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Macroergonomics in the service of agility – how work system design supports decentralization of decision-making and operational flexibility

Agnieszka Bartkowiak, Marcin Butlewski

Abstract

The research was carried out in SMEs from the food industry, producing pasta, in order to improve the production process, as a result of decentralization of decision-making and introduction of operational flexibility. As part of the research, problems occurring in the company were identified, especially in the aspect of ergonomics of production workers' positions, their well-being and the process of information flow in the organization. The surveys allowed for verification of subjective feelings of production workers both in terms of their well-being, cultural factors and the culture of agility. Since an agile organization is characterized by the ability to quickly respond to market changes and customer needs, which requires not only flexible structures, but also appropriately designed work processes that allow employees to make decisions independently, a proposal was introduced to reorganize the company's structure. Additionally, standardization of procedures was proposed as a result of introducing visual instructions for individual production stages, which will facilitate employee training and ensure the repeatability of the pasta production process. By analyzing the organization as a whole and taking into account the interactions between people, technology (production line devices) and the work environment, it was possible to create a system that combines these elements, which made it possible to continuously improve it, despite turbulent market conditions. Thanks to this, different organizations can adapt more quickly to unpredictable changes, improving operational efficiency and market competitiveness.

Keywords: ergonomics, organizational agility, operational flexibility, organizational adaptation, process optimization, pasta, information flow, SME, agility culture

Ergonomic analysis of working conditions in M18 Dromader airplane - recommendations for improvement in firefighting and agricultural aviation

Marcin Berlik, Marta Broda

Abstract

Firefighting flights are among the most difficult and dangerous aviation operations. They place a very heavy mental and physical strain on the pilot. Operating at very low heights, the high risk of collision with obstacles, and the need to perform movements with the utmost precision and coordination while simultaneously exerting larger forces on the controls pose a major challenge. Body position and musculoskeletal strain play a very important role in the safety of these operations, affecting not only the strain associated with performing the task, but also the pilot's reliability and possible musculoskeletal discomfort, especially in the case of operations lasting several hours or more.

After conducting interviews with pilots indicating major problems related to aircraft cockpit ergonomics, the musculoskeletal load in the cockpit of the M18 Dromader aircraft was analyzed. This type of aircraft is one of the most widely used firefighting aircraft in the world. The study was conducted using the RULA method for 24 body positions related to performing activities in the cockpit.

For the items examined, the load ratings ranged from 4 to 7 on a seven-point scale. According to these assessments, each item requires additional testing, and for most of them, the assessment indicates the need for urgent extended testing or immediate corrective action. Possible corrective actions and useful guidelines for the design of subsequent versions of the M18 Dromader aircraft or its successor were proposed.

How Ergonomic Approaches Support Sustainability and ESG Goals – From Green Ergonomics to Sustainable Organizations

Marcin Butlewski, Marta Broda

Abstract

The publication How Ergonomic Approaches Support Sustainability and ESG Goals – From Green Ergonomics to Sustainable Organizations addresses the role of ergonomics in achieving sustainable development goals and in ESG reporting. The starting point is to identify the convergence between ergonomics and the concept of sustainable development and to show the evolution of this discipline – from industrial ergonomics, through macroergonomics, to contemporary concepts of sustainable and green ergonomics. The article poses the research question: how do ergonomic activities influence the achievement of ESG goals in organizations? In this context, the main trends in research on the links between ergonomics and sustainable development were analyzed, ESG goals particularly supported by ergonomic practices were identified, and examples of good practices and potential ergonomic indicators that can be used in reporting were presented. The study was conducted using a systematic literature review in accordance with the PRISMA protocol, using the Scopus and Web of Science databases. The results indicate that ergonomics—traditionally perceived mainly in the area of social sustainability—has much broader potential and can also significantly support environmental and economic pillars. This reveals the underestimated role of ergonomics in current ESG standards and highlights the need for broader inclusion of its indicators in organizational reporting practices.

The Impact of Ergonomic Activities on Shaping Safety Culture in Manufacturing Companies

Wiktoria Czernecka

Abstract

Achieving a high level of safety culture is becoming the goal of many modern enterprises due to the possibility of shaping safe working conditions and obtaining greater employee awareness of threats at work and employee participation in taking actions to prevent dangerous situations. In order to improve the level of safety culture, activities are carried out in the area of safety promotion, safety training, analysis of accidents at work and risk analysis and presenting its results to employees. It is noted, however, that one of the elements supporting these activities may be taking into account ergonomics in work organization. As part of this article, research was conducted among 106 employees of Polish occupational health and safety services, who assessed statements regarding the implementation of ergonomics in various aspects of activities aimed at shaping a higher level of safety culture. Based on the data obtained in the study, the level of ergonomic activities undertaken in companies was determined in relation to the assessed level of safety culture. Based on the results of the correlation analysis, conclusions were drawn about the existence of strong and very strong correlations between the statements assessed by respondents and the assessed level of activities undertaken to shape the safety culture. The research results allowed for conclusions on the shaping of safety culture through ergonomics and appropriate activities in this area, as well as for the development of recommendations regarding their implementation in the company's everyday functioning.

Keywords: safety culture, ergonomics in OHS, social responsibility

Methodology of shaping textual information in educational classrooms

Grzegorz Dahlke

Abstract

When preparing multimedia presentations containing text information, one of the basic issues to consider is determining:

- the size of the font used;

- the amount of information on a single slide.

The final effect of the reception of content constructed from a specific font size will depend, for example, on:

- screen size,

- projector location,

- projector settings,

- the location of the recipient of the information in relation to the screen.

The tasks listed above are the responsibility of the room designer, but they should develop guidelines for the person preparing the presentation. Based on the relationships between the optimal viewing angle, field of view and reading speed ranges, a methodology for selecting font sizes in multimedia presentations has been developed. These parameters will depend on the distance and location in the field of view. Examples will be presented that can be used as a guide for presentation authors and designers of visual systems in teaching rooms.

