APPLICATION OF A WEB-BASED EDUCATION SYSTEM IN INDUSTRIAL PROCESSES

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Abstract: The authors present a multidisciplinary project called PROPYME, which is a team effort of the University of Vigo (Spain) and the FEUGA autonomous government foundation (Galicia, North West of Spain), both supported by several industrial enterprises from the Information and Communication Technologies (ICT) market. The main purpose of PROPYME project was to accomplish an innovative technology-transfer task from university industrial researchers, to Small and Medium Enterprises (SME), for enhancing their productivity by the automation of their industrial and management processes. This involves a SME´s effort not only by a financial point of view, but adaptation, knowledge acquisition and organizational changes. Moreover, embedding ICT´s involves adapting Enterprise Resource Planning (ERP) tools to integrate vertically process and systems, owned by the SME itself, facing to decision challenges based on economic value, knowledge and communication concepts. The PROPYME first phase is a portal Web with a demonstration multimedia tool, text, graphics, animations, audio and video, that shows fifteen industrial processes based on diverse technologies frequently used for industrial enterprises.

1 INTRODUCTION

The industrial sector should incorporate the Information and Communication Technologies (ICT) in the business processes. The automation of industrial and management processes supposes an improvement of the productivity in small and medium enterprises. It supposes an enhancement of the resources of a country and a major boost to the progress. Thus, it is necessary design and implement environments with the aim to transfer information about industrial automation to enterprises.

This paper shows a multidisciplinary project called PROPYME. It was promoted from the University of Vigo (Spain) and FEUGA (Enterprise-Galician University Foundation) autonomous government foundation (Galicia, North West of Spain). It was developed with the collaboration of several industrial enterprises, which supported the project with documentation about their industrial processes and allowing the access to their installations to get multimedia material (videos).

The first phase of this project is a portal Web (www.procesospropyme.com) with a demonstration multimedia tool that shows fifteen industrial processes based on diverse technologies frequently used for industrial enterprises. The first phase of PROPYME was accomplished during two years with the following tasks: coordination, specification and development (2004); implementation and diffusion (2005).

The structure of the multimedia tool is unique for all industrial processes to ease its understanding. This structure depicts the most of elements involved in the introduction of these industrial processes. Eight implementing elements are included as buttons in a user-interface upper bar such as (from left to right): business process, engineering project, technologies, technological components, implementation, complexity, applications and cost. The tool also includes six icons in the user-interface bottom bar to ease further advanced consults and direct contact with the experts (researchers team

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biography, video, glossary, bibliography, regulations or standards and team's e-mail).
The seven concepts assessed in the development of PROPYME´s multimedia tool were:

- Demonstrate to the industrial businessman about the importance and value provided by ICTs to its business processes.
- Have a global knowledge about advantages and drawbacks using those technologies.
- How estimate resources, difficulties, costs and teaching needs facing organizational changes.
- Learning the management of implementation and maintenance about an automated industrial process, assessing risks and trade-offs.
- Providing an understandable knowledge about university capabilities and ICT´s enterprises that give the needed know-how to increase productivity.
- Rising of powerful knowledge elements to provide a critical analysis about its own organization.
- Supplying the right decision-making knowledge.

2 STRUCTURE OF PROPYME

The PROPYME multimedia tool constitutes an environment where businessmen and professionals related to industrial processes can improve their knowledge about this area. In the present, the tool is made up of fifteen topics related to industrial processes: Industrial plant data acquisition, electronic commerce, production automatic control, digital dashboard (Jonhson, 2004), ergonomics in the job (Kohn, 1997), quality management ISO 9001, international knowledge management (Tapscott, 1999), maintenance management (Nyman, 2001), environmental management ISO 14000, radiofrequency identification, electronic instrumentation (Barlett, 2002), automatic maintenance in production lines (Fowler, 1995), setup time reduction (Claunch, 1996), traceability and artificial vision (Jain, 1995).

The structure of PROPYME web page is shown in Figure 1.

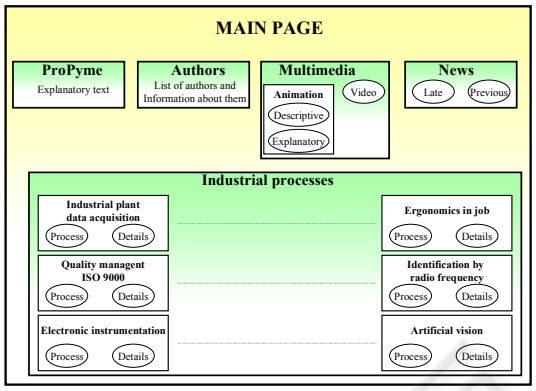

Figure 1: Structure of PROPYME web page.

The user can see in an easy way a summary of every industrial process included in the tool. The tool shows one box for each process with a brief description of the process and a descriptive animation. Thus, the user can get the concept of the process in a short time and in a friendly way. The user can choice one process and see all the information about it or only the details.

All the processes have the same structure to ease its understanding. The access to the information of the process is structured as it is shown in Figure 2.

The information is shown to the user in a standardized way for all processes with the aim to ease the use of the tool and reduce the time to get the required information. This standardization is one of the main advantages of this tool.

The user can access to different information about the industrial process with the buttons placed in the upper part of the user-interface. The information is presented with an explanatory text supplemented with an animation. The animations are a very important contribution in this tool because allow that the user understand the concepts better.

