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A Virtual Teaching Environment for Electronic Commerce

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Abstract- **Electronic Commerce is now seen as the future direction of commerce. Organisations are now developing and implementing a wide range of electronic commerce systems However, before organisations will be able to harness the potential of electronic commerce systems suitably trained people will be required. This paper examines virtual electronic teaching environment: the Deakin Electronic Trading Community. Central to this work has been to increase the student's knowledge in the area of Electronic Commerce by providing a tailored educational electronic environment by examining the underlying theory, structure and implementation of the virtual environment.**

I. INTRODUCTION

The world of commerce has dramatically changed. With the wide spread introduction of electronic commerce systems and technology it is now seen as the future of commerce. Organisations are now looking at the Internet and the World Wide Web and have perceived these technologies as the strategic basis for their push into electronic commerce. Such electronic commerce systems utilising the World Wide Web, WWW, are providing a method to: establishing and maintaining strategic advantage; increase market share, develop new markets and products; reduce costs and create effective working alliances to stay competitive. However, many electronic commerce systems use extremely new technologies and strategies with many of their basic concepts and principles not being fully formed nor understood. Moreover, the mechanisms and standards of the Internet and the WWW are only now being developed and utilised. The central problem faced by all organisations implementing electronic commerce will be twofold. First, organisations will need to closely examine the approaches used in conventional commerce and effectively adapt these to electronic commerce or develop new electronic commerce systems. Second organisations will need suitably skilled graduates in not only the principles of electronic commerce but also the basic building block mechanisms of the Internet and WWW. Today's graduates must have good understanding of the more common mechanism and programming languages used on the Internet and WWW for electronic commerce. Clearly, to address these two salient points the education of students in the area of electronic commerce is a challenging task.

The World Wide Web fast becoming the mechanism to deliver educational material for flexible learning. This rapid development has been seen in the wider development and implementation of educational environments, such as WebCT, Blackboard, and Eteach. The primary advantage in utilising the WWW is that it is seen to be free from geographical, time and participation constraints providing the student with greater flexibility. Similarly, the WWW provides a simple and universal method of receiving and displaying information through the use of a common web browser. Fueling this trend is the growing economic and government pressure on tertiary institutions to provide flexible delivery modes of their courses utilising the WWW to increase their student base. Indeed numerous tertiary institutions are rapidly investing considerable resources, time and intellectual property in the WWW as a means of conveying pedagogical materials for student learning. Indeed, most implementations have taken paper-based educational material and converted these into "electronic page turning" educational material [18]. Tragically, these implementations have paid little or no regard to any appropriate pedagogic design models and strategies for exploiting the WWW as an instructional medium. Moreover, this will require a rethink of the current pedagogical design models to examine how they are applicable to the delivery of course material by the WWW. This may require the redevelopment or completely new pedagogical approaches to educational models over the WWW.

This paper presents an overview of the Deakin Electronic Trading Community. The primary role of the Deakin Electronic Trading Community, DETC, is to provide an environment to allow students to study electronic commerce in a flexible manner. Moreover, the DETC is an electronic environment where the student can develop a greater understanding of the technology and strategies of electronic commerce in a controlled manner. In Section two, we outline the pedagogical issues faced by the Deakin Electronic Trading Community. In Section three we introduce the Deakin Electronic Trading Community. Section four introduces the instructional mechanisms of the Deakin Electronic Trading Community and section five outlines a logical model of the Motor Vehicle Trading Community within the Deakin Trading Community. Section six outlines the Deakin Electronic Trading Community Infrastructure Framework while section seven examines the student's development of the Deakin Electronic Trading Community. While Section seven and eight introduces the outcomes and evaluation plans discussed, respectively. In Section nine, we concluded this paper.

II. PEDAGOGICAL APPROACH OF THE DEAKIN ELECTRONIC TRADING COMMUNITY

Electronic commerce, or the conduct of business via computer networks [16], is now providing a wide range of solutions or technologies. These new technologies include vary greatly from Electronic Data Interchange [5] which is widely used in business to business electronic commerce through to Electronic mail (or e-mail) [7] which provides a flexible means to communicate. Both are tools that are promoting electronic commerce as the new future of commerce.

