eSCM: Education on Supply-Chain Management on Graduate Level and within Corporations

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Abstract: The paper presents a web-based institute proposed for sharing knowledge and integrate competencies in the educational and research area of supply-chain management. The Institute is being implemented as an Internet based portal and addresses as well students and teachers on university educational level, as employees in industry. Besides learning modules, the platform provides users with means to communicate, respectively to organize and execute project activities from remote locations. Means for on-line content editing and publishing, courses administration are made available as well.

Keywords: web-based education, supply-chain management

1 Introduction

The evolution of the world market in the past decades has led to the formation of new types of networked organizations, which, accordingly, raised new demands on the participants, such as the acquisition of new knowledge and skills. Information and communication technologies are rapidly evolving with their impact experienced in our everyday life, working routine and education.

To be properly prepared for the future, we must transform the traditional way of learning. Consequently, new approaches to learning are to be introduced and applied. Responding to the needs deriving from the changes in the activities of engineers, a virtual institute for distance learning in the field of supply-chain management is being established.

An Internet-based platform is proposed on the one hand for supporting e-learning on university educational level. On the other hand, it is suggested for creating new opportunities in the life-long-learning scheme for employees in the industrial sphere.

The Institute is being established in the framework of Leonardo da Vinci program, as a part of an international project funded by the European Union (project title: 'An internet-based education/training platform in the field of supply-chain management, for students, teachers and industrial employees'; acronym: eSCM).

2 Objectives of eSCM

The main objective of the eSCM project is to develop an internet-based platform for knowledge sharing and integration of competencies in the area of supply-chain management (SCM).

eSCM makes delivering courses via Internet possible, by using its integrated environment to manage course delivery and course design from a knowledge library of the materials to be learnt developed by selected researchers.

The sectors targeted by the project are universities and small and medium size enterprises (SMEs) with interest in supply-chain field or related paradigms, such as: production networks or extended enterprises. The project addresses the needs of young engineers-to-be close to embarking on working life or industrial employees whose qualifications need updating. Therefore, the main categories of potential users of project results are industrial employees, students and teachers at

technical universities. By the creation of virtual classrooms, users will have the opportunity to gain international experience without any economic impact related to travel and subsistence in other countries. The transnational nature of the project makes the transfer of information and experience between the users from all the countries involved possible.

The transnationality of the project is guaranteed by the collaboration of research institutes and enterprises from different countries in activities such as project development work, testing and evaluation tasks, study on SMEs' open problems: comparison between situations in different countries, project pilot cases development etc., and also by the theme chosen. The above transnationality emerges from the fact that manufacturing is no longer mainly home-based, enterprises enter supply-chains with industrial partners appearing all over the world, and the parts are manufactured where conditions are most favourable accordingly.

3 Characteristics of knowledge provision in eSCM

The eSCM Internet based platform is mainly, but not exclusively, created to support the traditional 'face-to-face' learning method with distance learning components. The aim of the eSCM project is, in fact, to draw up a concept for a virtual institute – and a web portal implementing it – as an aid to improve the quality and efficiency of 'face-to-face' teaching methods. The eSCM web portal will include educational material and a knowledge-base on supply-chain management.

One of the project's main advantages is the flexibility in fruiting on-line modules, which enables also working people to up-date competence and know-how, while avoiding in-classroom settings. The eSCM platform is being designed to support different educational styles, following users' requests or teachers' particular needs.

The content offered on the platform is built in a modular way in order to give teachers the possibility to specifically tailor their courses. eSCM courses can be implemented as well as stand-alone units as in combination with traditional teaching approaches.

The teacher selects the modules to be included in his/her course, builds a path in the pre-existent content, enriches it with the extra information he/she considers necessary and makes all this available for the students.

The above represents a great advantage also for the students, as they do not need to search for information in a learning site and to assemble a great quantity of disconnected material by themselves for making out what is useful to be learnt.

Teachers may further personalize their teaching method by using the platform for putting their own material such as videos of their lessons, tests, or just simply the slides of their courses.

The eSCM Consortium will test this newly integrated learning scheme in the educational institutes of each partner. A number of selected enterprises from small to medium size will allow for enlarging the evaluation of e-learning in their business contexts. The adoption of the eSCM platform for two selected project tasks in inter-enterprise contexts will eventually enable to test it as a collaborative environment for programmes of supply-chain performance improvement.

