Working Paper

GKC: Strategic utilization of Free capacity[1)]

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Gemba Kaizen creates excess production capacity or Free capacity. If this excess production capacity is left unused, it will result in an opportunity loss in the sense that the opportunity to make a profit using the excess production capacity will be lost. Thus far, we have been discussing the issue of Free capacity but have been putting off the discussion of what production capacity is. In this chapter, after discussing production capacity in detail, we discuss the strategic use of Free capacity.

I Production system and capacity

Prof. Katsundo Hitomi (Kyoto University), a renowned researcher in production systems engineering, explains systems as follows:

> A system is an 'organised whole' of a plural number of units. The essential sense of this term captures its organic (or materialistic) characteristics, or the *synergy effect*; that is, the total optimisation is greater than the sum of the partial optimisations.
>
> The effect was suggested by Laozi, a Chinese philosopher, about 2500 years ago; some time later it was noted independently by the Greek philosopher Aristotle. The German philosopher G. W. F. Hegel also mentioned this concept 200 years ago (Hitomi [1996], p.24).

1) This paper is an English translation of Chapter 6 of "Gemba Kaizen Costing-Visualization of Kaizen Effect" by Kazusa Yasuyuki and Hiiragi Shino (Kazusa and Hiiragi 2023). The book consists of six chapters, of which Chapter 6 mainly discusses the usage of the Free capacity mapped by GKC. The English translation of this chapter is published as a working paper for the purpose of discussion with overseas accounting researchers.

“It was also recognised as a production function that converts the raw materials into the finished products, and this function is controlled by the management system which performs planning and control (Hitomi [1996], p,47),” which is also from the perspective of the flow of goods (value stream).

In manufacturing companies, a wide variety of management resources, including physical resources such as machinery, equipment, and buildings; human resources such as workers and managers; and intellectual resources such as production methods, production technology, and skills are all invested to create an efficient production system. Many elements in the production system are physical resources. Since most of them are used for long periods of more than one year, they are recognized as fixed assets in accounting. Fixed assets are depreciated over their useful lives and treated as fixed costs called depreciation expenses.

On the other hand, short-term management resources such as raw materials and energy (e.g., electricity, gas, water) are also invested in the production system. Materials are processed through the production system; in other words, product design information is transferred to raw materials as a medium. The system ultimately produces a good product as a result. Many of these resources are treated as variable costs in cost accounting.

The ability to produce products is called production capacity. Production capacity is usually defined as the amount of production over a certain period, usually one year. Production capacity is also discussed in production systems engineering and production management. However, in accounting, particularly in cost accounting, production capacity has been discussed in relation to the allocation of manufacturing overhead costs. For example, “the size of manufacturing overheads depends on the scale of production capacity to be maintained... On the other hand, the scale of production capacity is usually determined by the normal volume of production” (Okamoto [2000], pp.163-164). Therefore, in order to make a planned allocation of manufacturing overhead costs, the normal production volume must be

determined.

Prof. Kiyoshi Okamoto explained, “What is normal production? This means how much production is carried out under normal circumstances. Therefore, we must know the following distinctions regarding the degree of production, or the level of production.” He was shown four standard operating rates: (1) theoretical capacity, (2) practical capacity, (3) average capacity: normal activity, and (4) expected actual activity (Okamoto [2000], pp.164-165).

(1) Theoretical capacity: This level of operation can only be achieved in an ideal situation where production is uninterrupted at maximum efficiency. It is expressed as the maximum production volume that is theoretically possible, but not actually achievable.

(2) Practical capacity: This is the maximum level of annual operation that can be achieved. It is calculated by subtracting the amount of production lost due to unavoidable stoppages, such as machine breakdowns and repairs, setups, defective materials, and worker absences and holidays, from the theoretical production capacity. If there is a work sift system, this is also taken into account.

(3) Average capacity: Normal activity - This is the long-term average operating level that is the result of seasonal sales forecasts and changes in production volume due to economic fluctuations. The period over which the average is calculated is more than one year, and five years is said to be common. ……It does not indicate production capacity, but rather, the level of capacity utilization. …… In cost accounting standards, this operating level is referred to as the normal operating level.

(4) Expected actual activity: This is the expected level of activity over the next year, also known as expected annual activity. It is also the level of activity that forms the basis of the overall budget, so it is also referred to as budgeted activity. It corresponds to the planned activity level in cost accounting standards (Okamoto [2000], pp.164-165).

