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GKC as Gemba Kaizen Costing: Visualizing Kaizen Effects

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Shino Hiiragi*
Associate Professor, Yamagata University,
Graduate School of Science and Engineering
4-3-16 Jonan, Yonezawa City,Yamagata, 992-8510, Japan
e-mail: s_hiiragi@yz.yamagata-u.ac.jp

Yasuyuki Kazusa
Professor Emeritus, Kyoto University
e-mail: kazusa@apu.ac.jp
*Corresponding author

The Melco Foundation
Nagoya, Japan

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: Visualizing Kaizen Effects

Yamagata University
Hiiragi Shino
Kyoto University
Kazusa Yasuyuki

Abstract

For companies around the world, global competition is no longer unusual but a part of everyday activity. “Kaizen” or CI (continuous improvement) is one of the ways to improve organizational capabilities, which has been said to be a major strength of Japanese companies.

Based on the previous researches about Kaizen effect measurement, new accounting theory and methods called Gemba Kaizen costing (GKC) have been developed that can illustrate the progress of Gemba Kaizen. They are consistent with Professor Takahiro Fujimoto's “design information transfer theory” in production control theory and the view of Taiichi Ohno, the founder of TPS (Hiiragi and Kazusa, 2016, 2017). The significance of measuring the Kaizen effect is explained in GKC, and the relationship between the external environment surrounding enterprises, such as economic trends, and corporate performance such as sales, costs, and profit, is clarified. Further, the key concept of opportunity loss is identified as a loss that could not be recorded as performance in the current term.

GKC is an accounting method that can be used to evaluate Kaizen and provide useful information for business management, and its characteristics are clarified in this paper. In addition, the key concept of a new theory of GKC that integrates production control, Kaizen, and cost accounting is also specified.

Keyword

Kaizen, Continuous improvement, GKC (Gemba Kaizen Costing), Production capacity, Visualization, Lean accounting, Opportunity loss

1. Introduction: Why are Kaizen effects measured with currency equivalent value?

For companies around the world, global competition is no longer unusual but a part of everyday activity. “Kaizen” or CI (continuous improvement) is one of the ways to improve organizational capabilities, which has been said to be a major strength of Japanese companies.

Various improvement activities are being conducted at many Japanese manufacturing sites, called Gemba. These activities, which occur daily, involve not only supervisors but also operators with the goal of increasing productivity for each process. Furthermore, it is believed that these activities will improve the efficiency and performance of the entire enterprise. Toyota Motor Corporation (Toyota), for example, is famous for systematic improvement of the Gemba using the Toyota Production System (TPS), which was created by Mr. Taiichi Ohno. In addition to the excellence of Toyota's achievements, the company reports in their annual financial statements not only the impact of the external environment, such as currency exchange rates and sales trends, on its performance, but also the impact of Kaizen cost improvement during the accounting period (Toyota Motor Corporation 2017).

The lean manufacturing system (lean) developed by benchmarking Japanese companies is typified by Toyota's TPS (Womack et al., 1990). It has been shaped around advocating “the flow of customer value” related to management of the entire business, and lean activities are developing globally (LEI 2017).

However, Kaizen effects at each Gemba of Toyota are mainly measured by the amount of material (material consumption, production per hour, and so on), the amount of time (required man-hours, lead time), or a quality index (such as the defect rate) (Tanaka, 2009). The influence on overall performance is calculated not by the manufacturing site but by company management. Toyota expresses it as “the performance follows the action,” (Tanaka, 2009, p. 280); in other words, the right process will produce the right results. In the “Kaizen Culture,” nonmonetary values such as safety and ease of work, as well as long-term aspects like stability of quality, raising employee awareness, employee education, and organizational capacity building through on-the-job training (OJT) are emphasized just as much as short-term financial performance (Tanaka, 2016).

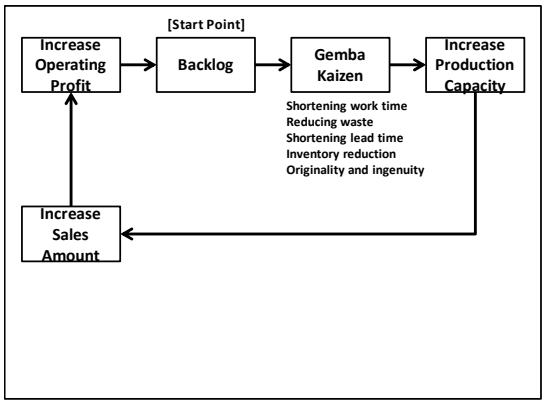
On the other hand, even Japanese companies have been heard saying “we want to foster motivation of employees” (Nagasaka et al., 2015) by measuring the Kaizen effect. Japanese researchers have conducted some studies on the topic; for example,

Senju and Fushimi (1982, 1983) and Senju et al. (1986). Okamoto (2000) applied TQM's overall equipment efficiency to a standard cost calculation, which focuses on the deterioration of the cost management function in standard cost accounting, as well as changes in production systems.