Comparison of selected methods for measuring the position of movement system segments in diagnosing work performance

Grzegorz Dahlke, Milena Drzewiecka-Dahlke

Abstract

During ergonomic studies of work processes, which include the analysis and assessment of employee posture, methods and tools are used that require the identification of the angles of the segments of the musculoskeletal system. Such studies are conducted in many ways, e.g. angle measurements on photographs or film (goniometers or analogue protractors, goniometers or digital protractors), measurements using electro-goniometers attached to segments of the musculoskeletal system, motion capture systems (phone applications, accelerometers, cameras scanning the movement of markers on the employee's body)). Sensory equipment, although expensive, is increasingly used in ergonomic studies of work processes. The benefits of using such tools, compared to the techniques mentioned at the beginning, are that they reduce the labour intensity of observation. However, there are also disadvantages, including measurement uncertainty, which affects the quality of the representation of the movements of the observed employee. The authors of the paper will present a comparison of measurements of the position of selected segments of the musculoskeletal system using electronic goniometers and accelerometers utilising indirect biomechanical models. The comparison will concern the upper limb and the impact of measurement differences on the assessment of work performance, taking into account methods and tools such as SWP Audit, REBA and RULA.

Organizational Ethics and Occupational Ergonomics as a Pillar of Well-being in Society 5.0

Aleksandra Dewicka-Olszewska

Abstract

Society 5.0, focused on the harmonious coexistence of humans and technology, requires a redefinition of the approach to work organization and management. In this context, organizational ethics and work ergonomics are the foundation for building the well-being of individuals and entire communities. Organizational ethics, by promoting transparency, responsibility, and trust, shape an organizational culture that supports lasting interpersonal relationships and sustainable development. Work ergonomics, in turn, focuses on adapting the work environment to a person's psychophysical capabilities, fosters increased efficiency, reduces burdens, and minimizes the risk of health and psychosocial disorders. The synergy of these two areas allows for the creation of people-friendly workplaces, where well-being becomes a strategic organizational resource. In an era of intense digitization and process automation, the humanization of technology and the implementation of practices that support a balance between innovation and employee needs are particularly important. This integration of ethics and ergonomics defines the direction of development for socially responsible organizations, which constitute the core of Society 5.0.

Keywords: Society 5.0, organizational ethics, work ergonomics, employee well-being, humanization of technology, sustainable development.

Factors affecting the Psychophysical Abilities of Operators in High-Reliability Organizations

Tomasz Ewertowski, Julia Brotier, Kinga Niemier

Abstract

Modern operational environments—particularly in high-risk sectors and High Reliability Organizations (HROs)—require operators to possess not only advanced technical competencies, but also high levels of psychophysical fitness and resilience to stress and attention-disrupting factors. The ability to maintain focus, respond quickly and appropriately to stimuli, and perform effectively under time pressure and task overload are crucial for ensuring safety and operational efficiency. These premises, combined with the authors' professional experience, led to an investigation of the factors influencing specific psychophysical traits of operators and how these can be applied in human resource management practices within HROs, such as aviation organizations. The study included two research groups: aviation students with flight experience (pilots) and aviation students from non-flying specializations. The research utilized a cross apparatus and a reaction parameter recorder to measure reaction time and response accuracy, both in distraction-free conditions and under cognitive interference. Additionally, a questionnaire was employed to examine self-reported factors potentially affecting the psychophysical characteristics of the participants. The results showed statistically significant differences between the groups, with notably better performance observed in the pilot group. The study also identified factors that positively influence psychophysical abilities, for example such engagement in reflex-based video games. Based on these findings, the authors proposed strategies for supporting the psychophysical well-being of operators as part of human resource management in high-reliability organizational settings.

Toward Human-Centered Innovation: Macroergonomics for Knowledge Work in Industry 4.0/5.0

Diana Freiberga, Zenija Roja, Henrijs Kalkis

Abstract

As knowledge-intensive sectors such as research and development, biotechnology, and information technology become increasingly central to innovation and economic growth, the complexity of their work systems continues to evolve. Industry 4.0/5.0, characterized by digitalization, artificial intelligence, and cross-sectoral integration, has introduced new occupational challenges, including heightened cognitive demands, globalized collaboration, and constant adaptation to rapid technological change. Despite these developments, macroergonomics remains underutilized as a framework for system-level design in such environments.

This study introduces macroergonomics as a critical yet overlooked perspective for understanding and improving the well-being and performance of knowledge workers in the modern, knowledge-based economy. We argue that the distributed, collaborative, and cognitively demanding nature of work in these sectors calls for a systems-wide approach - one that considers the interaction between individuals, technologies, organizational structures, and environments.

The paper outlines the key occupational challenges faced by knowledge workers and maps how macroergonomic models can address organizational fragmentation, design misalignments, and psychosocial stressors. We conclude with an agenda for future empirical research and a call to integrate macroergonomics into the design of complex, multi-actor work systems to support sustainable innovation and human well-being.

Keywords: Macroergonomics, Knowledge-intensive work, Industry 4.0/5.0, Occupational challenges, Systems-wide design

Ergonomic challenges in collaborative human-robot workplaces

Brigita Gajšek

Abstract

The integration of collaborative robots into human workspaces presents new ergonomic challenges that differ from those in traditional automation. This paper reviews current research on the ergonomic implications of human-robot collaboration, with a focus on physical, cognitive, and organizational factors. Studies reveal that while collaborative robots can reduce physical workload by taking over repetitive or strenuous tasks, they can also introduce new risks related to posture, movement variability, and attention demands. Cognitive challenges include increased monitoring, decision-making under uncertainty, and mental fatigue. Additionally, psychosocial aspects such as trust, stress, and perceived autonomy play a significant role in shaping ergonomic outcomes. This review emphasizes the need for interdisciplinary approaches that combine human factors, robotics, and workplace design. The goal is to inform safer and more effective human-robot collaboration by aligning technology design with ergonomic principles.

