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ERGONOMIC RISK FACTORS, KNOWLEDGE GAPS, AND TRAINING NEEDS IN SMES: RESULTS OF THE SAFE-D NEED ANALYSIS

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Abstract: The SAFE-D Project conducts a complete requirements study in three partner nations to satisfy the increasing demand for ergonomics-oriented training in small companies. Activity 1 employed a multi-method study methodology to identify gaps in workplace practices, opportunities for adult training, and ergonomic knowledge. The project developed a data-driven comprehension of ergonomic risks and training deficiencies through a mixed-method research approach that included the review of EU and ILO reports, national sector analyses, scientific literature, field observations in at least five enterprises per country, and structured surveys given to employees, managers, adult learning institutions, and job-seeking adults. All methodological instructions, survey instruments, baseline reports, and synthesised findings produced during the activity were combined into a deliverable document called Need Analysis. This document provides a solid analytical basis that clarifies user needs, raises awareness among target groups, and facilitates the creation of high-quality, adaptable adult learning materials that are in line with current ergonomic and occupational safety regulations. It also acts as the primary source of information for all subsequent project actions.

Keywords: Ergonomics; adult education; musculoskeletal disorders; curriculum development; workplace safety.

1. INTRODUCTION

One of the biggest occupational health issues today is work-related musculoskeletal disorders (MSDs), which can lead to long-term disability, lost working days and reduced productivity across a range of industries. According to empirical data, physical strain, repetitive activity, inappropriate postures and poor workstation design are the main causes of MSD prevalence in industrial and digitalised industries [1- 4]. Ergonomics has been acknowledged as a key component in reducing these dangers, promoting safer workplaces, and enhancing worker well-being. The recent ergonomic interventions are focused on factors such as workstation redesign, training, and participatory approaches and can improve self-reported symptoms and reduce biomechanical exposure, though the effectiveness of these interventions varies based on organisational readiness, method, and context [5],

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[6]. This variety emphasises the need for customised, context-specific solutions, especially in small businesses where risk profiles and restrictions are very different from those of large firms.

Currently employing a significant percentage of the adult workforce and accounting for over 90% of European firms, small and micro enterprises (SMEs) continue to face challenges in successfully implementing ergonomic practices. According to research, SME workers are often exposed to preventable ergonomic hazards, including prolonged static postures, poorly designed workstations, incorrect tool use and manual handling [7], [8]. Common obstacles to the adoption of ergonomics in SMEs include limited resources, restricted access to specialised knowledge, low investment capacity, and a lack of understanding of ergonomic concepts. Numerous studies have emphasised that SMEs require user-friendly, inexpensive solutions that are closely aligned with regular business procedures [9-11].

Adult education is crucial to equipping managers, SME employees and unemployed people with the skills they need to interact with workplace ergonomics. Through initiatives such as the European Skills Agenda and the Erasmus+ Programme, the European Union has consistently emphasised the importance of lifelong learning, upskilling and digital preparedness. During the 2023 European Year of Skills [12]Adult education was further positioned as a crucial tool for addressing worker adaptation, promoting safety and well-being, and supporting economic transformations associated with digitisation and sustainability. Ergonomics-focused adult education serves two purposes in this policy environment: it improves workplace health and safety and increases individual employability, particularly for vulnerable groups like women, immigrants, and job-seeking adults. However, in order to accomplish these objectives, courses must not only teach theoretical ergonomics ideas but also offer contextualised, practice-oriented approaches that are pertinent to SMEs with a variety of risk profiles and training requirements.

A complete needs assessment is the fundamental component of an effective ergonomics curriculum. A detailed evaluation of the target population, including their prior knowledge, job exposures, organisational capacities, and perceived barriers to training participation, should guide learning initiatives, according to previous research and curriculum development models. Mixed-method needs analyses that incorporate sectoral document study, standards analysis, workplace observations, surveys, and expert engagement are regularly recommended by methodological frameworks for curriculum design [13]. These methods have been demonstrated to help produce interventions in ergonomics education that are better in line with workforce realities and more likely to be accepted by organisations. Additionally, they make sure that the dynamic interaction between organisational, cognitive, and physical ergonomics is covered in training materials, which is crucial for thorough risk control.

