

# WHEN KNOWLEDGE MEETS INNOVATION TECHNOLOGY

## *The ENEA e-LEARN Experiences through Technology and Research*

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Abstract: ENEA is the Italian Agency for New Technologies, Energy and the Environment. The paper will deal with the ENEA challenges and initiatives to better spread scientific knowledge and promote research and innovation technology supporting innovative processes in the production system. Indeed, as in the mission of the organization, ENEA aims to disseminate and transfer technologies, provides managerial and technical-scientific support to both public and private bodies and enterprises and, finally, helps the Country's competitiveness and sustainable development underling the relevant role of training for developing new skills. An e-learning platform has been designed and implemented in order to achieve all these goals: an open and distance learning system that can be considered as a self training one by its users because they can learn whatever, whenever, wherever they want. The ENEA e-LEARN model has been considered to be one of the best ten practices internationally by CEN. The structure of the e-learning platform called MATRIX Multi Platform has been successfully used in the frame of several projects and in more than 150 on-line courses. Statistics show ENEA success in carrying out its knowledge objectives.

## 1 INTRODUCTION

In recent days, the European Community has reaffirmed the importance of:

- strengthening scientific and technological bases across Europe;
- developing its competitiveness in pursuit of sustainable development including the environmental protection;
- satisfying the needs of its citizens, by achieving a European Research Area (from here on, ERA) in which researchers, scientific knowledge and technology can circulate freely.
- ERA constitutes a core element of the Lisbon Strategy for Growth and Jobs.
- One should stress the necessity to guarantee that ERA is fully operational and

completely contributes to the “knowledge triangle” of research, innovation and education showing the international competitiveness and sustainable development of Europe and underpinning its ambitions to become a leading knowledge-based economy and society.

## 2 THE ENEA e-LEARN

The Italian Agency for New Technologies, Energy and the Environment (from here on, ENEA) has designed and implemented an e-learning platform in order to better spread scientific knowledge and promote research and innovation technology supporting innovative processes in the production system. Actually, as in the mission of the

organization, ENEA aims to spread and transfer technologies and provide managerial and technical-scientific support to both public and private bodies and enterprises, underling the relevant role of training for developing new skills. For this reason, ENEA is one of the key actors about Italian e-learning, thanks to the knowledge and the highly specialized skills of the researchers in supporting innovation. The Agency has been involving for a long time in the process of knowledge transfer towards enterprises and schools. Transferring and spreading the results of its research, and promoting their valorization with social and production purpose, ENEA supports the technologic innovation processes of the National production system with particular attention to Small and Medium Enterprises (from here on, SMEs).

The ENEA e-learning platform was born in 1996 and now it is a well-established reality offering a number of about 170 courses, which are more and more increasing, with more than 18.000 users in the last two years (from January 2006 to June 2008, as it is shown in the charts below for a depth analysis of the end-users).

## 2.1 Our Experience

ENEA offers a system that can be considered as a self training one by its users: it means that they can learn whatever, whenever, wherever they want. The ENEA e-LEARN model has been considered to be one of the best 10 practices internationally by CEN (Comité Européen de Normalisation), the European Committee for standardization (CWA 15660 Providing good practice for E-Learning quality approaches). The structure of the e-learning platform, called MATRIX Multi Platform (that will be better described below) is the result of years of work and experimentation of a panel of researchers, which leads to the fourth generation of the aforementioned platform.

A lot of studies (ASTD, 2001) have shown the advantages of e-learning in being able to provide flexible, "just in time" learning with smaller learning "components" than traditional course structures. This has fuelled the movement toward modular or unit based learning and the development of learning objects. Learning objects are based on the idea of an open standard supporting the creation of small components of learning. The key benefits of object based e-learning materials are seen as follows:

- Content of learning objects can be more readily reused for different purposes and it can be easily updated by replacing only the

outdated content rather than having to rebuild a new course;

- Customized learning can be created to meet specific individual needs;
- Learners are able to locate the particular information they need according to the context of their own work.

In our modular approach, the subject is decomposed into its essential parts and each of them starts from very basic concepts going to deep details in the successive modules. This learning system enables personalization within a learning design, so that the contents and activities within a unit learning can be adapted depending on the preferences, portfolio, previous knowledge, educational needs, and situational circumstances of users.

The so built courses are suitable for any worker at any educational level. Indeed, this modular approach by itself can solve the problems of those, with more expertise, who would be bored if they had started from the beginning. A self-evaluation test has been introduced between successive modules: in this way, any user can make the test to evaluate his knowledge of the subject and, then, decide whether to study the course from the beginning or skip the simplest modules.

