



Keio Business School

Practical Risk Management in Manufacturing industry

1. Definition of Risk

First of all, let's define the meaning of the word Risk used in this paper.

Risk: Latent possibility

When Risk becomes a reality, it could cause either good effects/results or adverse effects/ results in various activities of companies. This lecture will deal only with Risk which exert adverse effect/ results. It will also restrict discussion to Risks found in processes, excluding those which are generated by changes in the market, changes in corporate environment, and pandemics including infectious diseases.

Since Risks are latent, they are invisible and do not bring about effects as long as they don't take shape as actualized phenomenon. Once Risks actualize as events or phenomena, they may give adverse influence on the company in terms of lower profit, poorer reputation in the society, or deteriorated labor environment in terms of recruitment, etc. **(Fig1)**

Specific examples of Risk areas include: safety record; quality defects; and minor equipment stoppages. It is essential to manage Risk factors in order to prevent these events from happening. The point is, it is important not only to manage the result of the actualized phenomenon, such as quality defect, but also to construct a management system that enable to predict that a factor named "Risk" turn to phenomenon and to correct these factors so that it does not become an event.

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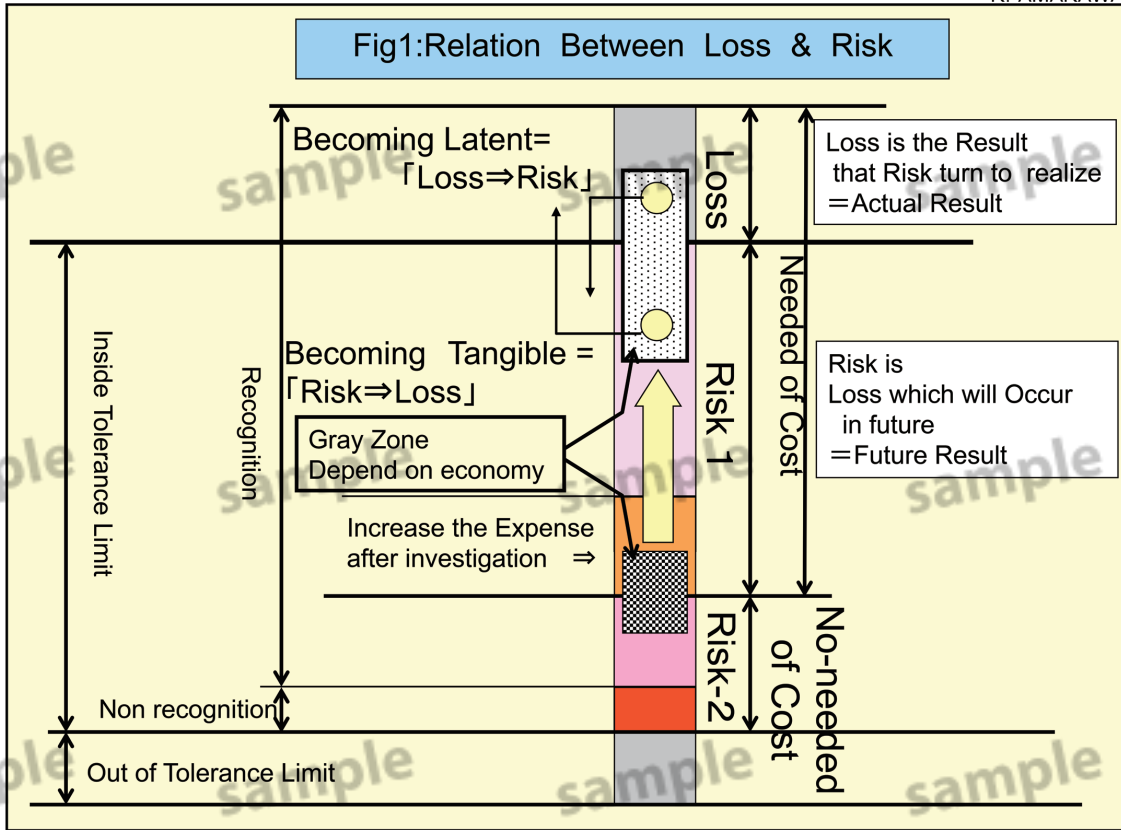


Fig1

2. Characteristics of Risk Factors

What needs to be done at first is to define “Cause” and “Factor.”