According to Prof. Okamoto, theoretical production capacity "is rarely selected as the standard operating rate, and is more meaningful as a starting point for measuring the practical production capacity described below" (Okamoto [2000], p.164).

However, from the perspective of eliminating Muda through Gemba Kaizen, theoretical production capacity is the most important, rather than practical production capacity. Theoretical production capacity includes "the amount of production lost due to unavoidable work stoppages, such as machine breakdowns and repairs, setups, defective materials, worker absences and holidays, etc." This "amount of production lost" is the very thing that Gemba Kaizen targets. In GKC, this is recovered through Kaizen, and is captured and utilized as "Free capacity."

From the perspective of Kaizen, there are other people besides us who believe that theoretical production capacity is desirable. The Consortium for Advanced Manufacturing - International (CAM-I) Model is one such model. It analyzes the entire production capacity, including not only manufacturing overheads but also direct costs.

Ⅱ CAM-I Model —Full Capacity Model—

CAM-I is an international consortium of industry, academic organizations, governments, and local authorities (CAM-I [2023] , p.2) . Since its inception in 1972, the name and activities of the organization has undergone several developmental changes. In this context, it began working on the Cost Management System (CMS) program in 1986. The CAM-I Model was proposed with the aim of contributing to management, while also being grounded in the manufacturing site. It involves a detailed measurement of production capacity and improvements (Klammer [1996], Acknowledgments, p.vii).

The CAM-I Model applies the maximum operating rate as theoretical production capacity, and subdivides and organizes capacity according to the

phenomena that occur at Gemba, thereby asserting its practical applicability that is directly linked to Kaizen (CAM-I [2023], p.2).

Figure 6-1 shows the Full Capacity Model (Full Model) , which includes all elements of the CAM-I Model.

Figure 6-1 CAM-I: The Full Capacity Model

Rated Capacity	Summary Model	Industry-Specific Model	Strategy-Specific Modela	Traditional Model
Rated Capacity	Idle	Not marketable	Excess Not Usable	Theoretical
		Off-limits	ManagementPolicy	
			Contractual	
			Legal	
		Marketable	Idle But Usable	Practical
	Non-productive	Standby	Process Balance	Scheduled
			Variability	
		Waste	Scrap	
			Rework	
			Yield Loss	
		Maintenance	Scheduled	
			Unscheduled	
		Setups	Time	
			Volume	
			Changeover	
	Productive	Process Development		
		Product Development		
		Good Products		

Note: The classification of “Scrap” and “Time” shown in the original text has been corrected.

Source: Klammer [1996], p.17.

In the original text shown in **Figure 6-1**, “Scrap” in the strategy characteristic model was classified as “Standby” in the industrial characteristic model, and “Time” was classified as “Maintenance.” However, looking at the original text, it is clear that the former is classified as “Waste” and the latter as “Setups.” We have therefore changed the classification of the industrial characteristic. The same corrections were made in the book by

McNair and Vangermeersch as in ours (McNair and Vangermeersch [1998], p.83).

In the Full Model of CAM-I, Rated Capacity, which corresponds to the achievable theoretical or maximum production capacity, is divided into three types: Summary Model, Industry-specific Model, and Strategy-specific Model, and is also contrasted with the Traditional Model. The details are as follows:

(1) In the Summary Model, Rated Capacity is divided into three categories: Idle, Non-productive, and Productive. Idle is a state in which production capacity is not being used. Non-productive is a state in which capacity is being used but no good products are being produced, while Productive is a state in which good products are being produced.

(2) In the Full Model, these categories are further subdivided into two levels: Industry-specific Model and Strategy-specific Model. Idle is subdivided into three categories: Not Marketable; Off-limits as stipulated in management policies, labor contracts, and legal regulations; and Marketable, which indicates marketability but orders cannot be obtained.

(3) Non-productive is divided into Standby, Waste, Maintenance, and Setups. Of these, Waste indicates visible waste in the form of Scrap, Rework, and Yield Loss.

(4) Productive includes not only the production of good products, but also trial runs for process development and trial production for product development. Evidently, these should also include non-value-added work and waste (Muda), but the Full model does not mention this point. Test runs and prototypes are "preparatory work" for mass production, and whether or not they are productive should also be considered.

