

INTERNATIONAL
CONFERENCE
ON OCCUPATIONAL
HEALTH
AND
SAFETY:
FROM
POLICIES TO
PRACTICE



December 6-7 | 2012 | Riga, Latvia



LATVIJAS
UNIVERSITĀTE
ANNO 1919

PROCESS MANAGEMENT IMPROVEMENT WITH ERGONOMICS SOLUTIONS

MSc. Henrijs Kalkis

University of Latvia

PhD candidate, lecturer

E-mail: Henrijs.Kalkis@lu.lv

6th of December, 2012



IEGULDĪMUS TAVĀ NĀKOTNĒ



"Promotion of International Cooperation
Activities of Riga Stradiņš University in Science and Technologies", agreement
No. 2010/0200/2DP/2.1.1.2.0/10/APIA/VIAA/006

TOPIC ACTUALITY (1)

☞ Nowadays we face rapid technological innovations, various kinds of organisations, changes in labor market, increase of intellectual work, demanding needs from internal and external customers...

☞ Hence it is important to look for new ways and methods in order to promote work productivity and increase in economic effectiveness of the organisation, maintaining human resources and not decreasing product quality.



TOPIC ACTUALITY (2)

☞ In process management and increase in work productivity, as world experience reveals, human factor or ergonomics is of great importance, especially, if proposals in the aspect of ergonomics are taken into account already in the stage of process designing.

☞ In Latvia, a human as a highly valuable and competitive resource at work is not sufficiently evaluated. Hence the issue on perfection of management of production processes in ergonomics aspect is particularly topical.



Research background

- medium size woodworking enterprise
- sorting, packaging and assembling processes (*operators*)
- selection criteria: full-time workers, no acute musculoskeletal symptoms, work experience at least five years in the wood-processing industry, and full consent to participate.
- The all-male group consisted of woodworking operators (60). The average length of service was 8 ± 3 years.



Variable	Workers (n = 60)	
	Mean \pm SD	Range
Age (years)	37 \pm 4	25–50
Height (cm)	180 \pm 5	173–187
Weight (kg)	81 \pm 9	65–97
Body mass index (BMI, kg/m ²)	25 \pm 6	17–36

The aim of the research

- The aim of the research is to study how efficiently ergonomics can be integrated in process management.

The research was carried out before (0-cycle) and after (Ergo-cycle) the ergonomics interventions in furniture production line.

Ergonomics interventions were implemented with process quality improvement and actions were as follows: purchase of automatic lifting machines in packaging process, new machinery tools for sorting and assembling the furniture parts. Participatory ergonomics interventions involved job rotation, staff training, involvement in decision making about necessary improvements in work process.

Research methods

Method	Application
Interviews and checklists	Data about quality and ergonomics problems was gained from plant workers
Key Item Indicator method (KIM)	Estimation of ergonomics risk severity degree (Kalkis, 2008)
Quick exposure check (QEC)	Quick identification and assessment of workload's influence on body parts (Brown and Li, 2003)
Fault Tree Analysis (FTA)	Quantitative method that allows for establishing the unfavorable errors in the operation of equipment or machinery as well as faults in the technological and other processes and determine the causality of the unfavorable event (Dehlinger and Lutz, 2006)
Failure Mode and Effects Analysis (FMEA)	identifying and prevention of the problems with products or processes before the errors take place and the possible unfavorable effects occur (McDermott, Mikulak, and Beauregard, 1996). The computer software <i>FaultCat</i> (Burgess, 2011) and <i>ReliaSoft „Xfmea”</i> (Xfmea; www.reliasoft.com/xfmea/)
Washington State Ergonomics Cost Benefit Calculator (WSECBC)	Financial aspects of process quality improvements with ergonomics interventions were calculated (Cost Benefit Analysis calculator, http://www.pshfes.org)

