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CHOOSING THE BEST ERGONOMICS STRATEGY TO REDUCE ABSENTEEISM

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Summary: The major part of the companies confront absented employees problems due occupational work related diseases that can be prevented by Ergonomics strategies. This paper covers the application of AHP to choose the best Ergonomics strategy considering the alternatives Labor Drills, Ergonomics Analysis and Ergonomics Management System. The criteria and judgments focus on Costs, Applicability and Acceptance of the Ergonomics methods with real data collection from a production area of a Brazilian manufacturing company.

1. Introduction

1.1. Main Objective – The Problem

This paper is to show the AHP – Analytical Hierarchy Process decision method use in a practical application. The work team chose a cellular phone company which one wants to decide the best ergonomics technical alternative and reach its strategic planning goals.

The strategic planning goals :

- Reduce employees absenteeism in 10%
- Improve occupational health and life quality.

The company needs to decide among three feasible ergonomics methods :

- LD – Labor Drill
- WEA – Work Ergonomics Analysis
- EMS – Ergonomics Management System

1.2. The scenario

The cellular phone manufacturer has three main assembling production lines with specific characteristics and totalizes one million products per year presented in three basic models: GL100, GL102 and GL104. The market share of this company is 35% and the cellular phone model GL100 is the sales leader. In terms of internal production volume the GL100 corresponds to 70 %, GL102 to 25% and GL104 to 5%, out of the total production volume.

The present scenario shows an increasing absenteeism along the assembling production lines which represents 22 days by month for all involved employees resulting in the average absenteeism

of 3 days by month by employee. It is a 34 % in overtime increase when compared with total available working time and US$ 4,370.00 in additional expenses.

2. Ergonomics Fundamentals

2.1 Concepts and Definitions

The acronym REL stands for Repetitive Effort Lesions and WRMD stands for Work Related Muskuloskeletal Disorder. Although the acronym REL has been replaced by the WRMD, the former is still better identifiable and used in some papers due to its long term use and applications even after the updated edition of the respective technical norm in 1997 by the National Institute of Social Security of Brazil. The acronym WRMD has come up because of the English term meaning work related muskuloskeletal disorder which fits the category of work related occupational diseases suggested by the World Health Organization (Longen, 2003).

According to Borges (2000), the phenomenon of REL / WRMD attracted more attention when it has acquired the feature of happening in different productive processes especially from the technological and organizational changes that have happened in the last thirty years. . Such changes have been induced by the automation and information technology of production, besides the different approaches of work force management that follows the processes of productive restructure in the global world with remarkable consequences to those who design work, and above all, for those who perform it. The somatic manifestations from workers constitute an alert which shows that men are not the ones who are sick, but work. Working is a human necessity, that is, a natural process which positively matches production factors, distribution, exchange and use of the numerous ways of life by different human groups. Therefore, the comprehension of " work", "production" in a wider sense seems fundamental (Longen, 2003). Working implies in a social reproduction process (Marx, 1985).

2.2. The Disease and Prevention Actions

The REL / WRMD are frequent problem and also one of great complexity in a world context, using prevention as the best path to fight and minimize its impact. Some professionals support the association of various measures including labor drills (LD) as a form of prevention. In a study involving a multifunctional team, aiming to reduce complaints related to muscle skeleton system, Moraes, Alexandre and Guirardello (1999) concluded in their experiments that a program involving alterations in some aspects of the organization, environment and work setting, linked to the decision to take supervised exercises, postural orientation may minimize the complaints related to the muscle skeleton system of seamstresses in a university hospital. They pointed out the importance of a multifunctional team, mainly of nurses and physiotherapists in the introduction and evaluation of a control and prevention program.

According to Alves (2000) discussing the association of labor drills, LD, as a preventive measure states that it is one of the most used preventive tools in groups which collective action is possible, not being the only solution to the company's problem. However, its use without proper criteria does not produce long time results, which may even worsen it and the appearance of new cases of REL / WRMD. The author quoted above also states that there should be an ergonomics evaluation prior to the introduction of LD programs as a way to identify situation that compromise muscle skeleton integrity.

2.3. Ergonomics Concept

Ergonomics is the study of man's adaptation to work. In this case work is considered in its widest context, that is, including not only machinery and equipment needed to transform materials, but also the whole situation where work happens. This definition is about not only the physical environment, but also involves the organizational aspects of how this work is programmed and controlled to obtain the desired results (Lida, 2002). Another definition of ergonomics is described as being the study of the relationship of man with his work, equipment and environment, and specially the use of his knowledge of anatomy, physiology and psychology in the solution of problems which

have been derived from this relationship (Ergonomics Research Society, England) (Lida, 2002). Ergonomics is at the same time a set of this knowledge (physiology, psychology, cognitive functioning) and practice of action (Resende, 2006).

