



The Ergoman Project: Designing The New Process Ergo-Designer Profile And Training Model

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Abstract

In the last twenty years ergonomics has received a great attention from different points of view: the design of products/services, the prevention/reduction of safety and health problems, to face human-machine interaction problems. Often all training activities and model related to ergonomics refer to curriculum profiles that are focused on product design rather than process design, but this last one become crucial when the attention is driven on the design of production lines or, in general, of workplaces.

In fact the human is central to process flexibility due to the ability to adapt to changing production scenario, equipment configurations, apply discretion and make choices difficult to program into equipment. If there is a mismatch between the workload exposure and the person ability, repercussions can include reduced productivity, injury and quality problems. Continuous inflexibility production lines are more easily designed for optimal worker performance. High value added process in industry customizes products and create high-value low-volume intelligent solutions, and this needs flexibility. Thus the challenge is to train students, post graduated and professionals with adaptive, quick-response, process ergonomics design and evaluation skills, for modern flexible manufacturing process to improve quality, productivity and health of the worker.

Trying to give an answer to this challenge, ERGOMAN, a Leonardo project funded by the European Commission, got some results presented in this paper: a competence needs analysis made in industries; the definition of a new competence profile for designers of ergonomic production processes and workplaces (Process Ergo-Designer); the identification of a suitable training model to train the different targets on the identified needed knowledge areas. The results of the project are exploitable in all EU-countries because the professional profile has been designed to respond to industrial needs and to European standards.

1. Introduction

New ergonomics issues, for example 'Ergonomics and Safety of Advanced Manufacturing Systems' and 'System Maintenance and Reliability', reflect not only changes occurring in the workplace and work environment, but also illustrate the need to optimise the ever increasing complexity of human-work systems and work processes. The new and old Ergonomic challenges that industry face today require the concentrated efforts of many different professionals and the constant updating/improvement of their competence in Ergonomics.

Thus, the challenge is to train students, postgraduates and engineers up to have adaptive, quick-response, process ergonomics design and evaluation skills, so that modern flexible manufacturing processes can improve the quality, productivity and health of the worker.

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Its aims are:



- The development of a new professional profile in the field of ergonomics for the design of processes and workplaces. This means the standardisation of professional competences in order to give the same accreditation to different educational systems and countries in Europe.
- To clearly define the steps in which a common framework for uniform competence building will be developed and also the steps needed for the development of a transnational training model for competence building. Furthermore this model will align the competences and skills of teachers and trainers in all European countries.

The main technical goals (and related results) are clearly defined as:

- Needs analysis [2], made through an investigation on big industries and SME, with respect of this new profile;
- Competence definition [3] (for the “Ergo-Designer” professional profile), necessary for the ergonomic design of workplaces, products and processes;
- Development of a Training model, necessary for the competence building of the aforementioned professionals;
- Set up a Network of interested parties, to support the centres of excellence (including the University and the training centres), the industries and the professionals working in the field of ergonomic design.

2. Results from Needs Analysis

The actual worldwide situation is pushing more and more on development of a flexible and proactive system based on effective and efficient design of processes and work methods.

Many factors are influencing these aspects, like the development of New Standards and regulations, the request of new technologies implementation and more productivity of processes, the observation of a fast evolution of the production systems. All these aspects lead to the needs of radical modification in the problems solution by a multidisciplinary systemic and preventive approach in the design phase for an “Integrated and systematic design application”. For the above reasons, the activities of ERGOMAN project focused on the identification of main needs of industry as far as ergonomic design of workplaces and as far as work environment of production processes.

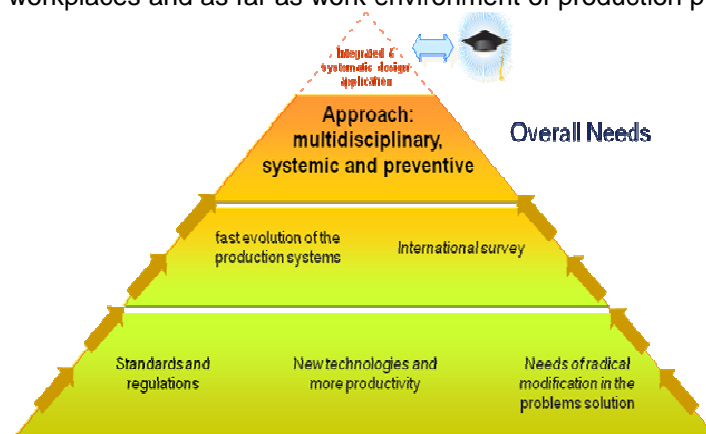


Fig.1 Identification of main needs of industry

The situation has been analyzed with the support of the universities involved in the project looking at the Europe situation, but paying particular attention to the Italian, German, Irish and Slovenian situation. For big industries, the investigation was carried out on Italian and German side; for SMEs, on the Slovenian and Irish side.