Cause : Origin or Matter which cause certain things, states, or change

Factor : Matter, Environment or Affect which becomes Origin of Cause

Let’s think about cause analysis of occurrence of the phenomenon, by using the case of a safety accident. When an accident happens, an analysis is conducted to pursue root cause. This case shows that causes can be broken down into multiple factors independent of each other, forming and covering a wide range. As we recognize from the analysis, these causes are classified into many categories such as various organizational hierarchy, various independent factors. As a result, it becomes clear that many countermeasures are required. Characteristics can be organized as follows:

- Viewed in time series, certain factors repeat occurring and disappearing.
- When certain small factors are growing up and larger than certain scale, it becomes reality and takes form as phenomena like an accident.
- An event does not happen by a single cause, but as a result of combination of multiple factors.
- Scale of impact and the range affected vary depending on the nature of direct cause that triggered the event and the surrounding environment.
- Not every factor necessarily causes the phenomenon.

This leads us to think that factors causing phenomena are very “uncertain.” Let me cite another example from a different viewpoint. Experienced operator often takes a skip some steps instructed in standards. Events, however, may not happen every time they do so. When one succeeds in omitting standard rules without causing an event, omission of such rules becomes a common practice. It should be remembered, however, that such practice might fail sometime. It is because of “uncertainty of factors” mentioned above.

The uncertainty is the key point of Risk Theory. Analysis of factors causing events reveals a large number of phenomena. This leads the following step, taking countermeasures to be either easy, or difficult one. On the workplace, let’s see actual prevent countermeasure for factors after the phenomenon happen.

- To take measures against factors whose measures are easy to implement
- To make revisions to the “paper”, such as standards, with relative ease
- To only list up items which take time to carry out, like development of human resources, and to deal with as matters to be considered later
- Issues related to organization and those of the corporate level, which need to involve upper management, are left untouched.

There are also measures prepared for presentation to upper organizational levels or for making excuses towards external organization, rather than for improving their own section/ department.

In General, Risk is evaluated using the following formula.

(Probability of occurrence of an issue) × (Extent of impact given when the issue occurs)

At first, the scale of Risk can be quantified using the formula, and then we may decide “acceptable Risk”, at last, we take some measures depending to the digitized size.

The most common trends with this method are:

Although this method allows numerical representation of probability of occurrence and scale of impact, it often leaves some ambiguity in evaluating actual conditions on the workplace situation, and in some cases, the original function of Risk evaluation method may not be exerted because the decision how factor level in the formula is selected is left with the sense of the analyst. Considering the above-mentioned characteristics of Risk, it would be difficult to organize activity for reducing occurrence of events to zero.

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3. Risk Management for Companies

Let's think about the Risk management in companies. Companies implement activities to eliminate Loss. Loss is the actualized phenomenon like failure, defect, accident, so the achievements can be confirmed after eliminating Loss. In the phase following Loss elimination, these events shown below, sometime, remain.

- Events which happen in workplace become smaller

Take the case of quality defect, for example. Ratio of Quality defect will be very small like 0.01% that means "one piece of 10,000piece". For the ratio of quality defect in medical tablet, it is 10ppm that means one piece in 100,000piece when a medical company is manufacturing these tablets. But shall we think actual effect of these defects? If these defects occur, a car gets damage and the recalling happen, or a single defective tablet might end up in killing a person! As a result, the large damage such as Loss of social trust will occur, or the credit Loss will occur like the recall, or sales volume will decrease. It should be remembered that, even though these defect are an extremely minor event in manufacturing stage, the probability can't be ignored that a phenomenon caused by a small defect can end up in significant ramifications.

- There exist Events which give major impact

A case in point is an explosion accident at an oil refinery. Cause may be very small and frequency of occurrence may be limited, but once these small issue happen, it lead to an extremely grave accident.