The Full Model of CAM-I is argued to provide accounting figures that

contribute to management decisions, using Gemba's control figures, and further focuses on production capacity categories such as "Idle" and "Non-productive" (Klammer [1996], p.22). However, the most important feature of the Full Model is that it places time at the basis. The assumption of 100% of total hours, 24 hours a day, 7 days a week, makes it possible to compare the ratios of each production capacity and to use the total costs as the basis for allocation (Klammer [1996], p.39).

Thus, the Full Model can support the Kaizen process in the field by classifying "Idle" and "Non-productive" in more detail (Klammer [1996], p.25). Prof. Takahashi Masaru (Yokohama National University) points out that "the actual production capacity referred to in CAM-I is different from the usage with which the author is familiar" (Takahashi [2019] , p.51) , but he also indicates that "Klammer (1996) presents a capacity model for CAM-I that measures capacity in great detail" (Takahashi [2019], p.49).

Ohno Taiichi's "worker movements" are divided into three categories: real work, non-value-added work, and Muda. Since non-value-added work and Muda can be consolidated into "non-real work," GKC applies this concept to the concepts of time and cost and considers them in two categories: real and non-real. A conceptual diagram of production capacity, which is described later, is also developed in two categories: used and unused. In the Full model of CAM-I, the three categories of production capacity were adopted based on a good understanding of Kaizen. There is also no significant gap in GKC's understanding of the items that have been subdivided in the Industrial Characteristics Model and Strategic Characteristics Model. The Full model of CAM-I is an attractive model for us, but it still has its issues. Regarding production capacity, CAM-I is claimed to be as follows:

> The common measure [of the production capacity] that did not incorporate any other bias was the **total time available**.…… total time available is 24 hours per day, 7 days per week, 365 days per year (168 hours per week or 8,760 hours per year) (Klammer [1996], p.10).

This argument may seem obvious, but CAM-I lacks awareness of the possibility that Kaizen can sometimes result in an increase in production capacity of over 100%. GKC also focuses on this point. In CAM-I, capacity is classified according to a single criterion, time, which is meaningful. However, in Kaizen, it is necessary to focus not only on time but also on other material efficiencies.

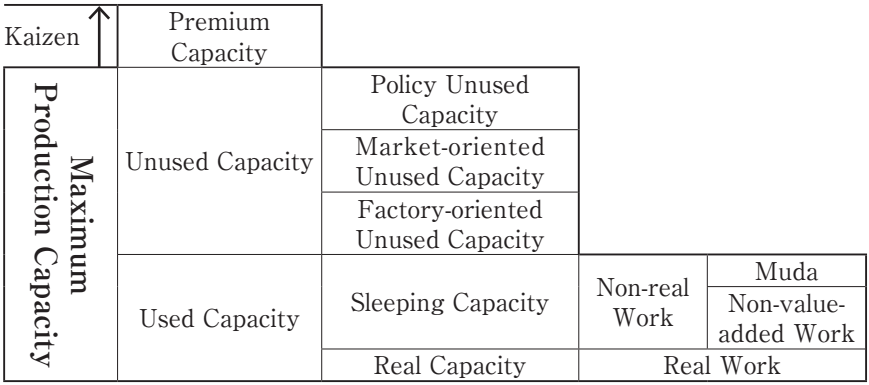
Ⅲ Essence of Gemba Kaizen —Increasing production capacity—

1. Conceptual diagram of production capacity

As mentioned above, Prof. Okamoto divided the standard operating rate into theoretical capacity, practical capacity, normal activity, and expected actual activity. The standard operating rate refers to the level of operation as a measure of the degree of operation, and was necessary for determining the allocation standards for manufacturing overhead costs in conventional cost accounting. On the other hand, in the Full model of CAM-I, the rated production capacity, which refers to the maximum achievable production capacity from the perspective of Kaizen, was divided into three categories: "unused," "non-productive," and "productive."

Kaizen increases production capacity and creates Free capacity. The creation of Free capacity is the result of increased productivity in terms of both time and quantity. From the perspective of Kaizen, we first consider production capacity from the perspective of *time efficiency*, while focusing on the meaning of "real work," "non-value-added work," and "Muda," which are the individual components of Mr. Ohno's "worker movements." **Figure 6-2** shows the conceptual diagram of the production capacity of GKC.

Figure 6-2　Conceptual diagram of production capacity



Source: Kazusa and Hiiragi [2023], p.178.