Electronic commerce over the Internet is widely recognized as a method to reduce costs, gain a strategic advantage and create effective working alliances to stay competitive. However, many of the basic concepts and principles central to electronic commerce using these new technologies are not

fully understood. The business practices involved in electronic commerce within a business framework are only now being developed and understood. Importantly, the Internet is turning isolated, national markets into a global "village" where every company must compete with domestic and international rivals [5][15]. Indeed, the European Community has established a trading zone that allows companies in many different countries to trade electronically in a seamless manner providing organisations with access to new and expanding markets.

Accordingly it is vital that organisation make use of approaches that enable them to operate effectively and efficiently in this new environment. In order for organisations to design and implement electronic commerce systems or adapt conventional commerce to electronic commerce they will need graduates who are knowledgeable about the principles of electronic commerce and skilled in the business uses of the Internet, WWW and their related tools [9]. This has lead to the impetus to investigate approaches to teaching business professionals and university students about the way in which organisations can exploit EC [14].

A. Education's Approach to the WWW

Educational institutions are now developing flexible delivery modes for their courses utilising the WWW as core technology. To date, however, most implementations have taken paper-based material and converted these into 'electronically page turning' material [18]. These types of implementation do not exploit the very dynamic nature of the WWW by providing students with a 'hands on' experience to provide "electronically situated learning" within an electronic commerce systems. Learning theorists [4] [12] [11] argue that learning is a "constructive process" which embeds the learner in an authentic, problem-solving environment. When this is joined with modern sociological views on learning, gives rise to the notion that knowledge is socially constructed for "myself" out of what confronts "me", but, it is always influenced by the immediate educational environment [3] [13]. Fundamental to these theories of learning are experiential methods of teaching which advocate "learning by doing". That is, the situation of the learner, or environment the learner is in, allows knowledge to be created and made meaningful by the context in which it is acquired [6]. Importantly, this "situated learning" occurs through the undertaking of authentic activities guided by expert practitioners in a structured environment [2]. As there are no current approaches to on-line e-commerce education the "situated learning" approach provides an excellent learning solution, as:

- many learning theorists advocate the use of experiential methods (e.g., case studies, laboratory training, business simulations) for teaching adults in preference to using passive techniques such as lectures, seminars [8] [10] [11] [17]. Providing practical experiences the student can reflect to stimulate their effective learning process; and

- Business simulations have been shown to be a successful approach to teaching electronic commerce to business professionals and tertiary students [14] [16] [19]. This technique involves participants adopting the role of an organisation and trading with other student-operated companies using electronic commerce technologies, e.g.,

the Internet and EDI.

B. Pedagogical Approach of the DETC

The strength of DETC is that it provides an environment that will support and direct the students in studying and understanding the elements of electronic commerce. DETC provides a 'virtual' environment that takes the student through a variety of scenarios typical of real EC operations providing a situated learning approach. Central to the concept of the DETC is the development of an educational tour through the DETC. The students follow the guided tour through the DETC where they will experience various facets of electronic commerce. Importantly, by guiding the students through the DETC we are able to tailor the way the students interact and focus them on a range of particular view of electronic commerce. The DETC will not only be able to measure and control many of the basic mechanisms of the technology, but will also illuminate through experiential learning, the principles and practices of electronic commerce a capacity not currently available in electronic commerce systems due the propriety nature of most commercial systems.

Many of the basic elements of electronic commerce systems are not currently available to students. Hence, this has required the intimate details of electronic commerce to be describe to the student in a more conventional manner, through lectures and tutorials. However, this approach does not provide the student with "*hands on*" experience into the operation of the elements of an electronic commerce system. The role of the DETC, is to provide an environment that will support and direct the students in studying and understanding the elements of electronic commerce through engagement in on-line processes.

