

# Using Ergonomics Checkpoints to Support a Participatory Ergonomics Intervention in an Industrially Developing Country (IDC)—A Case Study

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*To achieve ergonomics awareness in 3 subsidiary companies, an intervention team was formed. The aims of this study were to implement basic ergonomics through a participatory ergonomics intervention process that can support a continuous learning process and lead to an improvement in health and safety as well as in the work systems in the organization. The findings of this study (i.e., method, continuous learning and integration) were key to making the participatory ergonomics intervention successful. Furthermore, 4 issues of the ergonomics checkpoints (i.e., work schedules, work tasks, healthy work organization and learning) for assessing the work system were found suitable for both changing work schedules and for improving the work system. This paper describes the result of this project and also the experiences gained and the conclusions reached from using the International Labour Office's ergonomics checkpoints in the industries of industrially developing countries.*

ergonomic tools   intervention team   participatory ergonomics   industrially developing country

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## 1. INTRODUCTION

O'Neill discussed examples of indigenously and exogenously generated ergonomics research and development projects in industrially developing countries (IDCs). He concluded that the principles of ergonomics and its potential to deliver benefits were accepted and practised in small development and technology transfer programmes but not many decision makers were conversant with the breadth and depth of ergonomics [1]. Nishikido, Yuasa, Motoki, et al. pointed out there were no occupational safety and health activities in small and medium-sized enterprises. Countermeasures have been discussed worldwide in the past decade [2].

At present there are few practical examples to illustrate the benefits of an ergonomics intervention programme (EIP) in IDCs. The reason for this paucity is a lack of awareness and recognition in IDCs of the potential benefits of ergonomics [3, 4, 5].

Various checklists have been developed for different purposes, usually as tools for prioritizing

action plans in ergonomic design or redesign, comparative studies and training [6, 7]. Action checklists aiming at the active participation of both workers and employers have been developed [7, 8] and in many countries have proved to be effective in facilitating concrete action for improvement, especially in small and medium-sized enterprises in Asia [9, 10, 11, 12, 13, 14].

Furthermore, methods used for problem-solving can be commonly—but not always—preceded by analysis and diagnostics [15]. Problem-solving itself emphasizes innovation and creativity instead of meticulous fact-finding [15]. Some recent approaches in occupational safety and health minimize prior analysis and go directly to problem-solving, integrating analytic components into problem solving [7]. The term intervention refers to efforts made to effect change and render such change stable and permanent [16, 17].

On the other hand, participatory ergonomics is complex and diverse, it is an umbrella term for a fairly broad range of ideas and practice [18]. This

means that there is a range of models and ways of carrying out participatory ergonomics, and a multiplicity of tools and methods employed within participatory ergonomics initiatives. However, most commentators see participatory ergonomics as offering a common set of advantages [19].

The nature of a participatory ergonomics cycle [18, 19] enhances organizational performance by action learning. Thus, it is necessary to adjust the participatory ergonomics cycle of involvement. The degree of user involvement can be divided into six sets of categories, namely, *no involvement*, *symbolic involvement*, *involvement by advice*, *involvement by work control*, *involvement by doing* and *involvement by strong control* [20]. Nowadays, individuals are becoming more specialized in their work activities and are acting more as problem-solvers [21]. Ergonomists or ergonomics teams have to begin with microergonomics improvements that yield positive results within a relatively short period, which is often called picking the low-hanging fruit strategy [23]. When managers see positive results, they become interested in supporting further ergonomics interventions and also over time, senior management comes to support progressively larger ergonomics projects that change the nature of the work system as a whole [23]. On the other hand, a number of methods frequently used in various kinds of organizational studies have been adopted for use in macroergonomics analysis, intervention and evaluation [24]. Working conditions and ergonomics problems are best identified and solved in co-operation with those who are mostly involved in the process [25]. Thus, an EIP through workers' participation is assumed to be a useful method, in combination with other macroergonomics methods, for analysing a change process [24, 26, 27]. Imada [27] and Wilson and Haines [28] defined participatory ergonomics. "Ergonomic intervention must be a local process that responds to the particular needs of local people. In view of the many constraints, special attention is drawn to participatory ergonomics as an effective means of finding locally workable solutions" (p. 42) [29]. Another study found the main issues important for participatory ergonomics intervention, i.e., a shared vision, an awakened need of change and learning [30].

