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Development of Toolkits for Hazard Identification, Risk Assessment and Prevention of Work-Related Musculoskeletal Disorders based on a Collaborative Platform

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Abstract

Work-related musculoskeletal disorders (WMSDs) is currently not only a health problem in enterprises across six European regions which are Catalonia (ES), Lombardy (IT), South-West Bohemia (CZ) Upper Austria (AU), Estonia (EE), Provincie Noord-Brabantv(NL), but also impacts negatively on productivity and on the competitiveness of enterprises. This project, granted by Innovation 4 Welfare (I4W), will provide a high value to enterprises in the participating regions. However, although EU-legislation has established new and highly innovative technical standards the area of "physical ergonomics, specifically aimed at protecting the "working population" from biomechanical and organizational risks for WMSDs, it is still not easy for users to find a suitable tool or strategy for identifying hazards and assessing risks for purposes of WMSDs prevention effectively. Another equally important aspect is that there is a big gap between applications and the EN standards regarding to WMSD prevention within European regions. Hence, this project (TIAM) aims at developing a set of toolkits to help users find the most suitable and effective solution to the problem at hand, on the other hand, to strengthen the application of EN standards based WMSD prevention tools and methods in European workplace. As a result, four types of tools have been developed for both simple tasks and more complex variable tasks in this project. Additionally, there are two main policy recommendations which have been drawn from the result of the project: 1) Create legislative conditions supporting ergonomic methods in SMEs and risk management concerning WMSD; 2) Promote information on European legislation concerning the ergonomics and WMSD. This paper closes by suggesting that an essential element for successful prevention of WMSDs is the interaction between the workers and the policy makers, knowledge providers.

Keywords: Hazard identification; Risk assessment; Work-related musculoskeletal disorder, Occupational safety and health; Collaborative platform

Introduction

In industrialized countries, work-related musculoskeletal disorders (WMSDs) and injuries are the most common occupational health problems. WMSDs now account for over 50% of all occupational diseases (with peaks of 85% and 80% in Spain and France, respectively). They reduce company profitability and add to governments´ social costs. Figure 1 illustrates the most common work related musculoskeletal disorders and injuries, which are officers, workers of agriculture, cleaning workers, workers assemble line, workers of fishing industry, and so on [1-3]. Successful WMSD prevention can therefore greatly contribute to creating more and better quality jobs, as has been demonstrated in a number of successful cases in different work sectors (mainly in manufacturing). Moreover, EU-legislation has established new and highly innovative technical standards [4-9] in the area of "physical ergonomics, specifically aimed at protecting the "working population" from biomechanical and organizational risks for WMSDs.

However, it is not easy for users to find a suitable tool or strategy for identifying hazards and assessing risks for purposes of WMSDs prevention [10]. Additionally, there are no criteria or guidelines for teaching users how to select the best method for a specific case. Another equally important aspect is that there is a big gap between applications and the EN standards regarding to WMSD prevention within European regions. The WMSDs prevention toolkits of TIAM contain not only tools/methods, but also guidelines, processes, checklists and templates for the purpose of hazard identification and risk assessment of WMSDs and injuries.

The needs of the following five European regions has been addressed in details. Firstly, in region of Catalonia: according to ECTC survey on working conditions in Catalonia, 49% of Catalonian workers perform repetitive movements commonly associated with musculoskeletal problems. The proportion of women reporting repetitive movements at their jobs was 30.8% vs. 27.7% of men. 22.5% of the men and the 19% of the women reported usually or always straining their posture at work, while 50.2% of the women and 41% of the men reported never straining their postures while working. One of the main priorities of the Catalonian Strategy of Occupational Health and Safety 2009-2010 is to promote the quality of risk prevention advice and technical assistance to companies. For this reason, possessing the necessary tools to effectively deal with occupational health problems is a major priority.

