E-LITE[1] : A CONCURRENT ENGINEERING METHOD DEDICATED TO E-LEARNING TRAINING DEVELOPMENT FOR THE ENHANCEMENT OF RESEARCH PROJECT RESULTS.

(Application to IT interoperability curriculum in the frame of a French Project: ISTA3)

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ABSTRACT

Scientific research projects aim to produce new knowledge generally in domains of high specialization. Some of these projects have goals of improving the performance of companies. In this case, the issues of the capitalization and transfer of scientific knowledge and its rapid transformation into professional skills are directly addressed. However, there is no method to derive e-learning teaching material from project results. So, this paper presents the e-LITE Method and its application to the ISTA3 project to support the process of developing a e-learning training. This application has allowed us to highlight the contributions of the method that promotes better knowledge sharing between partners of a research project and the development and transfer of research results to the professional world. So, after the presentation of the method, an application to the ISTA3 project will be presented.

KEY WORDS

Concurrent engineering methodology, Vocational training system, e-learning, Interoperability, professional skill

1 THE CONTEXT OF APPLIED RESEARCH PROJECTS

The scientific research projects are aimed to produce new knowledge generally in domains of high specialization. Some of these projects have goals of improving the performance of companies. In this case, the issues of the capitalization and transfer of scientific knowledge and its rapid transformation into professional skills [1] are directly addressed. This paper presents the e-LITE Method and its application to the ISTA3 project to support the process of developing a e-learning training. This application has allowed us to highlight the contributions of the method that promotes better knowledge sharing between partners of a research project and the development and transfer of research results to the professional world.

[1] **e- LITE** is the acronym for « **e-L**earning as an **I**ntegration **T**echnology for research project **E**nhancement"

1.1 GENERAL CHARACTERISTICS OF RESEARCH PROJECTS

When a research project ends, in general, the dissemination of results is not complete because it is often not budgeted. The knowledge generated by the project is incomplete and poorly formalized. During the project, the knowledge whose construction is in progress or produced by the research process is unstable, often poorly managed and poorly shared between partners. They do not necessarily share the same vision of knowledge. This vision often depends on the point of view and on the expertise of the partner. It may differ significantly, particularly between academic and industrial partners.

1.2 ADDED VALUE OF CONCURRENT ENGINEERING IN A RESEARCH PROJECT

The value of the concurrent engineering approach proposed by the e-LITE Method is to enable the availability and rapid formalization of the knowledge produced by the research process of the project. Then, after an internal validation process of the project, this knowledge can be disseminated to the professional world in the form of training courses through e-learning, where the produced knowledge becomes business knowledge, built to be transformed into critical skills.

We recommend that the knowledge management of the entire research project be led by the training engineering process pilot. Figure 1 shows how, in the spirit of the e-LITE Method, the three main processes of an applied research project run simultaneously and are coordinated to produce research results, which are enhanced through formal training resources, assembled into e-learning courses, which will build critical skills in the industrial world [2].