This is where necessity of Risk Management lies. While improvement of eliminating any Loss and innovative activities must be needed for corporate growth and increased revenue, these activities are for seeking one-shot or transient benefits. Meanwhile, Risk Management is greatly different from KAIZEN activities: Risk Management is a continuous activity to maintain conditions against various types of changes occurring every day (**Fig2**).

Risk always arises and exists. No matter how small an event/ phenomenon a Risk may emerge into, there will always be a major impact depending on the environment, and the company must pour every effort into eradicating Risks. Let's think what will happen as a result. For the purpose of making sure that every single employee would perform one's operation in the same manner, the company will arrange so that operations are carried out basically following documentation, such as "standards", "standard codes", "rules" and "checklists". First-line operators, including maintenance person, are led to follow and act exactly as written in the documentation. But it is impossible to write their every move of all behavior in that standard and procedure in thinking of what happens in on-site. Every operator are human, not robots. In addition, whenever a machine failure, defect or accident happens, measures to prevent them are adopted, and at the same time new items and provisions are added to the documentation. As a result, documentation keeps growing every time "the event" occurs. Since operators are required to follow documentation precisely, after that, they give up thinking on their own.

This is the worst mechanism “the Devil Cycle” to be followed!

Let’s look at the actual example. It is very important to analyze the cause of an event once it happens, and take measure against the phenomenon that occurred. This, however, is only good in preventing recurrence of the same event, and is not sufficient in preventing similar phenomenon from happening. Let’s assume that a bearing of machine A failed has broken down. So operator analyzed and found the cause, and took measure against it. For this case, due to lack of oil, so operator refueled and lubrication standard may be established. But this action is only applicable to machine A, and not for machine B. Then, next, the bearing of machine B breaks down because of lack of oiling. Only then, operator added the rule of lubrication standard of machine B. So, repetition of such measures will increase the number of standard item or rules every time a phenomenon occurs. Coming to think of it, however, the truth is that shortage of oiling was caused by general lack of “standards” and “procedure” of lubrication, and therefore, action should be taken to work on the “insufficient basic conditions”. “Insufficient basic conditions” is based on human behavior. The structure is shown in the **Fig.3**. The countermeasure must be taken for insufficient basic condition, that is, human behavior itself. The standard and rule, of course, should be applied not only to machine A but also to every machine and operation. That is to say, what is important is to carry out activity for taking measures in order to work on root causes, rather than working on individual problems separately. For the purpose of detecting and finding out root causes, fundamental technology of ideal state is necessary. At the same time, it is very important to organize experiences systematically, and then, to acquire this organization as a skill, and make them part of individuals’ ability.