Secondly, in the region of Lombardy: WMSDs (mainly tendonitis, lumbar disc hernias and CTS) are the most prevalent occupational diseases. The Regional Authority has promoted a triennial (2008-2010)

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Figure 1: WMSDs and injuries is the most common occupational health problems in many industry countries.

plan for prevention of accidents and occupational diseases. One specific action is aimed at preventing WMSDs related to repetitive manual work. This specific action is mainly aimed at industrial manufacturing (in factories with more than 20 employees) but could also be extended to other sectors involved in the general triennial plan (i.e. agriculture; building, etc). For WMSD prevention, general guidelines, control procedures and good practices criteria have already been established, but more detailed, and sector-specific tools and good practices are still needed.

Thirdly, in the region of South-West Bohemia: University of West Bohemia (UWB) is situated in the city of Plzeň, where a lot of both traditional and new companies including SMEs are founded. The companies settled in Plzeň focus on broad spectra of manufacturing fields (engineering, heavy machinery, electronics, textile etc.), where all the branches are relevant to address the WMSDs for the employees.

Fourthly, in the region of Upper Austria: Between 2000 and 2005, painful positions increased from 26.9% to 34.5% of overall stressful work factors. Heavy loads increased from 21.1% to 22.0% of all stressful work factors; and repetitive movements increased from 40.7% to 47% of overall stressful work factors.

Finally, in the region of Estonia: For the past 10 years, physical overload disease has been the number one occupational health problem in Estonia, particularly in the textile and garment industry. Office-work involving prolonged computer use also causes musculoskeletal disorders resulting in work-related illnesses, or in their more advanced stages, in occupational diseases. The need for systematic preventive measures, therefore, is obvious. The need for a more detailed digital model to establish the connection between hazards' influence levels and stages of occupational diseases became evident during EU campaigns on risk assessment and WMSDs.

The project has been designed to collate successful experiences, innovations, and examples of good practice in WMSD and injury prevention based on a collaborative platform, and to provide a practical means of adapting and developing effective hazard identification and risk assessment toolkits to reduce the increasing incidence of WMSDs and injuries. It is obvious that sharing and adapting successful experiences, tools/methods and good practices is an effective and practical solution to preventing WMSDs and injuries. Furthermore, the toolkits will be evaluated and improved through feedback and application findings.

Therefore, the specific objectives of the project are the following:

1. Collate the existing tools/methods, successful experiences, innovations, and good practice of ergonomics interventions;
2. Improve tools/methods, guidelines, checklists and templates for hazard identification and risk assessment by adapting and applying them to new applications;
3. Develop toolkits based on a collaborative platform for hazard identification and risk assessment for WMSD and injury prevention;
4. Disseminate improved toolkits via specified website to promote good practices in WMSD and injury prevention.
5. Produce a report with recommendations for the local/regional authorities on how to foment WMSD prevention.

One of the main features and innovations of these toolkits is that they can be improved through feedback and findings based on a collaborative platform, which means: 1) the various toolkits and good practice uploaded by each region can be reviewed and adapted to other regions according to the problem at hand; 2) each region can evaluate and improve the toolkits after adapting and applying them to new applications; and 3) this collaborative platform is interactive and able to be continually updated even after the project has finished. Furthermore, the significance of this project is underlined by the breadth of its possible application to companies, industries, and organizations, and by the opportunity of utilization of the results globally.

TIAM project officially began on May 1, 2010. An important planning meeting with team from CEMOC and UPC was held on May 4, 2010, in Valencia (Spain). The kicking-off meeting took place on June 2, UPC, Barcelona. TIAM technical meeting was successfully held at CERPIE UPC from 21st to 22nd of Oct. 2010 in Barcelona, Spain. All participants of TIAM project communicated with each other to develop toolkits which include not only the tools/methods, but also guidelines, checklists and templates for helping users select suitable methods to solve their problems effectively. These guidelines, checklists and templates can provide an outline for key hazard identification and risk assessment procedures. A professional website, based on a collaborative platform, has been created for regions to upload toolkits and successful experiences, innovations and good practices in prevention of WMSDs and injuries (www.TIAM.eu).