Key words: workplace design, collaborative workplace, collaborative robot, ergonomics

The concept of standardizing remote workstations - a case study

Julia Giernalczyk, Wiktoria Czernecka

Abstract

Due to the dynamic growth of remote work, an increase in safety and ergonomics issues is noticeable when working from home. Employees organize their own workstations, which often go unchecked. Standardizing workstations can significantly impact their physical and psychological safety. This article focuses on researching and assessing the needs of IT employees regarding remote workspace organization. Based on this, ready-made solutions are presented, including optimal organizational models and tools that can be used to increase safety and prevent accidents. The commercialization potential of the proposed solutions is assessed, taking into account the potential for implementation in various organizations and the scale of economic benefits.

Keywords: safety culture, ergonomics in OHS, social responsibility

Improvement of Work Ergonomics by use of the Quality Management Principles

Adam Górny

Abstract

The inclusion of ergonomic guidelines aimed at improving working conditions in the principles of systemic organizational management is increasingly becoming a central prerequisite for the successful operation of business organizations. By adopting systemic principles to improve the quality of working conditions, organizations gain access to effective tools for eliminating hazards and strenuousness and consequently acquire the ability to grow and improve themselves. Any measures adopted within that framework are undertaken in recognition of the roles and tasks of employees, perceived as internal customers of specific processes. The important is identification of factors which ensured effectiveness to improve of work conditions. In particular, must reference to capabilities, which impact on improving of human functioning capabilities.

This activities can be related to the principles of quality management system. Principles to pay attention to include:

- customer orientation,
- leadership,
- commitment,
- process approach,
- systemic approach,
- continuous improvement,
- dedication to decision-making,
- partner relationships with suppliers.

In prospect, companies which adopt such management principles gain the ability to rationally select concepts (such as lean management, reengineering, benchmarking, just-in-time deliveries) thereby supporting organization management. As a consequence, they are in a position to improve their operations in keeping with ISO guidelines and are inspired to continually enhance their performance.

Keywords: quality management, work environment, management principles, improvement of work condition, ergonomics

Designing sustainable layouts in manufacturing by multicriteria scatter plot optimization

Jerzy Grobelny, Rafał Michalski

Abstract

The Facility Layout Problem (FLP), fundamentally defined as the optimal arrangement of n objects within a given space based on a coefficient matrix describing their desired proximity, is a cornerstone of manufacturing efficiency. This paper introduces a novel multicriteria approach to the FLP utilizing the fuzzy virtual force algorithm, a heuristic method that employs fuzzy logic to model relationships and distances between objects. The algorithm iteratively adjusts object positions to generate layouts.

Our proposed approach considers two primary optimization criteria: (1) Minimization of the average "economic" objective function. This is calculated as the sum of products of links and distances for all pairs of objects, representing a traditional cost-efficiency measure. (2) Maximization of the average uniformity of objects distribution. This novel criterion assesses the percentage of occupied zones within the designed layout, aiming to avoid congestion and ensure smooth material flow, particularly crucial in applications focused on sustainability.

To evaluate the sensitivity of our approach to parameter changes and to develop practical recommendations, we conducted a series of experiments. These experiments employed the fuzzy virtual force algorithm, analyzing critical parameters such as virtual force value, fuzzy distance definition, and the shape of the membership function for fuzzy relationships. We tested both real-life benchmark examples (Nugent 15 and Nugent 30) and randomly generated instances. They varied across five levels of object count (15, 20, 25, 30, 35) and five levels of relative relationship density (L10%, L25%, L40%, L55%, L70%), with relationship matrix values ranging from 1 to 9. The algorithm's crucial parameters – Virtual force value (1, 3, 5), Fuzzy distance definition (FD10, FD20, FD30, FD40), and membership function shape (Concave, Linear, Convex) – were also systematically examined.

Given that initial five-way full factorial analyses of variance revealed significant differences for almost all effects and their interactions, we proceeded with a series of nine three-way ANOVAs. These were performed for three distinct object counts (15, 25, 35) and three different relative relationship densities (L10%, L40%, L70%), involving the three alinks algorithm parameters. Based on these results, we developed recommendation tables for practitioners aiming to minimize the classic goal function, tailored to the number of objects and the relative relationship density characteristic of their specific problem.

Similar analyses were conducted for the proposed dependent variable assessing the uniformity of object distribution. The results of this analysis are also presented in a table, serving as a recommendation tool for practitioners seeking to optimize for layout uniformity. Finally, we compared our findings with results obtained using Drezner's algorithm and the non-metric multidimensional scaling procedure, identifying scenarios where each analyzed approach yields the best solutions across the two proposed criteria.

Ergonomic Features of Mobile Applications for Public Transport

Krzysztof Hankiewicz

Abstract

A key element of urban transport development, in addition to the development of the network and means of transport, is information supporting this type of transport. Public transport users most often expect information to be delivered via mobile devices. Therefore, this article discusses the importance of information in urban transport and presents a comparative analysis of mobile information applications for public transport passengers. The aim of this article is to assess the usefulness of selected mobile applications designed to support public transport users. The first part of the study analyzed the expectations and needs of public transport customers regarding obtaining up-to-date information about its operation. Basic functionalities, such as route information and timetables, are no longer sufficient. Nowadays, users expect, for example, real-time updates of vehicle locations and connection options that allow them to get from one location to another, taking into account transfers, in the shortest possible time. When analyzing the expectations of public transport users, we attempted to consider the importance of individual criteria. Based on the results of the expectations analysis, the fulfillment of ergonomic criteria for selected mobile applications was verified. The results of the analysis can be used by users to select applications tailored to their needs and simultaneously identify application elements that require improvement.