The needs analysis [2] aims to orient the educational model toward the application of ergonomics design for production processes in a more effective way than today.

The investigation was conducted by through observation, interviews, questionnaires spread to the people working in ergonomics and focus group of different companies.

Main results got from the analysis are summarised for each of the two different target group (big industry and SME) as follows:

- Main needs (for an ergonomist role in a big industry) are concerning the following application fields:

- Ergonomics tools and methods of evaluation (for ergonomic verification in phase of manufacturing process design)
- Technical design and technological engineering (for problems solutions on the process/equipments (compatible with ergonomics rules/guidelines)
- Software simulation and CAD-CAE methodologies (for detailed simulations of work activity and ergonomics analysis)
- Legislation and standards application (to guarantee the respect of the ergonomic standards for the suppliers)
- Engineering and design and procedures for product design (For product analysis, product review and proposal of technical solution for assembly)
- Work analysis and work methods definition (for planning of work activity and processes and methods evaluation)
- Human machine interface (for tools and equipments development and usability evaluation)
- Communication and interrelationship of personnel (for training and problem management)

➤ Main needs (or “desired competences”, for an ergonomist role in a SME) are concerning the following application fields:

- Design the workplace (for fast and safe moving of workers between machines saving time).
- Check for health hazards (for checking any potential threats to workers that can compromise their health)
- Set the machines (so the workers can easily access them)
- Check of work environment (for environment evaluation).
- Safety of the workers (for evaluation any dangerous moving parts of the machines that can hurt workers).

It is also possible to show the situation concerning the “needs perceived” by **managers** in the different countries (Italy, Ireland, Slovenia) as far as the three main areas of investigation (workplace design, workplace on production floor, organisation).

Needs are focused on biomechanical aspects (“development of ergonomic plans for new and existing workstations”) but an “ergonomic management program” as well as improvement of “workers skills about innovative aspects” are very important. The needs analysis carried out aims to the development of an educational model that should consider the following aspects:

- Educational model should be inspired by existing realities in which Ergonomics aspects are already a strong added value
- Different levels of knowledge and a wide range of available competencies and roles could represent a valid diversification for the creation of different figures of Ergonomics expert to be molded within the Educational model
- The more we want Ergonomics effects to be noticed, the more the Educational model should be modelled and focused on the study of Ergonomics aspects into the earlier phase of design and manufacturing.

3. The new Ergodesigner profile of competences

The definition of a profile of competences for Ergodesigners [3] is one of the main results of ERGOMAN project. It has been worked out through the following main steps:

- Analysis of the existing reference standards (HETPEP model for European Ergonomists [4], IEA Code of Conduct for Ergonomists [5], REFA Industrial Engineering (SIE)– Human Factor [6];
- Investigation of competences required (see needs analysis), also through the organisation of workshops with representatives from big companies and SMEs and discussion the processes and experiences in training of ergonomics there;
- Gap Analysis between the results of needs analysis and existing standards;
- Identification of main knowledge areas for the profile “ergo-designer for production processes” aimed to design tasks, work places, environments, tools as well as work organization and processes.



The identification of the main competences and main knowledge areas needed for the “ergo-designer” profile have been based on the philosophy concerning the World Class Manufacturing (WCM, [7]) and the Product Development Processes (PDP [8]).

Three competence profiles have been identified for three target groups of the project (students, professionals in big industry and process designers in industry).