According to **Figure 6-2**, the maximum production capacity, which is the ideal production capacity that can be achieved, is divided into unused and used capacity. Unused production capacity is divided into policy unused capacity, market-oriented unused capacity, and factory-oriented unused capacity. Used production capacity is divided into sleeping capacity and real capacity.

2．Unused production capacity

Unused capacity is the proportion of maximum capacity that is not being used for three reasons: policy unused capacity, market-oriented unused capacity, and factory-oriented unused capacity.

Policy unused capacity is production capacity that is not used for political reasons due to public regulations or management decisions. These include management policies, labor contracts, and legal regulations not covered by the CAM-I Full Capacity Model.

Market-oriented unused capacity refers to production capacity that is mainly unused due to insufficient demand in the market or because the company is unable to receive orders despite demand. In order to resolve this, it is necessary to make management reforms, such as sales efforts to

develop new customers and new product development, in order to increase the volume of orders rather than simply hoping for an economic recovery. However, this is not an easy task. Furthermore, the unused production capacity corresponds to the not marketable and marketable categories of the CAM-I Full Capacity Model.

Factory-oriented unused capacity refers to the unused proportion of production capacity that arises from factory stoppages due to equipment or machinery breakdowns, regular inspections, unavailability of parts or raw materials, and fire or natural disasters (e.g., floods, typhoons, tornadoes, earthquakes, tsunamis). In order to prevent factory stoppages, thorough maintenance inspections should be conducted in advance. After the stoppage, a quick response and early resumption of operations are desirable.

3. Used production capacity

If you subtract unused production capacity from maximum production capacity, the remainder is used capacity (operating capacity). This includes real capacity and sleeping capacity. Real capacity is that which adds value through real work. In contrast, sleeping capacity is that which arises from non-real work (non-value-added work and Muda) that consumes management resources, which are the source of production capacity, but does not produce value-added work as expected. In other words, it is "complete waste."

Mr. Ohno defined Muda (waste) as follows: "Waste - the needless, repetitious movement that must be eliminated immediately. For example, waiting for or stacking subassemblies" (Ohno [1988], p.57). In the CAM-I: Full Capacity Model "Scrap," "Rework," and "Yield Loss" are classified under "Waste" of "Non-productive."

"Non-value-added work may be regarded as waste in the conventional sense. For example, walking to pick up parts, opening the package of goods ordered from outside, and operating the push buttons, are tasks that need to be done under present working conditions. To eliminate them, these

conditions must be partially changed" (Ohno [1988], p.57). In the CAM-I: Full Capacity Model, these are recognized as "Standby," "Maintenance," and "Setups," which are included in Non-productive capacity.

If you completely eliminate Muda through Kaizen and thoroughly remove non-value-added work, sleeping capacity will decrease accordingly. The amount of this decrease will be the increase in production capacity that creates added value. This is the Free capacity created through Kaizen. This understanding of sleeping capacity is a unique view that is unmatched elsewhere.

Although the views expressed by CAM-I are believed to be based on a deep understanding of Kaizen, as far as the Full Model is concerned, the recognition of non-value-added activities and Muda is not always clear. Furthermore, there is no explicit recognition that Gemba Kaizen will reduce sleeping capacity and, as a result, create Free capacity. Therefore, it is necessary to further clarify the issue of sleeping capacity.

4. Discovering sleeping capacity

One of the authors examined the Kaizen effect as it appears in standard cost accounting. According to this, if efficiency is improved through Gemba Kaizen, the efficiency variance will be "displayed as a favorable variance" in the variance analysis of standard cost accounting; however, at the same time, the capacity variance for that amount will increase. "This is nothing other than a considerable amount of Free capacity created through Gemba Kaizen" (Kazusa [2017], p.338).

Standard costing allows for waste, such as defective products, loss, and idle time, so it is not well-suited to Kaizen. However, even with standard costing, it is still possible to confirm through variance analyses that Gemba Kaizen can turn sleeping capacity into Free capacity.

Kaizen involves completely eliminating Muda in the production process and reducing sleeping capacity by thoroughly eliminating non-value-added work, thereby creating Free capacity. The creation of Free capacity can be

said to be the result of previously "asleep" capacity that had been considered unusable, either consciously or unconsciously, being awakened to its full potential.

