

Participative Ergonomics: Let's Make It Better Together (Book Chapter)

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1. Introduction

Today in the market there has been terrible competition among organizations/companies. While customers' expectations have been going up almost to infinity the companies' and workers' working environment has become more difficult. Workforce is becoming more diverse that people from different social, cultural, geographical and technical backgrounds which makes organization structures more complex.

Work-related musculoskeletal disorders (MSD) are among the major problems in many companies. Workers are affected by pain, decreased production capability and wage reduction. For companies, MSD imply dysfunctional production patterns and economic loss.

Ergonomics is a way of designing work-systems to accommodate the capabilities of workers. Increasing number of injuries and accidents in workstations forcing companies to apply ergonomics programs. Ergonomics programs can play an important role in working environment to reduce risks of injury or disease while enhancing the quality of working life, improving productivity and morale of workers and decreasing injuries, sick leave, staff turnover and absenteeism.

There have been emerged new concepts on ergonomics which one of them has been participative ergonomics.

2. Participative Ergonomics

Participation and participative practices are the principal methodologies in the design and analysis of work systems [1], and they are also important methodologies for product design [2].

Effective implementation of the risk management process is essential to reduce the overall risk from hazardous manual tasks and prevent musculoskeletal disorders. The internationally recommended approach to achieve this is participative ergonomics.

The basic concept is to involve workers in improving their workplace to reduce injury and improve productivity. Workers who perform the manual tasks have an expert knowledge of those tasks and therefore are best placed to undertake the risk management process of hazard identification, risk assessment, risk control and evaluation.

Workers are the "experts" at what they do. They have the necessary skills and knowledge and know their jobs and work environments better than anyone else. They are in the best position to identify and analyze problems, and thus are able to provide and/or evaluate ergonomic solutions that not only will improve a given situation but also will be acceptable to those involved.

The use of PE techniques in ergonomic analysis and design interventions and their subsequent implementation tend to result in greater feelings of solution "ownership" among those involved and affected, in increased job satisfaction, and in a greater commitment to the changes being implemented.

Top management commitment is needed, but it may be difficult to obtain. In the case of high involvement programs, obtaining top management commitment is absolutely essential. An organizational philosophy must be adopted that advocates active participation and involvement.

2.1. Purpose of Participative Ergonomics

The purpose of participative ergonomics is to find sustainable solutions in the organization. Sustainable solutions result in a decreased risk of injury and illness, improved job performance and quality of work, in addition to improving the well-being of the organization due to decreased operating costs, stable workforce and improved morale.

2.2. Definitions of Participative Ergonomics

1. Participative ergonomics is a process of solving ergonomic problems by a cooperation of workers, managers, supervisors, union representatives, engineers, and if needed, outside expertise.
2. Participative ergonomics emphasizes utilization of employees' potential for conducting ergonomic improvements at work.

3. Participative ergonomics is the involvement of people in planning and controlling a significant amount of their own work activities, with sufficient knowledge and power to influence both processes and outcomes to achieve desirable goals [3].
4. Participative ergonomics is a macroergonomic approach to the implementation of technology in organizations that requires end users to be highly involved in developing and implementing the technology [4].
5. If there is a participation or involvement involves ergonomic design and analysis, then worker involvement can be said to constitute participative ergonomics [2].
6. A strategy for the improvement of working conditions based on ergonomic principles. This strategy is structured and arranged to allow the active participation of stakeholders involved in the process. Its ultimate goal is to improve working conditions and prevent musculoskeletal disorders [5].
7. Participative ergonomics is an active process that involves workers in the identification and analysis of workplace hazards, and the development of controls to minimize risk [4].
8. Participative ergonomics include interventions at macro (organizational, systems) levels as well as micro (individual), where workers are given the opportunity and power to use their knowledge to address ergonomic problems relating to their own working activities.