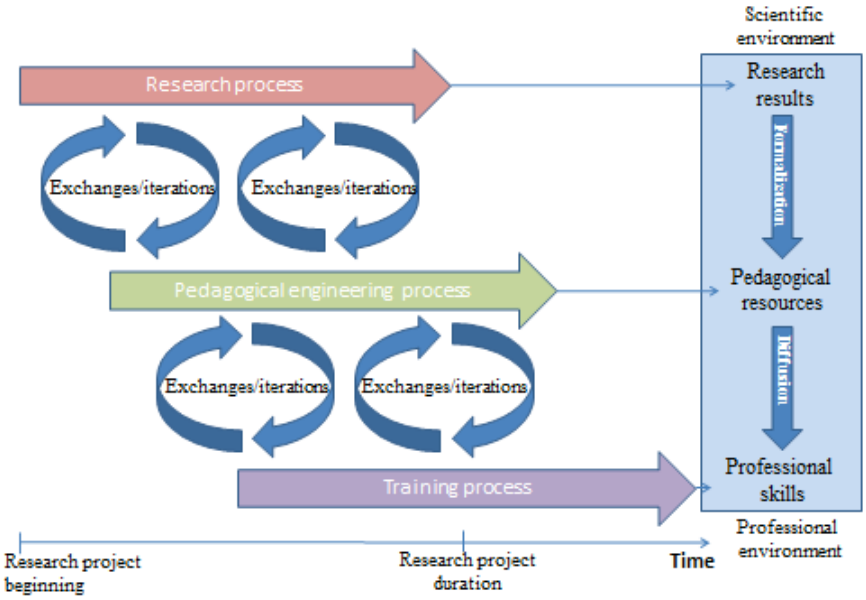

Fig. 1: the e-LITE Method principle

2 THE E-LITE METHOD

2.1 AIMS OF THE METHOD

The aim of the e-LITE Method is to facilitate the construction and a better sharing of scientific knowledge and professional skills in the realization of an applied research project.

This method is used to develop efficient e-learning systems designed to support the production, the updating and the dissemination of the scientific knowledge resulting from an applied research project. Also, it targets to transform these results into professional skills easily accessible for firms, particularly for the SME. Finally, it shortens the time of transfer of scientific knowledge into the professional word. This method is especially well adapted to the cases where the research project results are used in the training for new professions.

2.2 THE E-LITE APPROACH AND ITS STEPS

The e-LITE Method promotes a concurrent engineering of the research results and of the e-learning training system for the generation of the professional skills associated with these results. In the framework of a research project and in coordination with the research process of the project, the development of an e-learning training system using the e-LITE Method will be made up of the following steps:

Step 1: Define the communication and collaboration tools for good knowledge sharing between the partners in the project,
Step 2: Understand the research domain of the project and identify the professions impacted by the project,
Step 3: Analyse the activities for each profession,
Step 4: Design and formalize the training reference frames for each profession,
Step 5: Build curricula for each profession,
Step 6: Write the specifications of the e-learning training system,
Step 7: Design the performance indicators of the e-learning training system,
Step 8: Choose, implement and parameterize the e-learning platform,
Step 9: Write the course script, digitize and do the integration of the pedagogical resources,
Step 10: Do the cross validation of the pedagogical resources and publish them on the platform,
Step 11: Experiment with the e-learning system,
Step 12: Get feed-back on the experimentation to improve the e-learning training system before using it in a real environment.

At the end of these twelve steps, an e-learning system will be available to support the training on the concepts and the skills impacted by the results of the research project. Moreover, the realization of this e-learning system will allow better management, greater formalization and more effective sharing of the knowledge produced and managed by the research project.

3 E-LITE METHOD IMPLEMENTATION IN THE ISTA3 PROJECT

E-LITE Method has been designed and implemented in the ISTA3project. Now we will present the ISTA3 project and the application of the e-LITE Method in this project.

3.1 THE ISTA3 PROJECT

The ISTA3 project [3] was funded by the French Ministry of Industry (budget € 3.4 million). The 39-month course took place between 2008 and 2012 and covered the area of Interoperability of enterprise computerized systems and applications. This topic is a major issue. We recall that 40% of company IT costs are dedicated to addressing the non-interoperability of applications (Source: the Yankee Group 2001).

The acronym of the project (ISTA3) means "third generation Interoperability for Aeronautics Subcontractors" (in French: "Interopérabilité de 3ème génération pour les Sous-Traitants de l'Aéronautique") . A major contribution of the project was the development of prototypes of connectors between systems and applications of the same company or belonging to various companies at low cost, easily implanted through a flexible and appropriate methodology. The third-generation of interoperability (I3G) solutions is mainly characterized by a greater ability to enter or delete a partner in the collaboration without impose a fixed format on the partners and a capacity to address the problem of semantic reconciliation of messages between partners.

The project was based on research results of two recent European research projects (ATHENA, INTEROP-NoE). The project consortium consisted of a dozen partners, six academic partners, five companies and a training organization. An industrial group of SME / SMI with 150 people (the MIPNET group) and one of its subcontractors constituted the industrial case of the ISTA3 research project. In this project, about fifty people worked together and ensured a workload of 5500 men * days.

It is important to note that, during the construction of the project, it was agreed that a vocational training program through e-learning would be developed on the base of the produced research results and would support training for professions in Interoperability.