2.4 Ergonomics Methods

2.4.1 Labor Drills

It is the programmed physical activity at work of mild and moderate intensity with pre-defined exercises which are carried out during programmed breaks at work hours. In fact, the most fitting LD is the compensatory one which acts upon the antagonistic muscular synergy that are active at work. According to Kooling (1980), this kind of activity aims to provide compensation and functional balance as well as act upon the active recovery in order to take advantage of regular breaks during work hours to exercise the respective muscles and relax the muscle groups which are flexed at work to prevent exhaustion.

2.4.2 Work Ergonomics Analysis

The WEA - Work Ergonomics Analysis is a method which arranges and analyzes operational activities in an organization using the collaborator's description of the activity in the entire productive process and in the identification of the ergonomics risks that s/he has been exposed to (Couto, 1996). Through this identification WEA sets a course of actions to improve a better adaptation of man to work in a way that the physical and organizational factors of work are not aggressive to his/her health and safety asserting productive alternatives with a minimum of mistakes and damage to the organization. The WEA has been present in the Brazilian law since 1990 by the government decree number 3214/78 and NR-17.

The WEA accomplishment based on the demand analysis, evaluation of the activities through metric systems and in the compilation and interpretation of results achieved from courses of actions constitutes an efficient method of surveying the situation problem and to the improvement of work conditions (Santos, Paixão, 2003).

2.4.3 Ergonomics Management System

It is a management system which regards preventive, corrective, educational and maintenance actions aiming the improvement of work conditions, that is, focusing on the work, health, quality of life and safety of the collaborators.

It usually involves an interdisciplinary team, such as: labor physicians, physiotherapists, nurses, health, safety and engineering teams, and collaborators from the company's operation. The balance between the actions which guarantee the organizational strategic targets and the improvement of working conditions, quality of life and productivity of its collaborators is fundamental.

The EMS has a very wide scope and involves various actions and methods, such as: WEA, EM, Ergonomics Committees, lectures at CIPA, the company's physiotherapy section, Posture School, among others. It is a global intervention and also of management when compared to the methods LD AND WEA.

2.5 Carpal Tunnel Syndrome

It is a neuropathy resulting from the middle nerve of the carpal tunnel which is responsible for the sensibility and motricity of the thumb and some hand muscles. It is characterized by pain, changes in sensibility and tingling on the wrist which is generally related to repetitive or inadequate hand movement (Silva, 2004).

According to Zumiotti, the main symptom is parasthesia that happens basically in the middle nerve area, that is, in the thumb, index finger, middle finger and in the internal side of the ring finger.

It is a tingling sensation which usually happens at night because of the liquid retention which is common at this time of day. After that, there is a decay of sensitivity which makes it difficult to handle small objects and carry out simple tasks, such as: sewing a button, put thread on a needle or even raise a cup. Pain is not a present symptom even though it is typical in the beginning of the syndrome, but it can also be caused quickly by the abrupt pressure on the middle nerve in the carpal tunnel.

CTS is a medical condition that affects mostly adult people in typical working ages, which explains the most frequent cause of the syndrome in work related situations. According to Oliveira (2000), the sensitive kinds of complaints as well as those of nervous conduct changes, similar to those caused by the pressure of the middle nerve on the wrist are very common among workers. As to the occurrence, the CTS is more common in women and that usually happens between the ages of 45 and 54, and whose predominance rate may vary according to the methodology used. The average predominance in a population of 25 to 75 year olds is 2.7%, determined clinically and electrophysiological. (Oliveira, 2000).

3. Data Collection

The data collection was performed by field researches through employees interviews along the workstations and all involved areas. As a result, the following table shows de data to be used for decision analysis.

3.1. Data Collected

The employees data were processed considering the average monthly number of medical leaves equal to three days, 8 hours total a shift or 220 hours a month and an average salary of US$ 1,800.

Workstations	Number of Employees	Monthly Absenteeism (Days)	Monthly Overtime (Hours)	Number of Medical Leave	Monthly Total Cost (US$)
1	10	13	30	30	1,977
2	7	6	24	21	1,271
3	4	2	12	12	656
4	3	1	8	9	466
Total	24	22	74	72	4,371

Table 1. Model GL100 Workstations General Data

3.1. Ergonomics Method Cost Data

The cost data were got based on the market cost, suppliers proposals comparison and external consulting information, resulting in the next table.

Alternatives	Cost (US$)
LD – Labor Drill	6,000
WEA – Work Ergonomics Analysis	9,000
EMS – Ergonomics Management System	18,000

Table 2. Ergonomics Methods Cost Data

3.3. Judgments Data

The judgments data were collected through employees interviews in order to focus on three main decision criteria for the best ergonomic method. Therefore the tables 3, 4 and 5 were obtained

considering the importance of cost, applicability and effectiveness of the available ergonomics methods according to the Saaty Fundamental Scale. (Saaty, 1980).