The DETC provides a "*virtual*" environment that takes the student through a variety of scenarios that convey specific points of electronic commerce. The approach is based on "story boarding" of scenarios. The DETC's pedagogical approach is based on constructivism. The DETC provides an educational environment that supports the student by having them operate with descriptive scenarios allowing the student to construct a well defined view of electronic commerce. The following are the key concepts, which have come from this view:

- Students construct their own meanings from, and for, the ideas, objects and events they experience;

- Learning happens when existing conceptions are challenged;

- Learning requires action and reflection on the part of the student; and

- Learning is an interactive process among, not only the teachers and students, but also the learning environment, material and a variety of other external sources.

Importantly, the term "interaction" is primary to the DETC. Students interact with the DETC as they follow the scenario and establish their own meaning to electronic commerce.

III. DEAKIN ELECTRONIC TRADING COMMUNITY

The primary design principle of the Deakin Electronic Trading Community is to logically draw together groups of

organisations from a wide range of industries into effective trading communities. By grouping organisations into trading communities we are able to quarantine each industry and examine it in isolation. Figure 1, highlights a small selection of industries that are currently being developed into electronic trading communities within the DETC. Each organisation within an industry is selected to provide a realistic insight into how electronic commerce could be performed within a particular industry. Importantly, this could involve the development of an organization's electronic commerce system within the particular industry or the development of a wide range of organisations within an industry highlighting the value chain found within the particular industry.

This approach provides us with two distinct advantages in the development of the DETC. First, it provides the means to qualitatively and quantitatively examine and test the pedagogical design approaches employed in each trading community and establish how students learn and interact in the virtual environment implemented for the particular industry. Second, it provides a simple mechanism to develop each of the industries independently of each other. This allows a wide range of groups to become active members in the development of the DETC. This level of development could range from a groups of students developing a new industry through to the collaborative effort of another university developing an industry for their overall educational objectives in electronic commerce and then making it available to all the shareholders of the DETC.

A. Principle Concepts of the Deakin Electronic Trading Community

The principal concept of the DETC is to interactively demonstrate the principles and practices of electronic commerce within a controllable development environment for the students. The DETC will not only be able to measure and control many of the basic mechanisms of the technology, but also the principles and practices of electronic commerce that are not currently available in other electronic commerce systems due to the proprietary nature of these systems.

Central to the concept of the DETC is the development of an educational tour through the DETC. The students follow the guided tour through the DETC where they will experience a particular facets of electronic commerce. Importantly, by guiding the students through the DETC we are able to tailor the way the students interact and focus them onto a particular view of electronic commerce. The DETC provides the computing platform and environment to illustrate particular issues in electronic commerce. The DETC will provide students with an environment that will demonstrate to them the principles, mechanisms, and practices of electronic commerce utilising the Internet and WWW. The major advantage of this approach is that it can be tailored to illustrate the issues of electronic commerce in a very practical sense. This approach will reinforce these issues by showing their relevance in the field of electronic commerce. Importantly, it provides an extremely flexible means of assisting students in developing their knowledge of the policies and mechanisms of electronic commerce, which are currently not available in electronic commerce systems.

B. Objectives of the Deakin Electronic Trading Community

The objective of the DETC is to provide a test-bed which is effective, timely and flexible in teaching the basics of electronic commerce. Effective, in DETC allows us to demonstrate the issues, policies and mechanisms of electronic commerce to the students. Timely, in the ability of the DETC to be changed quickly to keep up to date in the fast changing area of information technology and electronic commerce. And importantly, flexible in providing teaching and learning strategies that can incorporated into the DETC making it accessible by students studying in on-campus and off-campus modes. By developing the DETC as a controlled development environment we are able to take a cross section of electronic commerce applications and study particular issues in electronic commerce. In essence, the DETC will simulate a
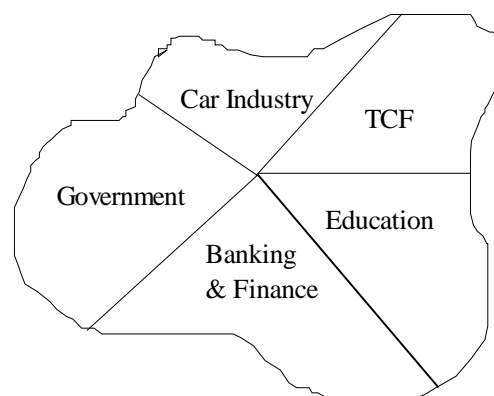

Figure 1: Industries within the Deakin Electronic Trading Community

real business trading community in real time and following established business processes.

