Kaizen (work improvement) is the forte of Japanese industry. Kaizen activities were born in the early 20th century under the name efficiency research. These activities were the beginning of industrial engineering (IE). Later on people began to rethink the single-minded devotion to improving productivity. Then the job re-design concept was developed. The main target of kaizen in the area of occupational health and safety in Japanese manufacturing is the improvement of inadequate working posture followed by the improvement of work for transporting and lifting heavy objects. Unfortunately, the kaizen activities undertaken by most Japanese companies are still focused on improving productivity and quality. The know-how for promoting kaizen activities that integrate the three aspects of IE, occupational health, and ergonomics is not being accumulated, however. In particular, the IE techniques should be incorporated into kaizen activities aimed at occupational safety and health, and the quantitative assessment of workload is required. In addition, it is important for on-the-job kaizen training in the ERGOMA Approach for production supervisors, who are the main advocates of IE kaizen.

**Key words:** IE; job redesign; double work; Kaizen training

INTRODUCTION

Kaizen (work improvement) is the forte of Japanese industry. Additionally, most of the publications regarding kaizen serve as practical resources based on the classical production management concepts and techniques in pursuit of efficiency (Kumashiro et al., 2000). Conversely, today many Japanese companies have expanded kaizen as part of their occupational health activities where the main focus is on securing the health and safety of the workers and is placing less importance on the improvement of productivity (Mikami et al., 2010). This tendency to be production management oriented is seen not only in Japan but in such neighboring countries and areas as South Korea and Taiwan as well (Kawakami and Kogi, 2005; Kogi, 2012). If we look at other Asian countries, which have been heavily influenced by Japan, such as Thailand for example, they have introduced not only the Toyota kaizen system but also karakuri kaizen as well. Further, this is being extended to occupational health as well under the management systems-oriented guidance of the ILO (ILO, 2001). In addition, in Indonesia, particularly in Bali, kaizen activities are being pursued in agriculture and fisheries from the perspective of occupational health.

The purpose of this report is to expound the importance of undertaking kaizen from both the standpoints of management and occupational health by getting the respective persons to work together. In other words, it is recommended that kaizen activities be advanced from both the perspective of the principles of analyzing work (to improve productivity) and behavioural principles of the workers required to do the work (pursuing the humanization of work). In particular, as we enter the age of...
dwindling birthrate and aging population, Japanese companies must make improvements in several areas including less demanding working methods, work with appropriate working postures, and better working environments in order to cope with the decreasing productive-age population ratio and making full use of the older labour force (Kumashiro, 1999).

Kaizen is an activity that, with just a little effort, makes work easier, improves efficiency or increases safety. For example, a “campaign to eliminate double work” is one way to promote kaizen. Double work is synonymous with muda (waste). The first step in a kaizen activity is to have questions about the way the work is performed. Then, the second step is to observe the target working method and identify what work can be eliminated. If the targeted work consists of multiple methods, study if even one of these can be eliminated. The third step, if there is a method that cannot be eliminated, is to start with the idea of kaizen to see if there is a way the method can be altered to a new method. A work measurement method is useful to narrow down the causes of current issues, which is one of the processes of kaizen activities. Work measurement includes a variety of means for analyzing the work. For example, one technique is to subdivide a certain work process into smaller one cycle work units, element tasks, motions, etc. If all of the component factors can be separated out, then action can be taken to target each component factor for kaizen and identify the muda.

LOOKING AT THE KAIZEN ACTIVITIES OF JAPANESE COMPANIES

For Japanese business kaizen activities, we can refer to the joint research projects jointly conducted by companies and the Japan Organization Employment for the Elderly and Persons with Disability (JEED) since 1986 from the perspective of an Occupational Health and Safety Ergonomics Approach (Joint research report, ). As of the end of March 2009, there was joint research on 380 themes being conducted with 255 companies. The joint research structure is largely divided into the four categories of job redesign, healthcare, human resources and wages, and skill development. However, it is difficult to clearly classify and observe countermeasures for aging, which is being conducted by many companies, into the above four categories (Kumashiro, 2002a; Kumashiro, 2002b). The aim is to gain a mutual kaizen effect that combines several different areas.

