

The State of Lean in 2007

After a seventy-year effort, the most prominent innovator of lean production—Toyota—has passed General Motors, the architect and archetype of the previously dominant system of mass production. In addition, Toyota has continued along its trajectory as the most consistently successful industrial enterprise in the world over the past 57 years—in terms of profitability and share growth. It has enormous momentum to continue moving ahead.

No doubt there now will be a surge of interest in “lean” methods. Indeed, there is a high likelihood of a “lean wave” similar in form (rapid embrace followed by rapid subsidence) and origin (the world’s consultancies) to the Total Quality Management, Business Process Reengineering, and Six Sigma waves that have come before.

However, before manufacturing engineers mount their boards to ride the lean wave, a great deal of wasted effort (*muda*) can be avoided with a brief look at where lean came from.



Toyota’s manufacturing plant in Valenciennes, France.

The basic concepts of lean are not new. They have evolved through a number of stages or “ages”, commencing nearly a century ago in 1914 when Henry Ford put together all of the pieces of what he called “flow production” at his Highland Park plant in Detroit. Ford can fairly be called the first systematic process (lean) thinker, but only in the special condition of a highly standardized product with practically no options produced over a very long product life.

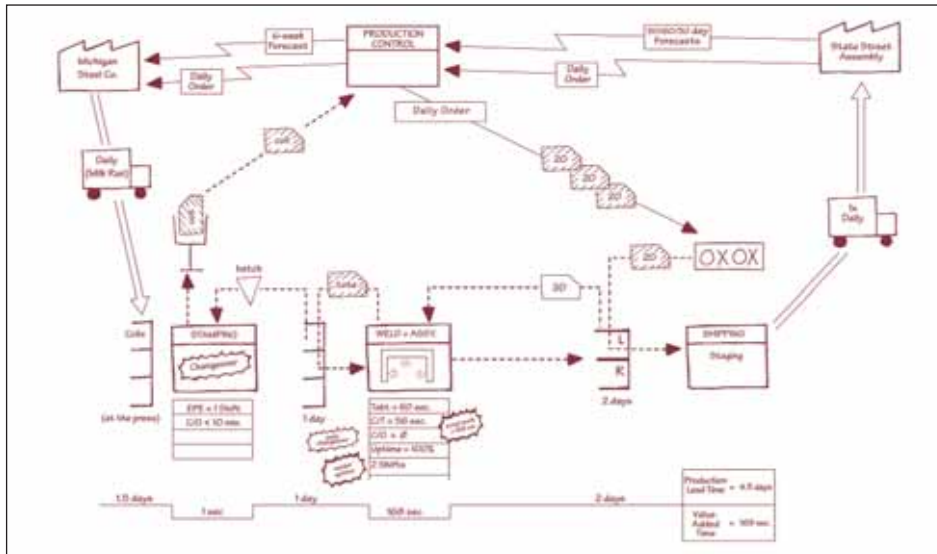
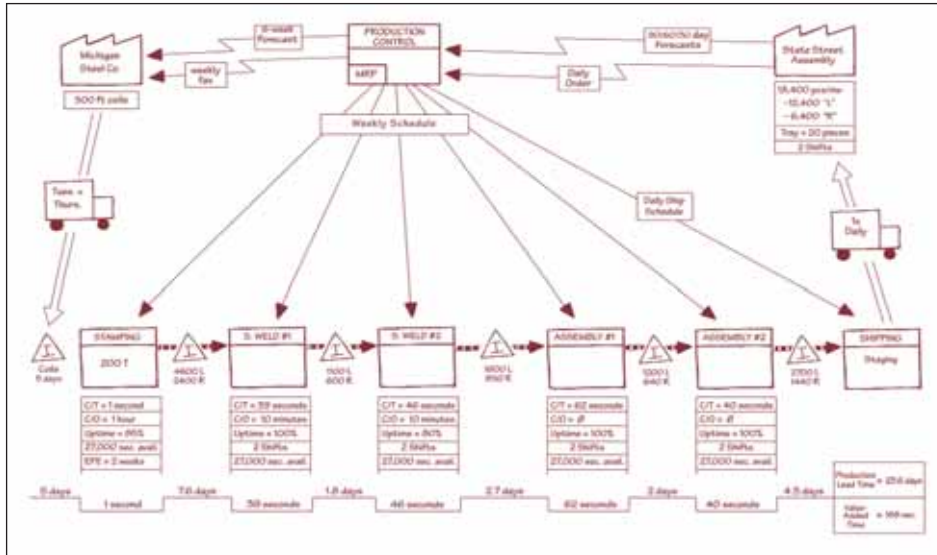
Inventions—ideas—become useful to organizations only when they are demonstrated in actual operations, at a moment of innovation. Beginning in the late 1940s, lean concepts were tested in all areas of Toyota’s business. The fulfillment system from order through production to delivery was transformed by