By employing e-learning tools, the eSCM provides direct savings over traditional classroom methods through lower cost and reduced travel, as well as, indirect savings through greater workforce proficiency and retention.

4 The eSCM web platform

The eSCM Institute's web site is available at: 'http//:www.e-scm.org' and can be entered in 2 ways: as a *registered user* or as an *anonymous user*. A schematic representation of the platform can be found on Fig. 2. The actors in the platforms can be categorized as content providers, teachers, students, employees in industry, and visitors.

The eSCM web portal calls for an analogy with a real educational institute. This is the main designing principle for creating the architecture of the eSCM portal.
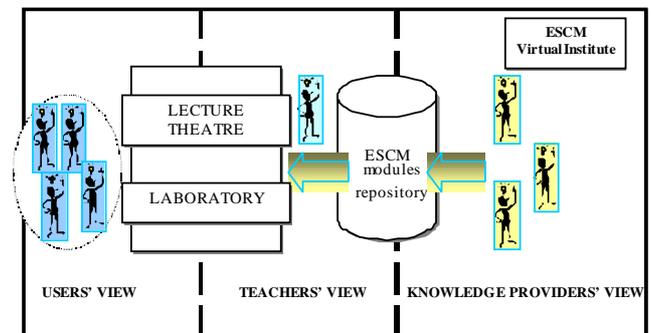

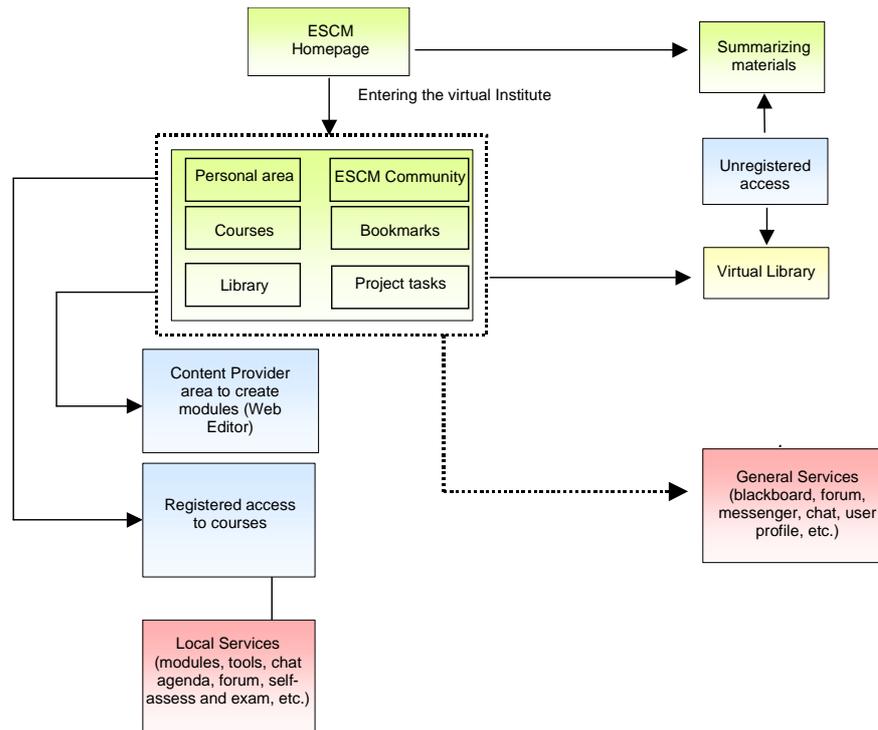Fig. 1: Accessing lectures materials & knowledge library in eSCM

Fig. 2: Schematic representation of the platform

The portal will provide three 'views' (Fig. 1) of the eSCM virtual institute:

- the 'user view' of classrooms, for individual learners or users attending tutor-supervised lectures, lab activities in eSCM and/or practical project tasks held in enterprise contexts;
- the 'teacher view' of teachers/tutors, managing the course organization and the delivery of learning materials to their own classrooms, in case education is not individual;
- the 'knowledge provider view' of professionals building and managing the learning materials in the eSCM knowledge repository.

Teacher-users may decide upon the organization of their own courses exploiting the opportunities of learning materials already available in the library.