Keywords: ergonomic criteria, urban transport, mobile application

The Use of Ergonomics Methods in Logistics Process - Case Study

Kristina Hudin, Tihomir Opetuk, Maja Trstenjak, Goran Đukić

Abstract

Ergonomics has become increasingly significant in modern workplaces, as employees spend long hours engaged in job-related tasks, often in static positions and under constant technological exposure. As a scientific discipline, ergonomics seeks to adapt working conditions to human physical and psychological abilities. Its main objectives are to increase productivity, safeguard health and safety, and improve overall well-being. When applied correctly, ergonomic practices help reduce fatigue, prevent workplace injuries, and promote a healthier and more efficient working environment.

By designing tools, tasks, and workspaces in harmony with human capacities, ergonomics minimizes unnecessary effort and discomfort. This enhances worker comfort and safety while also contributing to clearer operational standards.

With the rise of Industry 4.0 technologies—such as automation, digitization, and artificial intelligence—new ergonomic challenges have emerged. These rapid technological shifts demand continuous adaptation of ergonomic strategies to maintain safe, sustainable, and healthy work practices.

This paper presents a broad overview of ergonomics and outlines essential ergonomic methods. Particular emphasis is placed on the software solution ErgoFellow 3.0, which integrates a range of tools for evaluating and improving workplace ergonomics. The use of computer-aided ergonomics allows for faster and more precise assessments of working conditions, ultimately supporting safer and more productive work environments.

Keywords: ergonomics, logistic process, NOSH, OWAS, discomfort questionnaire

Universal Design in ergonomics teaching practices

Katarzyna Jach

Abstract

This presentation details the integration of Universal Design (UD) principles into ergonomics education, focusing on a multi-faceted approach that spans projects, laboratory work, and lectures. The core objective is to enhance student awareness and practical application of UD, which is defined as the design of products and environments to be usable by all people, regardless of age or ability. Student feedback suggests this multi-faceted approach, including a focus on digital accessibility, is highly engaging and valuable. The findings underscore the benefits of using a Universal Design for Learning (UDL) framework to create a more inclusive and effective educational environment.

Production Line reorganization in the third phase of the Product Life Cycle considering ergonomics and safety – case study

Katarzyna Kalisz-Szwedzka, Marcin Orzechowski

Abstract

The article presents a case study of the reorganization of a production line in the third phase of the product life cycle using Value Stream Mapping (VSM). The analysis identified key problems such as an excessive number of workstations, non-ergonomic transport solutions, oversized containers, and risks associated with forklift operations.

The implemented actions included redesigning the workstation layout, introducing overhead cranes instead of manual handling and forklifts, reducing container size by 40%, and eliminating unnecessary communication routes. These changes improved workplace ergonomics, enhanced safety, and optimized material flow along the production line.

Special attention was given to stacking operations. The study emphasized the necessity of compliance with occupational health and safety regulations, the reduction of manual handling tasks, and the adoption of modern solutions such as electric stackers. Another important element was training employees in safe lifting techniques and proper workstation organization.

In conclusion, the reorganization and integration of Lean Manufacturing tools with ergonomics and OHS principles proved effective. The results included increased efficiency, reduced risks, and the establishment of a foundation for a new, safer, and more ergonomic production line.

Keywords: VSM, ergonomics, workstation, internal transport, stacking operations

Wearable Sensor Systems for Ergonomics, Safety and Productivity in Industrial Environments

Marija Labaš, Maja Trstenjak, Tihomir Opetuk, Goran Đukić

Abstract

This paper investigates the development and industrial application of wearable sensor systems, with emphasis on their role in ergonomics, occupational safety, and productivity improvement. The study covers multiple technologies, including inertial measurement units (accelerometers), electromyography (EMG) sensors, physiological monitoring devices, augmented reality (AR) head-mounted displays, and powered exoskeletons. Several case studies from the literature are analyzed to illustrate implementation strategies and measured outcomes. Results demonstrate that wearable sensors enable objective assessment of biomechanical load, support task analysis and workflow optimization, and reduce risk factors associated with work-related musculoskeletal disorders. Advantages and limitations are systematically evaluated, with focus on technical aspects such as sensor accuracy, data integration, interoperability, and user acceptance in industrial environments. Positioned within the Industry 5.0 paradigm, the paper highlights the contribution of wearable technologies to cyber-physical systems and data-driven decision support. Findings confirm that well-designed wearable systems can enhance workplace safety and efficiency while supporting human-centric manufacturing.

Keywords: ergonomics, industry 5.0, wearable sensors, human factors, cognitive ergonomics

Human Factors in Shaping Preventive Measures in Quarrying Occupational Accident Investigation

Jelena Lezdkalne

Abstract

While human factors (HF) are increasingly acknowledged in workplace safety, their influence on preventive actions remains unclear. In high-risk industries like quarrying, understanding how HF findings are translated into corrective measures is key to improving organizational learning and safety culture. This study evaluates whether recognition of HF in accident investigations leads to meaningful preventive actions.

A retrospective review of 150 accident investigation reports (2014-2024) produced by quarrying company was conducted. Each report was analysed for HF mention, depth of analysis, and type of corrective actions, categorized by target and nature.

HF were referenced in 90 reports, yet only 24% recommended preventive actions beyond individual-level solutions. Most responses focused on training, reminders, or procedural updates, while systemic issues were rarely addressed. Reports with deeper HF analysis remained minority.

Findings indicate that recognizing HF alone does not reliably drive systemic change. To imrove safety outcomes, HF should be integrated not only into accident analysis but also into the development of preventive and corrective actions.