The platform, has been successfully used in the frame of several projects such as the awarded project DESIREnet, (Sustainable Energy Europe Awards, Category Co-operation Programmes), the DEPUIS Project (one of the six Europe INNOVA Standards Networks (2006-2008) working towards achieving a more successful exploitation of existing standards and enhancing innovation in Europe), the deployPromis, e-QUEM etc.

DESIREnet project on renewable sources of energy ([www.desire-net.enea.it](http://www.desire-net.enea.it)) produced some e-learning courses on:

- photovoltaic energy;
- solar thermal energy;
- geothermal energy;
- biomass energy;
- energy efficiency for building;
- wind energy;
- hydrogen energy and fuel cells;
- geographic systems to support decision makers energy scenario.

All those ones were produced using both traditional hypertext e-learning courses and video-web-seminars.

The DESIRE-net web-seminaries have been transmitted both in synchronous and in

asynchronous modalities toward more than 30 not European countries. The courses have been also translated into French by the African Engineers Association, who wants to promote renewable energies in French-speaking African countries. The DESIRE-net project was awarded during the 2008 SEE week as the best cooperation project in Europe.

The strategic objective of *DEPUIS* project has been to enable more companies, particularly SMEs, to use Life Cycle Thinking to decrease the environmental impact of their product by the design of new products, in conformance with the Communication on Integrated Product Policy of the European Commission. *DEPUIS* has developed a multimedia handbook with more than 30 e-learning courses, the majority in English, about 40 hours of video lessons and a few data bases to share the knowledge of the ISO technical committee among all the stakeholders. The multi-media handbook is a compilation of information from many sources and it is frequently updated. The main components are:

- A self-evaluation questionnaire to identify requirements for information about materials;
- A searchable database of standards for product data technology and for LCA;
- A searchable database of the e-learning courses, already available and planned;
- Relevant technical documents for download;
- Example of applications and good practice.

The aim of *PROMIS* project was to provide SMEs with integrated service for managing quality, environment, health and safety in the respect of existing European legislation. The objective was to give a holistic approach to SMEs supporting them in complying with the complex legal, commercial and social requirements at National and International level, by means of specific e-learning courses, qualified consultant's advices and a tailored legislation database.

*e-QUEM* is a project of the EQUAL initiative whose goal is to promote the skill of the energy manager also among the SMEs. For this purpose, ten e-learning courses have been developed on the different competences that an energy manager should have:

- Energy, development and environment;
- Fundamentals of energy;
- Duties of an energy manager;
- Rational use of energy;
- Renewable energy sources;
- Energy accounting;

- Normative, standards and contracts;
- Organization and management;
- Communication and marketing;
- Economy and finance.

Simplified courses for public administration are under development.

## 2.2 What is the MATRIX Multimedia Platform

The MATRIX Multimedia Platform (from here on, MMP) has significantly defined the real integration of heterogeneous web based applications in a single standard end-user interface by means of a portal site. The main issue of this project has been the idea to overcome the difficulties that a single end-user can face in the access of a new web site, of new on-line courses and the extremely repetitive actions of registration and login. In particular, the MMP can visualize in a single course catalogue e-courses retrieved by different e-learning systems and manage information like user-ID and Password and course accesses. The end-user is always informed to which e-learning platform the course belongs and by personal profiles the courses that he can access. The web interface of MMP is based on the structure of a Portal site for services and contents.

### 2.2.1 How the MATRIX Multi Platform Works

Matrix Multi Platform solves the issues concerning the integration of different systems through a unique graphics interface and unified number of tools and functionality. The main elements that characterize the integration of different e-learning services are:

- The Unified Course Catalogue: it visualizes the e-learning courses by a standard graphic and minimum data set valid for all the external e-learning systems;
- The Tracking/Report tool: it is a standard module for the tracking and reporting of the end-user actions during the studying time on the offered courses; MMP has defined an end-user tracking based on the data recorded by the system during the connection. The information is not intended as a standard method but is sufficient to make a knowledge valuation on the access frequency. These criteria are based on the total connection times in relation to the minimum studying time that the docent gives for the specific course.

- **The Auto-valuation Test:** it is a defined minimum number of questions necessary to qualify the end-user's knowledge after the study session. The questionnaire builder associates a set of weights and points at each correct and incorrect answer defined initially by the docent and tutor of the course. There is the possibility to insert a significant explanation for each answer
- **The Authoring system** (from here on, AS): it is an advanced tool aimed at the creation of hypertextual courses in order to simplify them, from their creation to their publication.

AS is included in the Matrix e-learning platform and can be used by both the lecturer and the Content Creator (CC). CC has the task to add the didactic contents provided by the teacher in the system, using the standard methodology and formats. To get to the AS, it is necessary to enter the "Services" section in the ODL (Open Distance Learning) Main Menu and to get to the "Teachers Management" page, entering the password and login.