The DETC provides a common thread for students undertaking the study of electronic commerce. As students progress through the major they will use the DETC in different ways for each unit. The advantage of this approach is the students are not required to relearn a new environment for each unit. In addition, this approach provides a dynamic approach to the delivery of the electronic commerce education in a flexible teaching and learning mode. The objective of the DETC from the students prospective is that it will:

- Help students understand the principles, mechanisms, and practice a number of forms of electronic commerce;

- Provide students an interactive environment that is adaptable to changing business practice; and

- Enable students to identify both theoretical and practical approaches to electronic commerce.

The objective from the prospective of the DETC, it is to:

- Provide an on-line flexible teaching and learning model in the delivery of a range of units in electronic commerce; and

- Provide a method to evaluate the effectiveness of the pedagogical approach used in an electronic teaching environment.

IV. INSTRUCTIONAL MECHANISMS OF THE DEAKIN ELECTRONIC TRADING COMMUNITY

The development of the DETC has presented a number of basic problems that needed to be solved for this implementation to be successful. However, underlying these problems there were two basic elements. First, the student need to be supported within the DETC by providing a common set of tools and navigational aids. These elements provide the directive elements of the virtual educational environment. Second, the instructor developing the tours for the student required educational management framework and tools to allow the instructor to direct the student to the important elements of the electronic commerce system that should be discovered.

To solve the first problem our early approach in the development of the DETC was to employ a common set of navigation and constructive tools. These provide the student and instructor the means to specific vistas of the DETC allowing the student and lecturer to use a common vocabulary and view when describing and following a tour within the DETC.

The second of these problems became more acute as the project progressed. To some extent this was covered by the expertise gained by the instructors and lecturers using the DETC. This was resolved more to be a management issue and by developing and providing a tool to the instructors this has helped in the development of a tour with the DETC while reducing the need to becoming intimate with the low-level operation (i.e., code) of the DETC.

A. Portholes in the Deakin Electronic Trading Community

A central advantage of the Deakin Electronic Trading Community is to provide students with a particular view of an issue in electronic commerce. In the DETC we refer to these as *porthole* views. The porthole enables the student to examine a particular facet of electronic commerce that the subject requires and allows the student to interact with it. Importantly, portholes can be constructed at various levels. Indeed, based on the subject material being discussed some porthole views will show the high level interactions (or policy of electronic commerce) between organisations within the DETC. Consider the audit trail of payments within an EDI transaction that can occur between eight companies. Conversely, we are able to provide extremely low level portholes that demonstrate the low-level mechanisms of electronic commerce. For example, the code showing how a connection is made to a database over the Internet. In the DETC we have defined a range of porthole views. These are:

- High level (macro) Portholes: The high-level porthole view is used to show the interaction of the organisations within the DETC. In electronic commerce many organisations interact at a high-level with information (messages) passing between organisations indicating their interaction. Indeed, business value chains are now becoming more and more widely utilised by organisation as they develop inter-organisation alliances. This type of porthole allows the student to examine the top down approach of electronic commerce.

- Low level (micro) Portholes: The low-level porthole view is used to show the operation within an organisation's electronic commerce system. The low-level porthole examines the building blocks of electronic commerce by focusing on the mechanisms used. This type of porthole often examines programming languages and code implementations of an electronic commerce system. This type of porthole allows the student to examine the bottom up approach of electronic commerce.

- Navigation Portholes: The navigation porthole provides the students with a method to navigate the tour they currently are on. This type of porthole provides a tour guide role by indicating where they are in the tour and allows the student to leave and return at any stage of the tour they are currently on. Importantly, the navigation porthole provides the student the means to communicate messages to the tour leader (i.e., course lecturer).