Keywords: human factors, accident investigation, high-risk industry, organizational learning

Exploring the Impact of Familism on Safety Culture in Family Firms – Methodological Challenges from a Systemic-Interpretive Perspective

Rafał Mierzwiak

Abstract

The aim of this paper is to examine the methodological challenges of studying the influence of familism on the safety culture of family-owned organizations. Familism is understood here as a normative system in which loyalty, emotional bonds, and intra-family relations shape decision-making, communication, and risk governance. In such organizations, decisions relat-ed to safety, hazard response or formal safety protocols are often deeply embedded in infor-mal and relational family logic.

Despite growing interest in both safety culture and family businesses as research domains, there is a lack of robust methodological tools that can grasp the complex, dynamic, and relational nature of family life as it influences organizational safety. This paper proposes a systemic-interpretive methodology, combining elements of qualitative analysis with structured system modelling.

The following methods are highlighted:

- Interpretive Structural Modelling (ISM) – to identify and hierarchise key factors that influence safety culture;
- MICMAC – to classify variables as driving, dependent, or linkage elements within the system;
- DEMATEL – to determine the direction and intensity of causal relations between familism and organisational behaviours.

This approach allows for a structured transition from narrative data to system models while respecting the subjective and contextual nature of the phenomena studied. The paper also dis-cusses methodological difficulties, such as:

- translating informal family values into formalised variables,
- dealing with incomplete and ambiguous data,
- triangulating between expert knowledge, interviews, and organisational context.

Preliminary findings from Polish family firms suggest patterns such as informal control, avoidance of written safety procedures, and strong reliance on interpersonal trust. Further stages of research will incorporate Fuzzy Cognitive Mapping (FCM) to model dynamic resilience and safety behaviour in succession and crisis scenarios.

This study contributes to the emerging field of safety culture in family firms by proposing an innovative research design tailored to socially embedded and culturally sensitive organisational systems.

Keywords: familism, family firms, safety culture, systems modelling, interpretive approach, ISM, DEMATEL, MICMAC, fuzzy cognitive mapping, qualitative methodology

The Effectiveness of Antagonistic Digital Advertising in the Soccer Sector

Arkadiusz Morawski, Rafał Michalski

Abstract

This study investigates the effectiveness of antagonistic digital advertising within the professional soccer sector, focusing on its impact on user engagement. The research employed a controlled experimental design, utilizing digital banners disseminated via search engines, websites, and social media platforms. Participants were exposed to advertisements featuring two independent factors: outfit type (neutral vs. club-specific) and banner slogan (neutral vs. antagonistic). The study specifically targeted fans of two prominent Polish football teams from Kraków (TS Wisła Kraków and KS Cracovia). The effectiveness of the digital banners was assessed across three key dependent variables: Click-Through Rate (CTR), conversion/registration rates (sign-ups for a free game account), and time spent on the landing page. The collected data underwent rigorous statistical analysis, including a series of two-way analyses of variance (ANOVA) and post-hoc tests, to identify significant differences between the independent factors, their levels, and any potential interaction effects. The findings aim to provide valuable insights into optimizing digital advertising strategies for sports organizations, particularly concerning the use of antagonistic messaging to drive user engagement and conversion.

Exposure to Blue Light and Its Consequences for Sleep and Psychophysiological Well-Being of Workers

Żaneta Nejman, Kacper Gapczyński, Kinga Szmyt

Abstract

The phenomenon of blue light is no stranger to anyone these days. We encounter it every day through the use of phones, tablets, computers, and laptops. Unfortunately, many technology users are unaware of its harmful effects. The growing interest in the impact of blue light on the human body is closely linked to the observed increase in sleep disturbances, especially among users of electronic devices.

The aim of this article is to analyze the negative effects of evening exposure to blue light on sleep quality, as well as its potential impact on employee well-being. The article presents the results of original research conducted using survey questionnaires, along with a description of the research methodology and an analysis of the results obtained. Additionally, a set of recommended best practices for reducing blue light exposure is provided. The study's results confirm a significant correlation between the use of blue light-emitting devices and the deterioration of sleep quality, highlighting the need for education in digital hygiene and preventive healthcare.

Keywords: blue light, sleep quality, psychophysiological well-being, employee well-being, digital hygiene

A Review of Theoretical Approaches and Models of Trustworthy and Usable AI in Healthcare - preliminary results

Swati Ojha, Rafał Michalski

Abstract

Artificial Intelligence (AI) continues to transform healthcare by enabling data-driven clinical decisions and enhancing diagnostic accuracy. However, the widespread adoption of AI systems—especially those grounded in complex, opaque algorithms—raises critical concerns surrounding transparency, trust, and usability. This systematic review examines the theoretical foundations and practical implementations of AI within the healthcare domain. We identify a diverse range of models aimed at improving the interpretability of AI outputs for clinicians and patients alike, while highlighting their strengths, limitations, and contextual suitability. Core challenges include aligning explainability with clinical utility, mitigating bias, and ensuring ethical compliance in patient-facing applications. Further, we explore cognitive and usability frameworks that influence trust formation and the acceptance of XAI tools. Our findings suggest that explainability alone is insufficient; systems must also be comprehensible, context-aware, and integrated into existing clinical workflows. We conclude by advocating for interdisciplinary frameworks that prioritize both technical rigor and human-centered design to realize truly trustworthy and usable AI in healthcare.

Challenges to Deploying AI in Healthcare - a survey based study

Swati Ojha, Rafał Michalski

Abstract

Artificial Intelligence (AI) has the potential to revolutionize healthcare by improving diagnostics, clinical decision-making, and operational efficiency. However, despite increasing availability, the real-world implementation of AI tools in clinical settings faces multiple challenges. This paper presents findings from a structured, survey-based study conducted among medical students, interns, and healthcare professionals to investigate the perceived barriers and enablers of AI adoption in healthcare environments.