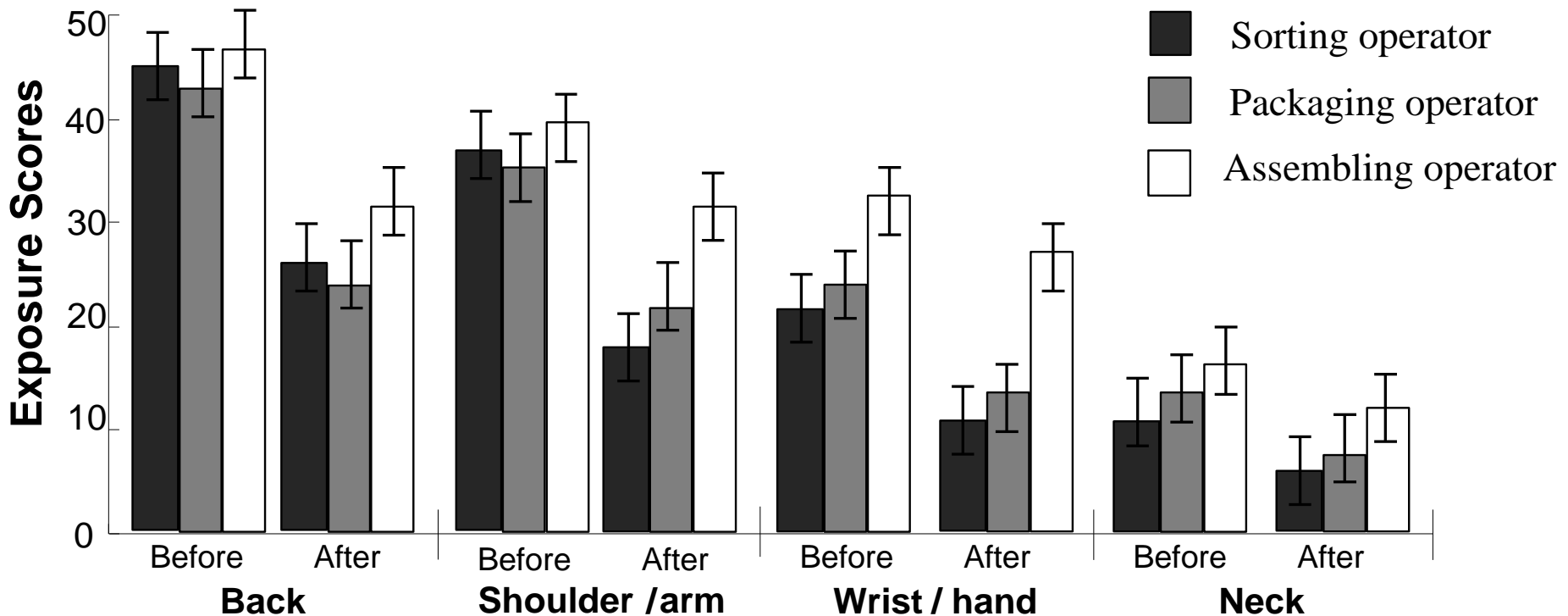
RESULTS (1)

- **Workload severity risk degree (Rd) by KIM method**

Furniture production line	Risk degree (Rd) (I – IV)
<i>Before ergonomics interventions (0-cycle)</i>	
Sorting operator	IV
Packaging operator	IV
Assembling operator	IV
<i>After ergonomics interventions (Ergo-cycle)</i>	
Sorting operator	II
Packaging operator	III
Assembling operator	II

RESULTS (2)

Exposure scores by QEC method before and after the ergonomics interventions in furniture production line

