. After much deliberation, management decided there was a need to pursue a Lean Manufacturing initiative.

After communicating to employees, Avery hired the services of a well-respected consulting firm. As a first step, an area of the factory was selected as a pilot project. A special event was conducted involving a number of key factory personnel, including the plant manager and various members of his staff.

The event went extremely well. Participants received training in the basic tools and techniques. As is usually

the case, the chosen pilot area was totally revised. Floor space was reduced, required work-in-process inventory levels were lowered, direct labor was redistributed, and manpower adjustments were made. Unneeded items consisting of inventory, old and infrequently used equipment, and such were removed from the area and stored in a special zone until a decision could be made as to disposition. In addition, work stations were redesigned with input from the operators; numerous visual controls were installed.

Afterwards, enthusiasm ran high. Work began on spreading the change plant wide. Twenty-four months later, however, one could find little evidence of a successful turnaround. Factory inventory levels remained as high as ever and slippage was evident in the selected pilot area, especially regarding work-place organization. Although a substantial number of smaller in-house events were conducted after the pilot, focus had been placed on making small improvements within the confines of larger production departments, which tended to be suffocated by the batch environment going on around them. As added competitive pressures grew, more and more effort was shifted from implementing Lean to addressing and resolving immediate production issues (firefighting). The strong enthusiasm on the front end slowly began to ebb and largely turned to skepticism on the part of employees. They began to view Lean as just another program, among the many that had started and died over the years.

This case is, for the most part, a fictional account. But it points to what's transpiring in much of U.S. industry. Initial efforts are generally impressive and filled with unique accom-

plishments and high enthusiasm. Following this, however, things frequently begin to slow, principally as a result of not fully understanding what to attack first, second, and so on (see Figure 1.1).

Figure 1.1
How to Go about the Job

- ✔ **Establish clear levels of accomplishment: Level I through Level IV***
- ✔ **Determine the tools needed: Poke-Yoke, TPM, SMED, etc.**
- ✔ **Train and communicate**
- ✔ **Enlist the workforce**

*** Details spelled out in Chapter Two, Figure 2.2**

To emphasize what I'm driving at, I once worked with a well-known firm where, six months after a highly successful event, I returned for a follow-up review. I was astonished to see that outside of some rather insignificant changes on the factory floor, little progress had been made. In addition, the pilot area, which was designed to be a showcase for how the process should both look and feel, had shifted back to a push system of production, after initially being targeted as the first pull area of the factory.

Upon further investigation, it became apparent that the objectives established for the change effort had in no way been met. In fact, no machine in the factory had a setup time

less than twenty minutes in duration and some machines took hours to change over. On two projects where team members had placed some effort, the post-pilot goals for setup reduction were far from achieved and no work whatsoever had been applied to error-proofing equipment. Even more disappointing, I learned in a follow-up meeting with plant management that they were pleased with the work accomplished. They noted that although the goals hadn't been fully achieved (a vast understatement), the team had improved setup on two pieces of equipment.

Much of their response was an effort to justify where progress stood, in order not be seen as lacking in their commitment. But as politely as I could under the circumstances, I cautioned them that the degree to which they expressed satisfied or disappointment said a lot about where they ultimately intended to take the process.

The silence was almost deafening as I told them that I didn't think Lean was really all that important to them. The plant manager, in particular, was visibly upset and asked me to provide the reasons I felt that way. In response, I proceeded to give each of them a copy of the participant feedback form I have team members complete on a follow-up visit. Among the findings:

1. No meetings had been conducted by management to check on how things were going or to redirect the activities of the team as needed, in achieving their stated objectives.
2. Collectively less than eighteen hours over a six-month period had been made available for team members to

work on stated objectives.

3. Although a majority of the team believed management thought Lean was important, all of them noted that "other things" came first, including:
   - Meeting production schedules
   - Meeting forecasted operating expenses
   - Providing support to higher priority or more important plant and corporative objectives

I noted that anything more than single minute changeover fell short of World-Class. It wasn't insignificant to the decision making process for issues such as adding business, increasing line rates, etc. I further reminded them that other pressing matters and higher priority objectives will always be there, in one form or another. In order to move a Lean initiative forward at a reasonable level of speed, there has to be a commitment to dedicate some number of resources to the process on a full-time basis, or at minimum some pre-determined period of time.