Preliminary results indicate a generally positive attitude toward AI, especially among early-career professionals. However, significant barriers persist, notably concerns over data privacy, lack of formal training, system integration issues, and legal uncertainty. While participants reported moderate levels of trust in AI-generated recommendations, their willingness to use such tools in clinical practice was strongly influenced by prior exposure and institutional support.

The findings underscore the importance of structured training, clear regulatory guidelines, and human-centered AI design to bridge the gap between innovation and implementation in medical AI. These insights contribute to ongoing efforts to optimize human-AI interaction in healthcare and inform future system development strategies.

Ergonomic Existential Dilemma of Strategic Conditions for Implementing Artificial Intelligence

Leszek Pacholski

Abstract

The presented research results are based on the concept of a strategic portfolio analysis for implementing modern artificial intelligence tools such as: language models (ChatGPT, DeSepeek, PLLuM, Gemini 2.5, Sonnet, Opus 4, Grok), AGI agents (Operator), and AI superintelligence, along with their accompanying technological artifacts (modern microprocessors and graphics processors units GPUs). The research utilized a brainstorming approach. The analysis utilized: Delphi method, a product lifecycle analysis, Porter's five forces model (intra-sector competition, buyers, suppliers, substitution, new competitors), a macro-environmental conditions: political, economic, social and technological (PEST method) and an assessment of strengths, weaknesses, opportunities, and threats (SWOT).

Leonardo da Vinci's model of the "Vitruvian Man" is a symbolic representation of human subjectivity in relation to "all things" in general. It also refers specifically to the processes of continuous creation and perfection of developmental order and harmony through science and technology. For this reason, this model has become a universal symbol of ergonomics, which classifies technological tool solutions as human-centric systems. Such systems must have the quality of internal order and harmony. They should be methodically created and continuously improved (controlled) through management processes. Therefore, technological tool solutions cannot be created and developed in conditions of unpredictable changes caused by their implementation and contrary to the moral and ethical ergonomic requirements of human subjectivity. The development of technological tools that support natural human limitations and capabilities in perception, information and knowledge processing, and reasoning, (enabling understanding of surrounding situations and finding appropriate responses, known as intelligence), has progressed throughout history from abacuses to molecular and quantum computers. The measure of contemporary technological achievements in this area are, among others, the achievements of neuro-informatics, expert systems and artificial intelligence systems based on the concept of neural networks and machine learning.

The conclusions demonstrates the ergonomic dilemma of strategic conditions for implementing artificial intelligence. On the one hand, its ergonomic utility and on the other, the existential threat to humanity. This threat is "Orwellian" and "Huxley-an" in nature, both globally and locally. It is a consequence of the possible victory (in the race for technological supremacy) of an autocratic political, social, and economic ruling cliques that rejects the democratic moral and ethical imperative of contemporary ergonomics.

Hospital Patient Identification

Janusz Pokorski

Abstract

Upon admission to the hospital, each patient should be provided with a wristband that enables recognition both within the facility and outside the hospital also by individuals other than medical personnel. The wristband should remain in place throughout the hospital stay, including hygienic procedures. The information displayed on the wristband must comply with the provisions of the General Data Protection Regulation (GDPR). Until recently, it was not permitted to include the patient's surname on the wristband. The PESEL number (Polish National Identification Number) still should not appear in an uncoded form, although it is required prior to admission to the operating theatre, diagnostic-therapeutic units and the blood service.

The wristband should include the following information:

- first name (in lowercase letters) and SURNAME (in uppercase letters);

- date of birth;

- Main Hospital Register Number (MRN);

- full name of the hospital – without it, the MRN or hospital ID is meaningless;

- phone number of a nursing station responsible for the patient – especially important if the patient leaves the hospital lawlessly;

- the PESEL number displayed as a barcode;

- hospital ID – the number assigned to the patient during first contact with the hospital and used during any subsequent admissions; like the MRN, the hospital ID does not need to be encoded.

Key words:

patient identification, confidentiality of data, PESEL, GDPR

The concept of the Estonian Musculoskeletal Disorders Questionnaire

Märt Reinvee, Kristiina Hovi

Abstract

This paper introduces the Estonian Musculoskeletal Disorders Questionnaire (EMDQ), a practice-oriented tool for assessing the prevalence of musculoskeletal disorders in the workplace. Work-related musculoskeletal disorders (WRMSDs) are a major occupational health concern across sectors such as manufacturing, healthcare, construction, and agriculture. Prevention largely depends on workstation-level interventions, where monitoring musculoskeletal discomfort helps set priorities. Although several tools exist for mapping WRMSD prevalence, they often face usability challenges for both workers completing the questionnaires and occupational health and safety (OHS) specialists analysing the data. The EMDQ is designed to address these issues. Available in both paper and electronic formats, it features a gender-neutral body map that divides the body into distinct regions, supporting inclusive dissemination among workers. The questionnaire is intentionally brief to minimize worker effort. For OHS specialists, the EMDQ enables automated data processing that: 1) visualizes the most affected body regions, 2) estimates prevalence within the sample and extrapolates to the entire workforce, and 3) compares company-level data with sectoral averages. Additionally, the EMDQ includes guidance to ensure compliance with GDPR, supporting ethical data handling practices.

Keywords: ergonomics methods, prevention of musculoskeletal disorders, assessment of musculoskeletal discomfort

The use of computer-aided 3D modeling systems in teaching ergonomics – examples of implementation using CATIA and Blender software

Michał Rychlik, Pola Wladman

Abstract

Modern Computer-Aided Engineering (CAE) systems integrate an increasingly wide range of technical knowledge, enabling the execution of advanced numerical analyses. Alongside the evolution of such software, various complementary technologies—especially in the fields of visualization (e.g., virtual reality displays) and human–computer interaction (interactive interfaces)—are also rapidly advancing.

The integration of 3D models of technical objects with digital human body models allows for conducting ergonomic analyses in a virtual environment. These analyses, known as Computer-Aided Ergonomics, have become an essential component of contemporary product and workplace design processes.