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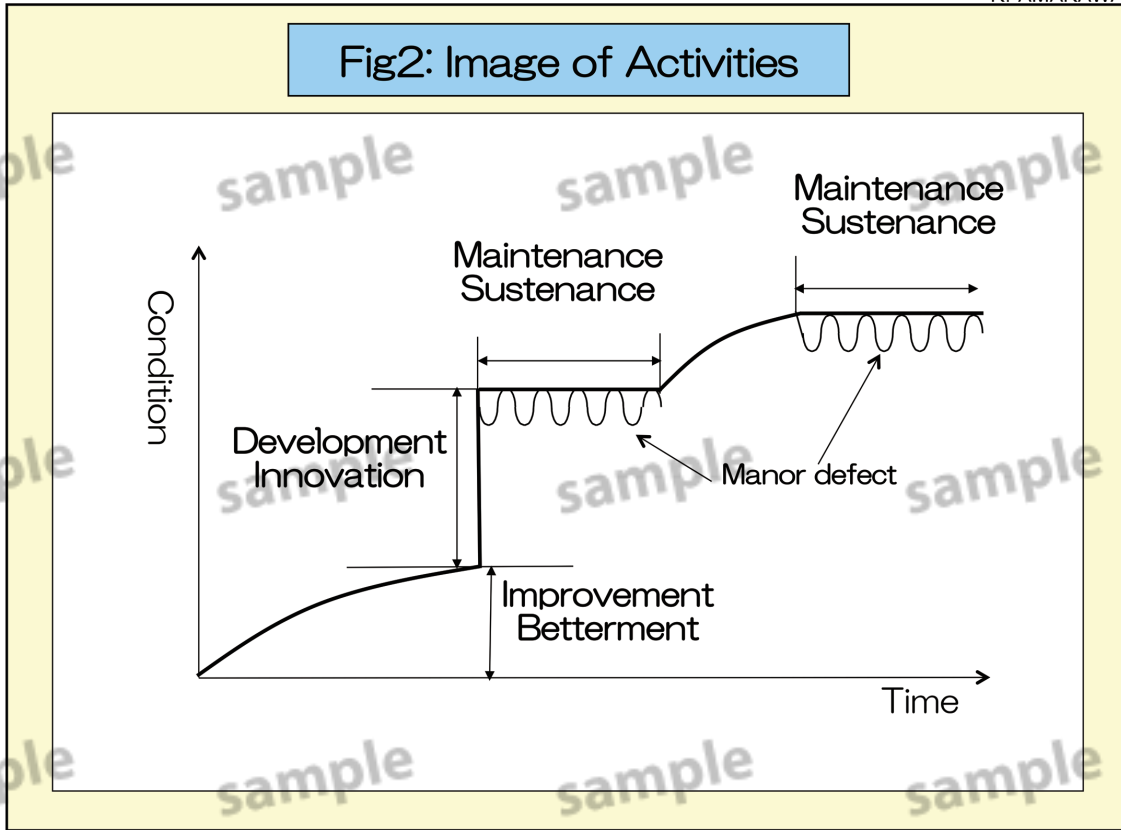


