Continuous Improvement Revisited: Organization Design as the Last Step in Gaining the Full Competitive Advantage of *Kaizen*

Shumpei Iwao, Keio University

By strategically choosing to adopt organizational design, firms will gain a greater competitive advantage than ever from kaizen. Shumpei Iwao argues that, contrary to common practice, the top-down approach to continuous improvement is sometimes much more powerful than the bottom-up approach.

In the 1980s, *Kaizen,* or continuous improvement,[1] was considered to be the primary competitive advantage of Japanese firms. In the forty years since then, the deterioration of these firms' performance has caused many to lose interest in the strategic value of continuous improvement. Yet if we approach its management from the perspective of organizational design, continuous improvement once again springs to the forefront of the study and practice of strategic management.

In recent years, the number of papers published in the US, UK, India, and beyond on the subject of continuous improvement has grown.[2] Yet these papers tend to treat continuous improvement as a series of incremental and independent events. As a result, management researchers and practitioners view seamless teamwork and strong skills and knowledge at production and service sites as the key factors in managing continuous improvement. From this perspective, the role of top management is limited to supporting workers and their teams.

This misunderstanding about the role of top management may be a result of the erroneous association of "continuous" with "incremental." Yet certain organizational designs can cause continuous improvement to produce large or radical improvements or breakthroughs. When top managers understand how organizational design shapes the management of continuous improvement and commit to applying it, their firms are likely to become more competitive.[3] We must therefore revise the concept of continuous improvement so that we can understand its full strategic value.

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Top managers should always be attentive to the chain reaction of problem solving which continuous improvement can create. Although other innovations can also touch off problem solving chains, those caused by continuous improvement are different. The chain reactions rooted in continuous improvement can sometimes lead to large-scale innovation. Top managers must therefore be ready to decide where to make and break such a chain. Some organizational structures are more compatible than others with each of three approaches to managing continuous improvement: aiming to develop most of the chain reactions, aiming to develop none of them, or developing some on a case-by-case basis. And only top management can design such organizational structures. It is therefore vital that top management oversee continuous improvement so as to maximize the organization's competitive advantage.

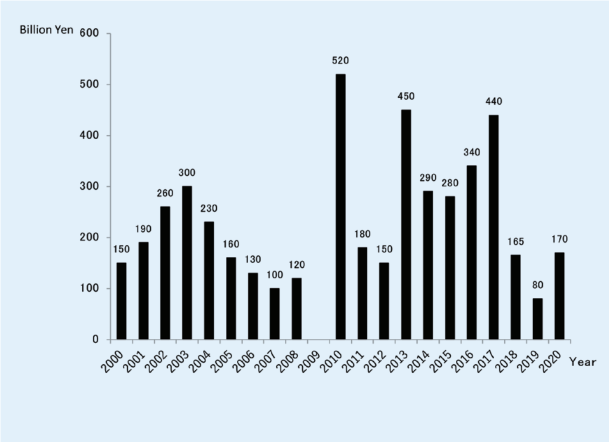

FIGURE 1: Toyota's Annual Profit from Continuous Improvement[4]

How Continuous Improvement Contributes to Competitive Advantage

To begin with, is continuous improvement necessary? Does it contribute to a firm's competitive advantage? If not, research on continuous improvement has very little value. Figure 1 shows the profits that the Japanese firm Toyota has made by pursuing continuous improvement.

These data were collected from Toyota's annual financial reports. Toyota has been publishing its calculations of the economic effects of continuous improvement in those reports since 2000. The firm's conclusion is that continuous improvement has contributed several hundred billion yen, or billions of dollars,[5] to its annual profits.

Toyota's consolidated net income ranges from several hundred billion yen per annum to more than two trillion yen. Continuous improvement activities produce about ten percent of that. Toyota also publishes the cost-saving effects of its value analysis and value engineering (VA/VE) activities, such as improving finished product designs, parts, and raw materials. According to Toyota Motor's Securities Reports, the company has been able to distinguish between the effects of VA/VE and those of continuous improvement at production/manufacturing sites since 2015. The reports state that, separate from VA/VE, continuous improvement has saved 45-70 billion yen per year (Figure 2).