3.1 THE ISTA3 VOCATIONAL TRAINING SYSTEM THROUGH E-LEARNING

If we take the approach advocated by the e-LITE Method, it has allowed us to develop the ISTA3 training system, a vocational training system to acquire skills necessary to prepare for the professions of 3rd generation Interoperability. The main activities of the twelve steps of the e-LITE Method used in the case of ISTA3 research project have been the following:

Step 1 : Definition of a collaborative space on the platform of InteropVLab

The ISTA3 project benefited from the fact that some partners were members of the Network of Excellence Interop-VLab and had access to the collaborative platform of this virtual laboratory. Therefore it was decided that we would use the collaborative platform of Interop-VLab and that all partners would have access to it. The organization of the ISTA3 project documents, document templates and the rules of publishing and sharing of

information within this collaborative space have been defined at the beginning of the ISTA3 project.

Step 2 : Understanding of the research area of the ISTA3 project and Interoperability professions

For the CNAM Pays de la Loire, pilot of the training engineering process, it was necessary, especially early in the project, to ask their two engineers to participate in many meetings of various work groups so that they would know the skills of the different partners, the concepts and objectives of the ISTA3 project. We also had to quickly identify what were the main businesses involved in the development of an interoperability solution.

Step 3 : Activity analysis for each profession

After step 2, three main professions were identified as actors of development of I3G solutions : I3G Consultant, Designer-Integrator of I3G solutions, User of I3G solutions .

The I3G consultant collects the needs for interoperability of a collaborative group of enterprises, specifies the I3G solution to the Designer-Integrator and then, pilots the implementation of the I3G solution.

The Designer-Integrator of I3G solutions analyses, adapts and clarifies the specifications provided by the Consultant, carries out the IT development of the I3G solution and participates technically to its implementation.

The User of I3G solutions expresses the needs of his company and his profession in terms of interoperability. He uses the I3G solution and helps to advance the solution. "User of I3G solutions" is a role rather than a profession because users usually have another profession.

Interviews with representatives of these three professions were conducted. They were the object of an activity analysis and formalization in the form of three activity frames of reference, one per profession.

Step 4 : Design and formalization of the training frames of reference (one per profession)

From the three activity frames of reference produced in the previous step, we successively deduced three frames of reference about skills and then about training, one per profession. Based on the anticipated standard profiles of the foreseen learners, some knowledge was considered as pre-requisite but despite this, the training frame of reference obtained for the profession of Designer-Integrator of I3G solutions was quite large and complex.

Step 5 : Construction of the training curricula for each profession

From the training frames of reference, curricula were defined for the professions of I3G Consultant and Designer-Integrator of I3G solutions. We didn't choose to develop a curriculum for the profession of User of I3G solutions because the assumption were made that a good I3G solution had to be transparent for its users. For the two curricula developed, the covered training perimeters were defined to take into account the development capacity of the different partners involved in the ISTA3 Project.

Step 6 : Specifications of the ISTA3 e-learning training system

Specifications about the implementation of the ISTA3 e-learning training system and e-learning strategy [4] were written. They determined the following main points:

- the different functions of the e-learning training system,
- training curricula and courses (with durations) offered by the e-learning training system,
- main training mode : e-learning,
- learner's support : a light tutoring, …

Step 7 : Specifications of the performance indicators of the e-learning training system

To evaluate the performance of the e-learning training system, we decided to principally take into account indicators related to learner satisfaction in the following areas:

- quality of course content ,
- adaptation of knowledge evaluations,
- learner satisfaction with tutoring,…

We decided that learners will have to give feedback on their satisfaction levels at the end of each course by answering an on-line questionnaire.

Step 8 : Choice, implementation and set-up of the e-learning platform MOODLE

The choice of the e-learning platform supporting the ISTA3 e-learning training system was made in a democratic way by the partners of the project. We chose the MOODLE platform because of the following elements:

- its various and adapted functionalities,
- its worldwide diffusion,
- its development in a freeware environment (like I3G solutions),
- the wish of partners to work on the same platform as Interop-VLab,
- the past experience of some partners on the MOODLE platform.