The methodology of International Labour Office (ILO) ergonomics checkpoints [7] could be used as a continuous programme for the ergonomics intervention process [31, 33]. For example, a tailor-built ergonomics checklist at the organizational level, in the Glucosan factories' study [34], in the application of methodology ergonomics checkpoint was created by a R&D team at in-house ergonomics workshops. It has been said that the ergonomics checkpoints in the categories were like clusters of grapes. Each cluster of checkpoints was a different shape and size depending on the various workplaces or organizations it related to [31]. Following this author's initiative, the ILO publication was translated into Farsi and in 2 years 5000 copies were distributed by the Glucosan factories [25]. However, those who received the publication and also participants of past ergonomics training workshops (i.e., 293 persons from various Iranian industries who took part in 24 workshops between 1996 and 2002) reported that applying the book without supporting intermim/senior managers was not effective in their organizations [31]. They requested a participatory approach [35].

## 2. AIM

The aim of this study was to implement basic ergonomics through a participatory ergonomics intervention process, which supports a continuous learning process and leads to improving health and safety as well as the work systems in the organization. The study's purposes were to (a) determine health and safety as well as work system problems by applying ergonomics tools in the three companies; (b) develop action plans for improving the problems at the workplaces; (c) obtain the support and involvement of top managers and division heads as well as members of the intervention team.

## 3. METHODS

### 3.1. Subjects

In 2004, a large industrial establishment made up of three subsidiary companies in the State of Gilan, Iran, became interested in taking

continuous advantage of ergonomics learning [30]. All managers (3 top managers and 8 heads of divisions), supervisors (28 people) and experts (5 people) of the three private poultry companies participated in running different ergonomics tools, i.e., the ergonomics checklist and the ILO ergonomics checkpoints [7] in all eight divisions. In total there were 44 participants, 14 female and 30 male. The average age was 26 (22–30) years for females and 35 (25–58) years for males.

### 3.2. Action Groups

Following the result of an earlier study [30], nine Action Groups (AGs) were formed together with a steering committee (SC) for the three companies, with all 44 people involved. Thus trainers were assigned to nine AGs consisting of 4–8 members from different sites. There were nine AGs because the situation was different in different areas: (a) mother stock farm, 6 people; (b) mother stock farms, 4 people; (c) after sales services, 4 people; (d) chicken factory, 8 people; (e) mother stock farms, 4 people; (f) Rasht office, 5 people; (g) mother stock farms, 4 people; (h) machinery and equipment, 4 people; and (i) parent stock farms, 5 people. The responsibilities of AGs, the SC (consisting of 10 members) and a supporting team facilitator were described in the first study [30].

### 3.3. Material and Procedure

To achieve the aim of the study, the ILO ergonomics checkpoints manual [7] was used to collect data for one year. This manual is a compilation of an ergonomics checklist that can be used to identify problems and ergonomics checkpoints that can be used to find practical solutions for improving working conditions from an ergonomics point of view. Its aim was to provide a useful tool for all those who intended to improve their working conditions for better safety, health and efficiency.

The following specific methods (applying the checklist, applying the checkpoints and more activities for engaging the AGs) were used to assess awareness building as it related to the

issue of health and safety and work systems in the organization.

#### 3.3.1. Applying the checklist

In this process, which lasted the first 6 months of the study, the participants were firstly observed as to how they applied the checklists of the ergonomics manual in the workplace regarding the process of identifying problems. They evaluated each problematic work area by using the ELMERI safety index [36]. The ergonomics index is calculated as a percentage of all items in the checklist (seven topics and a total of 128 items). The index can be calculated for each part of the checklist to identify the major sources of problems and ergonomics bottlenecks in the workplace [36, 37].