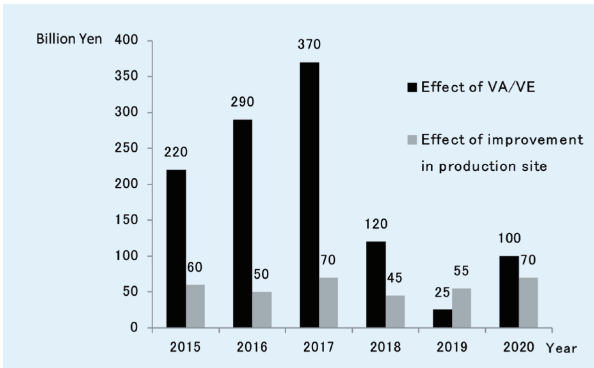

FIGURE 2: The Cost-saving Effects of Continuous Improvement at Toyota

The firm, then, draws a considerable portion of its profits from continuous improvement. Toyota, and others like it, also draw other tangible benefits from continuous improvement, honing management functions like product development, purchasing, and production engineering.

For example, the development of new products requires support from the production department in producing prototype models, jigs, molds, and so on. Continuous improvement can increase the efficiency of research and development, shortening product development lead-times.[6] Likewise, consulting with component suppliers about applying continuous improvement to their processes may enhance the competitiveness of the entire supply network. I conducted a one-month participant observation in Toyota's Takaoka factory and found that continuous improvement spurred practical development in both product design and production equipment.

So why have we been overlooking the potential advantages of continuous improvement? Perhaps because we did not fully grasp the nature of the chain reactions of problem solving it produces.

Continuous Improvement as a Chain Reaction of Problem Solving

The continuous improvement undertaken at factories in the Japanese auto industry creates chain reactions of problem solving. This term describes a phenomenon in which, when one process or task is changed, it causes an unexpected effect elsewhere. It then becomes necessary to make more changes in other areas or tasks, creating a sequence of changes and effects. For example, suppose changes to the layout of a factory floor opened up more workspace, creating room for a robot. This robot was better able to handle large and heavy parts than human workers, making it possible to assemble several vehicles, each with large and heavy parts, at the same time and on a single production line.

Innovations such as product and equipment development are fueled by chain reactions of problem solving. Product development is usually coordinated company-wide in advance and according to a set routine. Almost all functional units participate in developing a product, including marketing, design, trial production, purchasing, and mass production preparation.

Many researchers and practitioners have assumed that continuous improvement was unrelated to this coordination. In the existing research, problem solving through continuous improvement is often assumed to take place only within teams at the manufacturing site. In fact, continuous improvement, like other forms of innovation, causes chain reactions of problem solving, but ones which stem from a different logic than those driven by product development. This difference is caused by continuous improvement's positive feedback loops, which emerge from a complex system. In continuous improvement, an improvement plan is developed and implemented in the same physical place, while the production site is also where stakeholders' ideas are born and put into use. The initial assumptions made during planning may therefore change as the project is carried out. Enacting the planned project will reveal additional problems to be solved, and so forth. These positive feedback loops make up a complex system which spurs chain reactions.

The Toyota Motor Corporation saw continuous improvement result in major/radical innovation with both the QR code and the multi-product line. The development of the QR code began when Toyota's first tier supplier DENSO[7] adopted continuous improvement. DENSO initially automated the processing of *Kanban*[8] component identification slips for Toyota.[9] Meanwhile, the multi-product line allows Toyota Motor's Takaoka Plant to simultaneously produce five to six models on one assembly line.[10] Both were continuous improvement initiatives at Toyota Group's production site that were ultimately incorporated into the factory's strategy. Using O'Reilly and Tushman's[11] definition, these are categorized as radical innovations or explorations.

Continuous improvement at Toyota and DENSO, from small-scale operational changes to large-scale equipment development, are implemented simultaneously. As Toyota plant engineer Nobuaki Murai put it:

"My impression as a practitioner, at least at Toyota, is that there is no clear distinction between improvement and other capital investment projects. Both can be accompanied by small operational improvements at the time of equipment installation, or it can evolve from an operational improvement to equipment installation."[12]

According to a survey about continuous improvement investment which I sent to Toyota in November 2016 and June 2017, about 0.1 percent of continuous improvement projects at Toyota end up costing 100 million yen or more.

Both Toyota, which created the multi-production line, and DENSO, which invented the QR code, put manufacturing engineers, or in-line staff, at all their production sites. These in-line staff, most of whom have master's degrees or PhDs in engineering or science, control the budget for continuous improvement projects. The budgets for specific factories range from under one hundred million yen to several hundred million yen per year. The in-line staff select ideas generated by the workers and other staff members by considering their probable financial performance, their technological implications, and the current policies of top management.