I should note that management was in no way disinterested or thought that Lean was less important than other things. They were simply typical manufacturing managers, working under typical conditions, which strongly influenced an operating mentality that said:

- "Things are always going to get in the way, so never overstate an objective. If anything, strive for a goal that's something less than possible and offer a pat on the back for any improvements made."
- "The most important thing is to keep banging out parts

and components, even if it takes an abundance of downtime, scrap, and rework — and if and when inventory becomes an issue, we'll take our limps and move on."

The problem many manufacturing managers have is that they simply refuse to get out of the way of progress. They do not believe machines can run without breaking down and without producing scrap and rework. They do not believe setup can be reduced to near zero and that errors inherent to specific pieces of equipment and processing can be entirely eliminated. What they do believe, however, is there's no magic that would serve to make manufacturing anything other than a day-to-day chaotic exercise. Otherwise, they'd be pushing the hardest for the change and, in most cases, would be staying after hours and weekends to make it happen.

Admittedly, implementing Lean puts a strain on expenses, drains needed resources, creates unneeded downtime, and for the most part has no immediate impact on the big picture. But place the initial thrust on effectively improving a plant's key production equipment, which for years has served as the one thing that poses the greatest stumbling block to achieving Lean's stated objective, and attitudes will shift dramatically.

The Japanese and more specifically a number of ex-Toyota managers were the first to bring the general philosophy of the Toyota Production System to U.S. shores. The thing they never seemed to clarify, however, was precisely what should come first, second, and so forth, in order to move

the process across the entire factory. There could have been many reasons for this, including the possibility they simply didn't look at it in those terms. The skeptic, of course, would say it wasn't in their best interest to show the United States how to gain parity. I lean toward the theory that they didn't view the process in terms of speed of implementation, but rather in making certain that participants understood how the various tools and techniques were intended to work.

Anyone who knows anything about Lean Manufacturing has a special admiration for Toyota and what it accomplished. They have served as the basic role model for Lean initiatives in the United States. But suppose Toyota was placed in the position of having to do it again. Would they take the same basic steps we're using to implement the process?

I posed that question to a number of people who were implementing Lean in various organizations; they generally had to think about it a bit because it was something they had never considered. The majority came to the conclusion that Toyota would follow the same path we are currently using. Those who didn't respond in like fashion admitted they really didn't know for certain. No one was convinced Toyota would go about it in an entirely different manner.

I believe if Toyota had to do it again, they would first gear their equipment to support Lean, through a highly professional application of SMED (Single Minute Exchange of Dies) and Poke-Yoke (a Japanese term related to mistake proofing equipment). In fact, Toyota applied much more attention to their equipment than has come to be recognized — not because they were striving to hide something from us, but

because we did not pay close enough attention to what the recognized father of the Toyota Production System, Taiichi Ohno, was trying to tell us.

Implementing Lean

With respect to this, my entire thinking on the path of implementation was changed in the spring of 2006, as a result of being asked to consult with Brunswick in the development of a Corporate Lean Manufacturing Guideline. The workshop was conducted in one of the company's feeder operations in Mexico, which served as an internal supplier of wiring harnesses.

I was privileged to see a factory that had made outstanding progress. During the session, I was asked to rate the operation on a scale of one to ten. My immediate response was that the plant was a solid nine. But it quickly became apparent the group of executives in attendance was seriously disappointed I hadn't answered a ten.

I explained that my assessment was based on what I outlined in my first work *Fast Track To Waste-Free Manufacturing*, pertaining to three established levels of achievement. Although the plant was very close to reaching what was outlined as a Level III, there were still some things left to be done, such as the insertion of Owner-Operators. I did clarify that the plant was unquestionably one of the best I'd witnessed in terms of a plant-wide application of the tools and techniques.

One of the more compelling features of the factory was the speed in which continuing change could be made. For

example, during a morning tour of the factory, I mentioned to the plant manager that he might want to place center locators on press beds for quicker insertion of dies and fixtures. During the afternoon break, he showed me a machine that had been fitted with the locator and pointed out that the dies had been notched accordingly; all of these adjustments had to be done from scratch in the plant's machine shop.