Based on these studies, new accounting theory and methods called Gemba Kaizen costing (GKC) have been developed that can illustrate the progress of Gemba Kaizen. They are consistent with Professor Takahiro Fujimoto's “design information transfer theory” in production control theory and the view of Taiichi Ohno, the founder of TPS (Hiiragi and Kazusa, 2016, 2017). The significance of measuring the Kaizen effect is explained in GKC, and the relationship between the external environment surrounding enterprises, such as economic trends, and corporate performance such as sales, costs, and profit, is clarified. Further, the key concept of opportunity loss is identified as a loss that could not be recorded as performance in the current term.

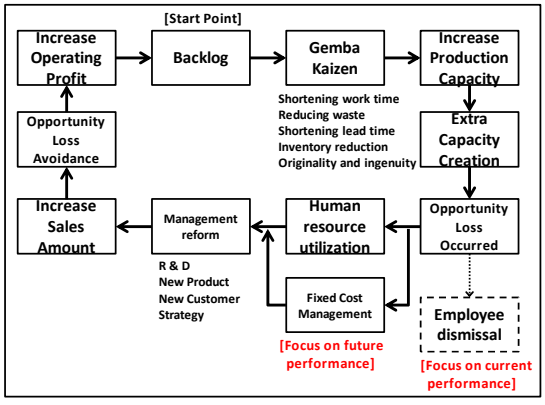
The importance of the opportunity loss concept in Japanese management was first proposed in Kazusa (2016). Further, in Hiiragi and Kazusa (2016), opportunity loss was identified as a key concept of GKC, and the Cycles of Kaizen and Management Reform were described. One of these is the Gemba Kaizen Cycle in the economic growth period (Figure 1) where the increase in production capacity tends to impact performance. The second is the Gemba Kaizen and Management Innovation Cycle (Figure 2), where increased production capacity becomes surplus capacity, and then orders and sales are expanded by effectively utilizing the capacity through management innovation.

Figure1 Gemba Kaizen Cycle (the economic growth period)



Resource: Kazusa (2016, p.9)

Figure2 Gemba Kaizen and Management Innovation Cycle



Resource: Kazusa (2016, p.11)

When the Kaizen effect increases profit (performance improvement) through the stepwise process shown in Figure 2, it is necessary to be able to measure and evaluate the improvement using monetary equivalent value, even in the middle stage, which is not reflected in the achievement. GKC or the theory of GKC asserts the importance of and further advocates use of these measurements in the costing structure.

GKC is an accounting method that can be used to evaluate Kaizen and provide useful information for business management, and its characteristics are clarified in this paper. In addition, the key concept of a new theory of GKC that integrates production control, Kaizen, and cost accounting is also specified. The key concept of the theory of GKC is clarified in section 2. Then "6 steps of Gemba Kaizen" that rely on design information transfer theory will be introduced in section 3. Finally, section 4 presents the upcoming challenges of Gemba Kaizen and GKC and improvements in the field.

Previous research in the accounting field related to Gemba Kaizen is provided in the previous reviews conducted by Hiiragi (2016) and Hiiragi and Kazusa (2016, 2017) and will be considered in a future draft. In this paper, we will focus only on the following points: that is, prior research can be organized into three perspectives: improvement of productivity and time management at Gemba, production capacity as a business management objective, and accounting to visualize the Kaizen effect.

2. Key Concept of GKC

In this section, after confirming the definition of Gemba Kaizen, three features of GKC and two important key concepts of the theory of GKC will be discussed.

2.1 Accounting definition of Gemba Kaizen activities

Kaizen or CI has many methods, but the definition also varies. Boer (2000) defined CI as follows: "CI is defined as the planned, organized and systematic process of ongoing, incremental and company-wide change of existing practices aimed at improving company performance." It is important that Gemba Kaizen is a company-wide optimal activity that is not limited to manufacturing sites. Otherwise, even if positive short-term and local outcomes are obtained, it will not lead to improvement in the performance of the entire enterprise or to organizational capacity building for future performance.

In addition, the objective of Gemba Kaizen is recognized as increasing customer value, and adding value will not only lead to better short-term but also better long-term corporate performance.