2.3. Benefits and Limitations of Participative Ergonomics

Participative ergonomics offers a variety of advantages both for workers and employers. They include:

1. Increased Productivity,
2. Improved Quality of Work,
3. Improvement in Employee Morale,
4. Cost Savings both in possible reduction in injury-related and production costs,
5. Time Savings,
6. Promoting the participation of different stakeholders in companies for the improvement of working conditions,
7. Better identification of hazardous manual tasks, risk assessment and solutions because of the workers' hands-on and relevant knowledge and experience with the task,
8. Worker ownership of the process resulting in increased support for implementing control measures;
9. Improved team work and cooperation,
10. Positive impact on the workplace safety culture,
11. Addressing one of the occupational risk categories with most significant impact on workers' health and well-being, and preventing exposure which is one the main among workers,
12. Identifying and addressing risk situations without the need of complicated technical protocols,
13. Promoting integration in companies' preventive policies and facilitating the development of preventive culture.

There are some limitations of participative ergonomics

1. Change, and the uncertainty of change is a challenge for individuals and organizations,
2. Risk of short term increase in the number of reported injuries because of the heightened awareness,
3. Costs associated with training and education.
4. Time needed to integrating ergonomics into procurement and workplace layouts,
5. Requires risk on behalf of management to give up some control to employees,
6. Must provide employees and supervisors with the time and resources.
7. Participative ergonomics requires the discussion and evaluation of ideas and for this reason the process is slower than if one person were to call all the shots. Staff need to be informed about the process, input sought, and feedback given.

2.4. Types of Participation

The concept of fit is very important in organizational design. Socio technical systems theory holds that no one part of an organization should be changed without an awareness and consideration of its role in the entire system. Major elements that need to "fit" are the people, the information processes, the technology, the reward system, and the organizational structure.

There are three major approaches to participation:

1. Parallel suggestion involvement (consultative participation)
2. Job involvement (substantive participation)
3. High involvement

These approaches basically differ in the degree to which they propose that four key features of an organization should be moved to the lowest possible level. These features are:

1. Information about worker knowledge
2. The reward system
3. Organizational performance
4. The power to act and reach decisions that influence organizational practices and policies

When these key features are moved downward in an organization, worker participation is being practiced. The parallel suggestion approach does the least to move them downward; the high involvement approach does the most. There is no more basic change in an organization than to move power, knowledge, rewards, and information to lower levels.

This is the very essence of participation and involvement. It serves to alter the basic nature of the work itself and directly impacts the job of every worker through empowerment and enablement. It also directly impacts the effectiveness of the entire organization [6].

2.4.1. Parallel Suggestion Involvement

Parallel suggestion involvement programs ask workers to solve problems and produce ideas that will influence routine operation of the organization. The most widely used approach is the quality circle or worker problem-solving group. They have no formal authority, direct rewards are not given, and they do not have the power to implement their own decisions.

Another suggestion involvement approach is that of quality of work life programs. They often employ a parallel structure at multiple levels in the organization and can serve to bring two adversarial groups together.

These programs serve to change the relationship between worker and organization. They may afford workers the opportunity to influence things they would not normally influence. However, it is expensive and difficult to maintain momentum due to resistance by middle levels of management and a lack of expertise on the part of workers to solve more complex problems [7].

2.4.2. Job Involvement

Job involvement approaches focus on designing work in ways that better motivate job performance. One of job involvement approaches is job enrichment, focuses on the creation of individual tasks that provide feedback to people, require them to employ a variety of skills, increase their influence over how work is performed, and give them a complete piece of work to perform. By involving the worker in enriching a job, the organization stands not only to achieve job satisfaction and increased motivation, but also to realize better job and workstation design (or redesign), improved workspace arrangement, and perhaps job modification or change [8].

The other job involvement approach is that of the self-directed work team. Self-directed work teams feature a formal system of worker involvement, direct worker participation, and a high degree of control. The team approach differs from individual job enrichment in that the work group is the primary unit of involvement. The job involvement approach has significant implications for how an organization is structured and managed. Involvement in this case is not a special activity, as in the parallel-suggestion approach; it is the way the organization conducts its business [9].