This article presents the application of the CATIA v.5 system (Delmia module) to conduct a numerical ergonomic experiment, as well as an alternative open-source tool—Blender software using the Armature rigging system. The discussion is based on examples from master's-level coursework, where both tools are implemented in didactic settings. The article also provides a comparative evaluation of the functionalities, advantages, and limitations of each solution in the context of ergonomics education in virtual environments.

Keywords: virtual ergonomics, CAD/CAX systems, virtual engineering

Assessment of Evacuation Readiness: A Report from a Selected Academic Community Study

Joanna Sadłowska-Wrzesińska, Michał Skwierczyński

Abstract

“Assessment of evacuation readiness: a report from a selected academic community study”

The research problem addressed by the authors concerns the assessment of the academic community's preparedness for evacuation in crisis situations. The study, conducted at the Faculty of Management Engineering at Poznań University of Technology, aimed to analyze both the level of knowledge and the subjective sense of preparedness to take action in a crisis situation. The assessment was based on a survey containing a knowledge test component, addressed to students, academic staff, and administrative staff. The results indicated a moderate level of knowledge of evacuation procedures, with a simultaneous overestimation of self-assessment of evacuation readiness. Furthermore, the low turnout may indicate limited interest in evacuation within the academic community, which underscores the need for in-depth analyses of the barriers to effective response, as well as preferred forms of risk communication. The authors emphasize the crucial role of regular training and practical exercises in building situational awareness and effective evacuation preparation.

Ergonomic Risk Mitigation Through Task-Specific Assistive Technology: A Case Study from Slovak Industry

Karolína Šablaturová, Karina Šošková, Dariusz Trachta, Kocůrková Lucie

Abstract

This paper presents a case study on the implementation of a custom-designed industrial manipulator in a Slovak manufacturing company, developed to meet the unique demands of its production process. The intervention aimed to reduce physical strain during manual handling of heavy and awkward components, while ensuring compliance with Slovak ergonomic legislation. Due to exceeded weight and force limits defined by national regulations, certain tasks in the original process could not be legally performed by female workers. This limitation not only affected workforce flexibility but also raised concerns about gender equality in access to industrial positions. The manipulator was specifically engineered to accommodate the handling requirements of the company's products, effectively reducing biomechanical load and enabling the safe involvement of women in previously restricted tasks. Preliminary observations indicate improved ergonomic conditions, task variability, and worker satisfaction. Although the cost-benefit analysis is ongoing, early qualitative data suggest operational and social advantages. This case highlights the potential of tailored assistive technologies to support both legal compliance and inclusive workplace practices. Final results will be presented during the conference.

Keywords: ergonomics, manipulator, industrial workplace, gender inclusion, manual handling, Slovak legislation, assistive technology, workplace safety

Proposed Legislative Changes in Ergonomics and Occupational Health Protection Against Physical Workload in Slovakia

Karina Šošková, Dariusz Trachta

Abstract

The paper presents proposals for changes in Slovak legislation on the protection of workers' health against physical workload, developed as part of public consultations conducted by the Public Health Authority of the Slovak Republic in 2025. The planned modifications include the amendment of Government Regulation No. 281/2006 Coll. on minimum OSH requirements for manual handling of loads, the introduction of a new regulation by the Ministry of Health specifying permissible musculoskeletal workload limits, and the update of Regulation No. 448/2007 Coll. regarding work categorisation in terms of health risk. The analysis focuses on refining limit values, workload assessment methods, and ergonomic requirements for workplaces, in line with the latest European standards. The aim of the presentation is to evaluate the potential impact of the proposed changes on improving working conditions and reducing occupational risk in Slovakia.

Keywords: ergonomics, physical workload, ergonomic standards, Slovak legislation, occupational health protection

The Use of Ergonomics Methods in Millitary Process - Case Study

Adriana Stubičar, Tihomir Opetuk, Goran Đukić

Abstract

Ergonomics is a multidisciplinary field that studies the interaction between humans and their working environment, aiming to improve efficiency, safety, comfort, and well-being. It has historically developed as a response to the need for better human performance, reduced fatigue, and optimized functioning in both civilian and military contexts. With the rise of Industry 5.0, ergonomics has gained renewed relevance, adapting to technological progress while keeping a strong human-centered focus.

This paper outlines the historical evolution of ergonomics, its main concepts and methods, and their applications across sectors, with a special emphasis on defense and security. The military domain is particularly significant, as ergonomics informs the design of equipment, protective systems, weapons, and operational procedures that enhance combat effectiveness, prevent injuries, and minimize strain.

A REBA analysis was carried out on various combat stances to assess ergonomic benefits and potential risks in handling these weapons. The findings provide insights into how ergonomically informed design can reduce soldier fatigue, improve weapon operability, and enhance training outcomes. Based on the analysis, several recommendations are proposed to further strengthen safety and operational efficiency.

This study contributes to a deeper understanding of ergonomics in the defense sector, highlights its strategic importance for modern armed forces, and opens avenues for future ergonomic innovations.

Keywords: ergonomics, ergonomic methods, military industry, REBA

Rational Adaptation in the Universal Design Paradigm

Maciej Sydor

Abstract

The complex relationship between Universal Design and reasonable accommodation is analyzed, presenting it as a key dilemma of inclusivity. Universal Design is, by definition, proactive, aiming to create products and spaces accessible to all users ex ante, without requiring subsequent modifications. It represents an ethical and pragmatic ideal whose goal is inherent inclusion. In contrast, reasonable accommodation is a reactive mechanism, and unfortunately, one that is too often employed when Universal Design has failed or was impossible to implement. This type of adaptation is individualized and is limited by the principle of proportionality, as it cannot impose an excessive burden on the entity responsible. Particular attention is given to alternative access as a problematic form of accommodation, which, by providing functionality through separate routes (e.g., side entrances, special versions of documents), perpetuates segregation and stigmatization of users. The conclusions are based on a medical analogy: Universal Design is the equivalent of prevention, while reasonable accommodation corresponds to symptomatic treatment. Although reasonable accommodation remains a practical tool, the overarching strategic goal is to strive for the full implementation of Universal Design. The aim is a world in which accessibility is no longer a correction of a barrier, but an inherent feature of the architectural and digital environment.