For example, LEI (2017) explains the lean state that Kaizen activities should aim for as follows: “The core idea is to maximize customer value while minimizing waste. Simply, lean means creating more value for customers with fewer resources.” There, flow of value for customers leads to design information transfer theory, described later.

In addition, LEI (2017) also insists that “Eliminating waste along entire value streams, instead of at isolated points, creates processes that need less human effort, less space, less capital, and less time to make products and services at far less costs and with much fewer defects, compared with traditional business systems. Companies are able to respond to changing customer desires with high variety, high quality, low cost, and with very fast throughput times.” The overall efficiency of corporate management is being pursued, not just cost reduction.

It is necessary to verify from an accounting perspective whether customer value is maximized with fewer resources and inputs. Okamoto (2000, p. 11) defined cost as the “monetary value of economic resources sacrificed to achieve a specific purpose.” Reducing that monetary value reduces the cost of improvement. Reducing this measurement is equivalent to “Cost Reduction in Kaizen."

However, it is not just cost reduction that should be measured in accounting for Gemba Kaizen activities. Merely lowering product costs and increasing profits in the short term is not enough. To improve the long-term performance of the company and realize sustainability, it is necessary to take into consideration companies’ resource management, including investments.

Based on this, “Gemba Kaizen” is defined in this paper from an accounting point of view, as “making change efforts so that more output can be calculated by using the same resource”[1]. In addition, this output amount and output possibility by expending the resources is called “production capacity” at an individual site or enterprise.

Companies acquire production capacity through various investments. Production capacity allows businesses to generate revenue by producing and selling products. Under conventional production capacity theory, it is important to understand and measure the amount of idle capacity; that is, capacity that is not effectively used given the maximum expected production, which makes it an indicator of management judgment.

For example, McNair (1994) analyzed in detail the point that conventional

[1] Of course, this does not deny the whole optimal viewpoint included in the definition of the Kaizen activity at this point. In this paper, in line with the basic definition of GKC to promote Kaizen activities through accounting evaluation and visualization, we defined Gemba Kaizen based on feasibility.

capacity management includes waste as “hidden costs” and discussed its causes. Alternatively, in “activity-based costing (ABC)” proposed by Kaplan (Cooper and Kaplan, 1988), “activity-based management (ABM)” (Kaplan, 1992), and “time-driven activity-based costing (TD - ABC)” (Kaplan and Anderson 2007), the purpose of allocating costs in detail has evolved to capture more than idle capacity.

2.2 Basic concept of GKC

GKC focuses on Gemba Kaizen, which is effective as a method for achieving evolution in all organizations, including commercial companies, and "visualizes" the Kaizen effect. As a result, GKC clearly expresses the potential for organizational capacity evolution and organizational performance improvement using accounting values. By adopting this method of accounting, the accuracy of present and future strategies will be improved, and ultimately, management accounting will contribute to the realization of the enterprise’s sustainability.

The basic concept of GKC consists of five items. These concepts can be divided into three features of GKC as a method, and two key concepts of the theory of GKC as a theoretical framework.

(Three features of GKC)

> Continuous Actual Costing:

Changes are monitored by continuously recording and measuring actual numbers.

> Short term and real time measurement:

Daily, hourly, real-time measurement is realized.

> Currency equivalent measurement of Kaizen effect:

Not only nonmonetary effects, but also monetary effects of Kaizen can be evaluated.

（Two key concepts of the theory of GKC）

> Creating and measuring opportunity losses:

Maximizing capacity utilization and available capacity increases accounting opportunity losses. Linking it to management reforms will improve performance. Now, Kaizen brings practical capacity closer to the theoretical capacity level, and furthermore, intends to increase production capacity beyond the theoretical capacity. Therefore, we propose a new concept called “Premium Capacity,” which can measure the “new creation of opportunity loss.”

> Relationship between two types of time concepts and improvement effects:

In Gemba, raw materials and work-in-process are both processed by workers or equipment to create products. Although it takes time to complete the products, these time concepts can be considered from two aspects. The first is time focused on workers (direct engineers), which can be classified into various times other than direct working time (Okamoto, 2000). Usually this is the time to handle in cost accounting. The second aspect is time focused on the flow of goods, that is, lead time. These two time concepts coincide only in the process cycle time (Hiiragi and Kazusa, 2017).

Details on these concepts are provided in previously published articles and will be considered in future drafts. As a precondition for visualizing the Gemba Kaizen effect, an example of Kaizen progress is illustrated in the next section.

3. Six steps of Gemba Kaizen and GKC

In this section, based on Professor Fujimoto's "design information transfer theory", the progress of Gemba Kaizen is organized into 6 steps, and simple accounting numerical examples are shown for each[2].