The structure of this paper is as following. Firstly, the objectives of this EU subproject have been discussed in the introduction. Secondly the methods were presented which have been applied in developing toolkits for hazard identification, risk assessment and prevention of work related musculoskeletal disorders based on a collaborative platform. Thirdly, the project results were explained. Finally, the discussion and the conclusion of this project were given in the end of this paper.

Methods

In this project, the main work and the methodology has been designed to follow the European standard and international standard. The risk assessment model presented here involved three methods. These methods have same basis, but differ in application complexity. The first method is a quick screening method. Method 2, an easy to handle method, shall be applied if the screening method indicates risks. Some additional risk factors can be taken into account in method 2. Method 3 is an extended assessment method, which assesses risks in a more thorough way and is supplemented by additional risk factors not presented in methods 1 and 2. All three methods have different levels of complexity. The most efficient approach is to begin the risk assessment by applying method 1 (the most simple one) and use methods 2 and/or 3 only if the assumptions and/or operational situations identified in method 1 are not met (Figure 2).

Figure 3 illustrates the flowchart of the risk assessment approach which will be implemented in this project.

In order to develop toolkits based on a collaborative platform for prevention of WMSDs and injuries, the approach is as following:

A collaborative platform will provide not only the opportunity to adapt and apply toolkits to new applications, but also the ability to improve toolkits through feedback and post-implementation findings. Thus the collaborative platform will be interactive and continually updatable.

The research methods have been located in six work components in order to reach the objectives of TIAM project. In the following context, the methods and the research tasks of those six work components will be discussed in details.

Work component 1

Review existing tools/methods and applications to create toolkits with guidelines, checklists and templates.

While there are some existing and published tools/methods of hazard identification, risk assessment for prevention of WMSDs and injuries, it is not easy for the users to find a suitable method for their specific problems. Furthermore, there are no criteria or guidelines for selecting the best tool/method. Finally, there are tools which are universally known, but others that are not. As a result, it is urgent to help users find the most suitable tool to effectively solve their specific problem.

The work component 1 focused on (1) review existing tools/methods and current strategies which have been successfully implemented for prevention of WMSDs and injuries in regions through systematic research of different levels and sectors of industry and organization (2) create toolkits with guidelines (applying protocol), checklist and templates to help select and apply to new applications for new users. In this case, toolkits with different levels of complexity were created.

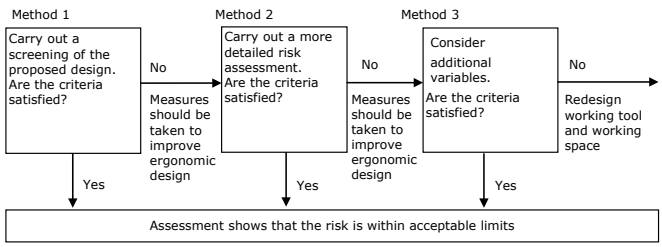

Figure 2: Flowchart identifying the step-wise approach to assessment (EN1005).

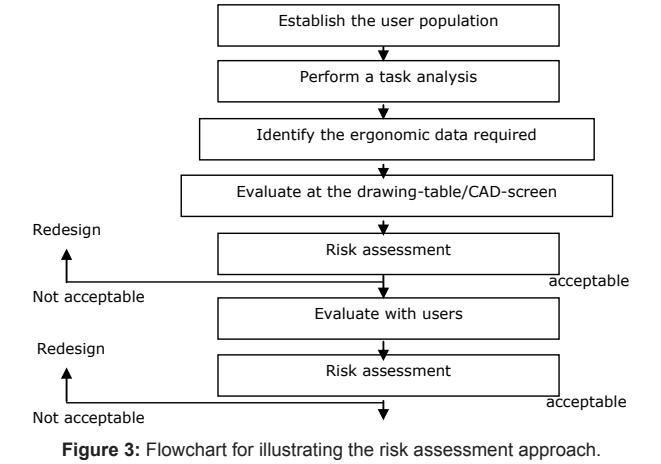

Figure 3: Flowchart for illustrating the risk assessment approach.