Looking at the joint research results from the past 23 years shows that the greatest percentage, 54.7%, was on job redesign followed by skill development (8.4%), human resources and wages (16.6%), and healthcare (20.3%). Job redesign by nature is kaizen. Therefore, there are many companies that consider job redesign and kaizen (work improvement) to be synonymous. If we put aside the sense of affinity between ergonomic kaizen, job redesign, and work improvement, we can interpret the characteristic measures for an ageing labour force implemented on the Japanese manufacturing floor as work improvement. Here, we will focus on the number of job redesigns implemented by paying attention to the concerns of Japanese companies in reducing the workload of the middle-aged and elderly workers (age 45 and above) in their companies. These results showed that the main concern was the workload on the musculoskeletal system, which accounted for 59.2% of all issues. The next major concern was relieving the identified workload on the musculoskeletal system by finding the causes of those workload and the corresponding countermeasures. The preventative measure most often mentioned by the work site is improvement of poor working posture (36.4%) followed by transporting heavy objects (29.5%), and lifting heavy objects (27.4%) (Table 1). The above information came from a kaizen activity conducted with aging workers in mind for an initiative for which half of the costs are covered by JEED to establish a proper working environment for the elderly workers (age 45 and above) in their companies. These results showed that the main concern was the workload on the musculoskeletal system, which accounted for 59.2% of all issues. The next major concern was relieving the identified workload on the musculoskeletal system by finding the causes of those workload and the corresponding countermeasures. The preventative measure most often mentioned by the work site is improvement of poor working posture (36.4%) followed by transporting heavy objects (29.5%), and lifting heavy objects (27.4%) (Table 1). The above information came from a kaizen activity conducted with aging workers in mind for an initiative for which half of the costs are covered by JEED to establish a proper working environment for the elderly workers (Joint Research Report, 1986-2007; Mikami et al., 2010). Needless to say, however, companies are implementing improvements taking into consideration workers in all age categories. The authors have been involved in many projects to date since this initiative was started. Based on our experience, the figures given here are the number of kaizen cases conducted by taking into consideration cost-effectiveness and are not the number of cases focused on a certain age category. This information is very interesting because it allows us to know how kaizen activities are being approached by Japan’s
manufacturing industry. In other words, this indicates that in many workplaces in Japan there is much workload on the musculoskeletal system for which the main causes are standing for long periods of time while working, poor work posture, such as while sitting, and the handling of heavy objects. Fortunately, this shows that Japanese industry is sufficiently aware of these types of problems and has given priority to kaizen activities for improving them.

Table 1. Motor system disorder prevention activities undertaken by Japanese companies for middle-aged and elderly workers (1986.4 ~ 2009.3).

<table>
<thead>
<tr>
<th>Work targeted for kaizen</th>
<th>Kaizen cases undertaken (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifting heavy objects</td>
<td>135 (27.4%)</td>
</tr>
<tr>
<td>Transporting heavy objects</td>
<td>145 (29.5%)</td>
</tr>
<tr>
<td>Poor working posture</td>
<td>179 (36.4%)</td>
</tr>
<tr>
<td>Walking and going up and down stairs</td>
<td>21 (4.3%)</td>
</tr>
<tr>
<td>Static muscle exertion</td>
<td>12 (2.4%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>492 (100%)</strong></td>
</tr>
</tbody>
</table>

The above figures are the data available up to March 2009 as joint research reports from April 2009 to March 2010 are to be released in October 2010 (Joint Research Report).

CASE OF MANUFACTURING FLOOR KAIZEN TRAINING

Here we introduce the case where 12 manufacturing floor workers of a certain small business were selected and given on-the-job style ergonomic kaizen dojo (kaizen training course) leadership training for one year (the training was held twice a month so as not to interfere with the main duties of the selected workers). The company introduced here is a small company with 260 workers that in the past has made sufficient capital investment and provided sufficient worker training for production technology. However, it has conducted no kaizen for ergonomics. In recent years, however, there has been increasing demand by workers for ergonomic kaizen of poor working postures, handling of heavy objects, and machine operation accompanying the aging of workers in the workplace. The managers and supervisors, however, had no idea about how to address that. This is why the ergonomic kaizen dojo was established. A summary of the training is introduced below to the extent possible.

Stage 1

Classroom lectures were used for the first month (2 training sessions + homework). The first classroom session started from the perspective that the purpose of kaizen was to facilitate the health and safety of workers and increase productivity and thoroughly communicated that the improvement results should be expressed in visual terms. Specifically, lectures on the systematic use of fundamental techniques of industrial engineering (IE) familiar to people in the workplace were given. This was done to repeatedly teach that, “The first step in kaizen is to use IE techniques to identify double work,” “To quantitatively assess the workload from double work by scientifically analyzing why double work occurs,” and that “The best work improvement for workers is when the workload is quantitatively assessed and then the corresponding workload is evaluated and ergonomic intervention implemented based on this evaluation.”