Fourth generation ODL is available on the following web address: <http://192.107.92.31/fadivgen2>. Authoring System interface is divided into three main areas:

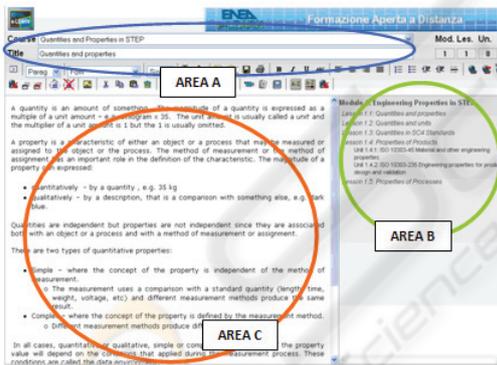


Figure 1: S.A. interface.

In the A area (top) there are the tools for creating page of the course and its properties. First of all, CC has to pick up one of the courses, whose framework will be displayed in the B area (Course Framework) and then he will insert or modify the contents of the single pages (modules, lessons, units) in the C area (Content). A area includes the standard formatting tools. In such way, CC can use an interface which is similar to any word processor. The AS will update the course framework and will check its consistency, while the lecturer supervises the contents of the Unit.

### 2.3 Who are the ENEA E-LEARN Users?

Thanks to the collaboration of the ENEA ODL (Open Distance Learning) users, filling in the questionnaires about customer satisfaction, we could realize a series of statistic researches that have been helping us to manage the catchment area and, above all, understand the end-users' needs, expectations and opinions just to improve the given services. This activity has been working since 2002: the period 2002-2005 can be found at the website <http://odl.casaccia.enea.it/FADIIGen/FadiISite/index.htm> (click on *Services* and then *Statistics*).

The statistics concerning the period from January 2006 to June 2008 are divided into five main areas "Users' gender"; "Users' geographic distribution", "User's job", "User's age" and "Courses' subject" as you can see below:

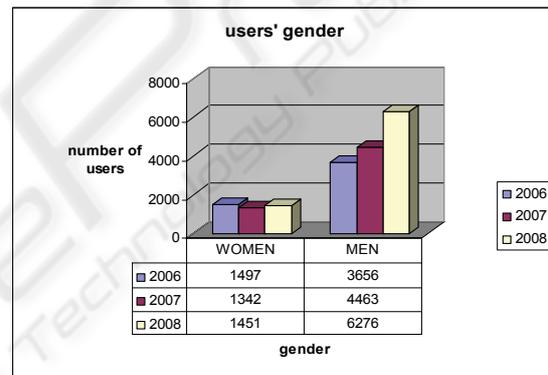


Figure 2: User's gender: The statistics show that more than two-thirds of the ENEA ODL users are men, even if the proportion of female users redoubled in less than two years.

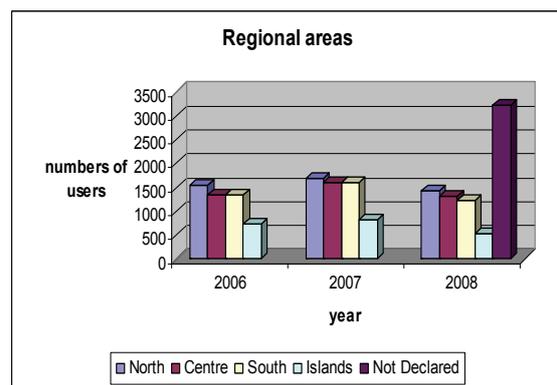


Figure 3: Regional areas: Taking into account that almost one third of the users have preferred not to declare where they are from, it is anyway meaningful that the 43% of the users come from the North of Italy.

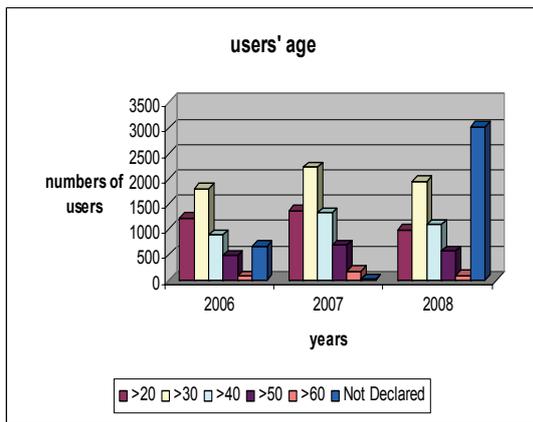


Figure 4: User's age: The statistics demonstrate that the ages 20-40 is maybe the most productive period for a person to increase their knowledge with self learning means.