2.4.3. High Involvement

The high involvement or commitment approach builds upon what has been learned from the suggestion and job involvement approaches. It structures an organization so that those at the lowest levels will have a sense of involvement not just in how well they do their jobs or how effectively their team performs, but in terms of total performance of the entire organization. High involvement goes much further than the other approaches toward moving information, knowledge, rewards, and power to the lowest organizational level. It can create an organization in which workers care about organizational performance because they know about it, are able to influence it, are rewarded for doing so, and possess the knowledge and skills to contribute to it [8].

High involvement ergonomics requires consistent and continuing change in virtually every part of the organization. Workers must be involved in decisions about their jobs and work activities. There are major implications here for job and workstation design/redesign and even for job modification. Workers also should be empowered to play a meaningful role in organizational level decisions concerned with strategy, structure, and other such important decisions. This would seem to argue for a structure with few hierarchical levels and wide spans of control. Expertise must be gained by all members of the organization in problem analysis, decision making, group process, and self-management. This in turn requires expanded training programs for both

technical training as well as for interpersonal and team skills. Clearly, creating a high involvement organization is a complicated and complex task [9].

2.5. Role of the Ergonomist

The role of the ergonomist in the PE design and analysis process is varied and complex, but a role common to all participative approaches is that of change agent. In some approaches, the ergonomist is primarily a trainer. Members of ergonomics committees or problem-solving groups should be given training in teamwork and interpersonal skills to permit them to perform effectively as a group, and management may need instruction in how to relate to workers who now may be making decisions.

The ergonomist also may function as a resource person, familiar with the technology in use and available with the skills and knowledge to help solve a problem or contribute to analysis and design of an ergonomic intervention. Finally, the ergonomist can be a facilitator of change.

The role of the ergonomist is to optimize safety, productivity, and comfort. Ergonomics should be ‘invisible’, meaning that the work environment should be intuitive and comfortable for the employees while allowing the employees to be highly productive and efficient without really needing to think about every movement.

Whatever the role of the ergonomist, and whatever the focus and level of the participative ergonomics process, participation will by definition involve team-based activities. This can vary from a design team or a workplace ergonomics group through to a participative structure with project teams and steering committees

3. Implementation of Participative Ergonomics Program

The key components of an ergonomics program include (Anton et al. 2013):

1. Organization: a plan for getting organized and involving stakeholders (employees, management).
2. Communication: systems for communicating activities and progress of the program.
3. Training: an effort to educate all levels of the organization about ergonomics.
4. Identification of the problem: determining that the incidence of musculoskeletal disorders or complaints is sufficient enough to justify ergonomic program development.
5. Ergonomic job analysis / exposure assessment: a systematic method to review tasks in all departments for needed controls/solutions. Emphasis is on easy-to-use but accurate exposure assessment methods.
6. Development of ergonomic controls: a trial and error process of developing and testing solutions.
7. Implementation and evaluation of ergonomic controls: the key part of the process; making improvements whenever feasible.
8. Medical management: procedures to recognize and treat employees with symptoms of musculoskeletal disorders at as early a stage as possible through early Health Services Coordination and risk identification
9. Monitoring Progress: ways to measure and evaluate the program Each of these steps will be considered in detail:

3.1. Organization

An Ergonomic Organization is the core of the Participative Ergonomics Approach. To organize a participative ergonomics program, key players are identified by top management. These key players become part of the ergonomics team. Choosing the right combination of key players is important, as well as determining the individual that is ultimately responsible for leading the team. Depending on the size of the organization, members of the ergonomics team will vary.

Successful participative ergonomics teams involve a combination of management and employees. Worker involvement in the Participative Ergonomics Approach is very important. Worker involvement will provide valuable insight into the issues surrounding a job and potential improvements. Worker involvement will increase the likelihood of acceptance of any beneficial ergonomic changes.