Besides learning modules, the platform provides means to communicate, organize and execute project activities from remote locations. Auxiliary functions of the Internet site, such as a '*chat*' and a '*forum*', facilitate communication amongst users. Additional services such as '*Instant Web-editor*', '*Edit Quiz*' utility, '*Exam's* and '*Self-assessment*' tools are also offered.

The auxiliary services may be grouped as *Contents Services*, *Communication Services*, *Interaction Services*, *Evaluation Services* and *Administration Services*. Their structure can be seen in Fig. 4.

The 'Service *Modules'* provides the content editors with course design and delivery means and allows tutors to browse in the content provider area to select a module to be added to a course; set up a descriptive text under the course title; specify a weight to arrange the module in the course module list; create folder in which they organize the modules by priorities (topic, level, etc.). The web-editor can be used for on-line delivery of educational material in course modules.

The '*Tools'* service allows selecting a tool to be added to a course.

'*Agenda'* is provided for allowing to organize and communicate the activities of the course to a group of users (i.e. allowing a teacher to schedule meetings with students for on-line chatting on specific subjects or to communicate the exam's date).

Blackboard is an asynchronous service for writing and sending messages to all registered users of a certain course; all the messages are immediately shown on a blackboard, reporting the date of emission of the message and the sender's name. Users who have been granted registration to this service may use the same service.
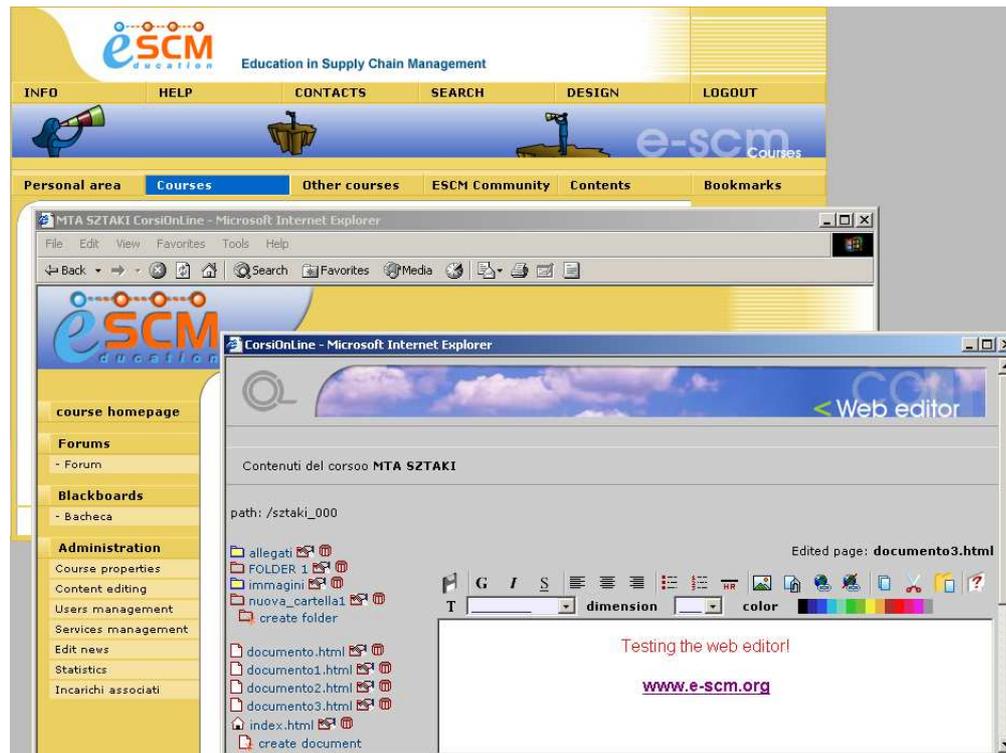
Fig. 3: Illustration of the web-editor service

The '*Forum*' is provided to support an improved co-operation between actors in learning environments and makes writing and sending messages to all the users of this area possible. A forum index is available and the possibility to send and share attachments; all the messages are organized by senders and subject. Differently from the blackboard, forum can be used to start and discuss complex matters.

'*User homepage*' service allows creating a personal homepage where users can introduce themselves and publish notes, papers and work to be shared with other users. Every registered user may create and personalize the contents of his/her homepage by using the online web editor tool. '*Messenger*' is a message sending service permitting to post messages from one specific user to another one.