Fig2

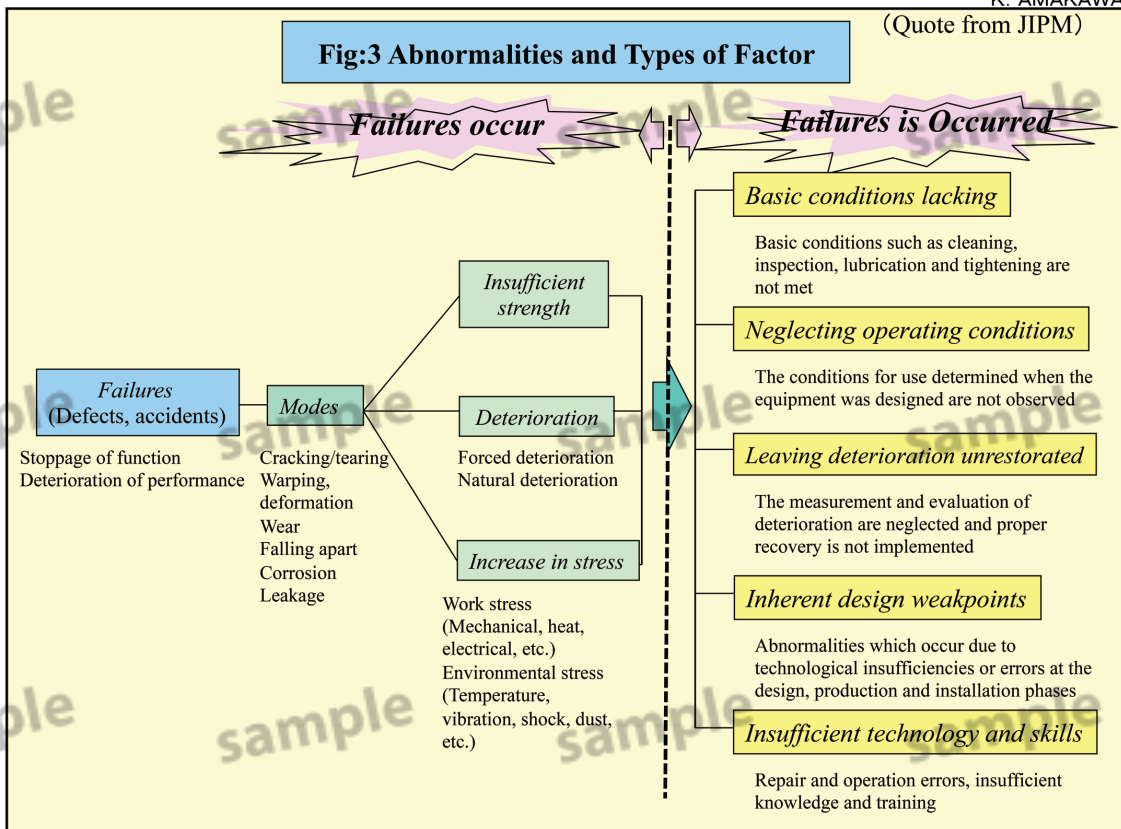


Fig3

4. Practices of Risk Management

As explained above, Risk Management requires building a relevant system and nurturing personnel to implement it. Standards, Procedure and Checklist are indispensable for every operation, but it is not sufficient only to complete the set. In order to perform functions, it is indispensable to define functions which are prepared for each and every employees who manage and execute corporate functions and to develop human resources to perform them. Another point to be noted: it should be made clear that Risk Management is part of business even though it may not easily lead to increased revenue. The items such as innovation, development and improvement are changes from current conditions, and therefore, the result of these actions is visible. These items are very important for corporate growth. It is necessary to create Risk Management indices besides indices of innovation. Organizing activities on the shop floor is not sufficient for management of shop floor.

As explained above, Human resource development by hierarchical level and visualization of company wide activities by means of Indicator System are essential.

① Visualization of Risk Management ~ Organizing and deploying Indicator System

The Indicator System are used to show individuals significance of one's behavior that they take in business, and their targeted values of each indicator indicate levels to be achieved through their efforts. Use of Indicator System makes each individual be aware of one's autonomous behavior, and gives each satisfaction and sense of achievement from the result of one's action. This will stimulate everyone to aim at ever higher goals. For that reason, in addition to development, innovation, and improvement, it is indispensable to deploy indicators for Risk Management for continuing stable manufacturing.

Now, how can we monitor Risk so that it may not be actualized as Loss?

Actual companies usually use the indexes such as availability of a machine, number of failure, number of defect, and number of accident. Of-course these indexes are very important, but these indexes indicate the result. Risk Management requires management of processes. It is because Risk is a latent factor in process, and it is necessary not for the Risk to be actualized. So that, indicators that shows what Risks are sleeping in the process are very important. And therefore, an Indicator System should be established which helps discovering Risk before Risk actualizes and grows bigger. We must monitor not only just the result of what has happened, such as failure, but also the factors that have generated these results. A case in point is the occurrence status of malfunctions of machine. Malfunctions are "reserve army" ready to cause failure, quality defect, so on. Malfunctioning does occur from time to time in various locations because machine certainly degrades. It is important to monitor constantly the occurrence and trend of deterioration and through daily inspection patrol and equipment maintenance/inspection, and keep records what has occurred. There is no problem if the number of occurrences, deterioration tendency, degree of malfunction and deterioration are not abnormal or within the predicted range. If, however, malfunctions or deteriorations are discovered in unusual places or show unusual size or kind, or if malfunctions of a different nature are found, it would be necessary to

analyze why these phenomenon have happened, and cope with the situation. Regarding the safety area, state of the on-site place should not be evaluated only by the only frequency of accident occurrence, but it is necessary to collect and analyze the HIYARIHATT data and also monitor the degree of observance of procedures. Monitoring of the degree of observance of 5S activities is also important. Systematic deployment and monitoring of process indicator, analyzing and noticing actualized data can guarantee to maintain failures, quality defects and accidents at zero level. It is not enable to guarantee to continue the ZERO status by only monitoring the result, such as number of accidents. This is the key of monitoring in Risk Management. This is monitoring in Risk Management (Fig4,5) .