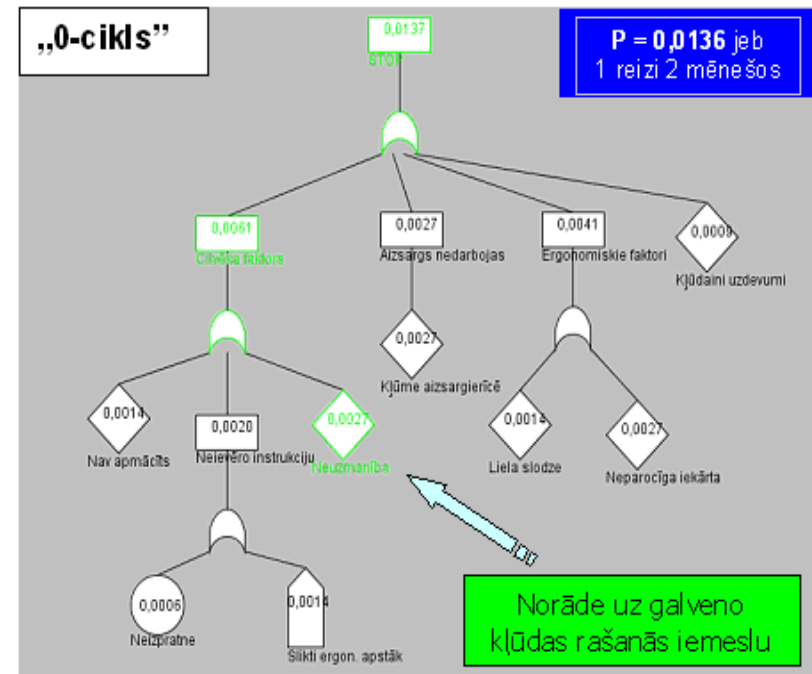


RESULTS (3)

FTA using the FaultCat software

After assessing the results of the fault tree analysis one must conclude that the likelihood of errors is significantly reduced by new technologies and ergonomic improvements, by lightening also the workload.

<i>Process</i>	Fault probability (<i>P</i>)	
	„0-process”	„Ergo-process”
Sorting	1 × 2 month (<i>P</i> =0,014)	2 × years (<i>P</i> =0,0055)
Assembling	2 × month (<i>P</i> =0,065)	1 × 2 month (<i>P</i> =0,014)
packaging	1 × month (<i>P</i> =0,03)	1 × year (<i>P</i> =0,0027)



RESULTS (4)

Management of risks and probabilities by FMEA

Process	Likely kind of fault	0-process				Ergo-process			
		Severity	Occurrence	Detection	RPN	Severity	Occurrence	Detection	RPN
Furniture production line	Machinery:								
	Sorting errors	8	7	9	504	8	4	5	240
	Assembling errors	8	6	8	384	8	5	3	200
	Other faults	6	6	6	216	7	5	3	108
	Ergonomics risks:								
	Muscles fatigue	8	8	9	576	8	6	5	160
	Heavy arm work	8	7	7	392	8	5	5	200
	Other faults	6	6	6	216	6	6	3	106
	Products:								
	Dimension faults	8	10	9	720	8	4	5	160
	Design defects	8	8	8	512	8	6	4	192
	Other faults	6	6	6	216	6	6	3	108
	Total RPN before technological improvements („0- process”)					8374	RPN in „Ergo- process”		

RESULTS (5)

Cost-benefit analysis by WSECBC

Efficiency	
<i>The ergonomics effects</i>	<i>Ergonomic risk reduction</i>
Eliminated the ergonomics risk of adverse effects	70%
Reduced the risk level of impact	40%
Reduced risk of exposure time	15%
Relieved heavy manual work	10%
Assessment of Productivity Improvement	
<i>Level</i>	<i>Process improvement</i>
High – accelerates the production process	10%
Moderate – reduces the waste motions	5%
Low – increases the comfort level	2,5%

The cost-benefit calculator WSECBC results shows that ergonomics interventions in furniture production line pays off in one year, while the benefits will grow every year, and the whole first year it sums up to 63 206 EUR, but in 5 years it is expected to benefit 319 030 EUR.

Conclusions (1)

- 1. Ergonomics risk assessment (KIM and QEC methods) proved that ergonomics interventions in the furniture production line lightens the workload for sorting, packaging and assembling operators.**
- 2. Despite technical improvements, packaging operator's work still requires hard manual handling, thus participatory ergonomics should be applied.**
- 3. FTA and FMEA are recommended for process analysis for identification and prevention of problems, incl. ergonomics, before the faults take place and the unfavorable consequences arise.**

Conclusions (2)

- 4. Ergonomics interventions should include not only improvement of machinery and working tools, but also employees training, job rotation, involvement in decision making a.o.**
- 5. The cost-benefit analysis is important to convince managers and stakeholders of the company about financial and less tangible benefits of ergonomics interventions.**
- 6. The approach of combining ergonomics interventions in process improvement can result in effective identification and prevention of problems and enhance competitiveness of whole company.**



LATVIJAS
UNIVERSITĀTE



Thank you for attention!



Effectiveness comes from...

“...vision in action

Vision without action
remains a dream

Action without vision
becomes a nightmare