An intensive survey had been carried out by the leading participants from a holistic perspective. The following items were considered when reviewing tools or methods: 1) population; 2) evaluation factors; 3) type of measures; 4) methods of analysis; 5) reports on research or activities; 6) company methods. Both complex methods that clearly require significant expertise and simple tools were considered. Tools/methods were reviewed which are either already being used or that may be amended and made usable by non-experts or experts in ordinary workplaces. These methods/tools had been comprehensively described, which had been categorized according to the type of WMSDs hazard(s) being assessed [11]. The survey and review of the tools/methods had referred to those categories. The categories used in their report are:

- Postures and loads (emphasis on posture)
- Loads & associated hazards (emphasis on load)
- Repetitiveness and associated hazards
- Wider range of physical hazards (physical work environment, work organization)
- Both physical and psychosocial hazards (posture, force, repetition, vibration, incentive payments, support, overtime, control)
- Psychosocial hazards (assessment of risk using questionnaire, relationship with management, being valued, workload issues, psychosocial environmental factors)
- Adapted for specific jobs or industries (mainly physical factors specific to handling, postures, workplace design, work environment, client characteristics, work organization-work load, isolation, shift, duration, variety; Building industry, Mining Industry; Office work; Data entry/intensive computer use)
- Measures of stress and fatigue (hazardous personal states, ratings of affective states related to cognitive fatigue, rating or ranking discomfort or pain in specific body locations)

Work component 2

Communicate and share the tools/methods among the participants and develop the toolkits with guidelines, checklists and templates.

By the end of work component 1, we have reported reviewing all the existing tools and methods. Furthermore, the criteria for selecting tools were ready for potential users. Work component 2 focused on communicating and sharing the tools/methods among the participants and developing the toolkits with guidelines, checklists and templates. As a result, the objectives of the work component 2 were as follows:

1) Define the information of the tools/methods, and a final format that is easily understood by the potential users.
2) Create an initial website for uploading tools and methods together with the selection criteria and guidelines (applying protocols) for all the leading participants.
3) Communicate among all the partners by sharing knowledge and comparing tools and methods used in different regions.

Firstly, the leading participants defined the information tools/methods regarding selection criteria, guidelines, checklists and templates for purposes of toolkit development. Secondly, the leader received the criteria of tools and methods. All the information have been published and shared through the website of TIAM project. Finally, an initial website for uploading the toolkits was created by CERPIE UPC. Later on, CERPIE UPC will further manage the website.

Work component 3

Collate successful experience, innovations and examples of good practice in prevention of WMSDs.

In order that potential users benefit fully from the proposed project, the leading participants also focused on collating successful experience, innovations and examples of good practice in WMSDs and injuries prevention in each region. Successful experience, innovations and examples of good practices in prevention of WMSDs was uploaded onto the website for sharing with others.

All the leading participants worked on collating successful experience, innovations, and examples of good practice in prevention of WMSDs from the beginning of the project. The following knowledge had been collated, for example, how the health insurance fee has been reduced by a successful and good practice of prevention of WMSDs in one region. It took a total 6 months to collate the relevant knowledge and information on good practices and innovations. Meanwhile adapting and applying the developed toolkits to new applications was carried out.

Work component 4

Adapt and apply the toolkits to new applications.

Due to communication among all the partners, and the website in which all the toolkits are uploaded, a collaborative platform has been created that clearly helped users find the most suitable tools to solve their problems effectively.

Consequently, the component 4 was to adapt and apply the preferred WMSD prevention toolkits in new applications. TIAM toolkits needed to be evaluated in terms of guidelines, checklist and templates through a process of adaptation and application.

