

THE IMPLEMENTATION OF ERGONOMIC PROGRAMS IN PRODUCTION LOGISTICS

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Abstract: *This contribution addresses the necessity of ergonomic programs implementation in production logistics in Slovakia; it also shows the importance of evaluation of their effectiveness regarding the costs and benefits. One of the appropriate methods for monitoring all costs and benefits from ergonomic programs is the cost-benefit analysis.*

Key words: *ergonomics, production, logistics, CBA*

- stage V – evaluation of the solution benefits (health effect and cost benefit).



Fig. 1. Ergonomic process

1. INTRODUCTION

Adaptation of workplace dimensions to individual workers provides opportunity to increase their work effectiveness (Hatiar & Cagaňová, 2009). This can be done by the ergonomic programs. The ergonomic programs and production logistics represent individual supporting processes of the company with specific goals. The logistics is aimed at: *“Delivering the product in the right quantity, composition, quality, and time to the required place at minimum costs with optimum supply services.”* The ergonomics is aimed at the efficiency of human work through, *“ensuring the human health, i.e. also their physical, mental and social satisfaction of people together with cost benefits.”*

The interconnection of these partial targets may lead to the penetration of individual areas as well as to opportunities to meet the customer requirements for supplies and services on required level while taking care of human health in all necessary main and supporting processes being realized to meet these customer needs. Individual goals will be thus interconnected and harmonized achieving so satisfaction for both the customer and the staff and finally for the company.

2. ERGONOMICS IN PRODUCTION LOGISTICS

The role of ergonomics as a supporting process in the logistics would be to perform duties associated with checking impact of work, means of work equipment and working environment on employees' health and thereafter perform activities by properly defined measures to prevent negative impact on work performance of employees. This should be done through ergonomic solutions.

To apply ergonomic knowledge and principles in the production logistic it is possible to use an ergonomic program based on participatory ergonomics principles as a supportive tool. This process usually includes a five stages cycle with following contents (Cook et al., 2000):

- stage I – identification of problems in the system, which is subject to investigation,
- stage II – analysis of the problem reasons and definition of their solution,
- stage III – problem solution proposal,
- stage IV – implementation of the solution,

The workers in production logistics may be exposed to a risk factor in terms of ergonomics which affects their work performance and thus the efficiency of companies and the quality of manufactured products.

In production logistics the area can be which offers opportunities for the application of ergonomic principles as outlined in the following table.

Production logistics	The area for the applying of ergonomics principles
<ul style="list-style-type: none"> • application of decision processes in production • the planning and managing of production and manufacturing stocks, • optimization of batches size, • reduction of production running times, • transport, storage and manipulation in production. 	<ul style="list-style-type: none"> • minimizing the static load of musculoskeletal system, • the choice of appropriate type and location of knops and dials, • the choice of appropriate level of mechanization and automation, • reducing carrying weight of loads on manual handling, • the choice of appropriate handling units (containers, pallets, cars), • minimizing the monotony of work.

Tab. 1. *The scope for the application of ergonomics principles in production logistics*

The afore-mentioned areas can be examined within the analysis which is a part of the ergonomic program. In present, the application and implementation of ergonomic programs is not the matter of course in Slovakia. Ergonomics is mainly applied in companies with foreign capital participation. The following tab. 1&2 describe the results of ergonomic analysis of the selected company showing the need of the ergonomics application in production logistics. In ergonomic analysis the impact on musculoskeletal system disorders of the employees was observed. Next aspect is to review the work environment factors on musculoskeletal disorders of employees.

	Packaging department n = 54		Surface treatment n = 30		Machinery department n = 63		Maintenance n = 11		Loading/Unloading n = 11		All n = 169	
	% with sympt.	% of MD visits	% with sympt.	% of MD visits	% with sympt.	% of MD visits	% with sympt.	% of MD visits	% with sympt.	% of MD visits	% with sympt.	% of MD visits
Neck	42,6 ⁽⁴⁾	11,1	26,7	10,0	33,3	4,8	36,4	9,1	36,4	9,1	42,2 ⁽¹⁾	11,1
Shoulders	38,9	13,0	40,0 ⁽⁴⁾	6,7	27,0	4,8	27,3	0,0	27,3	0,0	31,7	9,5
Upperback	40,7 ⁽⁹⁾	11,1	36,7 ⁽⁴⁾	6,7	34,9	7,9	36,4	9,1	36,4	9,1	40,7 ⁽⁴⁾	12,1
Elbows	20,4	3,7	26,7	0,0	9,5	1,6	18,2	0,0	18,2	0,0	16,6	2,0
Lowback	55,6 ⁽⁸⁾	22,2	66,7 ⁽¹⁾	20,0	69,8 ⁽¹⁾	19,0	63,6 ⁽¹⁾	18,2	63,6 ⁽¹⁾	18,2	61,3 ⁽¹⁾	20,1
Wrist/Hands	38,9	3,7	46,7 ⁽¹⁾	6,7	34,9	3,2	27,3	0,0	27,3	0,0	35,2	4,5
Hips/Things	20,4	7,4	26,7	0,0	23,8	4,8	9,1	0,0	9,1	0,0	21,1	4,5
Knees	50,0 ⁽⁹⁾	11,1	43,3	6,7	36,5	4,8	54,5 ⁽¹⁾	18,2	54,5 ⁽¹⁾	18,2	40,7 ⁽⁴⁾	8,0
Ankles/Feet	61,1 ⁽¹⁾	9,3	56,7 ⁽¹⁾	3,3	71,4 ⁽¹⁾	6,3	27,3	0,0	27,3	0,0	55,3 ⁽¹⁾	6,5