International standards that offer systematic advice for incorporating ergonomics into occupational health and safety (OHS) management systems include ISO 45001 [14], ISO 6385 [15], and the ISO 11228 series [16]. Implementing ISO standards in SMEs can promote worker participation, danger identification, and continuous improvement. However, due to their lack of experience, SMEs frequently find it difficult to implement standards, necessitating the need for simplified guidance and capacity building. A pedagogical strategy that bridges the gap between theoretical requirements and real-world workplace conditions is necessary for integrating ergonomics training into OHS systems. Thus, SMEs' capacity to absorb ergonomic concepts and satisfy worldwide OHS standards can be

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significantly improved by training programs backed by organised requirements analysis and explicit recommendations.

Research on ergonomics training's efficacy highlights both its advantages and disadvantages. Ergonomics training can enhance knowledge, awareness, and occasionally behavioural indications, including posture, lifting techniques, and workstation adjustments, according to controlled and quasi-experimental research. However, when training is given alone without associated organizational or environmental changes, results are frequently restricted. Without opportunities for practical education, managerial participation, or additional mentoring, many programs fail to provide positive outcomes. As a result, hybrid techniques that combine classroom instruction, digital learning, on-site consultation, and interactive workshops are becoming more and more integrated into modern ergonomics education frameworks. These hybrid models closely match the requirements of SMEs and recognise the complexity of ergonomic concerns.

2. SIMILAR PROJECTS

To guarantee that the materials are useful and context-sensitive, the following are usually integrated: requirements analysis, modular curricula and local piloting for adult learning and job skills in SMEs. The Erasmus+ programme documentation discusses small-scale collaborations as a means of encouraging this kind of innovation in adult education.

TRAIN4WORK aims to create online training in ergonomics and human-centred design that is freely available. Designers, engineers, and professionals in the workplace are its target audience [17].

RENEW healthcare students' education in ergonomics throughout Europe. It emphasises preventing musculoskeletal injuries and safe patient handling practices [18].

Ergonomics & Self-Management Training for Mature Workers with Chronic Low-Back Pain is a project supporting mature workers suffering from chronic low-back pain. It combines ergonomics training, self-management strategies, and health-behaviour tools [19].

Occupational safety method – practice for SMEs Erasmus Project develops practical occupational safety and ergonomic tools for small and medium-sized enterprises. It provides risk-assessment instruments, training materials, and safety-management guidance [20].

The PULSE project focused on building adult-learning pathways tailored to SME needs. It emphasises digitalisation, smart specialisation, and skill upgrading for workers [21].

3. METHODS

3.1. Study Design

A mixed-method, multi-country needs analysis methodology was used in Activity 1 of the SAFE-D Project to determine adult learning needs, current training practices, and ergonomic concerns in small businesses. In accordance with the project's approved implementation plan, the methodological framework included workplace observations, documentary review, and structured surveys given to

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various stakeholder groups. The project's deliverable document, Need Analysis, contained the complete methodological guidelines, observation templates, and data collection instruments.

3.2. Documentary Review

For the purpose of determining the regulatory, sectoral, and educational framework for ergonomics in the participating countries, the requirements analysis started with a thorough documentary examination. The EU and ILO reports on ergonomics and occupational health and safety, sector-specific national reports and data profiles, and scientific literature on risk factors for musculoskeletal disorders, ergonomic interventions, and adult learning practices were all included in this review. The results of earlier EU-funded studies that were pertinent to SMEs and ergonomics-related training were also assessed. With the goal to ensure that Activity 1 was in line with European policy frameworks governing adult education and occupational safety, these sources worked together to inform the development of observation categories and survey items.