Before adapting and applying the toolkits, it was necessary to correctly and effectively identify and assess hazards and risks in the sectors of the regions. The work followed European Standard and International Standard. The templates of the toolkits also referred to the previous one (Wendy Macdonald and Owen Evans, 2006) to ensure comprehensive identification and assessment of all relevant hazards.

Inside the template, the different types of WMSD hazards to be identified and assessed was categorized into 6 items: (1) Physical task demands that may cause hazardous activities and/or hazardous personal states; (2) Perceptual, cognitive and psychomotor task demands that may cause hazardous activities and/or hazardous personal states; (3) Overall job demands; (4) Physical environment; (5) Psychosocial environment; and (6) Employee characteristics. In addition, the following items will also be considered during the adapting and implementing of tools/methods: 1) population, 2) evaluation factors, 3) type of measures, 4) methods of analysis.

Work component 5

Improve toolkits and update website for disseminating toolkits and good practice.

After the adapting and applying activities, evaluation feedback and findings would be useful for improving toolkits. And the improved toolkits and methods could be used by further users. Therefore, work component 5 focused on improving and refining the toolkits based on the feedback and findings in terms of assessment methods, measure methods, analysis methods, guidelines, checklists and templates.

Firstly, the leading participants collected feedback and findings from the adapting and applying activities. Secondly, the leading participants analyzed the feedback and findings, and modified the toolkits. Thirdly, they sent the information on the improved toolkits to the leader of the project for updating on the website. Figure 4 depicts knowledge sharing in WMSD prevention: adapting, applying, and improving toolkits via feedback and findings among all participants based on a collaborative platform.

Work component 6

Produce report with recommendations for the local/regional authorities.

The work component 6 mainly focused on producing a report with recommendations on the prevention of WMSDs and injuries for local/regional authorities. The local/regional authorities include employers, contract managers, training organisations, manufacturers and health care policy makers. This work ensured that the advice provided for reducing work-related musculoskeletal disorders and injuries would be practical for companies.

Firstly, the recommendations were produced based on project feedback and findings relating to work organisational change (i.e. work scheduling and work practises and job extension, communication/social support networks) and organisational strategies (i.e. reporting systems for WMSDs and injuries, procedures for risk assessment, training programme design, equipment selection. maintenance procedures, workplace design, etc.). Secondly, the leading participants communicated with the local/regional authorities based on the recommendations regarding prevention of WMSDs and injuries. Thirdly, the recommendations were written both in 5 regional languages.

Results

More than 30 existing and published tools/methods have been reviewed from a holistic perspective in all regions. Both simple tools and more complex methods requiring significant expertise have been considered. This systematic review was addressed to collect the following information: information on the parts of body assessed, where the methods could and should be used (job, task or work setting), WMSD hazards considered, a description of the methods, process, equipment required, how to interpret the methods, results, limitations of the method and where the method was originally published.

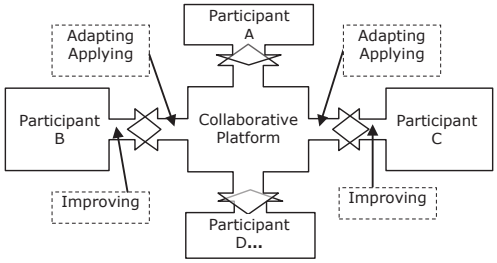

Figure 4: Scheme of knowledge exchanging.

Four selected toolkits were evaluated through a procedure of adapting and applying according to the practical problems at the workplaces. Finally, the feedback and findings of this adaptation and application procedure was incorporated into written reports for purposes of toolkit improvement.