3.1 Design Information Transfer Theory

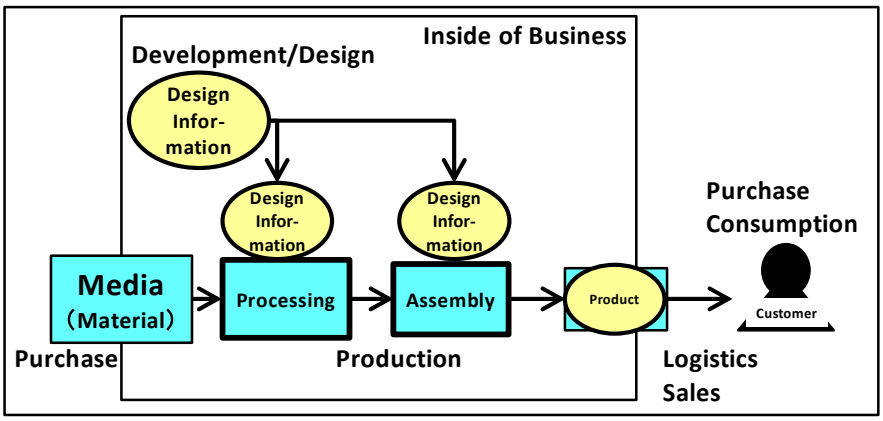
"Establishing the flow is the basic condition" in TPS (Ohno, 1988, p. 33). "Production method of what kind of production flow should be created at the Gemba for making as much as you need, if you need it" (Monden 1980, p.3) becomes important. The LIE explains flow creation as follows: "To accomplish this, lean thinking changes the focus of management from optimizing separate technologies, assets, and vertical departments to optimizing the flow of products and services through entire value streams that flow horizontally across technologies, assets, and departments to customers" (LEI2017), and they emphasize the flow to customers across technology, capital, and the organization.

Professor Fujimoto's "design information transfer theory" is the theorized version of flow at Gemba, the theory that explains "Monozukuri," that is, manufacturing with design information creation and transcription (Fujimoto 1999,

[2] Regarding the improvement progress and the effect measurement through all the steps, Hiiragi and Kazusa (2016) showed detailed simulations. In this paper, we will introduce a simple case to explain each step.

2007. What customers want is not the thing itself, but the function or utility that the thing provides. It is the "design information" that decides the function, and it is transferred to the raw material as the "media". The transferred medium is delivered to the customer. It is nothing other than delivering design information to customers. Figure 3 shows the design information transfer theory applied to the two-step production of processing and assembly.

Figure 3 Design information transfer theory at two manufacturing steps



Resource: Hiiragi and Kazusa (2016, p.78)

"Design information" created in the development and design division at the upper left of Figure 3 is transmitted to the manufacturing site as a design drawing or CAD / CAM information. Raw materials are added at the manufacturing site, and processed according to the design information. In design information transfer theory, this is expressed as transfer of information. Raw materials are "media" on which design information is placed, and as processing advances and information is transferred, they become work in process and finally products. Here, distances (arrows) always exist between real processes, markets, and customers. In addition, since there is some loss with every transfer, the medium in Chart 3 becomes smaller from left to right. Furthermore, if defects occur in the transfer process, customers will not receive products as designed.

As a "flow" toward customers, ultimately, the medium (raw material) should be consumed when received by the customer as a medium (product) instantaneously. Moreover, in an ideal state, there are no defects and material loss should also be zero. Gemba Kaizen is to create a "good flow" toward customers, aiming at the ideal state on the premise of "good design" of products, thereby realizing cost reduction and lead time (LT) shortening (Fujimoto, 2012).

One of the basic methods for creating flow at such a manufacturing site is industrial engineering (IE). Mr. Ohno stated that "Toyota Formula IE is an evolving IE, meaning that there is no point unless it is possible to reduce the cost and be an IE that leads to increased profits." (Ohno 1978, p. 128), and he emphasized cost control. GKC needs to be considered to realize that goal.