I congratulated the manager and politely stressed that putting such an effort into making the change was admirable, but showing me that he was going to use the idea wasn't necessary. I was already highly impressed with his factory. He look at me strangely a moment before replying, "Oh no, we would never make a change for show. Improvement to our equipment always comes first, before anything else."

It was then that I realized precisely how the factory had made so much progress, in such a short period of time. Their principle thrust, inadvertently or otherwise, had been to apply Lean Engineering to their equipment, In other words, they insured from the start that their equipment fully supported the process, in terms of an extensive and highly professional application of setup reduction and mistake proofing. They went further by keeping this in the forefront of their continuous improvement efforts.

As a result, it became clear to me that any operation, no matter how entrenched it might be with a batch mentality, could more effectively insert Lean if it placed an initial focus on getting its ***key production equipment*** aligned to support the effort. Something I can say for certain is if I had the chance to do it again, at any of the factories I was responsi-

ble for turning around, I would definitely take this approach — not because what was done was a failure by any means, but because I'm solidly convinced this approach would be a better way of handling the task.

I would challenge anyone to imagine how much easier it would be to make fast and lasting change on the shop floor, if a factory's key production equipment had a highly professional level of SMED, Poke-Yoke, Standard Work, and TPM thoroughly applied *before* starting to make flow changes on the shop floor. This doesn't mean other important elements of the process, such as Workplace Organization, 5-S, or 6C, could not be incorporated at the same time in many areas of the factory. But it does mean that work aimed at changing the flow, establishing point-of-use manufacturing, and setting up supply and replenishment links would be deferred until a plant's key equipment has been fully engineered (see Figure 1.2).

I have found that what is commonly viewed as the more obvious objectives of Lean are often seriously compromised because of production processes incapable of adequately supporting the change. As a result, the process tends

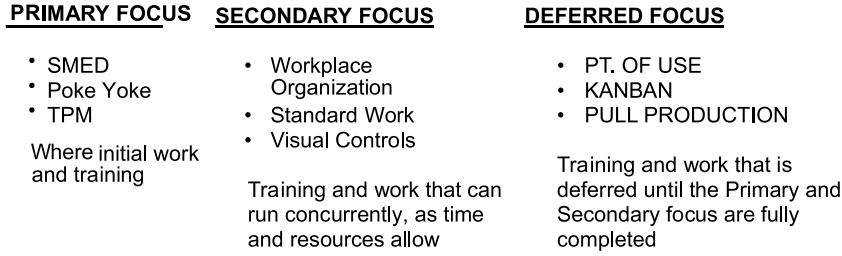

Figure 1.2 Training Stages and Focus

to lose the muscle it needs to move forward at an aggressive pace.

Toyota was successful because they were never satisfied with any single achievement or series of accomplishments. Instead, they were focused on a mission of total waste elimination. Completing this mission meant preparing the stage accordingly. To prepare, they had to get production processing as close as possible to zero setup, and also eliminate common processing errors. When a plant's equipment approaches this level of applied engineering, there is little excuse for the process not to move forward in an aggressive manner.

The overall content of this work provides the framework for what I sincerely view as a more appropriate means of implementing Lean, regardless of the size, type of operation involved, or products produced. Examining the key factors that have led us to where we are today is also important. In that way, we can understand precisely what we need to do differently.

THE TOYOTA FACTOR

There can be no argument that Toyota left a lasting and vastly important impression on Lean efforts in the United States. Read any book on Lean and you will find reference after reference to Toyota, along with examples of the improvements they have been able to bring to manufacturing. But nowhere to my knowledge can you find a specific step-by-step outline, as to the path that should be taken in implementing the process. Without this path, we have had to make our own way; as with any process of trial and error, there have

been both successes and failures. But we haven't, as yet, adopted a proven and universally accepted method of going about the task.

To strengthen the point, let's re-examine the typical technique used to launch Lean Manufacturing in the United States. In this basic approach, management appoints someone as its Lean guru. Management often contracts with a qualified consulting firm in order to get the ball rolling. A given production area is selected. Then over a period of time, participants are provided training in the various tools and techniques; they are asked to make what often amounts to eye popping change on the shop floor.