3.3. Workplace Observations

A minimum of five small businesses from industries with significant ergonomic risks were chosen for field inspections in each partner nation. Researchers methodically evaluated workstation design and physical layout, tool characteristics and handling requirements, manual handling activities, environmental conditions affecting safety and comfort, and organisational or workflow factors contributing to ergonomic exposure using a standardized observation template included in the Need Analysis deliverable. This methodical approach produced extensive qualitative insights into typical ergonomic risks seen in SMEs and guaranteed comparability between sites. The Need Analysis file contains documentation of all the processes and templates utilized for these observations.

3.4. Participants and Stakeholder Groups

For the purpose of obtain a thorough understanding of ergonomic needs and training gaps, four stakeholder groups were included: workers in SMEs throughout the partner countries; managers and administrative staff in charge of workplace safety; adult education institutions offering vocational or continuing education programs; and unemployed adults looking for training to improve their employability. In order to ensure that the sample represented those most impacted by ergonomic risks and most in need of specialized educational support, the recruitment strategy gave priority to industries with high physical task demands and focused on adult learners who have limited access to ergonomics-related training opportunities.

3.5. Survey Instruments

To guarantee uniformity across all participating regions, a set of structured questionnaires was created in accordance with partnership recommendations and verified for cross-country applicability. These tools identified perceived risk factors and musculoskeletal symptoms, recorded demographic and occupational information, and evaluated participants' ergonomic knowledge and prior training exposure. Additionally, they looked at learning opportunities' accessibility and availability, organizational support levels, ergonomic attitudes, and expectations for training formats, content, and delivery methods. The Need Analysis deliverable includes all of the questions as well as comprehensive administration instructions and scoring protocols.

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3.6. Procedures

Each partner nation complied with a standardised methodology for collecting information, which started with a study of documents to contextualise national occupational health and safety circumstances. After that, companies were chosen according to their size, industry, and accessibility. The four stakeholder groups were given surveys in either paper-based or digital versions, depending on participant and institutional access, while trained project researchers used standardised templates to conduct on-site workplace observations. After that, each nation produced a national report explaining its conclusions, which were subsequently incorporated into the Need Analysis paper for the entire partnership. The identification of both common and nation-specific ergonomic needs was made easier by this methodical methodology, which allowed for efficient triangulation of data sources.

3.7. Data Analysis

Three phases of data analysis were carried out. To attempt to identify recurring ergonomic dangers, behavioral patterns, and training barriers, a qualitative synthesis was first carried out in which observational notes and documentary review findings were thematically coded. With the objective to profile ergonomic knowledge, learning preferences, and risk perceptions across stakeholder groups, a descriptive statistical analysis of the survey data was conducted using frequencies, percentages, and cross-tabulations. Third, cross-country comparisons were conducted by looking at national summaries to find common ergonomic issues in SMEs, structural obstacles to adult education, and differences related to labour characteristics, industry type, or national safety regulations. After that, all of the results were combined into a single consortium report, which served as the foundation for the Need Analysis deliverable.

4. RESULTS

Activity 1 collected multisource data from all three partner nations to provide a thorough evidence base. Employees, supervisors, adult learners, and representatives of adult education institutions participated in the survey phase. Additionally, 15 small businesses, spanning industries such as manufacturing, services, food production, and administrative labour, participated in the workplace observation component (with a minimum of five per partner country). These enterprise profiles and demographic distributions are thoroughly compiled in the Need Analysis report.

4.1. Ergonomic Risk Factors Identified in SMEs

A number of recurring ergonomic hazards were found in workplace observations across businesses, including: (i) frequent manual handling tasks; (ii) repetitive upper-limb movements; (iii) awkward or static postures; (iv) insufficiently adapted tool dimensions; (v) prolonged standing or sitting without breaks; and (vi) workspace constraints that limit reach and movement efficiency. These risks were prevalent in all partner nations, suggesting systemic ergonomic weaknesses shared by SMEs across all industries. These hazards were clearly demonstrated by the standardized observation templates in the Need Analysis paper, which highlighted the poor ergonomic design of many workstations and the significant variation in tool suitability for various users.