② Educating the on-site Leader

Workplace is the melting pot of the various types of tiny changes around 4M. For the purpose of keeping stable manufacturing, it is indispensable to recognize these tiny changes, and judge and predict what kind of events might occur, at last, take actions to avoid them. A prerequisite for this to happen, of course, is that the workplace is standardized, but in addition, the following two types of capability are necessary. It is advised to develop such 2 abilities through “desk-top training” and “mechanism to develop skills through day-to-day duties”

- Technical Capabilities/Skill

Besides familiarizing operators with standards created with clear descriptions of procedures, the key to first-line operations is education and training of technical principles behind standards, enhancement of technical skills for carrying out operation smoothly. These abilities are the basis of on-site work and should be trained since operators are young.

- Systematic accumulation of many experiences

Performance of a workplace, such as continuation of stable manufacturing, achievement of expected production volume, and production of high-quality products, never can be realized by just one operator alone. Meanwhile, individual operators have varying talent and operational ability, so that, it is unrealistic to expect everyone to acquire the same level of capabilities. Nor can we expect everyone to have the same will for the growth of their company. For achieving expected company purpose under these circumstances, efforts of managers and first-line leader’s leadership are essential. Especially, mid-career employee, who are expected to be the next managers, are required to enhance their recognizing and judging capability based on systematic accumulation of their experiences, as well as their ability of conveying their intension. This will be conducive to forming strong teamwork for advanced manufacturing.

Developing these abilities will enable finding even little changings in on-site work place, and carrying out activities for eradicating them. These activities, when carried out, will allow nipping buds of little events/phenomena just when Risk has appeared as small phenomenon, before they grow big, making it possible to prevent breakdowns, defects and accidents from happening.

It is very rare for a single operator to work in production workshop, and multiple workers are usually stationed. It is vital, therefore, for workshop leaders to train and nurture their leadership as

indicated above which allows them to recognize what is happening in the workshop, judge/predict, and give instructions through their day-to-day operational practices.

That is the end

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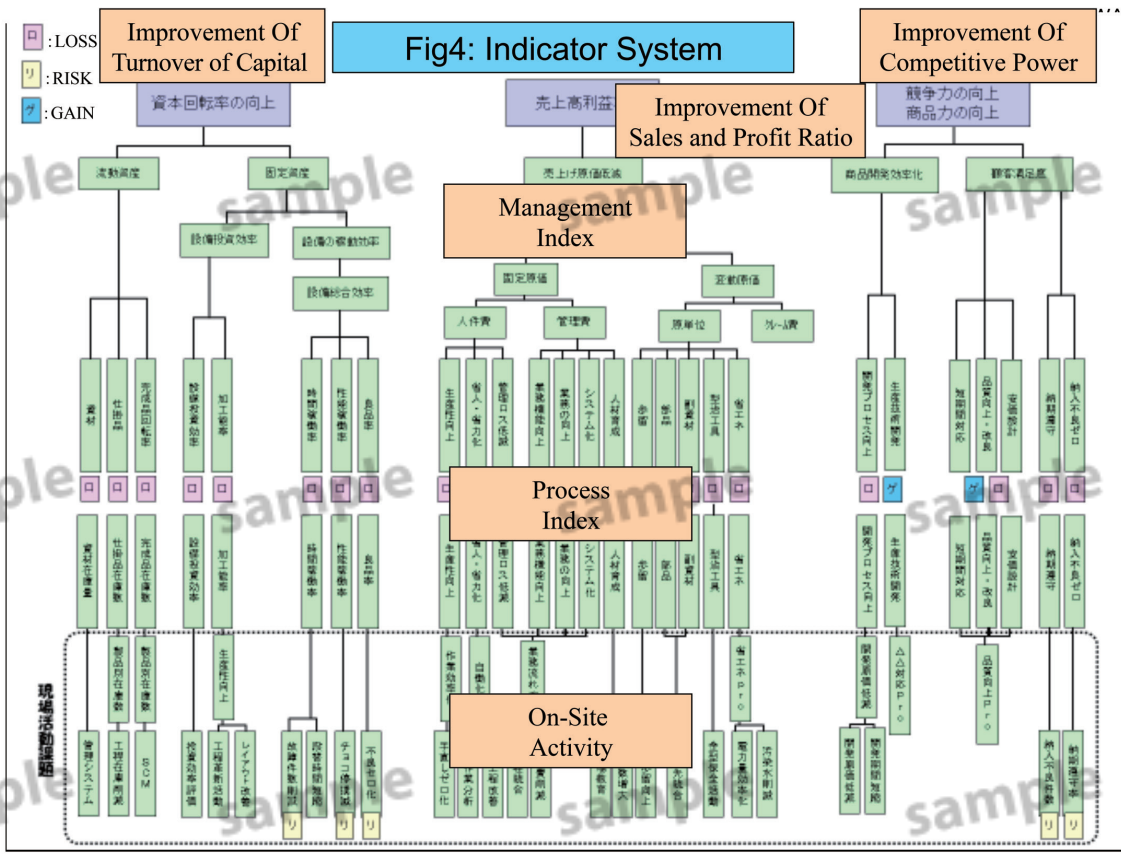


