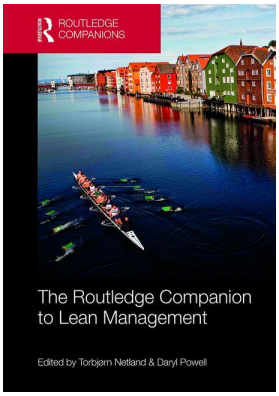

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The Evolution of Lean Thinking and Practice

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INTRODUCTION

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THE EVOLUTION OF LEAN THINKING AND PRACTICE

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Introduction

Lean thinking and practice has arguably become the most successful approach to business improvement of our generation. It has outlasted many other improvement approaches and been taken up by organizations in all kinds of industries across the world. Almost every large organization now has some form of lean program or internal lean improvement group and lean has spawned an army of lean consultants. Interest in lean has also resulted in a huge and growing literature on all aspects of lean, and lean is beginning to be taught on university courses in engineering and management. But as lean spreads it has been reinterpreted many times, and has been bolted onto other improvement approaches like "Lean Six Sigma" and "LeanAgile." This has led to considerable confusion. For a precise definition of lean terms see Lean Enterprise Institute (2003).

What distinguishes lean thinking and practice is that it did not derive from theory, but through observing business practices at Toyota that deliver superior performance in terms of time to market for new products and better product quality using less capital and human effort and hence lower costs in production. This enabled Toyota to grow into the largest and most innovative car maker in the world. Although lean involves several different practices that lead to different ways of thinking about working together, it is the way these practices are combined and used that distinguishes lean as a different business system.

The full significance of lean as a business system is learned step by step through experience in using these practices, rather than through classroom learning. Lean is in fact both a personal journey and a path of organizational development. Although Toyota has had its setbacks, it has proven to be highly resilient by going back and deepening knowledge of the basic lean practices in the face of each of these challenges. Toyota also continues to act as a powerful reference model for lean practitioners in taking the next steps on their lean journeys and as a way to clarify the confusion that surrounds lean today.

The Birth of Lean at Toyota

Toyota was a successful textile loom maker in the 1930s and developed a device for stopping the loom immediately on detecting a broken thread, enabling one person to supervise several looms

instead of just one. In 1935, Toyota decided to begin making automobiles. Toyota was determined to develop its own cars rather than license foreign designs and to fund this development itself rather than rely on banks. After a big strike in 1950 it also agreed with the unions not to make employees redundant in the future. Its response to this challenge was to create product development and production systems that could learn to improve product design and process efficiency faster using less resources in order to be able to compete with global car makers when the Japanese car market was opened and as they entered foreign markets. This story is told in Womack et al. (1990) and Shimokawa and Fujimoto (2009).

The Toyota Development System (TDS) was developed by Kenya Nakamura and Tatsuo Hasegawa. Powerful chief engineers, who are responsible for the success of their products and who negotiate for the necessary resources with department heads, lead the system. The chief engineers lead cross-functional teams, including production and suppliers, who initially spend more time exploring alternative design solutions using set-based concurrent engineering. This helps to avoid the rework and delays in realizing the chosen design solution. The progress of the work is reviewed on a daily and weekly basis in a visual management room, called *obeya,* where the team can respond quickly to delays and problems. Reusable knowledge is captured in many ways, including design check sheets, A3 reports, trade-off curves, and standard work sheets, so engineers can focus on developing new knowledge and deepening their own skills through solving new problems. These measures all contribute to being able to launch a new model every four years or less, rather than the eight to ten years that was common in the industry in 1990. More recently this system has also enabled Toyota to pioneer new technical innovations like hybrid engines and hydrogen powered cars. TDS is described in Morgan and Liker (2006) and the underlying concepts in Ward and Sobek (2014).

The challenge facing Taiichi Ohno, the architect of what became the Toyota Production System, was how to build several different products on the limited equipment that Toyota could afford at that time. Instead of resorting to producing in batches he carried out many pioneering experiments to build an integrated production system that was able to make a variety of products in single-piece flow in line with demand. This challenged the assumptions that there is a trade-off between quality and productivity and that bigger batches result in lower costs. His experiments led to the development of an interconnected set of practices called the Toyota Production System (TPS), described in Ohno (1978) and Shingo (1989).

After spreading the TPS thinking across Toyota's manufacturing operations, Ohno's group collected these practices and wrote them down for the first time in the early 1970s in order to teach them to their Japanese suppliers, and in the 1980s translated them into English as they opened their first joint-venture plant in the USA. The original TPS training material is contained in Narusawa and Shook (2009).