Since it has generally been assumed that interruptions or work stoppages are unavoidable and that it is natural for preparations to take half a day, the preconditions for production and work have not been questioned. However, the essence of Gemba Kaizen, as typified by the Toyota Production System (TPS), is "to pursue the true cause of the problem and seek a fundamental solution" (OJT Solutions [2014], p.158). As a result, Muda and non-value-added work, which does not create added value, are gradually eliminated, and sleeping capacity is reduced by the same amount. While much of Muda is visible, non-value-added work is not something that can easily be found without "pursuing the root cause." This is where the difficulty of Gemba Kaizen lies.

We have discovered that Free capacity is created by eliminating non-net work (non-value-added work and Muda), and have worked to theorize and systematize this as a cost accounting theory. This is the GKC theory proposed in this book.

When standard cost accounting is applied by manufacturing companies, factories are often operated at their actual capacity below their budgeted capacity. Whether the cause is market or factory factors, the factory's operating status is calculated as an unfavorable capacity variance. If an unfavorable capacity variance is calculated, the actual production capacity of the factory has definitely decreased by the amount of the unfavorable capacity variance. This unfavorable capacity variance is completely different from the Free capacity created through Gemba Kaizen. Free capacity is production capacity that can be used immediately. In contrast, production capacity corresponding to unfavorable capacity variance due to factory factors is in a state of non-production. Unless measures such as repairs and improvements are taken, it will result in unstable factory operation with defects even if production is resumed. Gemba Kaizen is also essential in this scenario.

In addition, Free capacity is utilized or disposed of through four management options that differ depending on management decisions. However, if nothing is done with this Free capacity, it will be classified as unused capacity due to market factors in the next accounting period. In accounting terms, Free capacity could be calculated as an opportunity loss. If Free capacity is left to sit around any longer, it will eventually be disposed of and disappear from the factory. However, such an outcome would not be accepted without question by those involved in Kaizen. A proactive response to Free capacity is urgently needed.

5. Creation of premium production capacity

Usually, Kaizen is developed with the aim of eliminating the various Muda contained in maximum production capacity (ideal capacity). Once maximum capacity is reached, the only possible solution is to expand the existing factory or build a new one. However, when Kaizen is carried out at a high level, production capacity may sometimes be increased at existing factories without expanding or building new factories. This is made possible by Kaizen that significantly changes the preconditions of the production system that is currently producing at maximum capacity. Such changes refer to innovative modifications to current production conditions and methods and the like,

For example, there are cases where the rated capacity of the machinery and equipment purchased is exceeded due to the user making their own improvements or devising a new way of using it. According to Masatomo Tanaka, former General Manager of the Operating Management Consulting Division at Toyota Motor Corporation, "At Toyota's Japanese plants, there was a sense that purchased machinery could be made 20% more efficient, and in fact, such equipment improvements were carried out in collaboration between the Gemba and production engineering" (Tanaka [2017]). This is an example of how Kaizen increased maximum capacity by 20%, creating premium capacity.

Even when a machine is used beyond its useful life, it can still produce premium capacity. A machine is made up of many parts, but not all of them have the same useful life. Some are short-lived, while others are long-lived. By replacing some of the core parts, the machine may be used for longer than its "rated" useful life. This is an example of how extending the useful life of a machine can even increase its maximum capacity, or in other words, create premium capacity.

This premium production capacity will not be easily achieved but it will enable us to secure the production capacity needed to meet the immediate demand, allowing us to postpone the capital investment required for a full-scale expansion of our production facilities. In this case, the Kaizen effect will be the savings in investment, including the cost of equipment. So far, we have organized the abilities related to time productivity. Next, we examine production capacity from the perspective of quantitative productivity.

6. Good production capacity and out-of-service capacity

Goods are produced from real production capacity and sleeping capacity. Unfortunately, material inventories, "works-in-process", offcuts, and defective products are also produced. Of these, the production capacity used in producing good products is called good production capacity. The capacity used for various products other than good products is collectively referred to in this book as out-of-service capacity.

All management resources invested in the production system that do not contribute to the production of good products are "non-value-added resources." Among the production capacities that have thus far been introduced, unused capacity, sleeping capacity, and out-of-service capacity are correspond to non-value-added resources. Non-value-added resources include loss or impairment, waiting time, and "factory inventory" such as raw materials, parts, and works in process stored in processes, factories, and warehouses. The ultimate goal of Gemba Kaizen is to eliminate all of these non-value-added resources.