Four tools recommended and applied in TIAM project are:

1. ERGOepm_LI software tool for applying the technical standard EN1005-2 for assessing manual lifting tasks. This procedure consists of calculating the range of the Revised NIOSH Lifting Index in worst case handling scenarios with its own frequency and with the total frequency [9].
2. ERGOepm_VLI software tool. It is a helpful tool to apply and compute the Variable Lifting Index, a new method for estimating the level of physical stress associated with variable tasks, defined as those tasks that involve lifting and lowering different objects with different weights over different geometries (e.g., horizontal reach and vertical height) [12-15].
3. OCRA system composed of two tools: OCRA Checklist and OCRA Index as preferred method in the standards ISO 11228-3 and EN 1005-5 [6-9].
4. ERGOepm_OCRA_Checklist_Map software tool, for building a UL-WMSD risk map of a production center, manufacturing process or small company [12,16].

Applying the TIAM tools of risk analysis in three companies had been completed in Czech Republic. One of the efforts was to assess risk factors from manual handling loads in the section of construction in CZ. From ergonomic point of view, the construction sector is significantly more difficult to analyze than industrial sector due to the following factors:

- The workplace is changing every day
- The workforce is highly itinerant
- Projects and their organization is complex

These characteristics imply important restrictions when making an intervention in terms of health and safety. The implementation of improvement alternatives and evaluating the biomechanical risks tend to be more efficient in sectors of lower variability. On the other hand, workers in this sector are constantly changing the content of jobs, besides there are unfavorable work conditions related to which they are subjected in their workplace. All these factors greatly complicate the control of the indicators for assessing the effectiveness of interventions to be made.

A procedure had been developed to collect the necessary information during a working day, which includes loads lifted, the postures required, the frequency and duration of lifting, to eventually characterize the exposure to risk through the calculation of the Variable Lifting Index (ERGOepm_LI and ERGOepm_VLI) which has been described in the new standard document ISO/NP TR 12295 Ergonomics - Application document for ISO standards on manual handling [5-7] and working postures [4].

Another effort was to assess risk factors from manual handling loads in the manufacturing industry in CZ. Regarding to adaption of toolkits, proposed methods (OCRA system and ERGOepm_OCRA_Checklist_Map) had been used to analyze the activities related to manual handling of manufacturing workers by evaluating three selected workplace, one of those workplace is in the company GRAMMER CZ. The company GRAMMER CZ enterprise is a subsidiary company of German concern GRAMMER AG. GRAMMER CZ, s.r.o. in Tachov, is the manufacturing company, which deals with the production of headrests for car seats and seats of trucks.

The measured assembly operations were characterized by the following parameters:

- Multiple positions of the upper extremities,
- Several prefabricated elements,
- High repeatability of movements,
- High speed of movements.

On performed measurement in company Grammer CZ s.r.o., the analysis was made and there were determined results and recommendations. Consequently report with measurement and checklists were passed on to company representatives, who were educated to use these OCRA checklists through application in other workplaces.

Feedback and findings from users of the toolkits

The feedback from users of TIAM toolkits was collected by designed questionnaire.

1) As an expert, do you think it is easy to implement the TIAM tools in the companies? Does it need additional training? What difficulties did you meet in your work?

The answer to this question is divided into two parts according to the methods:

- **NIOSH**

* This method is not difficult to understand for a non-expert. The entire toolkit is completely clear and unambiguous. It is easy to use, and it is possible to monitor any change of a parameter. A toolkit user can easily test any parameter. To sum up it means that the user can easily check the effect of a proposed work adjustment or of a workplace.

- **OCRA**

* This method is not as simple and clear as NIOSH. Compared to the NIOSH method, the OCRA checklist is much larger and a user spends a lot of time to learn how to use the checklist. The problem may be the deciding of individual employees evaluating work tasks. The change of an assessor may influence resulting evaluations.

* It is a subjective opinion particularly in the use of force. An assessor should know correct points corresponding to the Borg scale.

* By the determination of the number of movements it is not clear if the whole arm movement is included or if the movement of particular arm segments is taken into account (for example movements of individual fingers).

* It is not possible to use this method directly at a workplace during normal working process. Wide spectra of movements are evaluated hence it is necessary to record the whole working process. The record is then processed separately.

*The method takes into account only eight hours long working time.