Not so surprisingly, this normally turns out to be a highly successful venture. Everything from work station layout to simplified replenishment techniques are addressed and improved. Furthermore, new shop floor inventory levels are established, operator work is redistributed, and the pilot area is generally assigned new levels of throughput. As a result, some very substantial improvements are generally gained. In addition, the area is cleaned and shaped, and ends up performing in a much more disciplined manner than ever before.

But after the usual celebration, what we typically see is that the pilot area slowly begins to drift back to doing business as usual. If we were to look deeply into what's actually transpiring, we would find that much of the noted stall boils down to production equipment that isn't geared to support the process. As a result, newly established inventory and throughput levels become theoretical at best The pilot area begins to steer in a direction opposite to the fundamental prin-

ciples that were initially applied.

As mentioned earlier, many of the top consultants at the time were ex-Toyota managers. They were the first to bring the United States an abbreviated version of the Toyota Production System. As a plant manager, I was as inspired as anyone. Over an eighteen-month period, I went on to literally force the change in a factory that became a showcase. Later, a number of Wall Street analysts visited the plant and reaped considerable praise on the process. But the critical point to be made is that the abbreviated application of the Toyota Production System became the basic model for almost every Lean Initiative undertaken in the United States.

The Japanese were focused on quickly exposing participants to the basic tools and techniques. On one noted occasion, the approach went so far as placing an entire final assembly line in the company's packing lot — then over the weekend, rearranging work stations followed by fully reassembling the line on the shop floor. You can imagine the chaos that followed, when operators returned the following Monday, to find everything about their world had totally changed. All this was aimed at getting the workforce's attention regarding both the magnitude of change required and the potential benefits to be gained.

What the Japanese didn't dwell on, however, was precisely how to conduct a full insertion of the process across the entire factory. Without trying to put words in their mouths, they perhaps felt, "We can show you how to fly the airplane, but you have to be your own pilot." We should keep in mind that the techniques were essentially bundle implemented over an

extremely short period of time. This was necessary in order to make the point regarding precisely how the tools were intended to work. On the other hand, the system of production was developed and deployed over four decades at Toyota. We should not take for granted that the flavor presented by the consultants was precisely how to go about successfully installing the process, factory wide.

But again, the approach taken by the Japanese became the model most U.S. companies used in both starting and moving the process forward. In most cases, continuous improvement became the by-word and the ultimate measuring stick for success. As long as some improvement was being made, no matter how small or convoluted the effort might be, working in this manner was generally perceived as how things were intended to proceed.

Approaching Lean in this fashion is one way of getting there. However, it's much more time consuming and open to some very serious stumbling blocks as the process trudges along. There are four questions every good manufacturing manager who has been into Lean for a time should ask:

1. Are you truly satisfied with the progress of your company's Lean initiative?
2. Are you seeing solid profit improvement or something short of what you perceived the process would yield?
3. Have manufacturing lead times and overall inventory levels been significantly and permanently reduced?
4. Are your customers going out of their way to let you know how much more satisfied they are with delivery and product quality?

Any firm entering into Lean should strive to be as effective with the process as Toyota, Komatsu, Yanmar, Hatachi, and others. Anything less would be short sighted. Unfortunately, most firms never reach that level of commitment. They tend to approach Lean in a rather disorganized manner; in lieu of no clearly established end objectives, the process tends to wander. Although continuous improvement is is indeed vital to the process, much of our industry is striving to position itself where Toyota currently stands after forty years of effort. The only difference is Toyota is working to improve processes that have been highly engineered; for the most past, we aren't.

The book *Kaisha: The Japanese Corporation* by James C. Abegglen and George Stalk Jr. notes the following:

A Japanese factory required about thirty days to make its product before the development of JIT. Once setup times throughout the factory were reduced, the production period fell to twelve days. After the layout of the factory was changed to reduce material flow and inventory holding points, the production period was reduced to six days. Eventually, as all inventory holding points were eliminated, the period of production was reduced to two days. This is the equivalent of reducing the production lead time of the European construction equipment company from twenty-four weeks to a week and a half.

It is important to note that in this general overview of Japanese manufacturing, the very first thing done, and the one that had the single greatest impact on lead time (an 18-day improvement) was placing an initial focus on reducing

setup. Nothing was mentioned about continuous improvement being vital to what was accomplished, leaving the impression that the mission was to make it happen as fast and effectively as possible.