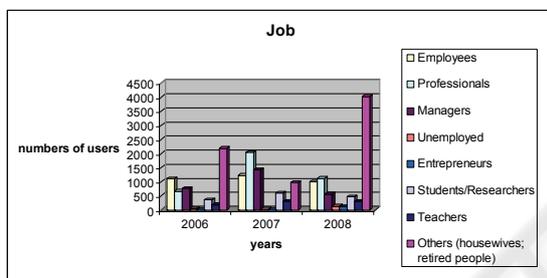


Figure 5: Job: The majority of the users did not declare their job. Probably, even though they are still working they are trying to keep themselves updated: that's the real sense of long life learning!

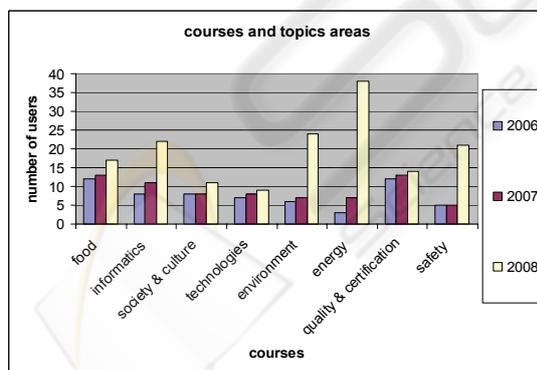


Figure 6: Courses and Topics area: ENEA includes 170 courses. Energy, Environment, Safety and Informatics are the topics areas mostly taken by the users: it depends not only on the main subjects studied by ENEA. As a matter of facts, the Agency's activities are carried out in the following four areas: Clean Energy, Technologies for the Territory, Technologies for the Future Advanced and Technology Applications) but even on the more and more increasing interest in such topics.

## 2.4 Some Considerations

The Italian production is undertaken by 97% of SMEs: most of them have less of 15 employees and are in the North of Italy (see fig. 3). It's rare that Italian employees can be involved in traditional learning courses because they cannot leave their workplace. The culture of innovation in SMEs is hindered because of a low scientific education level of the workers. Only 0.6% of SMEs workers, in fact, have got a technical university degree. It's so rare to find enterprises being able to translate the research results in success actions for their enterprise competitiveness. These peculiarities lead to the difficulty of transferring research results from the Italian research centers to SMEs. The New Economy can be considered as a Learning Economy, in which learning is a strategic resource for the growth and the economical development of industries and countries. ENEA launched an e-learning scientific platform in order to overcome the difficulty of technological transfer and, currently, ENEA offer includes 170 free courses (see fig.5). The Platform user interface is very friendly and it has been developed in the Usability Laboratory of ENEA. The courses are built thanks to the Authoring system (AS) which is an advanced tool aimed at the creation of hypertextual courses in order to simplify them, from their creation to their publication. The statistics showed that ENEA courses reinforce the virtuous circle, Knowledge-Training-Learning-Innovation: indeed the e-learning facilitates the training and learning processes. The ENEA ODL courses feedback reveals that many people got a new job, other ones grew professionally and someone else re-skilled thanks to these lessons. Finally, the courses are in Italian and in English for International users.

## 3 CONCLUSIONS AND FUTURE PERSPECTIVES

The European Union Recently issued recommendation and directives in order to make the circulation of the professional skills easier over the EU and the recruitment in each EU country (*Recommendation of European Parliament and of the Council 18 December 2006 n. 962 related to key competences for permanent learning; 23rd April 2008, concerning the European Qualification Framework (2008/C 111/01); and the Proposal for a Directive of the European Parliament and of the*

*Council on the promotion of the use of energy from renewable sources (COM-2008- 30 final).*

The European Qualification Framework aims at the free and easy circulation (mobility) of people in Europe. A common reference Framework is needed to make the learning final results transparent, formally and semantically understandable and then it is:

- Neutral –for the training and certification systems of the different countries based on units consisting of learning objectives or “learning outcomes” consisting of different levels the training objectives at each level are: knowledge, skill and competence.
- based on units consisting of learning objectives or “learning outcomes”
- consisting of different levels (the training objectives at each level are: knowledge, skill and competence)

According to the EQF, ENEA is going to develop new skills in the framework of ENEA-CEPAS agreement (Italian certification body) for:

- Designer of photovoltaic plants;
- Installer of photovoltaic plants;
- Inspector of photovoltaic plants;
- Expert in energy efficiency for buildings;
- Consultant for integrated management of QEHS, Quality Environment Health Safety;
- Expert of information management of product data

In conformity with ISO/IEC 17024 standard “Conformity assessment - General requirements for bodies operating certification of persons, CEPAS has developed a certification schema, which takes into account the whole study and work experience of the candidate. Here the schema.



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