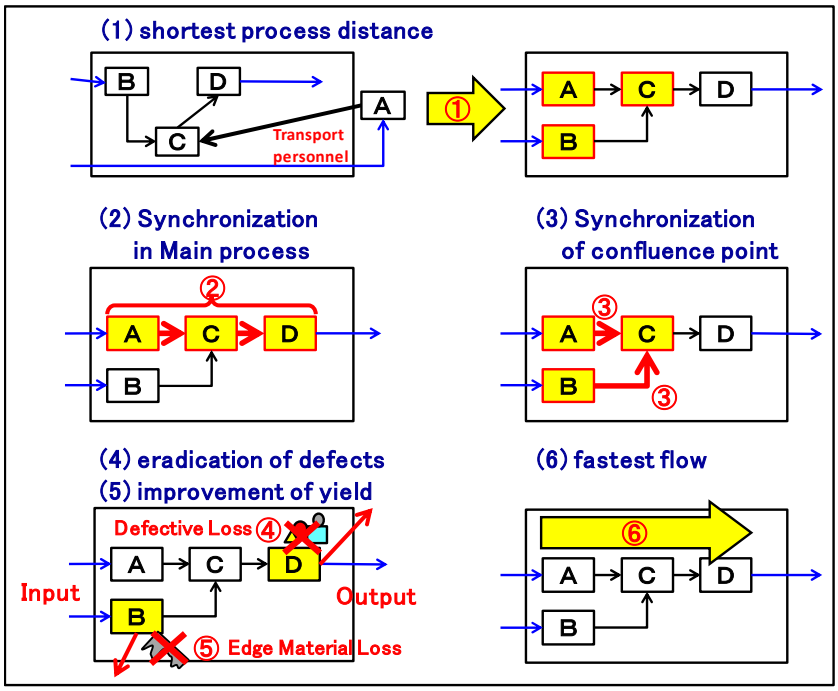
3.2 "6 steps of Kaizen process" at Manufacturing Gemba and GKC

"Good flow of design information toward customers" described by design information transfer theory is that the flow of materials, work-in-progress, and products does not stagnate and flows at the shortest LT. However, this cannot be realized immediately. To smooth flow, Gemba Kaizen also progresses systematically. In GKC, this was organized into six steps shown in Figure 4 (Hiiragi and Kazusa, 2016).

The improvement process is developed in six steps: (1) shortest process distance, (2) synchronization in main process, (3) synchronization of confluence points, (4) eradication of defects, (5) improvement of yield, and (6) fastest flow. Various Kaizen methods are used in each step. These methods include, for example, layout change, flow diagram improvement, standardization of work and work time, work improvement by the IE method, improvement of work efficiency of facilities and people by man-machine chart, operation analysis, line reorganization to improve organization efficiency, equipment improvement, cause-effect analysis, eight steps of problem solving, and others (Ohno, 1978). While using these Kaizen methods, each step of the improvement process defined in Figure 4 will occur. Below, we show a simple calculation example of GKC for each step of the Kaizen process based on Hiiragi and Kami (2016)[3].

[3] Since it aims to show cases that can occur at each step in a simplified manner, consistency of calculations through all the steps is not sought. For consistent calculation examples of these, please refer to Hiiragi and Kazusa (2016).

Figure 4　6 steps of Kaizen process



Source: Hiiragi and Kazusa (2016, p.79)

(1) Shortest Process Distance

Kaizen's first step is 5 S (Sort, Set in Order, Shine, Standardize, Sustain). If the arrangement of the equipment is not appropriate, a layout change is also frequently used. As a result, the distance between steps is minimized.

At beginner level Gemba, assets (machinery equipment, raw materials, work in progress, finished goods, jigs, tools, carriers, and so on) are cluttered like mountains, and people are also busily moving. However, it is often impossible to see the essential process flow. Therefore, at this stage, Kaizen activities dramatically change the scenery of Gemba, and the Kaizen effect is easy to see. It is a time when the motivation of organizations, including Gemba and management teams, is greatly increased, but if Kaizen fails at this stage, the Kaizen process will not move forward.

For example, if there is only one process in another building, the number of persons carrying the work in progress to the next process from that building, will create labor costs corresponding to the time used. Employing automatic transportation equipment for transportation will not incur labor costs, but instead will require capital investment, resulting in depreciation and maintenance costs.

As a remedy for such a case, the process could be moved from the other building

to the building where the equipment is located, and further changes could be made to the layout so that the shortest distance between processes is achieved. Kaizen effect reduces man-hours for transportation. As a result, for example, if one non-regular employee with hourly wage of 1,000 yen is reduced by one person, 8 hours of work per day, 20 days of monthly operation;

1,000 Yen×8 hours×20 days=160,000 Yen

of monthly cost reduction is achieved. Even if the employment and salary amounts do not change because of regular employees doing the transporting, GKC calculates the same amount of opportunity loss. This is the visualization of the Kaizen effect.

(2) Main Process: Synchronization in Main Process

Once the physical layout of the process is decided, the next stage is to eliminate the "detention" where WIP, that is media, does not flow.