#### 3.3.2. Applying the checkpoints

After 6 months, the ILO ergonomics publication [7] was introduced to the heads of divisions. After studying it, each head agreed to present a topic to the AGs during a one-day workshop. At the end of the workshop, the AGs discussed the manual and how it could be applied in the divisions.

The items (i.e., problematic work areas) marked PRIORITY on the basis of the application of the checklist were then selected as the most important working areas (i.e., areas whose improvement was likely to be beneficial) and they were observed using the checkpoints. Using the cause-and-effect diagram technique [38], each group examined the various factors that needed to be changed to achieve the desired effects.

#### 3.3.3. More activities for engaging the AGs

**3.3.3.1. On-the-job training.** Every 2 weeks all AGs met together in a 4-h evening meeting, at one of the divisions. At these meetings the AGs exchanged ideas and information and assisted one another in learning techniques for evaluating their progress. During these meetings the project facilitator informed them about new techniques for working better and conducting their duties as efficient teams.

**3.3.3.2. Evaluation of SC.** Every 2 weeks, the SC met at one of the divisions. Most members of the

SC were heads of divisions and the head of the SC was a top manager. At these meetings, they informed one another about the activities of the AGs and other issues that required SC input. One of the facilitators (from the Mehr E. Nami Institute [30]) was always present at these meetings.

**3.3.3.3. AGs' meetings.** All heads of divisions and their AGs had separate meetings every week at their divisions. During those meetings the AGs discussed the checklist and their action plans within the division.

**3.3.3.4. Monitoring AGs' activities and providing support.** Every 2 weeks the project facilitator participated without previous announcement in randomly selected AGs' weekly meetings. This was done to monitor the AGs' activity and support the groups if necessary.

**3.3.3.5. Evaluation of AGs' activities.** Every month all AGs met at one division to exchange ideas and discuss their progress on the checklist. AGs from eight divisions gathered together for one day, with 14–17 in a workshop. The workshop leader was the facilitator. After each AG had presented their activities, they were asked to evaluate their progress and give themselves a score for their progress.

### 3.3.4. Evaluating the project

At the end of the process of using the checkpoints (i.e., one year into the study), members of each of the eight divisions' AGs answered the following questions. This was the second major assessment of the project conducted after one year.

1. What positive or negative effects did the ergonomics training have on your duties and job?
2. What positive or negative effects did the project have on your company?
3. How did your activities in the AG compare with your other training and activities in your company?
4. How are your organizational and managerial duties in the company in comparison with the past?

Furthermore, during the process the facilitator (the author) also gained access to other data

sources. The most important of these were written accounts from the participants of what they had learned from their experience in the AGs. To complement this, the facilitator was also able to attend a one-day workshop at which each AG gave a presentation on their action plans.

Other documentation included records of meetings at the divisions, between the divisions, between the top managers and between the facilitators, as well as records of assessment activities. The facilitator used these kinds of information to refine the interpretations based on individual and group negotiations. Moreover, two top managers and heads of divisions evaluated the project in separate meetings with the facilitator.

Every 6 months a formal report was written, i.e., a report documenting the procedure of work (using the checklist and the checkpoints). Its results and some ergonomics information were then presented to the top managers. The intention here was to make it as easy as possible for the top managers to absorb and understand the procedure and the participatory ergonomics process.

Finally, the facilitator discussed the information regarding the evaluation of the project with most participants ( $N = 22$ ) in a meeting, and measures for improvement were taken by the AGs and the SC.

## 4. RESULTS AND INFERENCES

### 4.1. Application of the Checklist

All AGs worked separately on the checklist at the divisions. They had not had any previous experience of ergonomics training. During the first step of using the manual, direct observation and documents indicated that the AGs were interested in industrial hygiene factors (i.e., lighting, air quality, thermal conditions, chemicals, noise), improvement of workstations (i.e., sufficient work space, adjustable work height and seat, proper location of tools and materials) and work organization (i.e., involving workers in planning their day-to-day work, solving work problems by involving workers in AGs, improving jobs that were difficult and disliked, learning about and sharing ways to improve their workplace for one another, combining tasks to make the work more interesting and varied).