Stage 2

Next, the trainers were taught kaizen methods. Two months were used to do this (4 training sessions plus 4 homework assignments). For example, training is given on how to find several methods that could be used to achieve objective A and how to break down which means could be used for the various methods. Then lectures on fundamental ergonomic knowledge, such as human body metrolo-
gy and how to use the corresponding data as well as posture observation methods and the corresponding analysis and evaluation methods, were given. Elementary IE techniques, such as motion analysis, time research, and link analysis, were taught.

Stage 3
This stage is the first time that on-site training was given. From the third stage on, training was given as needed when on-the-job training could be provided and a special training time was not set. The techniques used as the teaching aids were improvement checklists and factory management general checklists developed by the authors. The former is similar to the ILO ergonomic check points (ILO, 2010) or the job conditions checklist (work improvement checklist) promoted by the Research Group for Occupational Fatigue in Japan Society for Occupational Health (Research group for occupational fatigue, 2002). The latter is a checklist that was uniquely developed by the authors. This checklist has the following three benefits. (1) It can be used to obtain an overall assessment of the company, (2) It can be used to assess the current workload conditions, and (3) It can be used as a common index for managers, on-site supervisors, and persons involved in occupational health to work to discover problems in the same area.

Training was given on how to use the above two checklists to discover current problems. At the same time the trainees made a summary assessment of the overall factory problems and problems in each workplace and were trained on how to assign priorities to the kaizen problems. Since in addition to training this provided data that leads to actual improvement, this was positioned as practical training that required a long period of time.

Stage 4
In this stage the trainees applied the techniques they learned in Stage 2. The OWAS method was used as the work posture observation method. The trainees applied the OWAS method together with other IE techniques while performing their own duties. The subject of the study was a workplace where many problems were found using the checklist and that had a high improvement priority.

Stage 5
In this stage the trainees pursued specific results using the training they had received through Stage 4. This case produced two different achievements. The first was the development of a workplace improvement checklist unique for the subject company. This checklist makes it possible to calculate the degree of risk from both the production perspective and the occupational safety and health perspective corresponding to the occurrence frequency of work that could give rise to a harmful effect and the degree of damage such a harmful effect could cause. This calculated value is then used to evaluate what improvement measures should be taken by assigning one of four stages from “action urgently required” to “can be left in the current state.” Second, there are several good practices that can be performed by using this checklist. This kaizen in which the experienced people in the workplace took a scientific approach to the work and set improvement priorities not only reduced the workload but also decreased expenses by having everyone participate in generating ideas.

This training has resulted in the implementation of a multitude of improvements and has developed the trainees’ knowledge and practical ability in ergonomics. This has resulted in not only the acquisition of workplace improvement awareness, but also a checklist that can be developed for other workplaces as well as numerous work improvements and improvements in the equipment used. Currently, these 12 people have become kaizen leaders and are training the next generation of kaizen leaders.

HOW TO PROMOTE KAIZEN

When planning kaizen, it is desirable for the following 3 steps to be used. The first step is to pro-
pose improvements that can be immediately implemented. Typical kaizen activities can be conducted through on-the-job and off-the-job education and training. The most basic and important kaizen activity is education on correct working methods, how to correctly handle tools and equipment, and how to avoid poor working postures. The second step is to propose improvements that required a little time and money. The activities in this step are what are generally known as kaizen to the public. In other words, this is the introduction of support equipment and tools, changing the layout of the workplace, etc. Step 3 is to propose improvements that require considerable time and money. This will obtain a large improvement effect. However, there is also the risk that an improvement might not be cost-effective. When much money, man-power, and time is involved, it must be considered whether it is better to improve the current situation or to switch to a completely new system. In many cases, it might be better to implement a restructuring rather than kaizen.

CONCLUSION

Kaizen is not classroom learning, it is practical application. There is also the risk of having the illusion that anyone can do it. Generating answers from kaizen activities taken without careful consideration could result in a change for the worse or could become kaizen that is not accepted by the people in the workplace. When performing kaizen, it is important to quantitatively assess what the current problems are. Observing the current situation plays an important role in doing this. Further, kaizen activities are not something that should be done by one person alone. A kaizen activity team should be formed and everyone on the team should observe the workplace and come up with several improvement proposals so that good improvements can be generated.

REFERENCES