When things accumulate, it is called a "bottleneck process." In principle, stagnation does not occur if all items always achieve "synchronization" at the same speed, and warehouse inventory will then be zero. However, in real life, synchronization is often disturbed due to differences in facility capability, work capability, and incomplete work combinations, and goods stagnate. On the other hand, when things do not flow in the downstream process, workers incur wait time and equipment is idle. LT also becomes long, and "7 wastes" in TPS (Ohno, 1978) occurs.

For example, the process with the longest cycle time is the bottleneck process. Prior to the bottleneck, work-in-process inventory is accumulated among the processes, so in the next process, the worker waits. If the cycle time of the bottleneck process is 600 seconds and the next process is 300 seconds, waiting time of 300 seconds for the next cycle occurs in every cycle. In the case of full-time employees, equivalent to ¥ 1800 per hour, converted to a per month payment at 0.5 yen per second, 40 cycles per day are produced, and when operations are carried out for 20 days per month,

0.5 Yen×300 seconds×40 pieces ×20 days=120,000 Yen

This means that labor costs are wasted. As synchronization progresses and waiting time decreases, labor costs are reduced accordingly. However, if the operating time is regular working hours of a regular employee, and the labor cost corresponds to a de facto fixed cost, no cost reduction will be realized. In this case, GKC calculates it as an opportunity loss amount.

(3) Main and Sub Process: Synchronization of a Confluence Point

Following the synchronization of this main process, synchronization at the main

flow (main process) and tributary (sub-process) confluence point is realized.

In actual Gemba, the process repeats, branching and merging. Even in such a case, after first seeing the mainstream process, the timing of tributaries entering and exiting will be combined and the goal will be “synchronization” at the confluence point. In that sense, (3) can also be described as an application section of (2).

As for the measurement of the Kaizen effect, the calculation in GKC is carried out in the same way as (3). That is, with variable time reductions, variable costs are calculated as cost reductions and fixed costs are calculated as opportunity loss amounts.

(4) Eradication of Defects, that is, Scrap reduction

Manufacturing defective products wastes resources, such as the inputs of raw materials, human labor, and facilities. It is “good flow” only if good products flow to the next process. For that, it is necessary to eradicate defects. This results in zero cost for damaged goods.

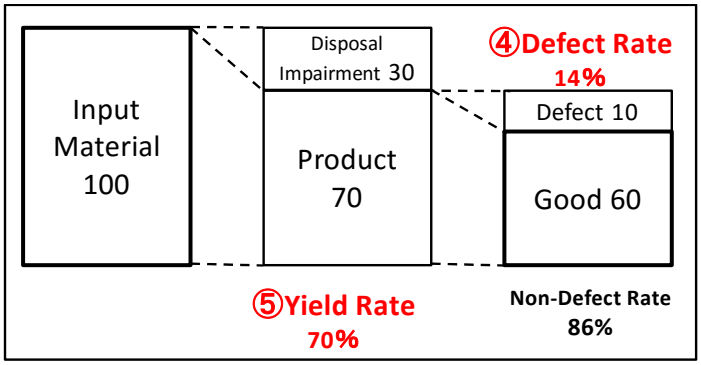
(5) Improvement of Yield, that is Reduction of waste / impairment

It is desirable for more products to be produced from the same amount of raw materials. In Gemba, part of the raw materials is disposed of or damaged due to design issues, technical restrictions on processes and work, and so on. The efficiency of utilizing raw materials is measured as the yield rate = output amount / input amount.

In manufacturing Gemba, defects, disposal, and impairment, as well as their quantity, is very likely to be managed using the ratio of defects to the input amount. There are indicators such as defect rate, orthogonality rate, and yield rate. If Kaizen activities are successful and these indicators improve, raw material input will be reduced going forward.

In steps (4) and (5), for example, if the product is 70 (30 are discarded / impaired) out of 100 units of raw material input, the yield rate is 70%. In addition, if the number of failures is 7 among the 70 products, the defect rate in the product is 14% and the non-defective rate is 86%. Ultimately converting, the percentage of good products compared to the input amount is 60%. Figure 5 shows this change.

Figure 5 Yield rate and defect rate



Source: Author creation based on Hiiragi and Kazusa (2016)

To realize these physical efficiency improvements, in addition to improving the processing method of people and equipment, if equipment factors are large, equipment maintenance such as TPM (total productive maintenance) and equipment improvement are also important. It should be noted, steps (4) and (5) are also often carried out in parallel with steps (1) to (3).

(6) Fastest Flow

Basic improvements are completed once in steps (1) to (5). Furthermore, the realization of the ability to flow the entire process at maximum speed is accomplished in step (6). By the way, if it is possible to achieve production capacity of Gemba at the highest speed, whether this can improve the performance of a company is determined by the level of demand. Even if only Gemba Kaizen evolves, unless orders catch up to production, corporate performance will not be improved, and opportunity loss will increase (Kazusa, 2010,2014). Visualization of this relationship is important in the stagnation/decline period of the current economy.