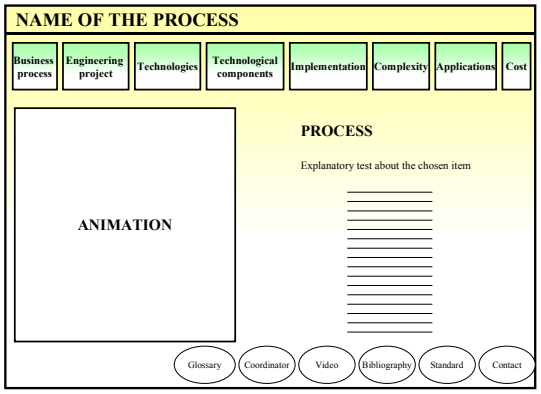

Figure 2: Components of the processes.

The user-interface enables the access to videos about the selected topic. Videos are essential in any multimedia tool because concepts that have a difficult explanation with words are understood better with a video about a real experience of an industrial process including this concept.

Often, the explanatory texts of technical topics include words or terms that their meanings are not familiars. A complete glossary about industrial processes terms has been development for this tool.

A lot of technical terms (bluetooth, fieldbus, data logger, Electromagnetic Compatibility, etc.) are defined in a clear and brief way. This glossary supposes a considerable help for the user.

The tool also includes a complete bibliography about every topic and information about standards so that the users can deepen and increase their knowledge.

3 EXAMPLE OF INDUSTRIAL PROCESS

An example of an industrial process included in the PROPYME tool is shown in this section to illustrate better the philosophy of this environment.

The electronic instrumentation processes are very important in the industry (Mariño, 2003). The electronic instrumentation is a discipline dedicated to measure any parameter, to converter these parameters in electrical values and to manage these values to provide the adequate information to a control system, a human operator or both.

The multimedia PROPYME tool included complete information about electronic instrumentation, which is very important for professionals in the field of the control systems. The electronic instrumentation processes are described.

The user can get information about the aims, main application fields, methodology for implementation, used technologies, components, requirements, development process, cost, application examples and bibliography.

3.1 Business Process

The elements of an Electronic Instrumentation System (EIS), aims, advantages, drawbacks and main application fields are described in this section. Each concept is illustrated by one video or animation. For example, the user can see a video about an electronic instrumentation system to evaluate the injuries of persons in automobile accidents. The video shows the crash of an automobile against a wall. The automobile has installed a crash test dummy with several sensors. An instrumental laboratory captures data of these sensors. The system also uses artificial vision to extract data about the movement of the crash test dummy and about the deformation of the automobile Thus, report about injury levels in several body parts and physical parameters (three axial acceleration, force, moment of inertia, etc.) can be obtained.

3.2 Engineering Project

The engineering project informs to the user about the project management (cost, profits, work planning), methodology, enterprises of electronic instrumentation and basic elements in an EIS. The sequence of phases that should be followed in the development of an EIS is:

- Requirements for the implementation.
- Element acquisition: selection of elements, measurement processing and selection of communication elements, visual display units, actuators, etc.
- Development process (viability).
- Operation process (robustness).

3.3 Technological Components

One important concept in the EIS is the used technologies and technological components. In these sections, the user can get knowledge about the basic components of an EIS, application fields, advantages and drawbacks. A complete description of the technological components taking part in an EIS and different ways of integration of these components are shown too.

3.4 Implementation and Complexity

The PROPYME tool explains in these sections the development and operation processes and the requirements for the implementation (specifications, physical and human resources and applicability).

With respect to the complexity, the user can see that an EIS is a set of diverse technologies. Knowledge about electronic engineering, specialization on physical, chemical, biological or environmental phenomena, transducers, software engineering, electrical engineering, system analysis, communication engineering, mechanical engineering and system integration are necessary to design, install and implement an EIS in a satisfactory way.

3.5 Applications and Cost

Some interesting applications of EIS, such as meteorology and communications and transformer monitoring, are exposed in these sections.

The user can know as an EIS is used to design a data acquisition system for meteorology integrating millimetre bands radio communication. This project was implemented in the North West of Spain. The read of meteorological variables is made with automatic data acquisition system using elements distributed in the covered area of meteorological radar. Figure 3 shows a map with the localization of the system elements (weather radar, WS: Weather Stations, CWN: Central Wireless Node, SWN: Secondary Wireless Nodes).

There are strategic and tactical reasons to justify an EIS. The cost of the system should take into account the cash flow in the time (costs and profits). The result is a calculation of the Return Of Investment (ROI). Each application should be considered and justified by its own merits.

The PROPYME tool shows the parameters to take into account in the cost calculation. The user can see an example of the cost calculation of an EIS for transformers monitoring in electrical power distribution substations.

4 CONCLUSIONS

This paper introduces the PROPYME project that is a multidisciplinary work for innovative technology-transfer in industrial automation.

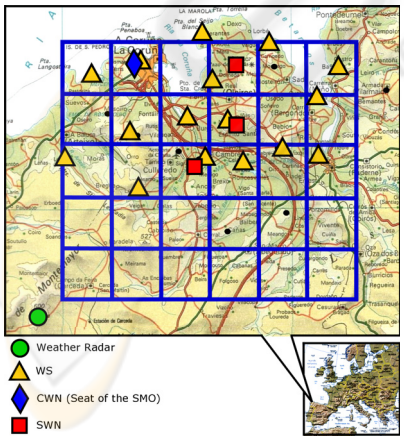

Figure 3: Elements of the meteorological System.

The first phase of this project is a computer and Web-based software with fifteen industrial processes. Users can access to a complete documentation about these industrial processes with a continuous support by the authors. The main advantages of this multimedia tool are:

- A complete and classified documentation about industrial automation processes.
- The structure is unique for all processes, which makes the access to the concepts easier.
- The tool represents a great effort of collaboration between university and enterprises.
- The animations and videos help to understand the concepts in a friendly way.

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