- Annotation Portholes: In each porthole view we are able to associate dynamic student annotation portholes. The annotation porthole pops up in a separate window to expand on the points that need to emphasize based on the porthole. This allows the student to gain extra information about the porthole to gain a better understand of the points that are being raised.

- On-line Help Portholes: The on-line help porthole is available to the student at every stage of the tour in the DETC. By providing an on-line help porthole this enables the student gain information about the points that are currently being raised in the tour.

- Examination Portholes: By providing an examination porthole we are able to study and evaluate the students knowledge gained in the tour. As students finish a particular tour within the DETC they are able to complete an examination porthole. This provides the student with basic feedback on their progress.

Importantly, the guided tour uses the porthole views to focus the student on the particular facet of electronic commerce that we want the student to understand. Importantly, from the instructor's perspective it provides the focal points of the tour.
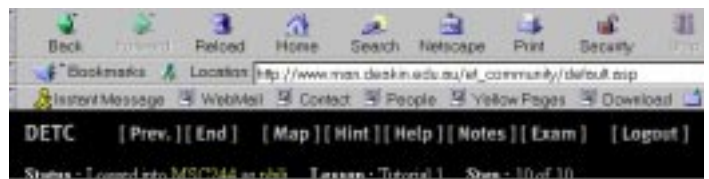

Figure 2: Portholes on the DETC Interface

An outline of the student interface to the DETC is shown in Figure 2 with a number of the DETC portholes. These are shown in the black panel of the Web browser. These are the notes, help, exam and navigational (map) portholes. Similarly the navigational tools of prev and next are shown in Figure 2. The status of these portholes changes as the student moves through the DETC. This allows the instructor to tailor the environment for each individual tour allowing the learner to be situated within the DETC examining the elements of electronic commerce.

B. The Scenario Manager in the DETC

In the context of education, however, our experience has shown that the Macro and Micro Portholes on their own are sufficient for providing students learning in this mode with adequate levels of instruction. This is because we found that it was necessary to lead students through the tour since without instructions on what they should do and when we found that students were not able to use these Portholes effectively on their own.

The development of a Scenario Manager for creating Web-based lessons or tutorials for students has help address this problem. The Scenario Manager has been developed so that an educator or instructor can devise, via the Web, a "story board" which leads students through a particular set of concepts which are illustrated with the DETC. More specifically, the Scenario Manager provides the means by which to devise an on-line tutorial comprising a sequence of explanatory, textual Web pages and associated links to pages within the DETC which demonstrate or allow the student to experiment with the concept being addressed.

As instructors we required a method to develop the sequence that we require the student to traverse but we do not want the instructor to be tied down with the technology of the DETC. Instead the scenario manager provides the instructor with a high level tool to quickly develop a lesson and link the relevant portholes together.

In the context of the EDI process lesson, for example, students would start off by clicking on a Web page link to this particular tutorial. Initially they are shown a page, which explains what the tutorial will teach them. From this point on, the students will use Navigation Portholes (that is, the typical Next, Previous, etc options, as shown in figure 2) which will lead them through the sequence of steps. Textual Web pages are included between each steps to explain to students what they are required to do and what they should see, so that the Scenario Manager fulfills the role of a tutor who would lead on-campus students in much the same way. On-line Help Portholes incorporated into the DETC are also available to provide additional context-sensitive assistance to students or to provide further instructional information on the concepts

being covered at that particular point in the on-line tutorial.

Further research is still required to determine the extend to which the Scenario Manager and its associated Porthole Views can duplicate some of the instruction given to the distance education student which would normally be given by a tutor. We believe that were the role of the tutor for that lesson is primarily demonstrative, this approach to distance education will be quite effective. We also anticipate, however, that students will need to make use of more conventional CMC facilities to discuss further the issues and concepts which the student was not able to grasp using the DETC system. For example, the DETC can provide links to email addresses, chat rooms and conventional web sites and other facilities which the students can use to enter discussions on the concepts they have covered using the DETC with fellow students and with e-commerce educators.