An example of an ergonomics team is presented below:

1. Internal team members: individuals directly employed by the company. For an organization to gain maximum benefit, the committee should include a participant from each in-house skill-group. This may include a general manager, an operations manager, human resources, health & safety, engineering, operations workers, maintenance department, information technology, Safety manager, Departmental representatives, Union representative etc.
2. External team members: individuals not directly employed by the company. Ergonomist, Medical professionals may be included.

Management commitment is especially important at the organization stage. Commitment can be demonstrated several ways, such as providing a budget for ergonomic solutions or allowing team members sufficient time to participate in the program during normal work hours. Top level management must determine the team's level of authority or decision-making power.

The last step of the organization process is documentation. Initial documentation of the ergonomics program can include goals/objectives and focus, membership and authority level, and specific actions that are taken.

3.2. Communication

Good communication of the participative ergonomics program is essential for sustainability. An important issue with communication is to keep the program expectations realistic. For example, avoid statements like, "Our goal is zero musculoskeletal injuries."

3.3. Training

For a successful participative ergonomics program, all employees should eventually receive basic ergonomics training. Employee involvement is the main property of participative ergonomics and is initiated by training.

The extent of this training is dependent on several factors. For example, ergonomic team members should receive more in-depth training than employees who do not directly participate in risk assessment or solution development. In general, three types of training exist:

1. Ergonomics overview for management: should focus on basic ergonomic concepts with emphasis on physical risk factors, cost of poor workplace design including the economic impact of a work-related MSD, and solution development emphasizing return on investment. Managers should also understand their company's MSD incidence rate and how it compares with the grocery industry in general.
2. Ergonomics Process Training for the ergonomics team: is advanced ergonomics education designed for safety managers and members of the ergonomics team. This training emphasizes methods to implement the ergonomics process into current systems using a problem-solving approach. These topics can be covered in 4 – 6 hours.
3. Ergonomics Awareness Training for all other employees: is used to involve all workers in the identification and analysis of risk factors as well as the development of solutions to decrease them. At a basic level, these topics can be covered in 45 minutes to 1 hour.

3.4. Identification of the problem

The followings are possible sources of information that could indicate the problem:

1. Reportable incidents or injuries contributing to days away from work, restricted, or transferred,
2. Reports of injury / incident clusters
3. Musculoskeletal complaints from grocery workers
4. Frequent absenteeism or requests to transfer jobs
5. Worker complaints
6. Complaints about quality & service

3.5. Ergonomic job analysis / exposure assessment

Ergonomic job analysis / exposure assessment is a systematic method of determining the most hazardous tasks or most problematic departments in the grocery store. Several methods exist to accomplish the analysis including review of injury reports, discussions with workers, musculoskeletal symptom surveys, and formal exposure assessment.

Initially, review first reports of injury or other incident reports. The reports can help you calculate the musculoskeletal incidence rate and injury rate for specific anatomical regions (e.g. low back, shoulder, hand/wrist). If possible, look at the last three years to see if a pattern exists, and inspect all injury reports, not just those that are recordable.

This step should be followed by discussions with workers in each department. A simple question to ask is, "if you could change one thing about your job what would it be?" Questioning such as this helps to reinforce the participative approach and usually provides excellent solutions.

If necessary, musculoskeletal symptom surveys can be used to get an idea of which anatomical regions are most likely to be injured, and which departments are most at risk. Although the existence of a musculoskeletal symptom does not mean that the individual has an MSD, information from the survey can help focus the program efforts.

Ergonomic job analysis is used to evaluate the store at the departmental or task level. There are two basic steps of analysis:

1. Identify risk factor(s) in the task.
2. Quantify the parameters of the risk factor(s).
Effort level – How hard is the task?
Effort duration – How long does the task take?
Effort frequency – How often is the task done?

There are three primary purposes of performing an ergonomic job analysis:

1. To prioritize tasks that need to be changed,
2. To identify which risk factor(s) exist in the task and which parameters of the risk factor are most problematic,
3. To gather baseline data that can be used to evaluate the effect of an ergonomic solution.