The point about adequate equipment engineering can be magnified by looking back at what Taiichi Ohno, the founder of the Toyota Production System, had to say in 1988, when asked where Toyota was headed because they "must have reduced all work-in-process inventory, lowering the water level to expose the rocks, (and) enabling them to chip away at the problems."

Ohno's response was, "All we are doing is looking at is the time line, from the moment the customer gives us an order to the point when we collect the cash. And we are reducing that time line by removing the non-value added wastes."

Ohno indicated that Toyota had reached the point where it could successfully apply continuous improvement. What he didn't say, but which I wholehearted believe, is that this should only become a driving objective *after* a great deal of fundamental work has been accomplished on the shop floor — more specifically, in the arena of engineering equipment to support the process.

The level to which Toyota currently operates came over the course of 26 years of development and another 18 years of improving the process. We can avoid a great deal of trial and error by focusing on the techniques developed by the Toyota Production System. In doing so, however, we have to recognize that some fundamental steps must be taken, and

be wise enough to see that they are fully accomplished. This calls for understanding what the operating rules should be, along with the steps required to implement the process, in a timely and orderly fashion.

THE COST JUSTIFICATION FACTOR

As I have said, Six Sigma is an excellent tool and I highly recommend its use. The problem is in the way it is applied in most cases and, just as important, the role it has played in creating a false perception about how to implement Lean.

Something I offer in my consulting business is a free factory Lean assessment. I offer the assessment for two reasons. The first is to help factories verify they're on the right track and to establish where further opportunities for improvement exist. The other reason is it allows me to continue to expand my knowledge and experience. The assessment provides me a means of keeping up to date with industry developments.

During a recent assessment, conducted in the fall of 2008, I was informed in the initial meeting with plant management that the operation had four Six Sigma Green Belts, two of whom were close to achieving Black Belt status. The ensuing conversation went something like this:

"So what kind of things do you have them working on?" I asked.

My question was met with a look of puzzlement. "Oh, just typical Six Sigma projects," the answer finally came.

"What I'm driving," I strived to clarify, "is where the

basic implementation strategy is being directed?"

"Their efforts are being applied across the board and we're seeing some excellent improvements," I was informed, before he went about showing me a list of projects that had been achieved over the previous twelve months and the pay-back on investment.

In quickly looking over the list, I saw a couple of things that fit well with implementing Lean. However, I saw far more items which were basic cost savings or cost avoidance projects, such as changing material in order to lower a purchase price, and eliminating redundancy in the order entry process. I decided to put the subject aside for the time and learn more about what was actually transpiring on the shop floor. What I discovered served to reinforce what I've seen in many U.S. factories.

The plant had done some reasonably good work in the basics, especially in the area of workplace organization and establishing various areas where the principles of U-Cell flow were being utilized. But no work whatsoever had been performed on setup reduction. I found that interesting because 20% or more of an operator's time, on average, was spent setting up the equipment.

I'm pleased to say the result of the assessment led the plant to make a correction in course. The power of Six Sigma was defused, to a large extent by projects that had little to do with aggressively implementing Lean Manufacturing. This isn't to say what they were working was of no significance or importance. But with respect to the training and leading role

assigned to this particular resource, their efforts were simply misdirected.

Just as important as the issue of misdirection is the perception this type of approach has created on an almost overwhelming scale in U.S. industry. Lean, to a large extent, has steadily transformed to a project-based process, with clear cost justification required before change of any kind is made. Nothing could be further from the mindset and conduct needed to implement Lean Manufacturing fully and effectively.

What needs to be done differently is to provide those performing Six Sigma with some reasonable flexibility in moving forward. We should be teaching them the guiding principles and allow the principles to guide their actions, without undue restrictions. Coupling this teaching with good implementation strategy, aimed at getting a plant's key production equipment in tune with the effort, would unquestionably result in some truly amazing accomplishments for U.S. industry.

THE ENGINEERING FACTOR

Another important issue that has played a role in the lack of overall progress has been the placement of less than qualified resources in the pursuit of three key elements of Lean: Setup and Changeover (SMED), Mistake Proofing (Poke-Yoke), and Work Measurement (Standard Work).