'*Self assessment*' and '*Exam*' service allow teacher-users to publish online quizzes useful for self-evaluation by the students. Exams can be taken only once, while self assessments many times.

'*Administration services*' include different sub-services, such as a registration service, to grant registration to users submitting a request for registration; a monitoring service, to provide a teacher with a tool to monitor students' learning activities and progress, etc. The '*Administration course*' service allows teachers/tutors to add and remove users and change the course's properties.

The '*Edit Course*' (Fig. 3) service offers the possibility to put courses online, updating the Web-site in 'real-time', no matter of the geographical location. Using the 'Web Editor' provided for the administration of the course's Web pages, creating and modifying pages and hypertexts without the need of knowing HTML language is possible. '*Edit Quiz*' allows the teacher to create quizzes or exam-like-tasks and to visualize the related statistics.

The advantage of this auxiliary services lies in the help offered to enhance collaborative learning and the efficiency of users' interaction during theoretical learning and practical activities, as well in enhancing co-operation in groups of users from and at different educational institutes working on the same project tasks.

From technical point of view, the eSCM platform has been developed on Java technology server side, following specifics of the standard J2EE (Java 2 Enterprise Edition). The adaptation to the standard J2EE allows the platform to be executed from any application server in compliance with the standards (from JRun to Bea Weblogic, from Tomcat to IBM WebSphere).

The reference implementation has been realized using the server application TomCat ver. 5.0.
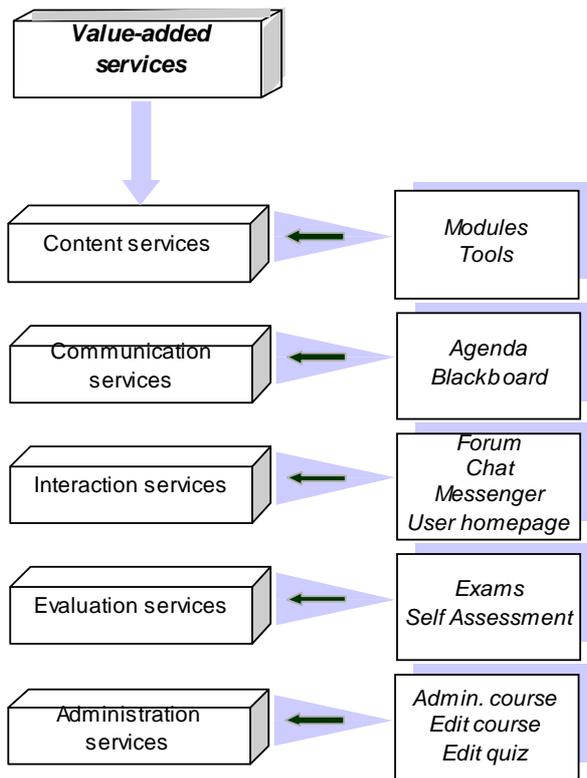
Fig. 4: Auxiliary services

The eSCM platform database supports SQL Server (recommended) and Access (advised just in test environment or with low numbers of users). The adaptation to support the database MySQL is in progress. In the project the SQL Server solution will be adopted.

The platform has also a synchronous service to communicate and to track users based on Java applet (Community Connector) technology. The Community Connector tracks user presence in the platform constantly, allowing users visibility within the community and their data tracking collection.

The server communication engine has been developed with a Java Application, while the client part is realised in Java Applet technology and it relies on the users browsers.

5 Content insights

The knowledge framework is built by analogy with a house – the 'eSCM house of supply-chain management', where in house' rooms specific learning topics on supply-chain management can be found.

The house model was developed in order to:
▪ provide a general reference model on the SCM topic;
▪ achieve a common understanding amongst the members of the consortium on the SCM concept, before the development of the materials to be learnt;
▪ facilitate a better co-ordination amongst the content developers;
▪ develop a 'metaphor' useful as a front end toward the final user of eSCM (student or employee in the industrial sphere) who is eager to find the right knowledge of SCM according to its requirement as a SCM practitioner.