Ⅳ Kaizen Map suggestion

1. Muda that is apparent in production processes

We have pointed out that management resources are input into the production system and become productive capacity to produce good products. We then analyzed production capacity in more detail and indicated that the maximum production capacity that can be realized includes unused and used capacity. It is noteworthy that, along with used capacity, sleeping capacity also exists, which does not produce added value due to non-value-added work and Muda. Completely eliminating Muda and non-value-added work to the utmost limit through Kaizen will reduce sleeping capacity and create a corresponding amount of Free capacity. If the Free capacity is properly managed, cost reduction and sales increase can be expected. However, if it is left unmanaged, it will not only result in opportunity loss, but will also become market-oriented unused capacity. In the worst case scenario, it will eventually be disposed of.

Used capacity includes both real production capacity, which generates added value, and sleeping capacity, which does not generate added value. In actual production, these two capacities are combined to produce the goods in the production system.

As explained in **Figure 4-1** of the GKC book (Kazusa and Hiiragi [2023], p.95), the management resources invested in production can be divided into good products (value-added resources) and non-value-added resources (e.g., waste, loss, factory inventory). This non-value-added resource and the inventory of unsold products are considered to be Muda. These are, so to speak, "visible Muda." In other words, only the production capacity used for the products that reached the customer was used effectively. Strictly speaking, maximum production capacity is the maximum annual production volume of "good products," and is achieved when both "visible Muda" and "invisible Muda" are zero. At the production level, the good production capacity is only the capacity required for the production of good product.

Maximum and good production capacity can be summarized as follows:

Maximum production capacity: Theoretical maximum annual production of good products

Good production capacity: Annual production of good products that is currently feasible

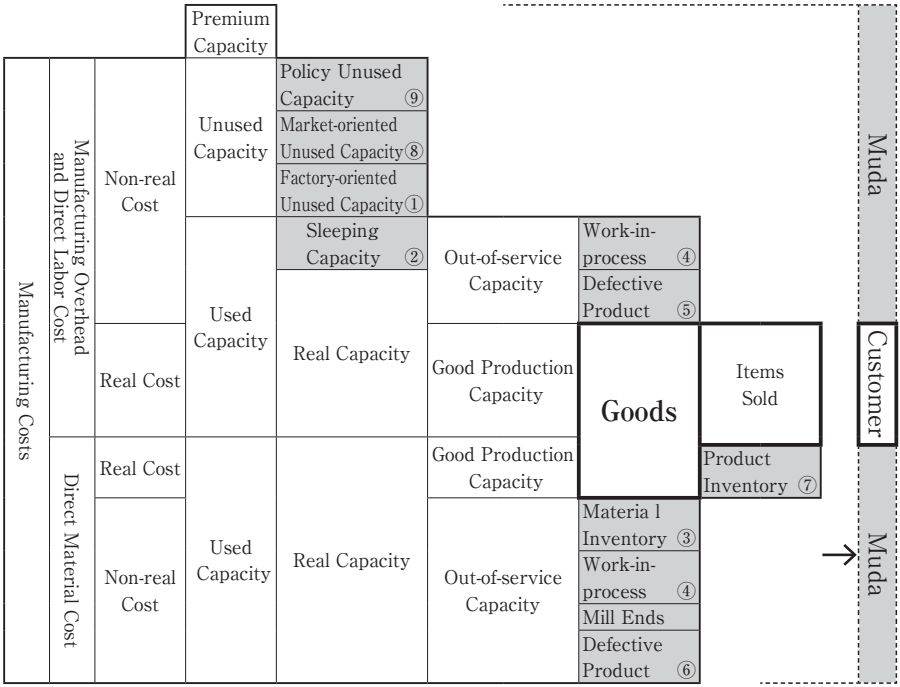
Between maximum production and good production capacity, there are all kinds of "visible Muda" and "invisible Muda." Firstly, maximum capacity includes both unused and used capacity. Furthermore, used capacity includes both sleeping capacity and real production capacity, which are used together in actual production to produce the products from the production system. These products are processed sequentially through the production process. Unfortunately, it is only possible to observe the "visible Muda" through this process.