**4.2. Application of the Ergonomics Checkpoints**

The results of improvements undertaken in the 12 months of the AGs’ activities are shown in Tables 1–2.

A method of common participatory steps for using and developing new ergonomics checkpoints within the process was also formulated (Figure 1). Figure 1 indicates the collective learning which the intervention team drew from a collective experience.

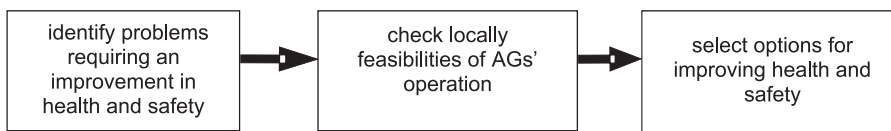
**TABLE 1. Improvements Undertaken by Action Groups (AGs) in Divisions**

| Technical Area                             | Problems Identified at Workplaces | Improvements |           |                   |
|--|-----------------------------------|--------------|-----------|-------------------|
|  |                                   | Planned      | Completed | To Be Implemented |
| Materials storage and handling             | 42                                | 38           | 21        | 17                |
| Hand tools                                 | 13                                | 10           | 7         | 3                 |
| Machine safety                             | 20                                | 15           | 10        | 5                 |
| Improving workstation design               | 39                                | 36           | 19        | 17                |
| Lighting                                   | 18                                | 13           | 9         | 4                 |
| Premises                                   | 35                                | 29           | 18        | 11                |
| Control of hazardous substances and agents | 15                                | 9            | 8         | 1                 |
| Welfare facilities                         | 29                                | 19           | 9         | 10                |
| Work organization                          | 58                                | 22           | 17        | 5                 |
| Total                                      | 269                               | 191          | 118       | 73                |

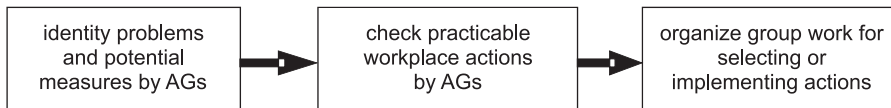
**TABLE 2. Examples of No- or Low-Cost Improvements Frequently Found by Action Groups in Divisions**

| Technical Area     | Improvements  |
|--------------------|---|
| Materials handling | use carts, hand-trucks and other wheeled devices or rollers when moving   |
| Workstation design | easy reach, work height, fixtures and good chairs   |
| Isolating hazards  | covers, guards and isolating hazard sources   |
| Lighting           | skylights, light-coloured walls and avoiding glare  |
| Premises           | natural ventilation, smooth floors, and heat insulation   |
| Welfare facilities | drinking water, eating and rest place to ensure good health facilities and provide a place for workers’ meetings and training |
| Work organization  | combining tasks, group and team work, job rotation, job enrichment, and break   |

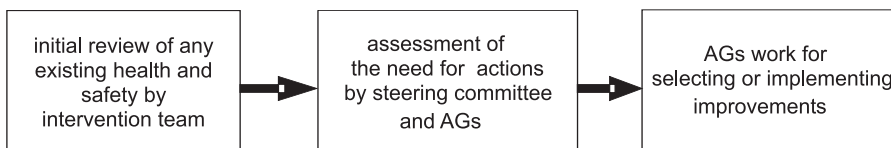
1. Developing health and safety at organization level with the checklist



2. Improving conditions of health and safety with ergonomics checkpoints



3. Integrating ergonomics in health and safety at organization level by the organization intervention team



**Figure 1. Common participatory steps for developing and using the ergonomics checkpoints.** Notes. AG—action group.



Work schedules (i.e., lack of or unsuitable planning, organizing and control), work tasks (i.e., improving the work environment and work system), healthy work organization (i.e., leadership and management practice, and continuous improvement) and learning (i.e., technical and social skills) have been found to be the criteria of particular importance for evaluation (Table 3).