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4.2. Current Levels of Ergonomic Awareness and Training

All participant groups had consistently low levels of prior ergonomics training, according to survey results: (i) most employees reported never having received formal ergonomics instruction; (ii) managers indicated limited access to structured workplace ergonomics programs; and (iii) adult learners and unemployed adults showed low familiarity with ergonomic principles, indicating a significant knowledge gap relevant to employability. Only a small percentage of businesses worldwide have put systematic ergonomics procedures in place. Widespread inadequacies in fundamental ergonomic abilities were confirmed by the respondents' frequent expressions of uncertainty about proper body posture, safe manual handling practices, and ideal workstation arrangement.

4.3. Perceptions of MSD Risks and Workplace Safety

The lower back, neck and shoulders, and forearm and hand were the areas where participants most frequently reported feeling tired, uncomfortable, or in pain. The risk variables found during workplace observations directly correlate with these self-reported indicators. Although they accepted the existence of hazards for musculoskeletal disorders (MSDs), managers identified a lack of resources and a lack of ergonomic expertise as the main obstacles to putting effective mitigation methods into practice. The growing significance of ergonomic literacy as a critical workforce skill is highlighted by the worries raised by surveyed adult learners about the effects of ergonomic problems on their long-term employability.

4.4. Needs and Expectations for Ergonomics Training

All stakeholder groups showed a strong desire for accessible and useful ergonomics training, with clear preferences for: (i) practical demonstrations; (ii) sector-specific examples; (iii) basic self-assessment tools; (iv) visual materials and ergonomic checklists; and (v) brief modular courses that fit into work schedules. The absence of structured learning paths devoted to ergonomics within adult learning systems was confirmed by reports from adult education institutions on the lack of ergonomics curricula. In order to effectively engage adult learners, these institutions also underlined the necessity of readily available educational resources and adaptable digital or hybrid delivery formats.

4.5. Cross-Country Similarities and Differences

Assessments consistently showed: (i) low ergonomic awareness, (ii) a high incidence of modifiable ergonomic risks, (iii) inadequate training provisions, and (iv) a lack of uniform procedures across all partner nations. The availability of training infrastructure and the digital preparedness of adult learners were found to differ slightly, but these changes did not significantly change the general pattern of needs found. In the end, the cross-country synthesis validated the importance of implementing a cohesive yet flexible ergonomics curriculum that permits contextual modifications based on national circumstances while upholding common core learning objectives.

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5. CONCLUSIONS

The results of Activity 1 of the SAFE-D Project demonstrate the ongoing existence of training deficiencies and ergonomic risks in small and medium-sized enterprises (SMEs) throughout Europe. The findings, which are in line with earlier research, demonstrate that workers still face avoidable risks of musculoskeletal disorders (MSDs) as a result of manual handling, repetitive motions, static postures, and poor tool or workstation design [22], [23]. Activity 1 shows that companies frequently lack the resources and technical capability to successfully operationalise these standards, which is consistent with an earlier study on SMEs. This is consistent with earlier research's findings that, because of their limited resources and expertise, SMEs often find it difficult to modify tools, set up workstations, and invest in ergonomic redesign [22-24].

The SAFE-D Need Analysis offers evidence-based insights that can guide scalable and context-sensitive solutions, serving as a vital link between global ergonomic norms and useful applications designed for SMEs. The pronounced gaps in ergonomic knowledge among employees, managers, unemployed adults, and adult education institutions observed in this project confirm these trends. At the same time, the strong interest expressed by respondents in modular, practice-oriented ergonomic training supports earlier findings that hands-on, context-specific learning is more effective than abstract theoretical approaches.

The creation of the deliverable Need Analysis paper is a significant contribution of Activity 1. This guide offers a transferable model for other adult education and workplace safety projects by combining methodological principles, observation templates, survey instruments, national summaries, and a consolidated cross-country analysis. Additionally, the document's structure makes it replicable across industries and nations, thereby addressing the European Skills Agenda's demand for training in digital-age safety and ergonomics.

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