Toyota and DENSO often launch continuous improvement projects from the bottom up, using the ideas of individual workers or teams. When technical problems arise, such as changing the plant's layout or funding new equipment, the workers can immediately consult with the in-line staff. Members of the in-line staff work in every department, such as body, molding, painting, and assembly, and are a visible presence on the production site every day, so that workers can easily and comfortably consult with them.

The top management of Toyota and DENSO took care to establish an organization design which allows their network of in-line staff to link organizational changes together, touching off chain reactions of problem solving.

Both incremental and radical innovations emerge gradually from the same small seed of continuous improvement.

The large-scale and major innovations that chain reactions of continuous improvement create tend to take months or even years to come to fruition. As a result, when observed in the short term, these innovations appear to be clearly separated into two groups, incremental and radical. Longer observation, however, reveals that both incremental and radical innovations emerge gradually from the same small seed of continuous improvement.

Organization Design as an Innovation Incubator

But remember, continuous improvement projects have only the *potential* to cause chain reactions of problem solving. For continuous improvement to spur both incremental and radical innovations, top management must cultivate those chain reactions, which may require the interest, involvement, and resources of various actors, both inside and outside the company. Top management should also be prepared to implement the innovations produced by these bottom-up efforts, transitioning seamlessly to a top-down approach. They may then choose to: (1) implement most of these chain reactions from the outset, (2) implement none of them, or (3) implement selected chains after considering each individually. In comparing these three options and strategically choosing one, managers should consider the resources that will be required, as well as which organizational functions will be affected, since both questions bear on the project's impact. The broader success of continuous improvement projects is thus dependent upon the organization's resource allocation structure as well as on the distribution of its in-line agents.

In 2017, I sent a questionnaire to a variety of Japanese automobile firms. Four responded. The combined sales of these four firms accounts for more than 65 percent of Japanese automobile production. Their answers revealed that some Japanese automobile firms have only a modest range of continuous improvement projects, while others have a much wider range, and others, of course, fall in between. Each responding firm had a different organizational structure, be it decentralized organization, centralized organization, or in-line staff organization. The relevant difference between a decentralized and a centralized structure lies in whether the budgetary authority for continuous improvement is at a lower or higher level. In-line staff organization, by contrast, relies on engineers who assist line workers in factories to connect the production site with the firm's headquarters.

The survey's results described both differences in the scale of continuous improvement between firms and in the process of obtaining the necessary resources. Organizations which allocated resources directly to their workers tended to generate only small continuous improvement initiatives. Those which concentrated their resources on the technical department at headquarters usually generated relatively large continuous improvement initiatives. But those which used in-line staff organization could generate both small and large continuous improvement projects simultaneously. This information suggested that the design of an organization may well influence the scale of its improvement initiatives.

I was not able, however, to prove the above causal relationship through comparative case analysis. I therefore created an artificial society and conducted a simulation to test my findings. The efficacy of such multi-agent simulations in the field of organizational change has recently been confirmed.[13] My simulation, based on Toyota's average factory size, consists of three types of agents: 2000 workers, 200 engineers, and 100 members of in-line staff. All three groups are guided by the same algorithm and produce ideas of a size that conforms to a uniform random number. These ideas are then realized only when they are linked to sufficient resources. This is a simplified version of the plan-do-check-act (PDCA) cycle. Its steps are: finding problems in the workplace (the random occurrence of ideas), proposing solutions (aligning ideas with resources and consulting others), and expending resources to enact those ideas (replacing resources and ideas with tokens representing the projects' outcomes).

The three types of agents differ in the size of the ideas they generate and organizational networks. I adopted a uniform random number that uses values from 0 to 1 for workers' ideas and 0 to 10 for those of engineers and in-line staff. In-line staff members are characterized by how they are perceived by workers, and they thereby maintain a wider network among workers than do engineers. The overall expectation for both ideas and resources was 1000 for all models. The simulation ended when all resources were exhausted, with the fixed seed number "1."

If an agent does not have enough resources to realize their idea, they will delegate the idea to surrounding agents. In this context, at the beginning of the simulation, the workers at the decentralized organization own all the resources. In the centralized organization, the engineers at headquarters own all the resources. In the in-line staff organization, either the workers or the engineers own all the resources, but the in-line staff coordinate the two using their wide network.