Tab. 2. The percentage occurrence of the MSDs by the employees and the percentage of doctor's visit because MSDs by the employees in the selected company

Factor of the working condition	Epidemiologic marker Odds ratio (OR)	95% confidence limits	Statistical confidence of odds
Repetitive work	6,41 ⁽¹⁾	2,47 < OR < 16,31	0,00001251***
Microclimatic conditions	5,19 ⁽¹⁾	1,49 < OR < 16,77	0,0043225**
Quality of work organization	4,28 ⁽¹⁾	1,75 < OR < 10,61	0,00053423***
Long remaining in work position	3,65 ⁽¹⁾	1,26 < OR < 9,86	0,0078447**
Not appropriate work rest schedule	3,30 ⁽¹⁾	1,36 < OR < 8,03	0,00517225**
High working movement	3,09 ⁽¹⁾	1,03 < OR < 8,53	0,030707*
Forced working postures	3,03 ⁽¹⁾	1,25 < OR < 7,36	0,00995108**
Heavy material handling	2,69 ⁽¹⁾	1,04 < OR < 6,69	0,03392525**
Work after injuries and in illness	2,36	0,98 < OR < 5,67	0,05191975
Work on physical possibilities limits	2,11	0,87 < OR < 5,06	0,09810437
Excessive trunk bending and twisting	2,06	0,84 < OR < 4,93	0,11740229
Work with hands above the head	1,61	0,68 < OR < 3,87	0,32596053
Quality of tools	1,44	0,58 < OR < 3,44	0,50001600
Quality of training and workshops	1,28	0,54 < OR < 3,19	0,68826325
Manipulation with small position	1,22	0,51 < OR < 2,93	0,77477022

Tab.3. The importance of the working conditions on the incidence musculoskeletal disorders in the selected company

3. THE EVALUATION OF ERGONOMICS EFFICIENCY IN PRODUCTION LOGISTICS

The efficiency of ergonomic program and accepted ergonomic measures can be expressed by health improvement of health and psychological comfort of employees, as well as by economic benefits achieved through cost benefit analysis.

We cannot focus on the ergonomic program as a financial investment, but it is necessary to consider all invaluable costs and benefits. The cost benefit analysis is therefore appropriate method for evaluation of ergonomic programs (CBA).

The task of CBA is to evaluate if there are certain benefits or losses following the measures proposed and what extent; CBA will compare the costs and find out the effect the cost has brought. CBA analyses not only positive effects that can be brought by the implementation of measures but also the negative ones. The disadvantage of CBA is the fact that it cannot include the impacts without quantitative or monetary data; in that case only the qualitative expression of benefits is possible. CBA does not answer the question of an optimum level of 'the benefit' is. Its result should only help in the decision making process (Drdulová, 2008). One of the CBA method advantages in compare with other attempts of public project evaluation is the fact that it is a systematic procedure which can be successfully utilized for any project (Sieber, 2004).

The order of the basic steps of CBA processing is not absolutely strict as well as their definitions. Nevertheless, the stages of CBA follow each other in a logical sequence, and their random reshuffle could lead to not good results and could complicate the achieving of valid results. This procedure is considered as one of the possible procedures, however, none of the following steps should be skipped. The

recommended procedure in the processing by CBA is as follows (Sieber, 2004):

- define the nature of the project,
- specify the structure of beneficiaries,
- describe the differences between the investment and zero option,
- determine and quantify all relevant costs and benefits for all life phases of the project,
- set apart supplementary 'invaluable' costs and benefits and their verbal description,
- transfer 'valuable' costs and benefits to cash flows,
- determine a discount rate,
- calculate criteria,
- carry out an analysis of sensitivity,
- judge the project on the basis of calculated criteria, invaluable effects and a sensitivity analysis,
- decide about the plausibility and funding of an investment.

4. CONCLUSION

Human and especially workers may be taken as one of the limiting factors in production logistics. Therefore, it is necessary to prepare such appropriate work conditions that the worker is able to perform his/her work while minimizing the effects of risk factors. The elimination of risk factors effects should be achieved through the implementation of ergonomic programs. Cost-Benefit Analysis is a suitable method for evaluating the ergonomic programs efficiency as not profitable projects.

The goal of ergonomic programs implementation into the area of production logistics is:

- propose appropriate work conditions with minimizing influence of risk factors,
- evaluating of effectiveness of accepted measures through CBA.

Implementation of ergonomic program should help for rising of company competitiveness; to faster adaptation for market changes and better functioning of logistic processes in company.

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