Ergonomic job analysis is performed by using exposure assessment methods. Three categories of methods exist:

1. Self-report or checklists,
2. Observational,
3. Direct measurement.

Direct measurement methods, such as electromyography, are most precise but require specialized equipment and technical expertise. More commonly, checklists and observational methods are used to assess exposure in organizations. A video camera is helpful for documenting risk during exposure assessment.

During the initial walk-through of each department, checklists should be used to identify physical risk factors (e.g., heavy lifting, repetitive motion). Checklists simply indicate if a risk factor exists or not. Although checklists are a good first step, detail is limited which makes it difficult to determine what type of ergonomic control is appropriate.

Observational methods help to bridge this gap. They help the analyst to identify the severity of the risk factor.

As an example using an observational method, let's say the analyst is observing a worker filling shelves with packages. The worker lifts the bag off a pallet placed on the floor, twists, and places the bag on shelves at different levels. The bags weigh 20 kg, there are 20 bags on the pallet, and the duration of one lift is about 5 seconds. If a checklist alone was used, the analyst would only know that the worker was exposed to potentially heavy lifting and awkward back postures. However, the analyst would be unable to estimate the risk of doing this task. Based on the checklist, the only apparent solution would be to stop lifting the bags, not a practical option.

3.6. Development of ergonomic controls

After determining the risk factors, controls or solutions need to be developed that address the risk factor. In order of effectiveness, three types of controls exist:

1. Engineering controls: are equipment that clear the risk factor. Using the previous worker example, a scissors lift would be an example of an engineering control. The scissors lift would allow the worker to lift from waist level, which would reduce the bent-forward back posture.
2. Administrative controls: include job rotation, selecting certain workers to do specific tasks, implementing policies that specify how a task is to be performed, and training in proper lifting techniques. Administrative controls are not as effective as engineering controls because the risk factors are still present
3. Personal controls: include safety glasses, gloves, lifting belts. Although personal controls are most frequently used, they are least effective since the worker must remember to use them.

3.7. Implementation and Evaluation of Ergonomic Controls

After controls are identified, they should be field-tested for an adequate period of time. It is important to realize that many controls need modification before they work successfully, it should be remembered that Ergonomics Process is a continuous improvement process.

3.8. Medical Management

Many MSDs become worse if not treated promptly. Simple low back pain can turn into a herniated disc requiring surgery if the warning signs are ignored. Thus, early reporting of musculoskeletal complaints is

recommended. Management should be familiar with their medical providers and vice versa. Medical providers can be part of the Ergonomics Team.

3.9. Monitoring Progress

The final component of an ergonomics program is frequent evaluation and modification. Ergonomics Programs should change as the organization changes. Progress can be monitored by good record keeping, such as use of an ergonomics log to document solutions. Injury reports and compensation ratings should be monitored at least annually to verify that the program is effective. The Ergonomics Team can also repeat checklists to see if risk factors are improving. To keep sustainability, a plan should be active to give education to new employees in ergonomics Process.

4. Economics of Ergonomics Program

Ergonomics is a strategic business initiative with financial, managerial, technical and human elements that yields a high return and increases overall productivity.

Everything in today's is evaluated and measured with money. A project will be started if and only if returns money. So the question is "Are ergonomic programs economically feasible or not to apply?"

The real question should be: "how much will it continue to cost if nothing is done?" Evaluating the cost of not implementing an improvement compared to the cost of the improvement may offer valuable insight into the program's value.

Workplace risk factors can be listed as follows;

1. Awkward postures
2. Force
3. Repetition
4. Duration
5. Recovery Time
6. Noise
7. Lighting
8. Temperature
9. Vibration
10. Motion

Cost of MSD is two folded one is direct another is indirect. Direct costs of MSD include medical treatment, rehabilitation, and worker's compensation. Indirect costs include loss of work time, decreased productivity, decreased work quality, retraining cost and diminished morale etc. in a MSD injury direct costs constitute 20-30 % of the total cost. On the other hand, indirect costs constitute 70-80 %. For direct costs the companies should make insurance contracts before. For indirect costs it is advised to apply ergonomics programs to decrease the total cost dealing with injuries and accidents to be occurred.