According to the needs analysis carried out in the project main competences and knowledge areas were defined for professionals in industry. They should have competences and knowledge about:

1. *National, international (and company) standards* related to ergonomics
2. *Safety rule and procedures*
3. Aspect related to *quality of production processes*
4. *Logistic and work organization*
5. *Environment and microclimate* aspect related to the indoor production
6. *MTM methodologies*

Based on these competence the “ergo-designer” profile has been created. This competence profile includes **28 competences** subdivide into **six groups**, collected in a “**Ergo-designer cross-matrix**” in order to be easily readable:

1. *Four* competences in “*Background*” (Anatomy / Biomechanics./ Work physiology and Psychology (see fig. 2)
2. *Five* competences in *Design process and problem solving*;
3. *Eleven* competences in *Ergonomic guidelines*;
4. *Two* Competences in *Work environment* (physical environment, indoor climate);
5. *Two* competences in *Work measurement*;
6. *Four* competences in *Implementing design*.

All competences are subdivided into three levels: Level 1: Low, Level 2: Medium and Level 3: High. The first group of competence developed in the Ergo-designer **Cross matrix** is shown in Figure 2.

DEFINITION				Competency Level 1 (low)	Competency Level 2 (medium)	Competency level 3 (high)
Anatomy for ergonomics Biomechanics for ergonomics Work physiology for ergonomics Ergonomics Psychology principles for ergonomics	Part 1 Background					
	To understand basic principles of human anatomy and motor function relative to human interaction with hand tools and machinery			To remember the important muscle groups and their function	To be able to analyse the muscle groups and their forces required to perform a set of work actions	To be able to understand, analyse and evaluate the muscle function and kinesiology involved in performing a human movement
	To understand basic biomechanics . How forces are generated and exerted externally and internally, and to appreciate the relationship between stress and tolerance of internal loads			To understand how internal and external forces are generated and exerted	To be able to perform a biomechanics analysis to determine the internal forces for hand, shoulder or lower back exertions	To be able to analyse and evaluate the acceptability of internal forces in the body due to external exertions
	To understand basic principles of work physiology and to appreciate the effects of energy availability on muscle and the cardiovascular system.			To know how energy is liberated in the body and how physiological loads impact on the cardiovascular system	To be able to measure or estimate the physiological cost involved in perform a task	To be able to perform, interpret and evaluate the physiological cost involved in performing a task
	To understand basic principles of ergonomics psychology : to appreciate the importance of design in accommodating human abilities , and to understand the sources of human limits			To know the psychology principles of memory, perception and cognitive loading	To be able to estimate the cognitive loading involved in a given scenarios	To be able to evaluate the cognitive loading in a scenario and determine its acceptability relative to human limits

Fig. 2: Three levels of competences for “ergo-designer” - group 1 “background”

According to the project work program next phase of consortium activity will be addressed to an extended validation of the competence profile “ergo-designer”.

4. The ERGOMAN training model

Another main result of ERGOMAN project will be the development of a training model [9] properly designed according to the different target profiles of the project (students, professionals and process designers in industry) and to the different knowledge areas/competences to train. The finalization of the training model is expected by next months.

More specifically, the training model will exploit the approach for each level of each competence reported in the cross matrix, developed on the basis of industrial skills needs and also in reflection of syllabi recommendations in ergonomics from both the International Ergonomics Association [5] and the Centre for Registration of European Ergonomists [4].



The training model will be portrayed by way of concept maps, one for each of the six separate competence parts of the cross-matrix: input and output training level and detailed topics for each cell of the matrix will be exploited. Also, beside the concept maps, the model will give indications for appropriate pedagogical approaches, training methodologies and technologies.

Conclusions

Basing on the Needs Analysis led on big industries and SMEs, the ERGOMAN project has elaborated the new profile of competence for Process Ergodesigners [3]. This profile, represented in a cross matrix with different levels of competences and the related knowledge areas, can be used as a reference framework for the different target of users (students and workers) and for ergonomics centers and companies, networks and universities, both for higher education (single competency to be acquired) then permanent education.

In particular, the ERGOMAN competence profile will be supported by a sort of guidance material, the Process Ergodesigner training model [9], that will detail how the needs for training in a particular ergonomics competency can be detected, the related topics to be face, the recommended technical and pedagogical model to be followed and which input level of competence is required. It will recommend how those specific competencies could be delivered to achieve a good quality of learning experience for the student or for the worker, and to what level.

The closure of the project is foreseen in September 2011: by this date the training model and the validation both of the profile and the training model will be finalized. The results obtained will be useful for organizations/companies and universities, to face this subject in an innovative and more focused way.

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