In figure 3 we have the interface of the Scenario Manager. The major elements of the interface are the "Add New Step" link at the base of the lesson and the actions for each step: edit, insert, and delete. For each step that is created a set of portholes can be associated with it. That is when a tutorial has been completed the instructor is able to associate an exam (through the Exam porthole) to the tutorial for the student. The example shown in Figure 3 is a ten step tutorial on searching on the Web.

V. DEAKIN ELECTRONIC TRADING COMMUNITY LOGICAL MODEL

The Deakin Electronic Trading Community can be considered similar to an island within the Internet where Deakin University has control over its operation. In the first stage of the DETC, it is proposed to implement a Motor Vehicle Industry manufacturing community. Figure 4 outlines the proposed components of the motor vehicle industry. This model outlines nine sites that will be used to provide the building blocks of the electronic trading community. Each site will provide an insight into a well-defined aspect of electronic commerce.

DETC Editor - Tutorials/Edit Steps

MSC244 - Tutorial 1

Step No	Link	Source	Action
1	Introduction	URL	Edit / Insert / Delete
2	Common Search Engines	URL	Edit / Insert / Delete
3	Task One - A	URL	Edit / Insert / Delete
4	Task One - B	URL	Edit / Insert / Delete
5	Task Two	URL	Edit / Insert / Delete
6	Task Three	URL	Edit / Insert / Delete
7	Task Four	URL	Edit / Insert / Delete
8	Task Five	URL	Edit / Insert / Delete
9	Task Six	URL	Edit / Insert / Delete
10	Task Seven	URL	Edit / Insert / Delete

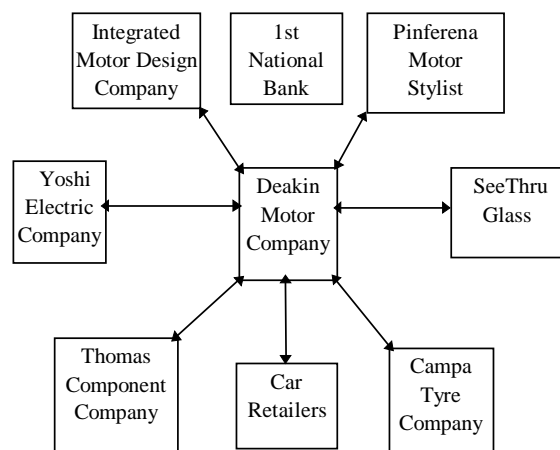Add New Step

Figure 3: The Scenario Manager

Figure 4: Motor Vehicle Trading Community

The scenario that we have developed for the Electronic Trading Community is centered on the Deakin Motor Company which manufacture and sell the D-Car family

sedan. The Deakin Motor Company builds this car by using a wide range of electronic commerce mechanisms among all the companies in the community (suppliers, dealers, and banks). Each site will feature one or more of the important mechanisms (i.e., Java, Electronic Data Interchange, Common Gateway Interface, Active Server Pages, and Databases). Importantly, each of these mechanisms will be used to develop the site as a whole. A brief outline of the sites follows.

- Deakin Motor Company: This is the central site for the car industry section of the Electronic Trading Community. This site will be the focus of the car trading community and is the most complex of the entire site in the community. It will use all of the mechanisms required to provide effective electronic commerce. The role of the Deakin Motor Company site is to provide a co-ordination entity by receiving electronic orders for the D-Car from the car retailers and then placing these with the part manufacturers to produce the requested car. These orders are then used as triggers to initiate the use of electronic commerce between all the sites in the manufacture of the D-Car. An initial prototype of the Deakin Motor Company site has been developed and is currently in use by students.

- Thomas Component Company: This site has been designed to provide many of the small sized components that are used in the assembly of the D-Car. The Thomas Component Company factory will maintain a considerable inventory of parts that can be ordered by the Deakin Motor Company. This site's primary mechanism of operation will be a complex database implementation. This allows the student an intimate look at how a database can be effectively used in electronic commerce. Similarly, it will allow the student to see how the database, its interface to the web, and electronic data interchange requirements for correct operation are needed in electronic commerce.