2) Do you consider those tools are efficient in identifying and

assessing MSD risks in your regional companies? Please give some comments.

* There are many regulations and standards for companies in the Czech Republic. Companies usually do not employ ergonomic experts hence it is very difficult to cover the issue. The expert is also responsible for MSD risks prevention.

* The TIAM toolkits are appropriate tools for companies without ergonomic experts. The toolkits identify MSD risks. Based on the initial estimate it is possible to perform basic changes or to invite an ergonomic expert. TIAM toolkits are an easy-to-use possibility to identify MSD risks without need of studying all standards, laws and regulations.

3) All your works are in manufacturing industries based on your reports. Would you please write some recommendation in adapting TIAM tools in manufacturing industry sector? Have you considered the TIAM tools maybe possible to adapt to other sectors? For example, construction sector, agriculture sector, etc.

* The Southwest Bohemia region is an industrial region. So the TIAM toolkits were applied in industrial companies. The NIOSH is applicable in any kind of industry where the loads manipulation and lifting is needed. Concerning loads manipulation and lifting the method is applicable in any sector not only industry.

*The OCRA tool seems to be suitable for activities with high repeatability - such as band production. However it is also one of the limiting factors. The sector suitable for application of the OCRA tool should consist of repeatable working processes. If the working process involves different steps, results obtained using the OCRA method may be misleading.

4) Please try to get some feedback from the companies about their opinion of the cost of the activity, and if the companies consider TIAM tools can improve their productivities or it is just because of the law issue?

* Most companies will appreciate tools for risks identification.

* Feedback from cooperating companies will be sent as soon as it will be received.

Besides, the corresponded answers to good practice questionnaire related to regional policy in prevention of MSD in workplace have been collected and further studied or compared in order to provide recommendation to local policy maker in the final stage of TIAM project.

Closely connected with this is that TIAM recommends one good practice from Lombardy can be considered in other participant region, which is Legislative Address of the Lombardy Region for the prevention of risk from repetitive strain and movements of the upper limbs. This is an address of a strategic regional government in the face of increasing reports of occupational diseases in particular diseases of the upper limbs that he now 60% of all occupational illnesses reported, wants to help reduce and / or contain this phenomenon. The action is twofold because on one hand, stimulate companies to take measures to improve risk control where the cost is offset by a reduction of rates for insurance against accidents at work and occupational diseases.

Additionally, we stimulate labor inspectors to control this risk consistently across the whole region. This activity has been clarified with the business associations and trade unions in a transparent manner. The National Institute for insurance against accidents at work and occupational diseases, monitor the progress at the regional level (Regional and Local Health Authorities), the accident rates related to the risk of repetitive strain and movements as well as on the complaints of illness professional. In the first case expects a reduction of accidents due to this risk and the second is expected in a first phase, the emergence of work-related disease risk and effort to repetitive motion of the upper limbs.

Discussion

It was not possible for TIAM project to provide descriptions and information on all WMSD risk assessment methods including computer-based and software methods and methods developed in-house. There are other methods which are available and may be useful in a variety of different workplaces and work settings.

We suggested that an essential element for successful prevention of WMSDs is the interaction between the workers and the policy makers, knowledge providers. The bad practice we have got from TIAM is that only Loumbardy and Catalunya regions have applied EN standard based tools and methods in prevention of WMSD, another three regions have very few knowledge regarding to EN standard tools. Specially, there is few ergonomics tool and method in Czech Republic. Therefore, there is a big gap between applications and the EN standards within TIAM regions.

Additionally, there is gender issue associated within the project. Male and female workers have been adequately taken into account. In some cases, men and women have different limitations in terms of physical and psychology factors from a statistic point of view. These differences, as set out in European standards, should be considered to identify risk factors and to define interventions to improve working conditions. Therefore, with this subproject, the gender issues have been adequately taken into account to guarantee the health care for both men and women.