However, if there is an overwhelming shortening of LT, it can be expected that a differentiation strategy will utilize this. Profitability is expected to improve by improving customer satisfaction. In addition, as it is only necessary to forecast the near future, accuracy of demand forecasting may increase.

For each of these steps, as an example of the Kaizen effect measurement, Hiiragi and Kazusa (2016) presented a simple “daily actual cost calculation” example on an actual cost basis in an attempt at theory. Although details will be skipped, important points of step (4) and after that, based on the simulation results are cited as follows:

In (4) and the subsequent steps that should be further improved, reduction of

manufacturing costs due to labor costs will not be seen at all. Because in step (3), production is possible only during regular time, and labor costs within that fixed time are de facto fixed costs. Therefore, even if cycle time is reduced, the waiting time that is “opportunity loss” only increases. In other words, a decrease in labor cost when work time decreases due to improvements in processes is related to variable expenses, but in the case of fixed costs, labor cost does not decrease and opportunity loss occurs because of the extra time. In this numerical example, the increase in opportunity loss amount is most significant in step (6) where time becomes the shortest. In summary, when material cost is originally a variable cost, cost reduction is achieved in proportion to the amount of material. Regarding labor costs, the variable cost portion such as the rearrangement of non-regular employees and the reduction of overtime hours is directly reflected in cost reduction. However, shortening the working time of regular employees with fixed time, which is a fixed cost, does not appear in cost reduction. Therefore, it becomes meaningful to measure the waiting time of workers in money as an opportunity loss (Hiiragi and Kazusa, 2016, pp. 82-83).

This simulation shows that there is at least a "time difference" between improvements at the manufacturing site and performance improvement. It is a remarkable analysis perspective for the future.

4. Future Challenges

In this paper, we pointed out various issues related to Gemba Kaizen and accounting, proposed GKC as a solution for them, and then clarified its basic concepts and features. Already our separate paper simulates each improvement step in GKC and the concept of time involved in the Kaizen effect is discussed in detail. However, the issue of production capacity, which is one of the important issues in modern manufacturing companies, is currently under consideration. In addition, there are still many areas that GKC should handle. They are not only those directly linked to costs but also Kaizen related to quality and Kaizen related to safety or environment. After considering these, we would like to further develop the structure and evolution of GKC.

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<References>

Boer H., A. Berger, R. Chapman, and F. Gertsen. 2000. *CI Changes from Suggestion Box to Organizational Learning: Continuous Improvement in Europe and Australia*. Oxford: Ashgate Publishing.

Cooper, R. and R. S. Kaplan. 1988. How Cost Accounting Distorts Product Cost. *Management Accounting,* April, 69(10), 20-27.

Fujimoto Takahiro. 1999. *Evolution Manufacturing System at Toyota*. London: Oxford University Press (Japanese original issued in 1997).

Fujimoto Takahiro. 2007. *Competing to Be Really, Really Good: The Behind-the-Scenes Drama of Capability: Building Competition in the Automobile Industry*. Tokyo: I-House Press (Japanese original issued in 2003).

Fujimoto, T. 2012. Kyoso-ryoku-kochiku no tameno genka-keisan shiron: sekkei-joho-tensha-ron ni motozuku zembu-chokusetsu-genka-keisan no kanosei [A Preliminary Note on Harmonizing Manufacturing (Monozukuri) Management and Cost Accounting: A Possibility of Full-and-Direct Costing based on Design-Information Theory of Manufacturing]. *MMRC Discussion Paper Series*, 410.

Hiiragi, S. 2015. Gurobaruka-fukuzatsuka jidaino seisan-kanri-kaikei [Production Management Accounting in the Era of Globalization and Complication]. Kazusa, Y. and N. Sawabe (Eds). *Jisedai-kanri-kaikei no soseki* [*The Cornerstone of Next-Generation Management Accounting*]. Tokyo: Chuokeizaisha, 297-320.

Hiiragi, S. and Y. Kazusa. 2016. Seisan-gemba no kaizen to genka-keisan: kaizen-koka no mieruka [Cost Accounting for Gemba Kaizen on the Shop Floor: Visualizing Kaizen Effects]. *The Journal of Cost Accounting Research*, 40(2), 72-86.

Hiiragi, S. and Y. Kazusa. 2017. Seizo-gemba ni okeru kaizen-koka-sokutei to 2shurui no jikan-gainen [Measurement of Gemba Kaizen Effect on a Shop Floor and Two Concepts of Time]. *The Journal of Cost Accounting Research*, 41(1), 76-89.