From Lean Tools to Lean Management

James P. Womack

Chairman and Founder
Lean Enterprise Institute
Cambridge, MA

Overview



Lean tools like current-state (above) and future-state (below) maps can't sustain progress unless applied within a lean management system that focuses on horizontal flow of value to the customer across departments and functions.

Taichi Ohno. The product and process development system was pioneered by Kenya Nakamura, Toyota's first Chief Engineer. The customer management system was formulated by Shotaro Kamiya. The supplier management system was devised by Kiichiro Toyoda as he created the Toyota Group of suppliers. And the management system that tied all the pieces together was added by Toyota Chairman Eiji Toyoda in the 1950s and 1960s.

Perfecting these interlocked innovations and diffusing them across every aspect of the Toyota company and through its supplier and dealer groups was a lengthy task that extended through the 1970s. It was only after the

energy shock of 1973 focused Toyota's energies that lean innovations were carried through the entire enterprise.

In 1977, Fujio Cho (the current Chairman of Toyota) and several collaborators produced the first explanation in English of the Toyota Production System (one of the five elements of the complete lean business system). [Y. Sugimori, K. Kusunoki, F. Cho and S. Uchikawa, "Toyota Production System and Kanban System—Materialization of Just-in-Time and Respect-for-Human System", *Proceedings of the 4th International Conference on Production Research*, London: Taylor & Francis, 1977.]

This article explained the two pillars of the "Toyota House"—Just-In-Time for production control and Jidoka for quality. It also revealed the system's competitive power. Comparing Toyota's operations with an American competitor's, the authors reported a more than doubling of labor productivity and a ten-fold advantage in velocity of

goods through the production process, expressed in inventory turns. In addition, the article reported setup times in stamping operations of 12 minutes versus six hours in the American competitor, and production of much smaller batches between changeovers. Finally, the authors noted that reportable injuries per hour worked at Toyota were slightly more than half the level of American auto companies.

This was highly provocative, particularly when combined with Toyota's continuing growth in export markets in the 1970s. It led to what I will call the Age of Discovery, in which innumerable investigators (of whom I was one)

began to visit Japan (and Toyota specifically) in order to pry out the secrets.

The MIT International Motor Vehicle Program's report, *The Machine That Changed the World* (Womack, Jones and Roos, 1990), which described the entire lean business system and gave the word "lean" its modern usage, came at the end of this process. At this point the debate was substantially over as to whether lean methods were better and whether they could be diffused globally by their Japanese originators. The question became how American and European auto companies could deploy them.

So far, diffusion of lean to fields beyond automotive has not taken the form that Toyota has pursued in its own operations. In its new, "greenfield" facilities around the world, Toyota has concentrated on putting in place a management system first, before thinking about specific lean techniques.

Toyota has concentrated on putting in place a management system first, before thinking about specific lean techniques. Toyota's emulators have done the opposite.

By contrast, most of Toyota's emulators have done just the opposite, applying tools first. This has led to what I will call the Age of Tools.

Tools are necessary. Anyone trying to create a lean enterprise will need 5S, poka-yoke, andon, SMED, cellular layouts, pull systems, concurrent design, target costing, and a host of other techniques. And these will need to be introduced with the aid of improvement methods such as kaizen, value-stream maps, and A3 analysis. But the evidence is very strong that despite a lot of hammering and sawing at the lean construction site, most lean practitioners are proceeding without clear blueprints as to the design of the overarching lean enterprise. And this makes progress with lean tools—no matter how sophisticated and how conscientiously applied—very difficult to sustain. This suggests the need for a new age. I will call it the Age of Lean Management.