In the process of using the ergonomics checkpoints, the SC and the heads of divisions agreed on the participation of the division's

employees to achieve better learning, work design and organization, access to more detailed information, final design of their action plans, evaluation of actions and their improvements and for easier acceptance of change at work.

#### 4.3. Results of the Methods Used

The results of the methods used to build ergonomics awareness and form the AGs are shown in Tables 4–6. In addition, 346 h and 5 800 man-hours were spent by the AGs on developing their activities and participating in the project.

**TABLE 3. Measures Selected as the Checkpoints for the Work Systems and Evidence of the Improvement of the Work Systems**

| Area                      | Problem in Plant Work  | Development of Main Checkpoints  | Improvement of Main Checkpoints  | Toward Improvement of Work Systems   |
|---------------------------|--|--|--|--|
| Work schedules            | lack of or unsuitable planning, organizing and control   | planning: production, technical, standards, quality control, after sales service, financial and official, developing health and safety, reorganization, developing organizational behavior, and developing human resources | standards, quality control, after sales service, improving health and safety, improving organizational behavior, design organization, improving human resources, and work system   | productivity, organizational behavior system with emphasis of understanding interfaces between individual, group, and organization job rotation system; to broaden the knowledge of managers or potential managers rotating into different position. job enrichment incorporates high-level motivators into the work system, |
| Work tasks                | excessive, unsafe work load, poor communication, improved working environment, and isolated work   | ergonomic worksite, communication aids ergonomics checkpoints, avoiding isolation  | safer practice, joint help, efficient work, organizational intervention  | team working, challenging tasks together with good leadership practices  |
| Healthy work organization | lack of leadership and management practices, poor change in management practice, stress, lack of a balancing of work and private life          | development of competence and the health of employees changes at all levels in organization, high job demands and low control at work, a balancing of work working hours and work arrangement                              | managerial practice, participation of people and the utilization of their ideas, job stress, the flexibility of working hours and work arrangement   | job satisfaction and job involvement, decreased stress, more degree of freedom at work   |
| Learning                  | lack of an innovative climate promoting the idea of lifelong learning, poor learning, poor career building and unsystematic managers' meetings | continuous improvement, applied future workshop, ergonomics checklist and ergonomics checkpoints, upgrading work skills and systematic managers meetings   | development of ideas and personnel competence, a shared vision, awakened need to change, learning, and common participatory steps for developing and using the ergonomics checkpoints, participation of employees in the work (plan and planning) through the intervention team activities in the participatory ergonomics process | continuous learning, common effort and goal for integrating ergonomics in health and safety process, and participatory ergonomics  |

**TABLE 4. More Activities for Engaging the Action Groups (AGs) in One Year**

| Kind of Activity                                 | Form     | No. of Participants | Duration (h) | Man-Hours |
|--|----------|---------------------|--------------|-----------|
| On-the-job training                              | session  | 44                  | 60           | 2640      |
| Evaluation of SC                                 | session  | 10                  | 42           | 420       |
| AGs' meetings                                    | session  | 4–8                 | 182          | 1092      |
| Monitoring AGs' activities and providing support | session  | 44                  | 32           | 1408      |
| Evaluation of AGs' activities                    | workshop | 8                   | 30           | 240       |
| Total  | —        | —                   | 346          | 5800      |

Notes. SC—steering committee.

**TABLE 5. Action Group Members Working on Applying (a) the Checklist and (b) the Checkpoints (Number of Participants = 44)**

| Kind of Activity | Duration (h) | Man-Hours |
|------------------|--------------|-----------|
| a                | 55           | 2420      |
| b                | 130          | 5720      |
| Total            | 185          | 8140      |

**TABLE 6. Duration of Various Activities of Action Groups (AGs) Within the Project**

| Duration | Topic |       |       | Total |
|----------|-------|-------|-------|-------|
|          | a     | b     | c     |       |
| h        | 55    | 130   | 346   | 531   |
| %        | 10.36 | 24.48 | 65.16 | 100   |

Notes. a—applying the checklist, b—applying the checkpoint, c—more activities for engaging the AGs in one year.