Once the MOODLE platform was chosen, it was necessary to parameterize the platform, define the different workspaces and determine the different development tools necessary for the development of pedagogical resources (e-learning development studio, screen capture tools,…).

All the help documents were written and put on line:

- technical-pedagogical Guide to help authors in the design of courses,
- user's guides about the use of the platform for authors, tutors, learners,…
- Guidelines for validation/qualification of courses.

The training about the use of the e-learning platform and associated development tools was done for all partners involved in the Work Package 4 (Training) of ISTA3 project.

Then, the implementation of the performance indicators for our e-learning training system has been done using the Questionnaire module of MOODLE.

Step 9 : Development and integration of the pedagogical resources

After the partners have been trained on the e-learning platform MOODLE and tools, the development of pedagogical resources began. In the frame of ISTA3 project, the developments have started slowly because

most of partners had to work also on the production of the research results of project and often these results was not available to develop the courses. Animation work and courses development assistance were not easy to the pilot of pedagogical engineering process. Nevertheless, at the end of this step, more than a dozen of courses have been realized, covering the main domains related to the Interoperability:

- methodology for development of I3G solution ,
- Interoperability in design,
- Enterprise Modeling with GRAI formalisms,
- Information system modeling for Interoperability with UML,
- Model Driven Architecture/Interoperability (MDA/MDI) [5],
- Ontologies,
- Service Oriented Architecture (SOA),
- Enterprise Service Bus (ESB),…

Step 10 : Cross validation of pedagogical resources

In ISTA3 project, only some courses have been validated because the production of e-learning by partners has been late but a pre-validation by the CNAM of on line courses has allowed to launch the experimentation phase of some courses of the e-learning training system without unconsidered risks.

Step 11 : Experimentation of the e-learning training system in the frame of ISTA3 project

Five courses of the e-learning training system have been evaluated in the frame of experimentation phase of ISTA3 project:

- Consultant approach in I3G domain ,
- Methodology for the design and integration of I3G solution,
- Interoperability in design,
- UML for the construction of a I3G solution,
- General principles of the model transformation and MDI.

This experiment took place over about a month with a class of students of an engineering school (ESTIA) ISTA3 project partner and a panel of twenty people or listeners alumni from various CNAM institutes (ISERPA, IIM-IESTO, EiCnam, ...) selected on Curriculum Vitae in function of courses taken. This experiment required the establishment of a double mentoring: a pedagogical engineer hosted and maintained communication with the learners transferring to the authors-course developers only matters requiring expertise learners. The experiment was conducted without incident, in good conditions.

Step 12 : Feed-back about experimentation to impove and implement the ISTA3 e-learning training system

The experimental phase of the ISTA3 e-learning training system showed overall a good satisfaction of the learners for the courses of the two curricula experienced. Synthetically, for all experimented courses, different indices of satisfaction are within the following ranges:

- Content of course: between 3.60 and 4.26 / 5
- Adaptation of knowledge control: between 2.30 and 4.50 / 5
- Perceived quality of the tutoring: between 3.40 and 4.40 / 5

This experiment allowed to identify:

- an underestimation of prerequisite knowledge to course "UML for the construction of a solution I3G",

- A lack of knowledge control at the level of the course "General Principles of the model transformation and MDI".

Overall this feedback on the ISTA3 e-learning training system did not cause significant change in this system.

4 CONCLUSION

In this paper, we present the e-LITE Method and how it has been applied for the first time in the ISTA3 research project. We have shown that the e-LITE Method, while remaining focused on the pedagogical engineering process and the development of an e-learning training system, also promotes good relationships between the three processes of research, pedagogical engineering and training related to a research project. It brings by its concurrent engineering approach a more rapid availability and a better sharing of the scientific knowledge produced by the different partners in a research project to transform these knowledge into skills to the professional world.

The IMS Laboratory of the University of Bordeaux and the CNAM Pays de la Loire are involved for three years in two research projects in which a promotion of the researches through an e-learning training system is foreseen. These projects will provide an opportunity to implement and evolve the e-LITE Method in focusing, even more formally, on the role of knowledge manager of the pilot of the pedagogical engineering process and on the importance of the capitalization of knowledge produced by research projects like e-learning training reusable resources.

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