In GKC, we focus on the "visible Muda" of material inventory, works in process, scrap, loss, and defective products. Of the used production capacity, the capacity used for these "visible Muda" can be called out-of-service capacity. Therefore, if we focus on "visible Muda," we can express good production capacity as the maximum production capacity minus various "Muda" because good production capacity can be calculated by subtracting out-of-service capacity from used capacity. However, these "Muda" include sleeping capacity as "invisible Muda." Sleeping capacity is the most important target for Gemba Kaizen.

2. Kaizen Map illustrating Gemba Kaizen and management innovation points

Management resources are invested in the production system before products are produced from the production system. After passing inspections, the final good products are shipped. **Figure 6-3** presents the Kaizen Map that illustrates Gemba Kaizen points and management innovation points.

Figure 6-3 Kaizen Map



Gemba Kaizen Point

① Avoiding equipment outages

② Elimination of many kinds of invisible Muda (Non-real work)

③④ Reduction of material and work-in-process inventories

⑤ Yield increase

⑥ Elimination of defects

⑦ Reduction of product inventories

Source: Kazusa and Hiiragi [2023], p.186.

Management Innovation Points

⑧ Develop new customers and markets

⑨ Management policies, labor contracts, legal regulations, etc.

Figure 6-3 illustrates the production capacity that is generated when the management resources purchased as production costs are input into the production system. Furthermore, it is shown that the products produced using the production capacity include not only good products, but also material inventory, works in process, offcuts, and defective products among others. Since the good products delivered to the customer are the products for sale, the production capacity that does not contribute to the products for sale is considered "Muda." This is shown on the far right of the diagram. Next, we explain the Kaizen Map in more detail.

(1) Manufacturing cost

Management resources that are invested in the production system are calculated as manufacturing costs in accounting. In GKC, Gemba Kaizen is related to both physical and time productivity. To reflect this, it is divided into direct material costs, which are mainly affected by physical productivity, and direct labor costs and indirect manufacturing costs, which affect both types of productivity. Direct labor costs and indirect manufacturing costs can also be read as processing costs.

Manufacturing costs are broadly divided into real and non-real costs, and this classification also applies to direct material costs, direct labor costs, and indirect manufacturing costs.

(2) Production capacity

The management resources invested create production capacity. As shown in the "conceptual diagram of production" (**Figure 6-2**), this is divided into used and unused capacity. The details of these production capacities are shown in the conceptual diagram of production capacity. However, in the used capacity shown in direct labor costs and indirect manufacturing costs (processing costs), the sleeping capacity and real production capacity are shown as a single entity. To emphasize this, they are deliberately shown as dotted lines.

Regardless of the classification of direct material costs and processing costs (direct labor costs and indirect manufacturing costs), good products are produced from good production capacity, and products other than good products are produced from out-of-service capacity. More specifically, direct labor costs and indirect manufacturing costs (processing costs) produce (4) works in process and (6) defective products, while direct material costs produce (3) material inventory, (4) works in process, (5) mill ends, and (6) defective products. Good products are produced from good production capacity, but only the good products that reach the customer are sold. The good products that do not reach the customer become (7) product inventory.

In addition, the premium production capacity is shown in the upper left portion of the diagram. The use of this production capacity also depends on the ability of the management team.

(3) Gemba Kaizen points and management innovation points

If there is potential for Kaizen wherever there is Muda, then points ① to ⑦ in the diagram are targets for Gemba Kaizen, namely: ① unused capacity due to factory factors (e.g., equipment shutdowns), ② sleeping capacity (invisible Muda), ③ material inventory, ④ works in process, ⑤ offcuts, ⑥ defective products, and ⑦ product inventory. Gemba Kaizen is about eliminating these Muda and improving the flow of the production process. Therefore, ① to ⑦ can be called Gemba Kaizen points (Hiiragi and Kazusa [2022], p.132).

Basically, the unused capacity shown in ⑧ unused capacity due to market factors and ⑨ unused capacity due to policy cannot be improved by Gemba Kaizen. In order to improve these, management innovations are necessary, such as new customers, new products, new technologies, and new businesses, as well as sales efforts. Therefore, ⑧ and ⑨ can be called management innovation points (Hiiragi and Kazusa [2022], p.132).

