THE ROLE OF "KAIZEN" IN A SUCCESSFUL ERGONOMICS PROGRAM

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Abstract
"Kaizen" refers to "continuous improvement", which is a philosophy that industrial competitiveness results from continuous small incremental improvements to jobs. Companies that employ this approach typically have a "kaizen shop", where employees and skilled tradespeople are able to work together to implement suggestions that benefit the workplace. Originally, the goal of the Kaizen program was to eliminate "non-value added" work from the job and to continuously improve the manufacturing quality. Newer Kaizen programs incorporate risk assessment and control activities for safety and ergonomics concerns. The company and employee benefit through injury and absenteeism reduction, and productivity, quality and employee morale increases. This case study reviews the role and success of Kaizen in one company's ergonomics program. The company's ergonomics program is guided by an ergonomist, but many of the changes implemented have resulted from the efforts of employees using the kaizen approach.

Keywords: kaizen, ergonomics, ergo program

LE RÔLE DE « KAIZEN » DANS UN PROGRAMME D'ERGONOMIE RÉUSSI

Résumé
« Kaizen » désigne une « amélioration continue », qui est une philosophie selon laquelle la compétitivité industrielle résulte de petites améliorations graduelles apportées aux emplois. Les entreprises qui utilisent cette méthode ont généralement un « atelier de kaizen », où les employés et les personnes de métiers spécialisés sont en mesure de travailler ensemble pour mettre en œuvre les suggestions qui profitent au milieu de travail. Au départ, l'objectif du programme kaizen était d'éliminer le travail sans valeur ajoutée de l'emploi et d'améliorer contiuellement la qualité de fabrication. Les programmes kaizen plus récents incluent l'évaluation des risques et les activités de contrôle relatives aux préoccupations en matière de sécurité et d'ergonomie. Ainsi, l'entreprise et les employés profitent d'une réduction des blessures et d'absentéisme ainsi que d'une hausse sur le plan de la productivité, de la qualité et du moral des employés. La présente étude de cas examine le rôle et la réussite du concept de kaizen dans le programme d'ergonomie d'une entreprise. Bien que le programme d'ergonomie de cette entreprise soit guidé par un ergonome, bon nombre des changements mis en œuvre découlent des efforts déployés par les employés ayant utilisé l'approche de kaizen.

Mots-clés : kaizen, ergonomie, programme d'ergonomie

INTRODUCTION

Kaizen Defined

Kaizen is the Japanese term for “continuous improvement”; it’s one of many management programs that attempt to tap into employees’ experiences and skills to eliminate non-value added work (i.e. improve work efficiency) and to improve job quality. The Kaizen method was first described in 1986 by author Imai Masaaki, in his book “Kaizen: The Key to Japan’s Competitive Success” (Masaaki, 1986), although the Japanese philosophies of standardized job instruction and process improvement, which are core components of the Kaizen process, have been around since the end of World War II (Huntzinger, 2002). The Kaizen method has been adopted by many companies in Japan. However, in North America, this program is typically found in joint North American-Japanese venture companies or in transplanted Japanese production companies.

The Kaizen method is based on five (5) core activities, also known as the “5S” principles (Masaaki, 1986):

- “Seiri” – tidiness; sort, clean up, and dump what is not needed (eliminate waste)
- “Seiton” – orderliness; organise, identify and arrange everything in work area (i.e. “a place for everything and everything in its place”)
- “Seiketsu” – standardize; simplify and standardize work processes to ensure change is maintained
- “Seiso” - cleanliness
- “Shitsuke” – discipline; maintain practices set in place

Implementing Kaizen involves training all employees in the “5S” method. A few select employees, dubbed the Kaizen team, may receive additional training in welding, construction and time studies so that they would be able to recognize improvement opportunities and to be able to make the physical changes to the workstation themselves. Kaizen teams can take on minor change projects, leaving maintenance workers to focus on keeping production operational.

Kaizen typically involves small incremental job improvements with minimal resources and production upheaval. Some companies hold Kaizen “events” that yield similar results, but in one massive improvement project (Manos, 2007). With either method, time and resources to make job modifications are typically provided unconditionally by upper management.

Because a Kaizen program is meant to be continuous, a company will usually track, measure, and evaluate the success of ”5S”, particularly in cost-savings to the company through a reduction in energy, materials, inventory, scrap and sometimes manpower, and time savings through the use of more efficient equipment, work space, work methods, and shorter travel distances for parts and tools. Additional benefits include an increase in employee morale and customer satisfaction, and a reduction in employee absenteeism and turn-over. This tracking is important for determining the effectiveness of the overall Kaizen program and to benchmark future improvements.

Kaizen and Ergonomics

Kaizen programs have changed since 1986, from focusing predominantly on better and simpler ways of working, to incorporating the reduction of injury risk, including strains/sprains (Kilbom et. al, 2006). Although companies saved money and time by applying the “5S” principles to a job, they didn’t necessarily reduce the risk of worker injury. In some cases, the number of strain/sprain injuries increased as “non-value added” muscle recovery time was

eliminated. Now employees are trained to recognize a sixth “S” principle known as “Safe” and that ergonomics hazards are simply another type of “waste”. They learn to understand that jobs requiring excessive reaching, bending, twisting and walking, result in longer cycle times, inefficient processes, and injuries.