If one describes a supply chain by means of the eSCM house of SCM, then, the supply chain can be represented as a production system operating under a common 'roof' frame. Under the 'roof', companies, members of the chain, operates both accordingly with their own objectives and strategies and with the integration and co-ordination mechanisms agreed upon with other companies of the chain. The operation is actuated by means of supply chain processes. The model that outcomes from the House definition in the example of Fig. 5 depicts three companies – each company is represented by a company model – co-operating in a supply chain. Their co-operation is seen as being under the agreements achieved in terms of co-ordination and integration decisions, and this is represented by the 'roof' of the model. In such a way, the single house represents a single supply chain; in fact, under the same supply chain 'roof', different organisational entities cohabit and act (accordingly with their own objectives and strategies) in order to improve the value of the whole building.

The eSCM house is structured under three levels. The '**supply-chain**' level is defined to contain the materials to be learnt on inter-enterprise network organisation (organisation of the supply-chain network, network governance, supplier selection) and co-operation mechanisms (ICT based collaborative business practice, advanced planning systems).

The '**company**' level contains the materials to be learnt on company's objectives (supply-chain costs, delivery reliability and service level) and strategies (global marketing, collaborative and outsourcing strategies) for supply-chain operations management.

The '**process**' level is defined to contain the materials to be learnt on the supply-chain process modelling (on strategic, tactical, execution levels).

A teacher visiting the 'House' may find a library of lectures or lab activities provided by other teachers or researchers.
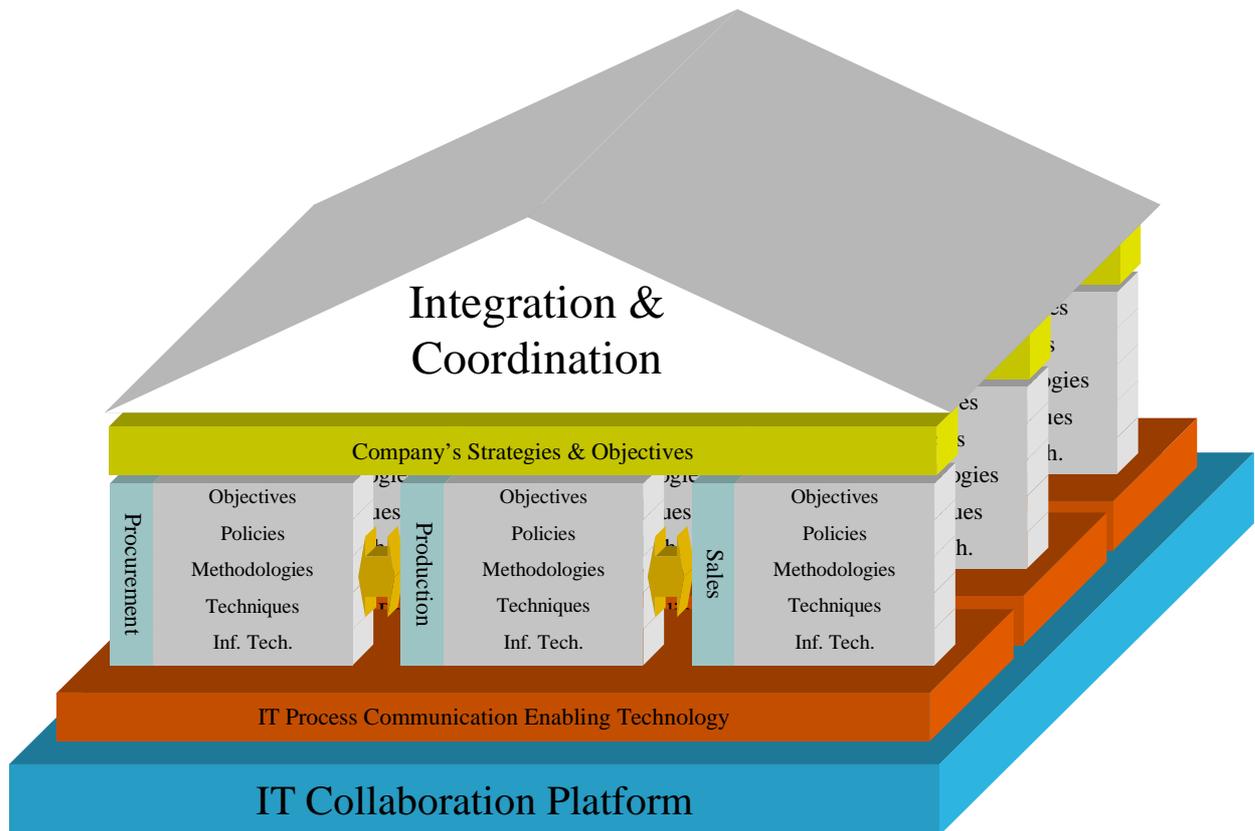
Fig. 5: The eSCM house of SCM