The unique contribution of lean thinking is to change the focal plane of organizations as they provide goods and services to consumers. (And this includes practically all organizations in today's world, from manufacturing to healthcare to retail to government.) Such organizations have always been organized by departments and focused vertically, and probably always will be. Knowledge, assets, and careers are most easily managed in departments or functions aligned with the top of the organization chart. Indeed, the current

lean exemplar, Toyota, is a highly vertical organization with strong functions reporting to top-level executives.

The lean challenge is to introduce a new and predominant focal plane for managers, which is the horizontal flow of value to the customer along a complex value stream traversing many departments and functions. This is both within the walls of the organization and extending to independent organizations. Focusing horizontally exposes wastes of all sorts, along with mismatches between what the organization really wants to do and what the customer really wants done. The problem is that in most organizations no one is responsible for seeing and improving the horizontal flow of value while ensuring that the customer's needs are really being addressed.

One of my favorite activities on my value-stream walks through many organizations is to pick up a good or point to

a service at the customer-end of the value stream. I ask who is responsible for assuring that the entire stream is free of waste, clearly attuned to customer desires, and responsive to changing customer needs. In most organizations this question produces an awkward pause. "Do you want to talk to someone in marketing? How about in sales? Maybe the senior manager of the factory? You seem to be asking to speak to someone who doesn't exist in our organization." Precisely.

The predictable result of managers and production associates focusing on their piece of the value stream is a lot of point-optimization and a striking under-optimization of the entire stream. To make progress in gaining the full benefit of the many lean tools available, a new concept of lean management is needed.

For most of economic history enterprises were little more than workshops, with a master craftsman and a few apprentices to think through simple design and production processes. The entire activity was easy to see, and hardly any coordination was needed between the steps along value streams. Let's call this the Age of Craft Management.

As Ford made his breakthrough to Flow Production between 1908 and 1914, he realized that a new type of management was needed that could address lengthy flows of products in a massive organization. Conveniently for Ford, he was able personally to provide the necessary horizontal oversight of value flows during this extraordinary period. He

Overview

could directly oversee the development of the Model T in 1908, and was directly involved in laying out all of the assembly and fabrication value streams needed to put the fabrication and assembly of the product into continuous flow. Ford could brag, as he did in his 1922 volume, *My Life and Work*, that the Ford Motor Company had no organization chart and largely be right about the early days of the company.



But Ford's system could never deal with a wide range of products, short product lives, many options, and gyrating markets. And Ford himself soon lost contact with his development and production streams as he became a world figure after 1914. His company quickly became chaotic and unmanageable.

As it happened, Alfred Sloan, as President of General Motors after 1920, had a new concept of management to address the problem of complexity in what business historian Alfred Chandler called "giant enterprise." This ushered in today's Age of Mass Production Management.

Sloan took as a given that in a giant enterprise it would be impossible for the top executive to know personally more than a few of the managers. Thus it was important to figure out how to control and align their activities to support the overarching objectives of the organization.

One technique was to create a very formal organization chart and grant clear authority to the senior manager of each area. But how to make sure each departmental or unit manager was doing a good job? The answer was to create quantitative metrics of performance, some physical (e.g., inventory turns or percentage of scrap) and some financial (e.g., adherence to budgets and return on invested assets.)

To avoid managers with a narrow view, Sloan also rotated his senior managers through different areas of the organization as preparation for top-level assignments. The advantage was exposure to a wide range of problems. The disadvantage was very modest knowledge of the technical issues involved in marketing or production or purchasing.

This latter problem was addressed by the creation of large staff organizations of experts. The quality staff, the manufacturing staff, the human resources staff, etc. If managers encountered a problem with the performance of the area under their authority, it was a simple matter to call for staff help to find a remedy.

The end result of Sloan's innovations was to create a cadre of managers with clear authority and a clear scoreboard, all trained to provide the answer to every problem. But the weakness was that managers often had little technical knowledge of what they were managing within their departments, little or no training in problem solving as a scientific activity and, most important, no grasp of the flow of value across many departments en route to the customer.

As Toyota began to gain momentum with lean techniques in the 1950s, Chairman Eiji Toyoda gradually created a management system able to take full advantage of the new methods. The key was to make someone responsible for each value stream, but often with no formal authority. The most striking example was the Chief Engineer, who was responsible for developing a product along with a design and production process for that product that satisfied the customer while earning Toyota an acceptable profit. Unlike chief engineers in other companies, Toyoda granted the Toyota chief engineer little authority. Indeed, to this day Toyota's chief engineers have no direct reports in engineering or any other function.