#### 4.4. Results of the Project's Evaluation

Regarding the first question (What positive or negative effects did the ergonomics training have on your duties and job?), positive effects of the ergonomics training on the duties and jobs of the members of the AGs can be inferred as follows:

- An improvement in carrying out their duties and the classification of their work, as a result of the setting up of work groups, each of which collectively carried out work and was responsible for its results. They combined tasks to make work more interesting and varied in their divisions. They also considered the workers' skills and preferences in assigning personnel to jobs in the divisions.
- Finding problems in their company and better analysing the problems of the company through the application of the ergonomics

checkpoints methodology [7], used by the AGs for problem-solving in their company.

- A better design of the plans and better problem solving, i.e., the AGs could choose to develop a list of ergonomics actions considering both the desirability and feasibility of each action.
- A better survey of the problems of the work system, because they solved work problems by involving workers from the divisions in the AGs.
- Team work due to the most effective team synergy. Synergy means that the team members interact in such a way that they achieve more than they could possibly achieve individually.
- Creating systematic thinking at work, because there was continuous learning at work.

Regarding the second question (What positive or negative effects did the project have on your company?), it can be inferred that as a result of the activity in the ergonomics group, improvements and positive changes took place, such as a learning process was created at the individual/group level, a suggestion process was developed, creativity increased within the working group, there was joint problem-finding by the group, and an exchange between the different units of experts' information and ideas. There was some resistance to the course of change (i.e., people's negative attitudes, positive and negative views of personnel and owners, weaknesses of the company), which have to be taken into consideration.

It can be inferred with respect to the third question (How did your activities in the AG compare with your other training and activities in your company?) that in comparison with other

training programs and activities in the company, this was a new method and the top managers' clear support was necessary.

Furthermore, it can be inferred with reference to the fourth question (How are your organizational and managerial duties in the company in comparison with the past?) that in relation to their organizational and managerial duties in the past, the following was observed:

- Clear role of interim/senior manager in planning and organizing the company.
- Improved organizational and managerial duties, such as greater allocation of authority to experts, more promotion for the company. Designing a real organization because they have a sense of belonging now.

Most heads of divisions (i.e., 7 people out of the eight divisions) accepted the process of developing and improving the work system and activities in their divisions.

The heads of divisions evaluated the project and told us, "The project has helped colleagues to become more familiar with their jobs and cooperate to solve the problems concerning their divisions. The plan and planning has been clearer and we have found a clearer path to doing our duties. Instructing ergonomics and forming the planning committee has caused us to have a wider view about the problems of the company, especially 'managerial and organizational issues' in our company. In ergonomics training and learning, we learnt a good method for our company (i.e., involving employees in planning work and solving work problems by involving them in the AGs and the SC). In other words, the strong points, opportunities, weak points and threats became more apparent to them through the participatory ergonomics process".

The head of the SC, a top manager (a company owner) said, 'Before, I was a crisis manager for the divisions in the three companies so I can see the good suggestions of the AGs for improving the workplaces. I am more motivated now. I am in a better situation in my role as a facilitator in the work system.' Furthermore, he evaluated the project and informed us, "The participants were very positive during this project and we took

new techniques and skills for improvement and change into our company. The company could be better still, but the top managers (the other owners) need time to think about what they are doing and the impact of their actions. The monetary problem and marketing problems, as well as leadership style, have not allowed top managers (owners) to pay much attention to the internal affairs of divisions and the company."

The top manager (an owner) evaluated the project and told us, "Ergonomics is a good scientific method, but I have a problem with direct orders from the heads of divisions and other top managers in the line now. I do not have time to reply when they ask me 'why this' and 'why that?' Previously, I replied to them, that they can and know alternative solutions at work now and that their AG activity is supporting them." The top manager accepted that the capacities and the behaviour of the personnel changed. They were in a better position to provide suggestions; they had the ability to sense and respond.