Enhancing HRM Effectiveness for Generation Z through Ergonomics and Spatial Collaboration

Gerhard-Wilhelm Weber, İsmail Özcan, Jacek Dominik Śledziński, Marcin Butlewski

Abstract

The entry of Generation Z into the labor market presents significant challenges for Human Resource Management (HRM) in the Wielkopolskie region of Poland, where low unemployment intensifies competition for talent. Information technology students, who exhibit elevated salary expectations and limited organizational loyalty, require HRM to move beyond traditional incentive structures. This study integrates spatial data with cooperative game theory to extend the MARS model through a coalition-based perspective, with particular emphasis on how proximity to Poznań influences salary expectations. Spatial proximity emerges as a key factor that enhances coalition value, while Shapley values provide a mechanism for the equitable distribution of rewards among participants. Incorporating ergonomic considerations into HRM strategies, including physical workspace design, cognitive task allocation, and organizational structure, can improve both individual well-being and collaborative productivity, thereby supporting sustainable team performance. Urban centers amplify the market potential of young professionals, reshaping regional labor dynamics and compelling employers to adopt innovative strategies. By shifting the focus from individual outcomes to collaborative dynamics, this approach highlights the transformative role of cooperation and equips HRM with novel tools for team formation, workspace optimization, and compensation design. Future research could further investigate the determinants of collaboration or examine the competitive interplay between corporations and students in order to leverage the distinctive attributes of Generation Z more effectively.

Key words: Game theory, decision theory, human resource management, ergonomics.

(This abstract bases on joint work with Prof. Maciej Safranski and Prof. Magdalena Graczyk-Kucharska from FEM, PUT, Poznan, Poland.)

Ergonomics in the Internet Space – Analysis of the Content of Selected Online Sources

Małgorzata Woźnicka

Abstract

The main goal of ergonomics is to design work systems, products and the environment in a way that is adapted to the psychophysical capabilities of humans. It is traditionally associated with the professional environment, but its principles are also applicable in everyday life.

In the era of widespread digitalization and the growing importance of the Internet, it is becoming important to examine how the subject of ergonomics is present in this space - what is it associated with, who publishes information on this topic and what aspects of ergonomics are most often exposed.

As part of the analysis, in incognito mode, a search for the term "ergonomics" was conducted in the three most popular Internet browsers. For each of them, the first ten search results were analyzed, excluding sponsored content and defining services. Additionally, a search for the term "ergonomics" was conducted on YouTube.

A total of 18 websites were identified. The analysis showed that the most frequently discussed topics concerned the ergonomics of computer workstations and the definition of ergonomics, including conceptual and corrective ergonomics. This information was published mainly by companies providing training and consulting services in the field of workspace organization and health and safety, as well as companies producing and selling office furniture. In the materials available on the YouTube platform, ergonomics issues also appeared in the context of physiotherapy.

Keywords: ergonomics, promotion, website, YouTube.

Selection of the Level of Automation Based on the Functional Profiles of Persons with Disabilities in Sustainable Workplace Management

Kamil Wróbel

Abstract

Purpose: This study addresses a gap in the literature regarding the integration of human functional profiles, such as sensory and motor disabilities, into automation systems in the food production industry. While most research focuses on the automotive sector, the food industry requires exploration due to its strict hygiene standards and flexibility needs. The study responds to two questions: RQ1: Which human dysfunction profiles correspond to recommended automation levels? RQ2: How does dysfunction type predict human-automation interaction quality? It examines appropriate automation levels for workers with disabilities in a jar-capping process.

Design/Methodology/Approach: A quantitative study collected data from 35 experts in ergonomics, disability management, and psychology. Experts evaluated human-automation interaction during jar capping for sensory, mental, and physical dysfunctions using the International Classification of Functioning (ICF). Viewing videos of manual, semi-automatic, and automatic processes, participants assessed feasibility, fatigue, work pace, and defect rates. Interaction quality was rated on a 1–10 scale, with the Weighted Average Method predicting interaction quality. Fuzzy logic addressed complex, subjective interactions in dynamic work environments.

Findings: Sensory dysfunctions like sound discrimination had smaller impacts compared to physical dysfunctions such as joint limitations. Cognitive dysfunctions, including planning difficulties, benefited significantly from automation. Advanced automation supported memory and visual impairments, while semi-automation suited moderate joint dysfunctions. Concurrent automation levels tailored to dysfunction types optimized collaboration and fostered sustainable workplaces.

Practical Implications: Findings guide organizations in adapting automation to workers' functional profiles, offering a framework for inclusive, ergonomic workplaces. The study emphasizes compensatory solutions for cognitive and motor dysfunctions, supporting better workforce integration of individuals with disabilities.

Originality/Value: This study contributes to the field of human-automation interaction by focusing on the food production sector, an area that has received less attention in automation research. Its novel approach centers on adapting automation to diverse human functional profiles, including sensory, physical, and cognitive dysfunctions. By using the ICF to categorize these profiles and applying fuzzy logic and the Weighted Average Method, this research offers new insights into optimizing human-automation collaboration. The study's focus on inclusivity and ergonomics provides valuable guidelines for industries seeking to design automation systems tailored to the needs of workers with disabilities.

Keywords: sustainable workplace management, automation level selection, human dysfunction profiles, ergonomics of human-automation interactions, fuzzy logic.