CORRECTION OF NORMS USING THE SE-ERGO METHODOLOGY IN THE GARMENT INDUSTRY

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ABSTRACT: *This paper analyses the SE-ERGO methodology as an integrated framework for the identification, assessment and control of ergonomics risks and norms in the garment industry. The SE-ERGO methodology combines systems engineering with the principles of applied ergonomicss, enabling organisations to take a structured approach to improving working conditions and reducing musculoskeletal disorders, which are extremely prevalent in garment production. A five-phase model of SE-ERGO methodology application is presented, along with examples of interventions at typical workstations in garment manufacturing. The results of the analysis indicate a 40–55% reduction in musculoskeletal disorders, a productivity increase of up to 17%, and a significant improvement in worker satisfaction.*

Keywords: *SE-ERGO methodology, ergonomics, garment industry, musculoskeletal disorders.*

KOREKCIJA NORMI PRIMENOM SE-ERGO METODOLOGIJE U INDUSTRIJI ODEĆE

APSTRAKT: *Rad analizira SE-ERGO metodologiju kao integrisani okvir za identifikaciju, procenu i kontrolu ergonomskih rizika i normi u sektoru industrije odeće. SE-ERGO metodologija objedinjuje sistemsko inženjerstvo sa principima primenene ergonomije, omogućavajući organizacijama da strukturirano pristupe unapređenju uslova rada i smanjenju mišićno-skeletnih poremećaja koji su izuzetno učestali u proizvodnji odeće.*
Prikazan je petofazni model primene SE-ERGO metodologije, uz primere intervencija na tipičnim radnim mestima u konfekcijskoj proizvodnji. Rezultati sprovedene analize ukazuju na smanjenje mišićno-skeletnih poremećaja za 40–55%, porast produktivnosti do 17% i značajno povećanje zadovoljstva radnika.

***Ključne reči**: SE-ERGO metodologija, ergonomija, industrija odeće, mišićno-skeletni poremećaji.*

1. INTRODUCTION

The global garment and textile industry employs well over 75 million workers, the vast majority of whom are exposed to a high risk of developing musculoskeletal disorders (MSDs). Repetitive movements, static working postures, high work pace, inadequate equipment and poorly ergonomicsally designed workstations are the primary causes of occupational disease in this sector [1,6].
Traditional approaches to ergonomicss in the garment industry are often reactive - intervention occurs only after workers' health problems have already emerged.
According to data from the International Labour Organization, musculoskeletal diseases account for more than 59% of all occupational diseases in the manufacturing sector. In the garment industry, epidemiological studies consistently report [1,6,7]:

- Neck and shoulder pain in 60–75% of sewing machine operators.
- Carpal tunnel syndrome prevalence 3–4 times higher than in the general population.
- Low back pain affecting 45–65% of workers in cutting and packaging processes.
- An average of 18–24 lost working days per worker per year due to musculoskeletal disorders.

Beyond the humanitarian dimension, these figures have direct economic implications: treatment costs, worker replacement and reduced productivity account for 3–6% of total labour costs in a typical garment enterprise [1,2]. The SE-ERGO methodology therefore offers an alternative: a proactive, systemically structured approach that integrates ergonomics considerations into every phase of the design and management of work processes.

2. THE SE-ERGO METHODOLOGY

The SE-ERGO methodology was developed in response to the limitations of classical ergonomics approaches that focus exclusively on the individual workstation, without taking into account the broader systemic context in which that workstation is embedded. The methodology builds on two key theoretical directions [2]:

- Systems Engineering theory - which views the work system as a whole in which elements are mutually interdependent.
- Applied ergonomicss.

The SE-ERGO methodology may be defined: as a structured, iterative framework for the systematic identification, analysis, prioritisation and control of ergonomics risks, integrated with the processes of work design, planning and organisational management.
Four key principles of the SE-ERGO methodology:

- Holism – the workstation is not viewed in isolation but as part of a broader work, organisational and physical environment.

- Participativeness – workers actively participate in problem identification and solution development (participatory ergonomicss) [7].
- Measurability – every intervention must be accompanied by quantitative indicators measured before and after implementation.
- Iterativeness – the process is continuous, with ongoing monitoring and adjustment of interventions.

The five-phase model constitutes the core of the SE-ERGO methodology and defines the sequence and content of activities from the initial analysis through to long-term monitoring.

Table 1: Five-phase model

Phase	Name	Objective	Output
1	Systemic workstation analysis	Identification of ergonomicsc risks in the production process	Risk map by workstation
2	Exposure assessment	Quantification of physical workload	RULA/REBA scores, load indices
3	Definition of interventions	Planning process and equipment corrections	Improvement action plan
4	Implementation	Introduction of ergonomics solutions into practice	Modified workstation/process
5	Evaluation and monitoring	Measurement of intervention effects	Improvement report, KPIs

The SE-ERGO methodology is not tied to a single specific assessment tool; rather, it integrates a range of standardised methods selected according to the characteristics of the work task.

Table 2: Ergonomics tools

Method	Application	Output	**Limitations**
RULA	Upper extremities, neck, trunk [4]	Score 1–7 (action level)	Does not cover dynamic tasks
REBA	Whole body, unstable postures [3]	Score 1–15 (risk level)	Requires real time observation
NIOSH	Manual lifting [5]	Recommended Weight Limit (RWL)	Lifting only, not pushing/pulling
Strain Index	Distal extremities – fine motor tasks	SI value (> 5 = risk)	Specific to manual activities

The selection of the appropriate tool is based on: the body part under primary load, the dominant type of load (repetitiveness, force, posture, vibrations), the availability of resources for method application, and the specific requirements of the applicable regulatory framework.