A list of topics of the materials to be learnt is now being developed in a book of reference of eSCM. These reference topics will in fact become, during the project life and after, an argument of the 'House', in the sense that they will fill one or more rooms in the 'House' concept, and will live 'under its roof' for the users of eSCM. The rooms wherein the materials to be learnt 'will live', will be, naturally, selected accordingly with the educational content that is expected to be found in each room by an user that will visit the 'House'.

The topics are hereby enlisted, in general terms, by means of the index of the book of reference that is now being developed:
- Fundamental issues in Supply Chain Management,
- eSCM Reference model,
- Strategic planning in SC,
- Tactical planning in SC,
- Execution in SC,
- Collaboration methodologies,
- Event management in SC,
- Network Information Management in SC,
- IT systems in SC,
- SC performance measurement,
- Business process modelling and analysis of SC,
- Lessons learnt from a real industrial case.

Supply-chains and related paradigms: Within this theme different interrelated concepts that can be found in the literature regarding the involvement of companies in networks such as supply-chains, virtual enterprises, extended enterprises etc. are overviewed. Besides benefits, important features, existing architectures and techniques are presented as well; open problems are exposed.

Fundamentals of supply-chain management: This title will cover an actual and fundamental overview of SCM on management level and work force level. To understand more about the effects and motivation of SCM the Beer distribution game will be shown. SCM is backed by information technology. An overview of current IT-systems and their processes will be also given.

Logistics issues in supply-chains: In the vertical distribution of management responsibilities, as far as industrial companies are concerned, there appear a varying number of levels belonging to hierarchical pyramid, depending on complexity of operations, on the communicative means between the levels, on the economic effort used for communication and on the organizing solutions used for accomplishment of structures.
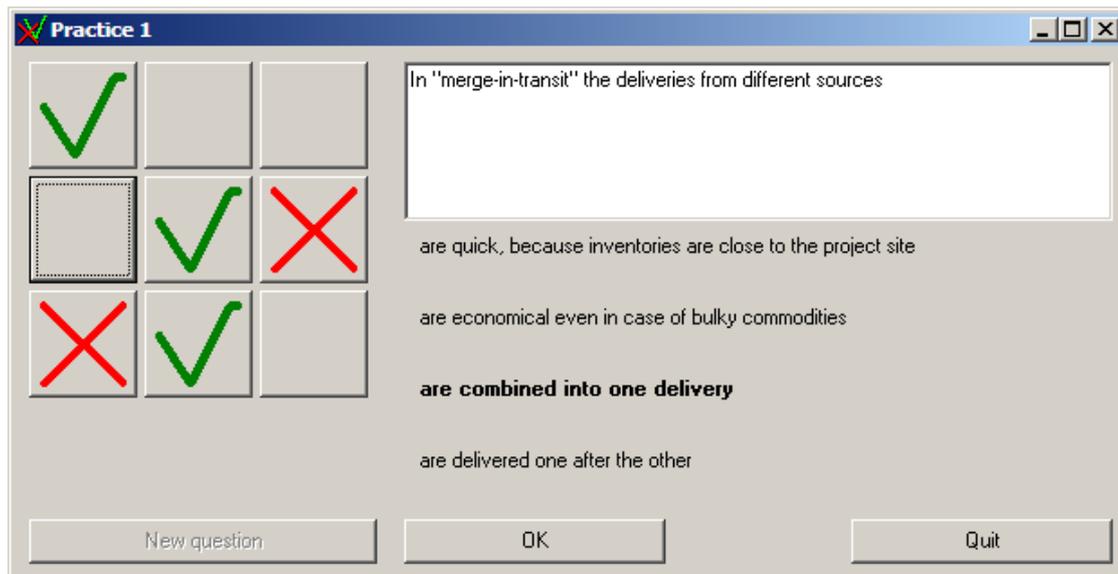
Fig. 6: Testing knowledge acquisition by entertainment games

Modelling and analysis methods of supply-chain processes: As a part of this theme, materials to be learnt referring to both descriptive and analytic techniques for the analysis of supply-chain processes, the identification of their inefficiencies and evaluation of their possible improvement will be developed.