However, the distinguishing feature of Ohno's approach was to engage the whole workforce in seeking improvements, rather than relying solely on expert engineers. He challenged and taught front-line and support staff how to define and improve their own work, using the Training Within Industry system pioneered during World War II in the USA (see Dinero, 2005). This enabled the front line to establish a standard way of doing each task as a local base line for improvement, which in turn enabled them to see and respond quickly to any deviations from this standard. In analyzing the root causes of the many issues that interrupted their work he also taught them how to use the scientific approach to solving problems, using Deming's plan, do, check, act (PDCA) method (see Deming, 1982).

Indeed, it is the repeated daily practice of PDCA, using the perspectives of TPS, that develops the capabilities of individuals and teams to continually improve their work and improve the performance of the system as a whole. Toyota is often quoted as saying it "makes people in order

to make cars." These enhanced problem-solving capabilities enabled Ohno to link activities together, remove all kinds of buffers and delays, and with much shorter lead times to use simpler planning systems driven by demand rather than by forecasts. This accelerating continuous improvement system is called *kaizen* (see Imai, 1991). The net result of deploying TPS was to achieve double the productivity and one-third of the defects of American assembly plants by the mid-1980s (see Womack et al., 1990).

Similar logic was used to develop very different approaches in other areas of the business, including production engineering of right-sized tooling, supplier coordination, and sales and marketing. Eiji Toyoda, the long-time president and then chairman of Toyota, also used these principles to build a management system to support kaizen and to focus and align activities towards key corporate objectives, which was finally written down in the Toyota Way (Toyota Motor Corp, 2001). Again, the key to doing so is building common capabilities at every level of management to plan and solve business problems using another version of PDCA, called A3 thinking, and a planning framework, called *hoshin kanri* (see Dennis, 2009 and Shook, 2010). It also involves a very different way of supporting, mentoring, and challenging front-line teams. The evolution and details of Toyota's management system are described in Hino (2002), Liker (2004), and Liker and Convis (2011).

The Evolving Understanding of Lean

Our understanding of lean has deepened over time. The MIT International Motor Vehicle Program (IMVP) benchmarked Toyota's superior performance and coined the term lean to describe this system in Womack et al. (1990). The results reported in this book caused quite a stir across the global auto industry and beyond. But it quickly became apparent that simply collecting and training with all the lean tools was not enough for others to follow Toyota's example. So we set out to observe Toyota's practices in more detail, along with some of the pioneering organizations who had learned directly from Toyota. From this, we were able to distil a set of five principles—value, value stream, flow, pull, and perfection—behind a lean system and a common action path to realize them in Womack and Jones (1996).

This triggered a wave of interest from practitioners across the world and led us to establish the Lean Enterprise Institute in the USA (www.lean.org), the Lean Enterprise Academy in the UK (www.leanuk.org), and 15 other non-profit institutes across the globe, now members of the Lean Global Network (www.leanglobal.org). Their mission is to research, teach, and publish do-it-yourself guides to the building blocks of lean, including Rother and Shook (1999), Rother and Harris (2001), Brunt and Kiff (2007), Baker and Taylor (2009), Dennis (2009), Glenday (2009), Smalley (2009), Shook (2010), Harris et al. (2011), and Jones and Womack (2011).

In observing the pioneer firms outside of Toyota building their own functional equivalent of Toyota's management system we discovered three challenges all firms face. The first is to build a daily management system to enable front-line team leaders and managers to make the work visible, to be able to respond to problems immediately, and review obstacles on a regular cadence. The basis for this is helping the team to define their standard work, improve on it, and gradually link these steps with upstream and downstream into a continuous flow. The next step is to link separate activities with customer demand using Kanban pull systems and to level the workload to establish stability and responsiveness. This all depends on team leaders and line managers developing the problem-solving skills of their subordinates, described in Sobek and Smalley (2008), Shook (2010), and Rother (2010).

The second challenge is that no one can see or is responsible for the horizontal sequence of activities that creates the value customers pay for, from concept to launch, from raw material to

finished product, and from purchase to disposal. Vertically organized departments instead focus solely on optimizing their activities and assets to make their numbers.

To help teams see the end-to-end processes or value streams they are involved in, Toyota uses another tool which we call value stream mapping (see Rother and Shook, 1999; Jones and Womack, 2011). As teams map their value streams they realize the problem is not the people but a broken process and, having stabilized their own work, they then see new opportunities for collaboration to improve the flow of work and align it with the pull from real customer demand.