As a result, Muda occurs in the Gemba Kaizen points and management innovation points indicated on the Kaizen Map. We recommend those involved in Kaizen and management to make good use of this Kaizen Map

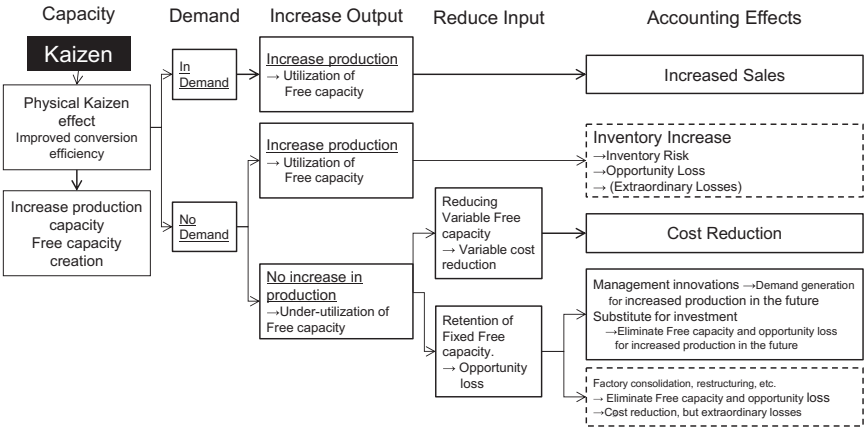
and engage in more debates about Kaizen.

In addition to increasing production capacity at these points, there are also Kaizen measures that can significantly change the current production conditions themselves. For example, if the speed of the machinery can be increased through equipment improvements, production capacity may increase beyond the 100% currently assumed. This is the premium production capacity shown in the upper left portion of the diagram.

Ⅴ Management innovation utilizing Free capacity

In this study, we have examined how to increase production capacity through Gemba Kaizen and how the Kaizen effect manifests itself as a result. Kaizen effects can be categorized by focusing on whether or not there is market demand. **Figure 6-4** shows the Strategic Decision Tree for the Free capacity created through Kaizen.

Figure 6-4 Free capacity Strategic Decision Tree



Source: Kazusa and Hiiragi [2023], p.189.

In **Figure 6-4**, in the leftmost part of the diagram, "Capacity" shows the increase in production capacity due to Kaizen. There are three possible factors that could have an accounting effect on this: (1) the market is in demand/not in demand, (2) product output is increased/not increased, and (3) input resources are decreased/not decreased. "Demand" in **Figure 6-4** is split into whether or not there is market demand. If there is demand, it is best to increase production. Following the "demand exists" path shown at the top of the diagram will lead directly to increased sales. However, if production is increased despite lack of demand, following the "no demand" → "increase production" path will result in increased product inventory, which, in turn, will increase inventory risk and cause a loss of opportunity loss (i.e., profits that could have been gained by producing other products will be lost).

On the other hand, if production is not increased due to lack of immediate demand, the path will be "no demand" → "no increase in production," as shown in the lower part of **Figure 6-4**. If output cannot be increased, then it is considered that input can be reduced instead. Since the management resources that correspond to variable costs can be reduced relatively quickly, cost reduction is achieved. However, cost reduction cannot be achieved immediately if management resources are equivalent to fixed costs. Therefore, enough "work" must be created to enable fixed cost recovery. For this, Gemba Kaizen alone is not sufficient; management innovation is necessary, such as R&D, new product development, cultivating new customers, and developing innovative management strategies (Kazusa [2016], p.11). If these progress smoothly, they will create new demand, enabling future production increases and, of course, profit increases.

There are also "countermeasures" that are not necessarily preferable. One such measure is to reduce management resources that correspond to fixed costs. This is known as restructuring. In this case, the opportunity loss that is created is reduced at a considerable cost. In addition, management problems arise, such as extraordinary losses.

The Free capacity Strategy Decision Tree shows the Kaizen effects that arise from Free capacity created through Gemba Kaizen from a comprehensive and monetary perspective. With this, management strategically combines the parameters of "market demand," "output increase," and "input decrease" with an eye to the future in order to utilize Free capacity.

Traditionally, when referring to Kaizen effects, the focus has been on cost reduction. However, in GKC, we focus not only on cost reduction, but also on opportunity loss. We also present a Free capacity Strategy Decision Tree that supports management's strategic decision-making by visualizing the future image of the company. This is the first attempt at linking GKC and corporate management from an accounting viewpoint, and it is a perspective that has not been seen in previous research. We would be glad if GKC could be applied in corporate practice.

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