The matter of applied engineering has been seriously downplayed in the United States, principally due to the perception that came out of the early Japanese influence on the process. I have repeatedly seen the process falter after the initial stage of implementation, most of which has occurred

because proper expertise was not applied to SMED, Standard Work, and Poke-Yoke.

Given reasonable training, many of the techniques of Lean can be carried out by participants who have no engineering expertise; such as 5 S, visual controls, and the like. On the other hand, SMED, Standard Work, and Poke-Yoke are extremely technical tasks that are best suited for the talent of a seasoned engineer. In fact, I would go as far to say, they cannot be adequately and thoroughly undertaken otherwise.

Ohno spoke to the appropriate use of engineering talent. Although his words have served as the foundation for much of what Lean Manufacturing has come to be in the United States, the engineering aspect of the process has been sorely under-emphasized. In fact, I believe some of his words have been taken completely out of context. To make the point, we should examine some facts, misconceptions, and conclusions.

Fact #1

In the vast majority of undertakings, Standard Work is performed by hourly and salaried participants who have no real experience and minimal training in the science of Work Measurement.

Associated Misconception

The theory behind this approach is if the person being observed is an experienced operator, there can be reasonable assurance the operator will perform with good effort and

to the prescribed method.

The Problem

There are several problems with this, two of the more important being:

1. Participants involved in performing work measurement usually have other jobs and responsibilities.Therefore, Standard Work tends to become something performed on a part-time basis at best, which leaves little time to become proficient at the task or to be driven to make it a full success.
2. It has been thoroughly proven that most operators under observation usually perform at a pace and often a method that doesn't represent normal conditions. There are numerous reasons why this happens. However, the point is that sound work measurement practices take both method and effort into respect and adjusts performed time to more adequately represent a normal pace.

Conclusion

Given a basic understanding of an automobile, almost anyone can change a spark plug. But delving into the inner workings of a combustible engine and doing a dependable job requires an experienced mechanic. It is absolutely no different when it comes to the science of work measurement. Standard Work will be much more reliable for making crucial management decisions pertaining to manpower requirements, cost estimates, and the like if the job is performed by a qualified Industrial Engineer. In addition, the more

advanced aspects of work measurement (the re-methodization and re-redistribution of labor) can be much more professionally and effectively applied.

Fact #2

In the vast majority of undertakings, Poke-Yoke and SMED are usually last on the list of priorities. If and when they are performed on equipment, the work is seldom done by someone who is fully qualified, trained, and formally dedicated to the project.

Associated Misconception

The theory is that when improvements are scheduled in specified areas of the factory, the assigned team members will decide if and when such work is important; they will then make the necessary change or see that appropriate talent is brought in to assist as required.

The Problem

Once again, there are some serious flaws with the theory. To name a couple:

1. Unless a qualified engineer has been assigned as a formal member of the team, the likelihood of the matter ever coming up would be small. Great attention is usually applied to the more basic aspects of Lean. Therefore, little time if any is left for more sophisticated applications, such as applying SMED and Poke-Yoke.
2. Assuming that the first problem noted is somehow addressed and fully resolved (which would be highly unusual), little actual improvement would be made.

The reason is doing the job effectively requires devoting attention to *all* key equipment. In the same respect mentioned for Standard Work, effectively doing the job of SMED and Poke-Yoke requires someone with a high level of skill and expertise in equipment engineering, who can be devoted to the effort full time.

Conclusion

Being effective with SMED and Poke-Yoke requires an engineer or group of engineers who are assigned the task for a specified period of time, until the work is fully completed. Anything less is not going to bring a plant's equipment up to World Class standards. Putting aside Ohno's frequent speech about teamwork and better utilization of the production worker, I've seen enough to believe the more critical tasks associated with the Toyota Production System were performed by highly qualified engineers — what Ohno refers to as "Toyota Style Industrial Engineering."

This type of front end work has been minimized in most Lean Manufacturing efforts undertaken on U.S. soil. Instead, crucial tasks such as Work Measurement, Mistake Proofing, and Setup Reduction have been turned over to participants who lack the skill to perform the job effectively.

Ohno tended to group separate types of engineering under one category called *Toyota Style Industrial Engineering*. He noted,

> *IE is the use of techniques and systems to improve the method of manufacturing. In scope it ranges from work simplification to large-scale capital investment plans. IE*

has two meanings. One aims at improving work methods in a plant or in a particular work activity. The other one means the specialized study of time and action.