Instead of authority granted by the organization chart, the chief engineer depended on deep knowledge about the product and the process to ask the organization if it was truly creating a product and process that would meet customer and company needs. Doing this meant, above all, asking hard questions of those working in the departments and functions. Over time, Toyota insisted that all of its managers perfect this process of solving problems through very structured methods based on PDCA.

At the same time, as Toyota was developing managers able to see value-creating processes and propose ways to improve them, it was de-emphasizing the mass production management practice of developing precise metrics for managers to meet at the end of the reporting period. Toyota concluded that this type of management was the equivalent of end-of-the-line quality inspection, which it had long abandoned for creating quality at the source. Instead, Toyota told managers to focus every minute on how the process under their oversight was working, and whether its condition was normal or abnormal. They were then urged to take immediate corrective action in the event of abnormalities. The fundamental belief was that if the process was right, the results would be right.

Sustainability has long been an issue in the lean movement. This is the ability of organizations to sustain improvements in processes. In other words, the capability of managers to make rapid lean leaps through kaizen (incremental change) and kaikaku (revolutionary change) that are permanent rather than ephemeral.

The root cause of the problem is vertical management. Most improvements in organizational processes are led by internal improvement teams (another department) or external consultants (an external department with special knowledge). As long as the “lean team” is in place dramatic results can be achieved, and even steadily improved.

The problem comes with the simple fact that most line managers have received little training in value-stream analysis to steadily improve every process once the improvement team leaves. And they have no training whatever in “standardized management” in the form of the periodic audits of every process required to sustain improvements. (This standardized management is the crit-

I feel like a lean archeologist. I can see dim evidences of brilliant processes at some point in the past, but they are now buried under wastes.

ical complement to the standardized work of the primary employees actually touching the product and creating value as it flows along the stream.)

The only thing standing between a brilliantly flowing value stream and steady regression to the sclerotic mean is lean management. Its lack is the reason that so often on my value-stream walks I feel like a lean archeologist. I can see dim evidences of brilliant processes at some point in the past, but they are now buried under wastes and confusions of many sorts.

If the need is for lean management, what are its constituent elements? The first is the need is to have someone clearly designated as the responsible person for the state of each value stream. These include the three primary value streams for each product family, running from concept to launch, order to delivery, and through the service and support cycle. And they include the many support streams supplying the human resources, materials, process technology, and methods needed at each point along the value stream.

At Toyota this person is the Chief Engineer for each family of vehicles (a “platform” in car speak), who must ensure that the product and its provision process are able to meet the needs of the customer and the need of Toyota to make an adequate return.


In other organizations it will be different. For example, I have been a witness in recent years to a dramatic and highly

successful effort at General Motors to “lean” its internal business processes. Thirteen internal value streams were chosen to get started, and each was assigned a responsible person with a high-profile job in some other part of the organization. This lean leader was responsible for overseeing the lean leap and ensuring that the new level of performance was not only sustained but steadily improved.

Like the Chief Engineer at Toyota, these individuals had no *authority* on the organization chart to compel better performance. Instead, they voluntarily took the *responsibility* to lead a process of mapping the value stream. This involved everyone touching the stream and was followed by a discussion of the performance gap and the changes that would be necessary to serve the customer, who was inside the organization in these cases.

The task of the manufacturing engineer becomes much easier when someone takes responsibility for the performance of each value stream, and the gap in its current performance can be identified and agreed upon. The role of

process technologies in value-stream performance can be determined and experiments can be conducted with better technologies that are more capable and with higher operational availability, often “right sized” to product family value streams rather than shared by many value streams.

If an Age of Lean Management can now be overlaid on the current Age of Lean Tools, every organization and every value stream will benefit. And the manufacturing engineering function or department, still vertically organized to channel knowledge and careers, will find a more satisfying role in speeding the horizontal flow of value. 



James P. Womack

Management expert James P. Womack, PhD, is the founder and chairman of the Lean Enterprise Institute, a nonprofit training, publishing, and research organization chartered in August, 1997, to advance a set of ideas known as lean production and lean thinking, based initially on the Toyota Production System.