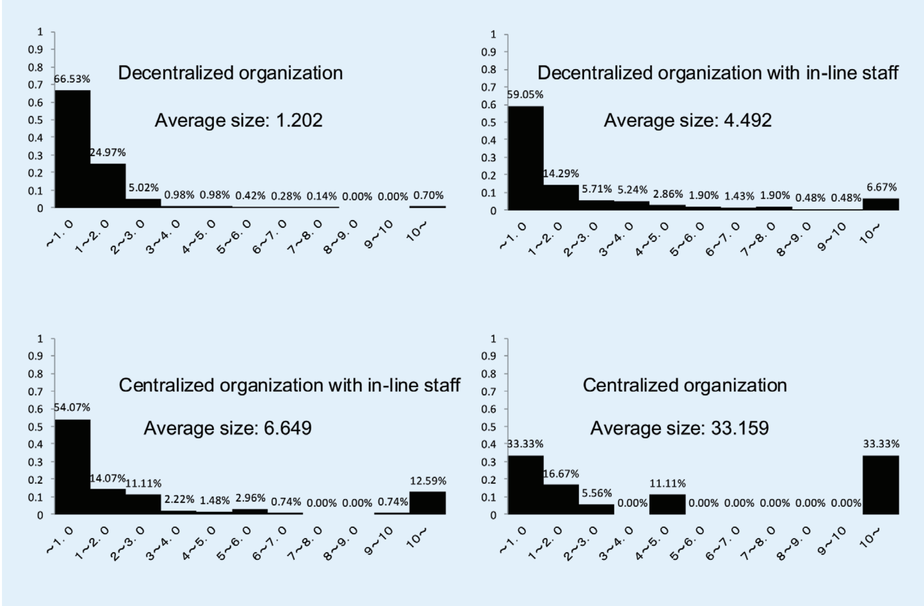

FIGURE 3: Results of Multi-Agent-Simulation Modeling of Continuous Improvement

A firm's organizational structure influences the potential of its continuous improvement projects and the direction and success of the resulting innovations.

Using these multi-agent simulations, I successfully replicated the results of the questionnaire and the case study (Figure 3).[14] I can therefore confidently say that a firm's organizational structure influences the potential of its continuous improvement projects and the direction and success of the resulting innovations. Firms which do not want to launch any chain reactions should use a decentralized structure. While some chain reactions can begin at lower levels, those chains are shorter and simply will not have wide-reaching effects. Firms which want to create broad-reaching chain reactions, by contrast, will do best with a centralized design. Firms which plan to consider each chain individually before putting it to use will find that an in-line staff design will allow them that flexibility.

In figure 3, the x-axis of each graph represents the different sizes and values of continuous improvement projects. The y-axis is a scale of 0 to 1 representing the percent of total continuous improvement projects in each category.

In the simulation of a decentralized organization (top left), about 66.53 percent of continuous improvement projects had a value of 1 or less. Only 0.7 percent had a value of more than 10. Decentralized resource allocation thus generates relatively small-scale innovations.

The centralized organization (bottom-right), which allows engineers at headquarters to monopolize resources, produced about 33.33 percent projects with a value of 1 or less. Meanwhile large-scale improvement projects with a value of 10 or more were also 33.33 percent.

When I added in-line staff to the decentralized organization (top-right), large-scale continuous improvement projects with a value of 10 or more increased from 0.70 percent to 6.67 percent. Likewise, when I added in-line staff to the centralized organization (bottom-left), its continuous improvement projects valued at 1 or less reached about 54.07 percent, while 14.07 percent had a value between 1 and 2, 11.11 percent had a value between 2 and 3, and 12.59 percent had a value of 10 or more.

The average size of continuous improvement projects for the decentralized organization (top-left) was 1.202, and for the centralized organization (bottom-right) 33.159. The scale for the centralized organization is relatively high because projects with a value of more than 100 were included (value of over 10). When the in-line staff organization is added to the decentralized organization (top-right), the average continuous improvement size was 4.492, while for the centralized organization (bottom-left), it was 6.649.

These simulations showed that, even when the workers were engaged in the same continuous improvements and generated similar ideas, the allocation of resources and the organization's structure would generate variation in the success of continuous improvement.

That more large-scale projects are produced by centralized organizations may seem to be a natural consequence of the monopolization of resources by engineers at headquarters. However, deploying in-line staff allowed the simulation to replicate Toyota and DENSO's continuous improvement trajectory. Even when a decentralized organization uses bottom-up continuous improvement methods, in-line staff will allow it to generate large-scale projects. Similarly, even a centralized organization which concentrates its resources on the engineers at headquarters can generate more small-scale continuous improvements by using in-line staff. Unlike centralized engineers, in-line staff have networks among workers and are recognizable and accessible to them.