Finally, there are ethical issues associated with the subproject, but they have also been adequately taken into account. In designing the workplace, disabled people or people injured by work-related musculoskeletal disorders must be taken into consideration. The TIAM project will help give those people the opportunity to exercise their right to work. Therefore, the ethical issues have been adequately taken into account.

Conclusion

The TIAM project has developed a set of toolkits for identification and assessment of risk factors to prevent work-related musculoskeletal disorders (WMSDs) and injuries based on a collaborative platform. The toolkits and the collected successful experience and innovations in prevention of work-related musculoskeletal disorders and injuries will help target users including employers, contract managers, training organisations, manufacturers and health care policy makers find the most suitable tools and strategies to effectively identify hazards, and assess and control risk.

The TIAM project has successfully completed all the envisaged tasks and further cooperation between all the partners has been strengthen. Regarding to the technical and scientific advances, three internal documents have been developed:

- General specifications of good practices to fulfill. In order to ensure only good practice (information) that is reliable and meets identified criteria for prevention of work-related musculoskeletal disorders and injuries will be reported, in this

Document 1, we tried to define and establish criteria for Good practices.

- Application form to report good practices. This document has been supplemented with the reporting of a real good practice, to use as an illustrative example.
- TIAM questionnaire related to regional policy. This questionnaire seeks to identify good practices in terms of regional policy in the prevention of work-related musculoskeletal disorders (WMSD) by asking several important questions to all regions participating in TIAM projects.

There are two main policy recommendations have been draw from the result of TIAM project:

- Create legislative conditions supporting ergonomic methods in SMEs and risk management concerning WMSD;
- Promote information on European legislation concerning the ergonomics and WMSD

Within the TIAM, four EN-standard based tools and methods have been provided to TIAM partners to help manage the prevention of WMSD in companies. As policy makers, they need promote and develop regulations and guidelines based on the new knowledge. After that, the policy makers should make sure the periodic controls of labor inspectors in the companies following the defined procedures.

The project of adapting the toolkits has identified the difficulty of implementation of the EN and ISO standards for the assessment of biomechanical overload of the construction work, mainly because the construction work is complex and highly variable one.

As a possible solution to this problem, a procedure has been developed that allows a systematic analyzing which collects enough information of a working day of the construction work, to assess the risk of manual lifting, so the tasks can be identified which have higher contribution to the exposure and its causes.

As we can make a conclusion, WMSDs is currently not only a health problem in enterprises in all regions, but also impacts negatively on productivity and on the competitiveness of enterprises. The development of this TIAM project has provided a high value to enterprises in the participating regions.

There are four main innovation contributions of TIAM which are: 1. Partner companies have been innovated in TIAM project by applying new procedures in organization management to deal with WMSD problems. 2. Specially, online Good practice database (DB) can stimulate the innovation in other companies out of TIAM regions, in terms of technical procedure or organization solutions. 3. Software tools based on EN and ISO were provided to the partner companies. ICT companies can further develop those software tools for commercial purposes. 4. Service companies can use TIAM software tools to provide new services, for instance, organization design and ergonomics consult services.

The long-term objective of TIAM project is in the future, the website will permit a valid assessment of the workplace factors for identify WMSDs and consequently may also be used for development of prevention measures. Hence, the TIAM project will significantly enhance health care, life quality and productivity; effectively reduce sick leave and economic/social costs connected to work related muscular disorders and injuries. Therefore, the TIAM project has contributed to achieve the strategic objectives of I4W in the following two areas: It increases competitiveness through innovation and transition to a knowledge-based economy; it stimulates the creation of new solutions in the field of health related issues.

Summary

The companies are the main stakeholders of TIAM project. However, it is difficult for users to find the most suitable and effective solution to the problem at hand and there is a big gap between applications and the EN standards regarding to WMSD prevention within European regions. This paper not only presents the developments of easy using toolkits for hazard identification, risk assessment and prevention of work-related musculoskeletal disorders but also presents a strategy to strengthen the application of EN standards based WMSD prevention tools and methods based on a collaborative platform.

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