Fig4

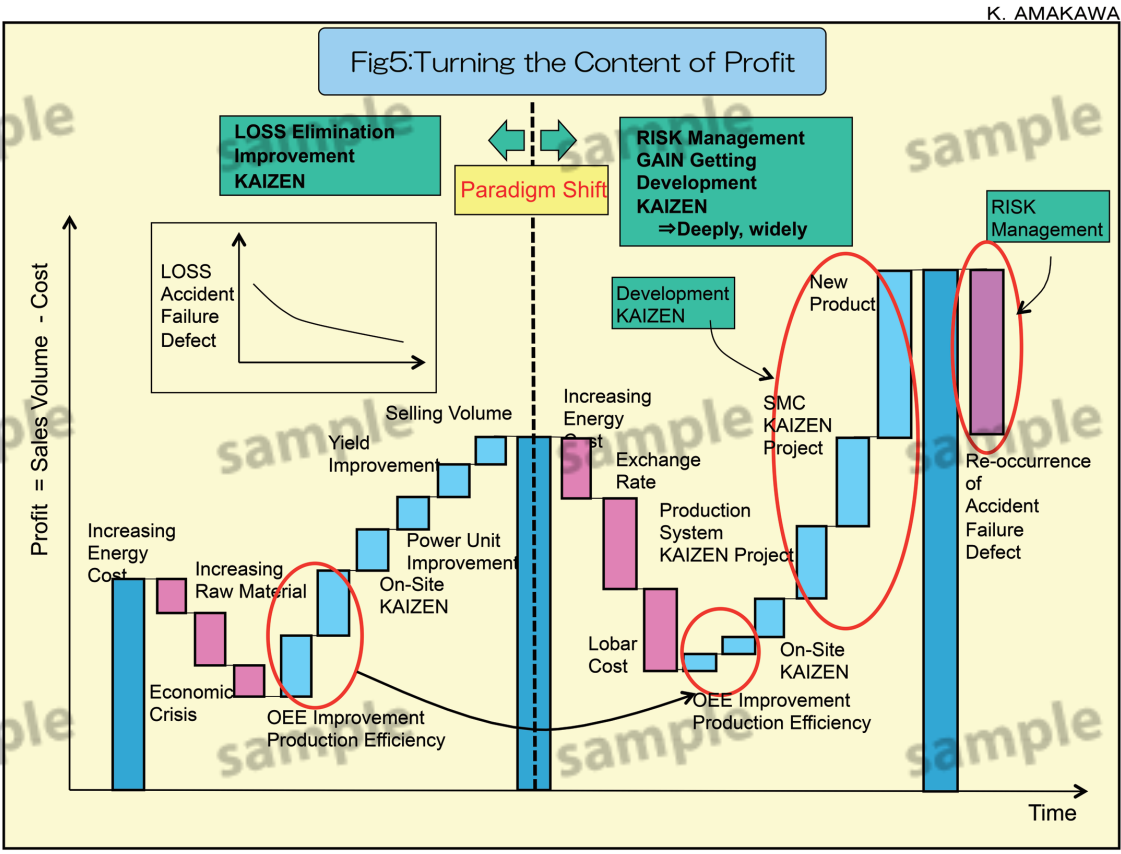


Fig5

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