In the United States, where by his own admission Industrial Engineering was born, the work he specifies is typically split between two fields of applied engineering. One is Manufacturing Engineering, the other Industrial Engineering. Although a large portion of the skills and educational focus are similar, the applied expertise at a plant level is usually substantially different.

As working experience goes, the manufacturing engineer tends to be more mechanically inclined, the industrial engineer more oriented toward methods and procedures. I make this distinction because it is important to understand that using only one of the engineering skills noted can sometimes leave an operation short of needed ability. As a past manager of Industrial Engineering, I carry a high level of respect for both functions. But for anyone to think that a typically experienced mechanical engineer can effectively do an industrial engineer's work (or vice versa) is misinformed. There is a unique difference in assigned focus and ability, and a definite need for both.

In *Fast Track,* I addressed the importance of Industrial Engineering under the topic *Your Greatest Warriors Against Waste.* However, I now believe the specific application of both Industrial and Manufacturing Engineering is required on the front end of a Lean initiative in order to adequately move the process in the right direction. The distinction between the two is important because the initial step outlined for *Level One*

Lean (LL-1) rests with getting *all* key production equipment in the plant up to a prescribed level of performance.

The question will arise, I'm certain, as to precisely how many engineers would be required for such an effort and how long it should take. The required number of engineers would vary depending on the complexity of the equipment involved and the size of the operation. But the goal should be to see that the initial work outlined doesn't exceed a year and preferably less, if at all possible.

As a first step, the assigned engineers should receive advanced training in the principles and concepts of Lean Manufacturing, with special focus on SMED, Standard Work, Poke-Yoke, TPM, and Workplace Organization. The assignment of two full-time engineers, ideally one mechanical and one industrial, to begin the process of appropriately engineering equipment would be essential.

THE CONTINUOUS IMPROVEMENT FACTOR

I've already elaborated somewhat on this, but in the simplest way of putting it, we have to somehow change management expectations and the focus of the participants in the process, from making certain we get it right the first time to making certain we kill batch manufacturing and do it as fast as humanly possible.

This was the focus of many of the early proponents of Lean, such as Richard J. Schonberger. In his book *Building a Chain of Customers*, he reflects, "*The real problem is commitment, and that's the purpose of this book and others like it, plus the many other forms of spreading the message. I can only say the ball is in your court. Do your utmost to educate*

any in the company who will listen, get little fires lit (small projects started) everywhere, and don't stop for sign-offs at every step."

In building on the principles of *Waste-Free Manufacturing*, I strongly encouraged the same approach, but took it a step further by noting, "Just Do It — But with knowledge." The knowledge that's most important is focusing early attention on getting a plant's key production equipment up to an acceptable level of compliance in order to provide a stable foundation for continuous improvement.

Key Reflections

- We've come to overlook the influence a plant's key equipment, which was designed to support a batch manufacturing environment, can have on speed of implementation. The equipment can often slow an initiative to near creeping progress.
- One of the more serious flaws in the way Lean is approached in the United States is the fact that there is no universal means of approaching the task and measuring progress. Once a firm gets past a basic commitment to Lean, the focus has to be placed on keeping the process moving forward rapidly. Just as important is making certain the tools of Lean are used to their ultimate level of benefit.
- The techniques used by the Japanese consultants were essentially "bundle implemented" over a very short period of time. This was necessary in order to demonstrate precisely how the tools were intended to work. On the other hand, these same tools and techniques were developed and deployed over four decades at Toyota. Therefore, we should not take for granted that the methods the early Japanese consultants used represent how we should go about installing the process.
- Because of what Lean Manufacturing has come to mean in the United States, more attention has been focused on techniques aimed at making small improvement rather than on a well thought out strate-

gy aimed at making a factory waste free, as quickly as humanly possible.

- Many in our industry are trying to position themselves where Toyota currently stands after forty years of effort. The only difference is Toyota is working to improve processes that have been highly engineered (in SMED and Poke-Yoke) and, for the most part, we aren't.
- We have to realize there are fundamental steps that should be taken and be wise enough to see they're fully accomplished. This calls for recognizing the rules of engagement, and embracing the steps required to implement the process in a timely and orderly fashion.