Supply-chain demand planning: One of the major problems faced by modern companies is the uncertainty related to the turbulence of the market environment.

This uncertainty leads to the necessity of frequent modifications to the production plan and to managing safety stocks of the products in unstable demand, in order to reduce (or avoid) stock-out events. Since the amount of safety stocks (and the related costs) is related to uncertainty, a lot of effort has been done to reduce it. The purpose of the demand planning activities through a supply-chain is to improve the decisions concerning production plan and safety stocks amount by improving the knowledge about the future amount of the demand of the market. The information about future sales could be shared within the entire supply-chain to improve coordination between partners and to avoid the so-called 'bullwhip effect'.

After-sales service management: During the past years, the concept of service has been revised radically: today's customers show interests not only in the quality of the products they buy (reliability, price, functionality etc) but even in the services offered by the vendors, which aim at increasing the fidelity of their clients. The binomial product/service becomes even more important, and the companies have to organize their activities in order to guarantee higher service level at lower cost. In particular, after-sales service has a critical role in setting company strategy. After-sales service comprehends all the activities performed in order to guarantee to the customers the continuous availability and the reliability of the goods they have bought (a typical example of these activities is the repair of damaged components). Other services aim at reducing customer obligations, for example withdrawing obsolete products.

Lessons learnt from a real industrial SCM case: To confirm that SCM is not just a theory and to show how the industry implements the idea of SCM and the collaboration networks, a real industrial SCM case presents the feasible functions based on currently available IT-Systems. Subtopics to be included: Problems and challenges in the automotive processes and industry; Problems of SCM-IT systems; Supplier Collaboration-business cases.

The eSCM platform considers not only the demands on the use of new media in education, but also the necessity to offer knowledge in an attractive and easy-to-understand way, through exercises, instructive games, interactivity.

To make learning easier and more attractive the practice of theory is helped by tests built as entertaining games. Examples of such teaching-games can be seen in the screenshots of Fig. 6. On the example presented, users have to answer questions related to what they have learnt. A correct answer will be marked with green color (V sign), an incorrect one with red (X sign). If the user obtains 3

green marks in one-line he/she will be declared winner and a congratulation message will appear. He/she can (should) try to improve his/her performance by reducing the number of red marks to zero. These instructive games develop also the spirit of competition of learners, because they will tend to compete with the other learners in reaching a better and/or quicker solution of the game.

Emphasis is placed on the solution of case problems that serve as metaphors for realistic SCM projects. Examples of real industrial cases are presented to offer learners the possibility for evaluating the types of problems they will have to face in an industrial environment.

6 Conclusions

eSCM aims at improving the learning schemes on students at university educational level and employees in the industrial sphere by integrating 'face-to-face' course programmes for students at technical universities, and by integrating working experience of industrial employees in SMEs, with supplementary e-learning activities on supply-chain management.

eSCM also aims at improving ICT based practice in collaborative problem solution: by promoting the application of ICT for training on practical lab activities, furthermore for projects running in collaborative environments. An other objective of the project is to establish a bridge between research, educational and industrial practice.

The project will make possible to quickly assess, configure, and execute comprehensive training programs that deliver better supply-chain training, in shorter time and at less cost than traditional classroom methods.
The project will use a variety of proven techniques – including e-learning courses, business simulations, virtual events, test cases – making supply-chain education accessible online anytime, anywhere. The

unlimited accessibility coupled with comprehensive and consistent content gives hopes of wider employee participation.

7 Further information about eSCM

The Consortium working on the eSCM project comprises five active partners and five so-called passive partners represented by-small and medium-size enterprises contributing to the evaluation of the eSCM platform in their business context. The active partners are listed in Fig. 7.

The work presented is a part of an ongoing project; the development period of the project is of 30 months (October 2004 - March 2007).

Responsibility for the information presented falls on the authors and not on the European Commission and the National Agency of the Leonardo da Vinci Program either.

Further information on the project is available on the eSCM web portal at http://**www.e-scm.org**.

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Fig.7: Active partners in the consortium