However, the top manager told us, "I understood that I did not put time in on the project. Most of my activities are about solving the monetary and marketing problems for our company. More productivity for the company is good for us, but managing the people is more important. I am going to put more time into the divisions." This could be interpreted that the top manager also experienced fear of change and of the personnel making mistakes. However, this is more related to cultural issues and leadership style.

## 5. DISCUSSION AND CONCLUSION

Table 7 shows the number of man-hours spent by the AGs in conducting ergonomics intervention.

**TABLE 7. Time Spent by Action Groups (AGs) on Conducting the Ergonomics Intervention**

| Time      | Topic |      |      | Total |
|-----------|-------|------|------|-------|
|           | a     | b    | c    |       |
| Man-hours | 2420  | 5720 | 5800 | 13940 |
| %         | 17.3  | 41.1 | 41.6 | 100   |

*Notes.* a—applying the checklist, b—applying the checkpoint, c—more activities for engaging the AGs in one year.



The results of this project and the experience of using ILO ergonomics checkpoints [7] in the pre-intervention phase of an ergonomics intervention programme in IDC industries [25, 31, 35] make the following arguments and conclusions possible.

The participatory ergonomics intervention process must consider both the task and the people level (i.e., a sociotechnical approach in which both technical and human-centred approaches are acknowledged and merged [39]). Using ergonomics tools could help to bring about an ergonomics know-how transfer at the organization level as a kind of built-in ergonomics awareness among managers and workers.

Figure 1 shows the use of the ergonomics checklist and the ergonomics checkpoints in the divisions, whereas Table 3 shows the evidence of how the work system improved. However, what were the individual applications in the different divisions? It was inferred that the division heads' opinions and the top managers' opinions of people at work differed (see Douglas McGregor's theories X and Y or a combination of the two, known as theory Z [40]). However, there are different ways of using and understanding research on the ILO ergonomics checkpoints book [7]. The challenge is the different attitudes of employers at work; i.e., *you won't* or *you can but you won't because you do not have an organizational commitment yet* or *you can't, and even if you could, you wouldn't because you do not have learning and organizational commitments at work* or there is no culture of *building a creative workplace* [41].

However, in this project using the ergonomics checklist and the ergonomics checkpoints was possible because most members of the intervention team were willing. *They could* and they were willing to support one another. All of them (i.e., *I will, I won't, I can, I can't* and combinations thereof) are important, especially when discussing topics such as what you have learned, what you might do differently next time and why people act the way they do [41].

In using the process the participants found learning discipline in the continuous learning as it is the nature of the participatory ergonomics

process that it meets and formulates the common participatory steps for developing and using the ILO ergonomics checkpoints [7]. However, at the start of using the ILO ergonomics checkpoints book, working collectively, they met the facilitator's trained eyes and they found self-confidence in the ILO checklist. The AGs' meetings and their feedback to one another, as well as the company network built by the intervention team, helped them in an emotional way and in sharing their experiences and knowledge of the work system. Finally, the successful application of the ILO book occurred when they could apply the why and the how of using the book's methodology to build new checkpoints in the participatory ergonomics process at their workplace and in their work system.

According to Oden "integration means to form, coordinate, or blend all components into a smooth function or unified whole, thus causing all the parts to work together in a manner that will make the whole process most productive" (p. 309) [39]), towards building tailored ergonomics checkpoints in the workplace in a continuous learning process implemented by the intervention team.

Information on evaluation gathered at the last meeting from the members of the AGs and the division heads regarding the questions was discussed. Then, the measures for improvement were taken. There is a need for, and expectation of, future activities. More support and commitment from top managers is necessary for the work system to improve, so the journey is difficult. They need to have a new leadership style in their company now. Most participants said that there were many fears in their view of the future, such as *the fear of change, of making mistakes, of loss, of the unknown, of failure, of low support from top management, etc.*

High energy and positive feeling, as well as a deep commitment to learning and significant change are necessary among the top managers, division heads and employees in the three companies now. There was a significant difference within the top managers (the three owners), which could be due to an increased

knowledge of managerial and organizational issues in the top manager who was engaged and participated from the beginning of the project. He said that the start of the project was difficult, but there was no end, no limitation to learning and improving the work system in the company now. After the project, he followed the meetings of the interim/senior managers through the heads of divisions regularly every 2 weeks, he also held meetings of the board of managers as well as followed up strategic plans.