Kaizen programs that incorporate ergonomics may use a “Burden Analysis Tool” to identify and “score” the ergonomic “burden” of a job. This analysis tool was developed, through a joint research project conducted by the Toyota Motors Manufacturing Company and the University of Tokyo (Iritani et. al., 1997). The research associated higher levels of muscle activity with certain postures. For example, back bending required more muscle activity in the back as compared to standing upright. Adapting this research into a simplified analysis tool can allow companies to use it *proactively* in the development of a job, or after the initial installation of the work station but before full production. However, more often the tool is used *reactively* following an injury or worker complaint. Although the burden analysis tool typically focuses on back (Shiseijuryo-ten) and upper limb (Joshi-ten) issues, it can be used in conjunction with other common ergonomics assessment methods to identify hazards.

Training to use the “Burden Analysis Tool” is more intensive. Only certain employees will be asked to learn the method since it involves learning how to videotape processes in a certain manner for task, posture and repetition analysis, how to use strain gauges to measure applicable weights and forces, and how to stopwatches to measure static postures. The employee also has to have some mathematical ability to develop the “burden” score, although a software program can be used to automatically calculate scores given measured inputs.

The burden analysis score from each job can tracked like the other “5S” parameters, for high risk jobs. These scores are important for identifying ergonomics risk, prioritising jobs for improvement, and developing appropriate countermeasures to minimise injury risk. Using the arm or back burden score individually, or as a combined score, jobs with higher ratings are prioritised for resources and development. Following changes, the job is typically re-scored to ensure that the burden has been reduced. Companies with long-standing Kaizen programs typically adopt a burden analysis target, and work to ensure that all jobs that score above this threshold are targeted for improvements first. This threshold is lowered regularly, so that ergonomics hazards and strain/sprain injuries continue to be reduced.

Burden analysis scores have also been used to develop job rotation patterns, ensuring that employees are able to rotate through a series of jobs with variable “burden” rates, and between jobs that vary in body demands. (e.g. A job with a high back burden score and a low arm burden score is combined in a rotation scheme with another job that scored low in the back burden score, but maybe higher in arm burden score.)

Experienced ergonomists can easily learn the “Burden Analysis Tool”, and then supply the company with information about which characteristics, dimensions, and other specifications are critical. More importantly, ergonomists can teach the “Safe” section of “5S” by training workers to identify ergonomics hazards.

The principles and benefits of Kaizen (increased production, better quality etc.) overlap with the principles and benefits of an ergonomics program. Both are ongoing programs require participation from all employees, training at all levels, identifying problems and developing solutions, modifying the work environment and the worker interface. A good ergonomics program improves productivity and efficiency, quality, employee morale and comfort, while

reducing errors, injuries, and absenteeism. In some cases, ergonomic intervention may result in a reduction in manpower or an elimination of a job through automation of a particularly hazardous task or job. Therefore, dozens of ergonomic issues can be identified and fixed relatively easy and cheaply by utilizing existing resources already available to the Kaizen program.

CASE STUDY

The Company

The company that is the focus of this paper has been operational since 2003. It is based in Canada, but is a subsidiary of a Japanese firm. It employs approximately 170 people to manufacture exhaust pipes, mufflers and body assembly parts for the automotive industry.

The Kaizen Program

Since the company's inception, all of its employees have been trained to implement the "5S" principles. The company also developed a separate kaizen shop within its first year; training a select number of plant employees in the "trades" (e.g. welding) to support the implementation of ideas generated through the Kaizen program. Utilizing plant employees to form the kaizen shop meant that members were intimately familiar with the parts production and the layout of the workstations. Members were also chosen based on their creativity and existing technical skills. Kaizen team members reported to the plant supervisors. Therefore, most ideas generated by the employees or supervisors did not have to be approved by upper management to get implemented. A kaizen coordinator, under the direction of the Maintenance Manager, oversaw the supervisors, assisted in the implementation process, and tracked its progress. Quick fixes (e.g. part storage shelf height modifications) were typically assigned to the kaizen team, and completed relatively quickly during scheduled breaks, between shifts or over weekends. Projects requiring more technical expertise were assigned to maintenance workers or to the engineering department (e.g. part assembly fixture modifications), or given to the kaizen team to implement under the guidance of one of these groups (e.g. part hopper). By 2005, the health and safety coordinator and the production control department were also utilizing the kaizen shop to quickly address health and safety and material handling concerns. Kaizen team members and their supervisors were responsible for organizing their own work and materials, resulting in the use of standardized materials that could be bought cheaply in bulk. The team also recycles old and broken equipment, which keeps implementation costs low.