Toyota and DENSO, therefore, had good reason to assign staff with graduate degrees the seemingly trivial task of patrolling the factory floor each day. Lean production, which generates a diversity of large and small continuous improvement projects, required these seemingly fat organizations to efficiently manage their chain reactions of problem solving.

Conclusion: Toward a Paradigm Shift for Continuous Improvement

Is continuous improvement always incremental? No. Earlier studies on continuous improvement are misleading because they confuse the process with the result. In fact, the innovation process and its result are not the same. Continuous improvement is one component of the innovation process that influences whether each particular innovation is incremental or radical. Either major or radical innovations may be generated through continuous improvement.

> Continuous improvement is a process, not a static outcome.

Continuous improvement is a process, not a static outcome. Yet the results of continuous improvement have often been erroneously characterized as incremental innovations. Scholars have also paid little attention to continuous improvement outside the realm of production, focusing largely on workers at the lower levels of the organizational hierarchy. I urge you to reconsider how you think about continuous improvement. In practice, continuous improvement projects can be characterized as chain reactions of problem solving, driving changes in product design and involving many different departments within an organization. These chain reactions can even lead to major innovation. It is up to managers to decide how long a chain they want or are prepared to deal with, and to establish the appropriate organizational structure for their particular purpose.

Firms that do not use a top-down approach to continuous improvement are likely to miss out on radical innovations which span the organization. Such broad effects are much less likely with a bottom-up approach. In either case, placing in-line staff in all departments will increase the firm's flexibility and range. ■

Author Bio

Shumpei Iwao is an associate professor of technology and operations management at Keio University. He earned his Ph.D. in Management from the University of Tokyo. He was awarded the 73rd Keio Award from Keio University, 37th Susumu Takamiya Book Award and 36th Susumu Takamiya Publication Award from the Academic Association for Organizational Science (Japan), and 22nd JSPM Book Award from the Japan Society for Production Management.

Endnotes

1. In Japan, continuous improvement is called Kaizen. The concept of Kaizen has become popular in business communities all over the world and even appears in the Oxford English Dictionary.
2. Gonzalez Aleu, F., & Van Aken, E. M. (2016). Systematic literature review of critical success factors for continuous improvement projects. *International Journal of Lean Six Sigma, 7*(3), 214-232.
3. Original data and analysis for this article appeared first in Iwao, S. (2019). *Innovation wo umu Kaizen: Jidoshakojo no Kaizen katsudo to zensya no soshiki sekkei* [KAIZEN activities revisited: Organizational structures and innovation strategies in the Japanese auto industry]. Tokyo: Yuhikaku (in Japanese).
4. Data from 2009 is not available due to the financial crisis.
5. In 2020, 1 dollar ≒ 100 yen.
6. Clark, K. B., & Fijimoto, T. (1991). Product development performance: Strategy, organization, and management in the world auto industry. Boston, MA: Harvard Business School Press.
7. Nomura, M., Sawada, Z., Hoshino, Y., Masuzawa, Y., & Fujimoto, Y. (2002). Development of the QR-code (Two-dimensional Symbol), and application to a production management system, *Production Management: Transactions of the Japan Society for Production Management, 8*(2), 107-112.
8. Kanban is one element of the Toyota Production System; it is used for parts supply management.
9. Ogawa, S. (2020). *QR code no kiseki: Mnonozukuri syudan no hassousenkan ga kakushin wo unda* [The miracle of QR code]. Tokyo: Toyokeizai (in Japanese).
10. Iwao, S. (2017). Revisiting the existing notion of continuous improvement (Kaizen): Literature review and field research of Toyota from a perspective of innovation. *Evolutionary and Institutional Economics Review, 14*(1), 29-59.
11. O'Reilly III, C. A., & Tushman, M. L. (2013). Organizational ambidexterity: Past, present, and future. *Academy of Management Perspectives, 27*(4), 324-338.
12. The interview data is recorded in Iwao (2019).
13. Miller, K. D., Pentland, B. T., & Choi, S. (2012). Dynamics of performing and remembering organizational routines. *Journal of Management Studies, 49*(8), 1536-1558.
14. Simulation program code is available at *Harvard Dataverse* (https://doi.org/10.7910/DVN/UN14B7).