In industry after industry, we have seen value streams that used to take many months from beginning to end now take a matter of days, with far fewer defects and more reliable delivery. This is only possible because front-line staff know how to react quickly and tackle the root causes of problems that will arise in any tightly synchronized and interdependent system. It is also much easier to adapt to changing circumstances. Over time, these emergent capabilities achieve performance superior to systems designed and supported solely by experts. This is a key difference between value stream analysis and business process reengineering.

The third challenge is that the traditional approach to managing by the numbers and through functional politics at headquarters wastes a lot of management time, fails to align activities with corporate objectives, hides problems, and takes management away from front-line value-creating activities. Relying on expensive enterprise systems to force compliance with the command and control instructions from the top has in many cases made things worse and much harder to adapt to changing circumstances.

Toyota's planning process, *hoshin kanri*, is used to define the overall direction of the organization and to conduct a dialogue up and down the organization on proposed actions to achieve it, again based on PDCA (see Dennis, 2009; Shook, 2010). As a result resources and energies are prioritized and aligned through a visual process that reaches right down to the front line. This also lays the basis for collaboration across functional silos. Management in turn spends a lot more time at the front line, understanding its issues, eliminating obstacles and coaching problem solving. In this way management learns by helping colleagues to learn and does this by asking questions rather than telling them what to do. This builds very different behaviors and an environment where employees are challenged to fulfill their potential.

There have been several different descriptions of the lean business system, including three novels by Ballé and Ballé (2005, 2009, 2014), a collection of articles by Womack (2013), a CEO's perspective (Byrne, 2013) and a review of the spread of lean by Stoller (2015).

The Spread of Lean and Lean Consumption

Lean thinking and practice has spread across almost every sector of activity, from retailing and distribution to discrete and process manufacturing, service and repair, financial services and administration, construction, software development and IT, healthcare, and service delivery in government. It has even created a framework for improving the viability of digital start-ups. While the focus on value creation, value streams, and learning has been common, the sequence of improvement steps has varied for different types of activity. Fortunately, we have found that lean practices work equally well in different cultures.

The full potential of lean is realized when it is embraced by the whole supply chain. Toyota's aftermarket parts distribution system is still the global benchmark supply chain, delivering near perfect availability of the basket of parts at the point of use with only a tenth of the lead time and inventory in the pipeline from the point of production. Not surprisingly this inspired retailers like Tesco and Amazon to develop their own rapid response distribution systems that are essential for convenience retailing and home shopping. Manufacturers like GKN have also moved away from

concentrating activities in focused factories in distant low-cost locations to creating rapid response supply chains to serve customers in each region. GE Appliances (now owned by Haier) is also using lean to design a new product range and production system for household appliances in North America, bringing this activity back from China.

While most of the attention has been focused on the upstream supply chain, lean actually begins with the customer's use of the product or service. We developed a framework for using lean to define value from the user's perspective (see Womack and Jones, 2005). Consumption is in fact a series of processes that interact with the provider's processes. Mapping both processes shows where they are broken and cause mutual frustration and unnecessary cost. This reveals opportunities for improving user experience at lower cost and even generating new business models. In the digital age it is now possible to track the customer's use of the product or service and enter into a two-way dialogue with them. In a very real sense customers and users are becoming an important part of the supply chain delivering today's products and services and co-developing tomorrow's solutions.

Conclusions

From this chapter it should be clear that lean is not just another improvement methodology, but a very different set of behaviors and a management system. It is not just a set of tools for production operations in the auto industry, but a much broader framework for creating more productive value creation systems in all kinds of sectors and activities. Readers should beware of the confusion that is caused by partial descriptions of lean, which often miss the key elements that make it work as a system.

Lean shares the same scientific approach to the analysis of work with many improvement methodologies, like BPR, Six Sigma, and TQM. But it differs from them in how it is used. Rather than relying on experts to design better systems, lean builds superior performance by developing the problem-solving capabilities of the front line, supported by a hands-on management system.

Lean is therefore a path or journey of individual and organizational learning and leads to more challenging and fulfilling work for those involved. It is learned by doing it and through repeated practice rather than by studying it in books or in the classroom. While it is driven by practice and not theory, lean raises many interesting new hypotheses about learning and collaborative working for different academic disciplines to think about and research.

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