According to statistics in US 650,000 work-related musculoskeletal disorders and 400,000 injuries every year result in costs over 20 billion dollars to employers each year. Direct costs of MSDs are \$20 billion a year. Indirect costs of an MSD case can be up to five times the direct costs. These costs include Worker's Compensation and medical expenses.

In reality, ergonomic changes are beneficial for workers and companies as well as society. Ergonomic programs are not luxuries but necessities for organizations and do not necessarily require a large budget. In-house solutions and modification of existing equipment can help keep the costs down.

5. Conclusion

Ergonomics problems and solutions may not transfer exactly from one country, region or industry to another. Although the basic human characteristics are the same they take on local differences for some reasons such as geographical, social, economic or historical. Consequently, ergonomics issues should be identified and addressed locally because each set of circumstances is different. Importing solutions without local assessment may fail.

Participative ergonomics is a hot topic of ergonomics and depicts a strategy for the improvement of working conditions based on ergonomic principles. This strategy allows active participation of all partners involved in the process. Its ultimate goal is to improve working conditions and prevent musculoskeletal disorders. Participative ergonomics offers a variety of advantages both for workers and employers to justify an ergonomic program:

1. Injury reduction/safety improvement,
2. Improvement in the overall quality of work life,
3. Improved product quality,
4. Improved production efficiency/ productivity.
5. Contribution to the profitability and strategic competitive advantage of the company.

Participative ergonomics applications can make workplaces and organizations where everybody feels happier including workers, bosses, families, governments, societies, etc. with the participation of all partners together.

References

- [1]. Brown, O., Jr. (2002), Macroergonomic methods: participation, in *Macroergonomics: Theory, Methods, and Applications*, Hendrick, H.W. and Kleiner, B.M., Eds., Lawrence Erlbaum Associates, Mahwah, NJ, pp. 25–44
- [2]. Hendrick, H.W. (1996), *Good Ergonomics Is Good Economics*, Human Factors and Ergonomics Society, Santa Monica, CA.
- [3]. Wilson, J.R. and Haines, H.M. (1997), Participative ergonomics, in *Handbook of Human Factors and Ergonomics*, 2nd ed., Salvendy, G., Ed., Wiley, New York, pp. 490–513.
- [4]. Noro, K., & Imada, A.S. (1991). *Participative ergonomics*. London, UK: Taylor & Francis.
- [5]. Ergopar, A participative ergonomics procedure to address occupational risks, 2014, <http://ergopar.istas.net/recursos/>
- [6]. Brown, O., Jr. (1994), High involvement ergonomics: a new approach to participation, in *Proceedings of the Human Factors and Ergonomics Society 38th Annual Meeting*, Human Factors and Ergonomics Society, Santa Monica, CA, pp. 764–768.
- [7]. Lawler, E.E. (1992), *The Ultimate Advantage: Creating the High-Involvement Organization*, Jossey-Bass, San Francisco.
- [8]. Brown, O., Jr. (2000), Participative approaches to work systems and organizational design, in *Proceedings of the XIVth Triennial Congress of the International Ergonomics Association and 44th Annual Meeting of the Human Factors and Ergonomics Society*, Vol. 2, Human Factors and Ergonomics Society, Santa Monica, CA, pp. 535–538.
- [9]. Brown, O., Jr. (1996), Participative ergonomics: from participation research to high involvement ergonomics, in *Human Factors in Organizational Design and Management V*, North-Holland, Amsterdam, pp. 187–192.
- [10]. Anton D, Weeks D, & Hansen D. (2013), *Ergonomics awareness training for grocery workers (Multimedia)*. Olympia: Washington State Department of Labor & Industries.

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