Kaplan, R. S.1992. In Defense of Activity-Based Cost Management. *Management Accounting,* November, 58-63.

Kaplan, R. S. and S. R. Anderson. 2007. *Time-Driven Activity-Based Costing: a simpler and more powerful path to higher profits*. Boston, MA: Harvard Business School Press.

Kazusa, Y. 2010. Kikai-sonshitsu no soshutsu to kanri-kaikei: Kyosera to Kyanondenshi no jirei-kenkyu kara [Creation of Opportunity Loss and Management Accounting: Case study of Kyocera and Canon Electronics]. *Kigyo Kaikei,* 62(3), 324-333.

Kazusa, Y. 2014. Nihonteki-keiei to kikaisonshitsu no kanri: Ameba-keiei to Toyota-seisan-hoshiki no doshitsusei [J*apanese Management and Opportunity Loss Management: Homogeneity of Ameba management and Toyota Production System*]. *Kigyo Kaikei,* 66(2), 198-210.

Kazusa, Y. 2016. Nihonteki-keiei ni okeru kikaisonshitsu-kanri to koteihi-kanri: Ni honteki-kanri-kaikei no kihonteki-tokucho no chushutsu [Opportunity loss management and fixed cost management in Japanese management: Extraction of basic features of Japanese management accounting]. Kazusa, Y. and Y. Nagasaka (Eds). *Monozukuri kigyo no kanri-kaikei* [*Management Accounting of Manufacturing Companies*]. Tokyo: Chuokeizaisha, 1-19.

LEI (Lean Enterprise Institute). 2017. "What is Lean?" LEI HP: https://www.lean.org/WhatsLean/

McNair, C.J. 1994. The Hidden Costs of Capacity. *Journal of Cost Management* 8(1), 12-24.

Monden, Y. 1980. Genka-teigen to Toyota-seisan-hoshiki [Cost Reduction and Toyota Production System]. *Osaka Prefecture University The journal of economic studies*, 25(3), 1-16.

Nagasaka, Y., G. Ree, N. Imai, S. Tokuzaki, T. Shinoda, O. Maruta, S. Hiiragi. 2015. JAMA2013-2014 Sangaku-kyodo-kenkyu gurupu "Jisedai manejimentto-kontororu no tameno mezosukopikku-moderu ni kansuru akushon-kenkyu" kenkyu-hokoku-sho [The Japanese Association of Management Accounting 2013-2014 Industry-Academia Collaborative Research Group: Action Study on Mesoscopic Model for Next Generation Management and Control, Research report]. http://www.sitejama.org/publications/docs/studygroup/JAMA2013-2014sangaku-report.pdf.

Ohno Taiichi. 1988. *Toyota Production System: Beyond Large-Scale Production*. Portland, OR: Productivity Press (Japanese original issued in 1978).

Okamoto Kiyoshi. 2000. *Genka-keisan-ron rokutei-ban* [*Cost Accounting*]. Tokyo: Kunimoto Shobo.

Senju, S. and T. Fushimi. 1982. *Shimban Keizaisei-kogaku no kiso: Ishikettei notameno Keizaisei-bunseki* [*New Edition Economic Engineering Foundation: Economic Analysis for Decision Making*]. Tokyo: Japan Management Association.

Senju, S. and T. Fushimi.1983. *Keizaisei-kogaku no oyo: Saisan-keiei no Keikaku-gijutsu* [*Application of Economic Engineering: Planning Technology for*

Profitable Management]. Tokyo: Japan Management Association.

Senju, S., T. Fushimi, S. Fujita. T. Yamaguchi.1986. *Keizaisei-bunseki kaiteiban* [*Economic Analysis Revised Version*]. Tokyo: Japanese Standards Association.

Tanaka, M. 2009. T*oyota-shiki kaizen no kaikei-gaku* [*Management Accounting for Continuous Improvement the Toyota Way*]. Tokyo: Chukei Publishing Company.

Tanaka, M. 2016. T*oyota-shiki gemba-kanri: monozukuri nihon-saisei no tameno 7tsu no kaizen* [*Toyota Gemba Management: Monozukuri Seven Kaizen for Japanese Revitalization*]. Tokyo: Business-sha.

Toyota Motor Corporation. 2017. *FY2017 Financial Results*, http://www.toyota-global.com/pages/contents/investors/financial_result/2017/pdf/q4/presentation.pdf

Womack, J. P., D. T. Jones, and D. Roos. 1990. *The Machine That Changed the World - The Story of Lean Production*. New York: Macmillan Publishing Company.