Criteria	C	A	E
Cost (C)	1	1/3	1/5
Applicability (A)	3	1	1/3
Effectiveness (E)	5	3	1
Total	9.00	4.33	1.53

Table 3. Importance of Criteria Judgments

Alternatives	LD	WEA	EMS
LD – Labor Drill	1	1/5	1/9
WEA – Work Ergonomics Analysis	5	1	1/7
EMS – Ergonomics Management System	9	7	1

Table 4. Ergonomics Methods Effectiveness Judgments

Alternatives	LD	WEA	EMS
LD – Labor Drill	1	1/5	1/3
WEA – Work Ergonomics Analysis	5	1	1/3
EMS – Ergonomics Management System	3	3	1

Table 5. Ergonomics Methods Applicability Judgments

4. AHP Method Application

The AHP decision method application expects the decision vector calculation in function of the decision matrix based on Judgment data and the criteria weighting vector. To finalize the criteria consistency is done. To get started the cost harmonization is calculated as shown in the table 8.

Alternatives	Cost (US$)	Harmonized Cost
LD – Labor Drill	6,000	0.182
WEA – Work Ergonomics Analysis	9,000	0.273
EMS – Ergonomics Management System	18,000	0.545
Total	33,000	1.000

Table 8. Ergonomics Methods Cost Harmonization

The following tables show the normalization of the judgments data.

Criteria	C	A	E	Mean	Vector W
Cost (C)	1	1/3	1/5	0.405	0.105
Applicability (A)	3	1	1/3	1.000	0.258
Effectiveness (E)	5	3	1	2.466	0.637
Total	9.00	4.33	1.53	3.871	1.000

Table 9. Normalization of the criteria importance judgments data

Criteria	LD	WEA	EMS	Mean	Vector W
LD – Labor Drill	1	1/5	1/9	0.281	0.055
WEA – Work Ergonomics Analysis	5	1	1/7	0.894	0.173
EMS – Ergonomics Management System	9	7	1	3.979	0.772
Total				5.154	1.000

Table 10. Normalization of the Ergonomics Method Effectiveness judgments data

Criteria	LD	WEA	EMS	Mean	Vector W
LD – Labor Drill	1	1/5	1/3	0.405	0.110
WEA – Work Ergonomics Analysis	5	1	1/3	1.186	0.323
EMS – Ergonomics Management System	3	3	1	2.080	0.567
Total				3.671	1.000

Table 11. Normalization of the Ergonomics Methods Applicability Judgment Data

After judgments data normalization and cost harmonization the decision matrix is built and calculated. Later the criteria weighting vector is obtained in order to determine the decision vector.

Follow the calculations:

[Decision Matrix] . [Criteria Weighting Vector] = [Decision Vector]

$$\begin{bmatrix} 0.182 & 0.110 & 0.055 \\ 0.273 & 0.323 & 0.173 \\ 0.545 & 0.567 & 0.772 \end{bmatrix} \cdot \begin{bmatrix} 0.105 \\ 0.258 \\ 0.637 \end{bmatrix} = \begin{bmatrix} 0.083 \\ 0.222 \\ 0.695 \end{bmatrix}$$

The best choice is the EMS – Ergonomics Management System with **69.5 %.**

Now, the coherence index calculation.

$$\lambda = \begin{bmatrix} 9.000 \\ 4.333 \\ 1.530 \end{bmatrix} \cdot \begin{bmatrix} 0.105 \\ 0.258 \\ 0.637 \end{bmatrix} = 3.037$$

$\lambda = 3.037$

Then :

$$CI = \frac{\lambda - n}{n-1} = \frac{3.037 - 3}{3-2} = 0.035$$, where CI = Coherence Index

$$CR = \frac{CI}{0.52} = \frac{0.035}{0.52} = 0.067$$, where CR = Coherence Ratio

Note.: 0.52 is obtained from the Saaty Table for n=3 (Saaty, 1980)

According to Saaty, as the CR is less than 20% the criteria are coherent.

6. Conclusions

The AHP shows that the best ergonomics method choice is the EMS – Ergonomics Management System with 69.5 % preference when compared to LD and WEA.

The final result is considered acceptable due the high scores obtained for the method effectiveness judgments, that is nine in the Fundamental Saaty Scale (Saaty, 1980).

On the other hand is the worst alternative in terms of cost and return of investment when compared to others. In this case, the annual expense will be around US$ 53,000.00 and the investment US$ 18,000.00, with a payback less than five years.

The criteria data were considered coherent by AHP method with a CR – Coherent Ratio and a CI - Coherence Index equal to 6.7% and 3.5% respectively.

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