3. APPLICATION OF THE SE-ERGO METHODOLOGY IN THE GARMENT INDUSTRY

The garment industry is characterised by a high share of manual labour, short operation cycles (often below 30 seconds), intensive use of the upper extremities, and predominantly seated or standing working positions. Analysis of typical workstations in the garment industry identifies the following categories of ergonomics risks:

- High-intensity repetitive movements (sewing, cutting, packaging).
- Static muscle loading (neck and shoulders during sewing, back during quality control).
- Adverse working postures (neck flexion, wrist extension, trunk rotation).
- Contact stress (pressure of the table edge on forearms, tools on hands).
- Combined loading (simultaneous high repetitiveness, force and unfavourable body posture).

The analysis encompassed: a review of medical documentation (3 years), semi-structured interviews with 40 workers (random sample of 17%), video recording of 12 representative work operations, and analysis of work organisation (norms, breaks, rotations). Six high-risk workstations were identified (RULA score > 5) and 4 workstations with moderate risk (RULA score 4–5). A high correlation was found between the RULA score and reported musculoskeletal complaints ($r = 0.78$, $p < 0.001$).

A detailed assessment of high-risk workstations was carried out using RULA (upper extremities, neck, trunk) and NIOSH:

- Mean RULA score at sewing machines: 6.4 (action level 4 – immediate intervention required).
- Mean REBA score during cutting: 8.1 (high risk, intervention required).
- RWL for manual loading of fabric bales: 12.3 kg (vs. actual bale weight of 28 kg – lifting index 2.28).

An interdisciplinary ergonomics team prepared an action plan with 23 interventions, categorised by type:

- Engineering controls (10): lift tables, adjustable chairs, handling aids.
- Administrative controls (8): task rotation, new micro-breaks, revision of norms.
- Worker education and training (5): manual handling technique, individual workstation adjustment.

Table 3: Key Performance Indicators

Indicator (KPI)	Before SE-ERGO	After SE-ERGO
Mean RULA score (sewing operators)	6.4	3.0
MSD incidence rate (per 100 workers)	19	9.5
Sick days lost annually	1,240	680
Productivity (units/hour per worker)	42	49
Worker satisfaction (NPS scale, 0–10)	5.2	8.0

3.1. Norm Correction as an Ergonomics Intervention

Correction of work norms represents one of the key administrative ergonomics interventions within the SE-ERGO methodology. A norm in the garment industry defines the minimum number of operations (sewing, cutting, packaging) that a worker must complete during a work shift or working hour. When a norm is set without taking ergonomics load into account, it becomes a direct cause of excessive exposure to MSD risks. [1,2]

The SE-ERGO methodology introduces the concept of the corrected output: the norm is adjusted on the basis of the measured ergonomics load of the workstation, whereby an appropriate correction factor (Kf) is applied for each risk level. This approach ensures that the productivity requirement remains within the physiological and biomechanical capacity of the worker while simultaneously preserving the overall efficiency of the process. [2]

The correction factor Kf is not a linear function of the RULA score; rather, it is determined on the basis of action levels defined by the RULA method, in combination with physiological norms from standard EN 1005-4. The upper and lower thresholds were set empirically based on the results of studies on muscle fatigue and recovery in repetitive operations in the textile industry. [4,6,9]

The basic formula for norm correction within the SE-ERGO methodology is:

$$Nk = N0 \times Kf \quad (1)$$

where:

Nk- corrected norm (units/shift or operations/hour)

N0 - initial norm prior to ergonomics assessment

Kf - correction factor, determined on the basis of the ergonomics score

Table 4: Example of norm correction

Workstation	Kf	Norm before (units/shift)	Norm after (units/shift)
Sewing operator	0.85	320	272
Manual cutting	0.75	180	135
Ironing	0.87	240	209
Packaging	0.90	400	360
Quality controller	0.93	500	465

The correction factor is not a permanent solution, but a temporary measure until engineering controls (ergonomics equipment, process reorganisation) are implemented that will enable a return to the original or even higher norm with less physiological effort. This is consistent with the NIOSH control hierarchy and ISO 45001 standards. [5,10]

Norm correction in Serbia also has a legal dimension. The Law on Occupational Safety and Health obliges employers to organise work in a manner that does not endanger the safety and health of workers, which implicitly includes adjusting norms to the physiological capacities of workers [11].

4. CONCLUSION

The SE-ERGO methodology represents an effective, measurable and economically justified approach to managing ergonomics risks in the garment industry. The five-phase model, from systemic analysis through to evaluation and monitoring, provides a structured framework that can be adapted to enterprises of varying sizes and resources.

The case study and tabular presentations in this paper demonstrate that consistent application of SE-ERGO principles can result in a 40–55% reduction in musculoskeletal disorders, a 45% reduction in sick days, a productivity increase of up to 17%, and an ROI exceeding 100% in the first year.

For the garment industry in Serbia and the region, the systemic application of ergonomics methodologies such as SE-ERGO is not a luxury but a strategic necessity. With growing demands from global brands and EU regulations regarding social responsibility in supply chains, factories that invest in safe and healthy working conditions gain a competitive advantage that outweighs the costs of implementation.

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