The Ergonomics Program

An ergonomist was hired by the company in 2005 to run the ergonomics program under the direction of the health and safety coordinator. Weekly visits were scheduled for the ergonomist to support the program. Her duties included:

- reviewing and summarising strain/sprain injuries for each job
- surveying the workers for discomfort, ergo concerns and suggestions for improvements
- conducting assessments (physical demands descriptions, ergo summaries) for all jobs
- providing ongoing support for office staff, the return-to-work program and the implementation process
- performing follow-up assessments to ensure that ergonomics hazards were eliminated or minimised and that no new concerns arose
- conducting design reviews
- increasing ergonomics awareness within the facility by maintaining an ergo bulletin board, writing and posting success stories, facilitating lunch'n'learn sessions, and holding awareness contests

- maintaining an ergo project status log, providing regular progress reports and conducting annual audits

Because this company supplies a Toyota plant with parts, it was encouraged to use Toyota's Burden Analysis Tool. Therefore, the ergonomics consultant learned and predominantly used this method to assess jobs for ergonomics hazards. At the ergonomist's discretion, a more detailed analysis could also be performed if hazards were not clear. With guidance from the consumer, a threshold was determined for both back and arm burden scores, so that jobs with scores that exceeded those thresholds were immediately prioritised for implementation. Burden scores were also reported in a table format so that jobs with higher combined back and arm burden scores were prioritised for the available resources.

The ergonomist met with key stakeholders regularly to review the results of the employee surveys and analysis results, and to conduct brainstorm countermeasures for all identified hazards. Following the meeting, the ergonomist completed a report summarised all findings in an ergonomics report. Since each job could have several risks and a long list of countermeasures, the ergonomist was asked to prioritise, so that the most hazardous elements of each job would be corrected first. The health and safety coordinator conducted regular meetings with the kaizen coordinator and the ergonomist to review updates and to close off projects. The ergo summaries were posted and frequently updated as an assurance to workers that their ergonomics concerns were being addressed.

Program Results

The ergonomist had the opportunity to evaluate the ergonomics program, and the effectiveness of the kaizen team within it, by performing follow up assessments on nine workstations. These reviews were conducted approximately 12 to 18 months following the original assessments. Comparisons of the before and after assessments were averaged among the nine stations and the results are as follows:

- 23% reduction overall in discomfort ratings; 4 jobs discomfort decreased, 4 jobs discomfort increased, and 1 workstation remained the same
- 21% reduction in first aid and medical aid strain/sprain injuries, and a 100% reduction in lost time injuries (only 1 lost time associated with these jobs reported in 2005 and none thereafter)
- Five workstations showed a 15% reduction in combined arm/back burden score, while the remaining four workstations either remained the same or increased score by 14.6%
- Three out of the nine workstations that had original arm burden scores above the company's threshold, were brought under the threshold following workstation modifications; one workstation's arm burden increased to above the threshold following modifications
- All workstations had original and follow-up back burden scores that fell within the given threshold
- All workstations had implementation rates ranging from 36% to 79% (61.6% on average)
- An average of 6.3 new ergo suggestions were provided following the re-assessment (range from 1 to 16)

DISCUSSION

Approximately two-thirds of the workstation modifications were implemented within two years of being identified as concerns. It was not possible to assess whether this implementation rate is typical or exceptional as compared to their original kaizen program. Certainly, in my experience, this implementation rate in any ergonomics program would be considered

exceptional. Many of the countermeasures that were not completed required significant engineering involvement and production downtime. For example, fixtures needing to be raised or lowered also required re-teaching the welding robots. Other recommendations asked suppliers to modify part tote weights. Unless a cost-savings could be realized, these suggestions were not prioritised for implementation. Many hazards were improved (heights and reaches), but still identified as a concern in the follow-up because they did not meet ergonomics guidelines. For example, a parts slide rack was lowered, but not enough to bring working heights below shoulder height for most workers. Some new concerns were identified, both by the employees and the ergonomist, during the follow up. This could be the result of an increased awareness of ergonomics hazards, or that main issues had been addressed, and now minor issues were more noticeable. The kaizen program allowed all concerns, whether in violation of ergo guidelines or not, to be addressed, so employees were more likely to participate in the identification of concerns, no matter how minor.

Reductions in both discomfort and injuries were generally realized. The increased scores in some jobs may be indicative of production rates increasing over the same time period, and some jobs taking on additional tasks. Only half of all jobs showed any improvement in burden scores. This, again, could be the result of an increase in production between assessments.

CONCLUSION

Overall, the kaizen shop appears to be an effective tool in quickly implementing simple countermeasures identified by the ergonomics program. Occasionally modifications did not achieve the required impact and required re-tooling. In these cases, the team member may have pursued a modification that did not address the ergonomic concern (i.e. designed for function, without considering the human-machine interference). Providing the kaizen team formal ergonomics training, with clear ergonomics design guidelines (e.g. reaches), and including one or more kaizen team members in the ergonomics meetings, would help to minimise build errors.

The kaizen team could not be used to implement more complex countermeasures. These changes relied on the availability and resources of other departments. Dedicating a maintenance worker and/or an engineer to the kaizen team would provide the necessary expertise, and improve implementation timelines and rates.

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