This study was an attempt to implement basic ergonomics through a participatory ergonomics intervention process. According to Imada and Nagamachi without improved organizational support, team processes, team building, role definition, role clarity, communication, management commitment and a supportive culture, our success is limited [42].

Following is a summary of my recommendations for using the ILO ergonomics book [7] in IDC industries.

- There is no limitation to using the ILO ergonomics checkpoints in the workplace in IDC industries, but first there must be an understanding (through research) of where you and your organization stand now. This is so because each organizational intervention with ergonomics tools will come across questions about the level of emotions in the organization and your position for using the checkpoints in your organization and because this will determine your limitation of expectations on it. Please do not address big issues (e.g., culture issue and no/poor team work in the IDC industries). On the other hand, combining the skills of a facilitator with the staff of your workplace can ensure appreciative intervention so that you can improve your actions at work. In this way, reflection learning and appreciative conversation help you and your co-workers to improve your activities and promote your work system.
- When using the ergonomics checklist individually at your workplace or workstation, it is important to take pictures and keep records to illustrate the situation before and after the improvements. This helps your co-workers or

your manager understand better the usefulness of the checklist so they will better support your further activity. On the other hand, you first need to make sure you have the ability to improve your work at your workstation/place more than in the past. If the ergonomics checkpoints and methodology open your mind or you are finding a positive challenge in your work system, then you need a facilitator at the group and organization level. Someone with trained eyes from outside the company can see the bigger picture. If the system is complex, it can be difficult for those within to see beyond the work system process alone.

- when using the ILO ergonomics checkpoints book collectively at the organizational level, it is important to pay attention to organization metaphors, e.g., organization as machines, organization as politics, organization as organisms, and flux and transformation (see also Cameron and Green [43]). On the other hand, a facilitator first needs to know the following: Who will train whom and who will learn at group or organizational level? What is the nature of the organization (i.e., complex, formal or centralized)? What were the previous experiences of training people at work? What is the purpose of using the ergonomics checklist and checkpoints (e.g., for improving health and safety and working conditions or building an ergonomics awareness at the workplace or the promotion and integration of health, safety and ergonomics within the work system)? What is the leadership style in the organization? Is there any resistance to training at the organizational level? What is the top manager's opinion of people at work? To what degree do participation, engaging people in their work and a learning culture exist there? Stories of the people at work give you/us more information about the organization and a starting point for using the ergonomics tools.
- One key finding of the project and the case studies in the Iranian industries [25, 33, 34, 35], (in my own experience) is that using the participatory ergonomics process at the organizational level can bring a positive cultural change in the workplace. However,

you/we must fully respect the top manager's and the employees' learning, knowledge and experiences. It might be that the top manager wants the ergonomics intervention programme to stop. Your/our limitation is not people or managers and top managers at work or the big cultural issue of team work. Your/our limitation for the promotion of ergonomics may be that your/our knowledge and experiences within the IDC are not yet sufficient. There are poor examples of the participatory approach in IDCs. Thus, the challenge is how advanced are the abilities to train people and organizations within participation at the work system in an IDC and how far reflective learning and action can bring different ways of understanding (research) using the ILO ergonomics checkpoints book [7] and the ergonomics tools for the different ergonomics intervention programme in the IDC? Thus, it is important that you or a facilitator accept ergonomics as software technology, technique, know-how transfer that have potential challenges in IDCs, as this author has investigated and mentioned, *What are the challenges?*, *What are the adjustments?* Also *What is needed in the way of developing and testing systematic techniques for ergonomics intervention in the IDC and further research study?* Universal applicability, generalizability, of findings and recommendations are essential (see also Helali [44, 45]).

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