- Integrated Motor Company: This site has been designed to provide engines, transmissions, braking systems, suspension and drivetrains. The Integrated Motor Company manufactures all items. The site will use Common Gateway Interface, CGI, as a basic mechanism, to show the level of inventory of parts required to manufacture the D-Car. Importantly, this site will enable students to study CGI scripts in a safe manner as CGI has a number of inherent security problems. Our approach will allow CGI to be used safely while demonstrating the power it is able to provide in electronic commerce.

- Seethru Glass Company: This site provides all glass required for the D-Car. The Seethru Glass Company follows a Just In Time approach, JIT. As orders are electronically placed the Seethru Glass Company must manufacture and deliver the requested items within the allotted contract time. Active Server Pages will be used as the basic mechanism for the development of the site.

- Pinferena Motor Stylists: This site provides many of the new and upcoming designs for the Deakin Motor Company. This site is primarily designed to show how Java can provide information in a dynamic manner. This site will enable students to examine effective marketing and strategic plans implemented by electronic commerce.

- Yoshi Electric Company: This site provides all electric

assemblies to the manufacture of the D-Car. This company provides a diverse range of electric assemblies ranging from light globes up to on-board computers for electronic fuel injection. This site has been selected to use as an instance of Electronic Data Interchange, EDI. As orders are placed with the Deakin Motor Company for the D-Car information is transferred using Open EDI to the Yoshi Electric Company. This will enable the student to see the operation of EDI in action. Similarly, the implementation will provide the student with an insight into the secure EDI interaction of F-EDI between the First National Bank, Yoshi Electric Company and the Deakin Motor Company.

- First National Bank: This site provides secure transfer of funds between the sites of the car trading community. This site is designed to provide secure commerce on the Web. The First National Bank will provide a site that will show students how security can be achieved. This site will implement both encryption and authentication and the currently used industry standards of security, e.g. RSA.
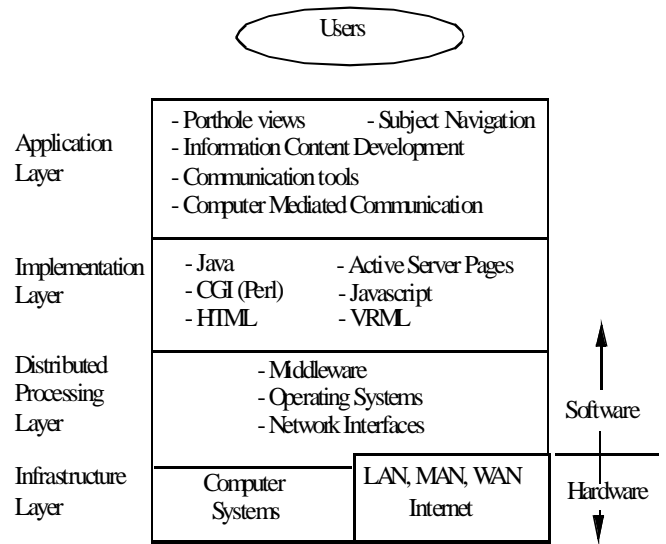

Figure 5: DETC Framework

VI. DEAKIN ELECTRONIC TRADING COMMUNITY INFRASTRUCTURE FRAMEWORK

In the original development of this virtual teaching environment was the ability for the system to be scalable. That is, it should be designed in such a manner that will allow it to be expanded by a wide range of stakeholders of the DETC. In order for this to be possible the initial design of the virtual teach environment it must be as modular as possible. To solve this we developed the Deakin Electronic Trading Community Infrastructure Framework.

One interesting problem faced by the Deakin Electronic Trading Community is the implementation mechanisms used to develop electronic commerce systems are also used in the development of the DETC. This requires students to use and master many of the technologies that are used in electronic commerce systems and the DETC. This highlights two important points in the development of the DETC. First, as students become more comfortable with developing

electronic commerce systems they will be able to develop elements of the DETC to demonstrate their understanding, and visa versa. Second, the DETC must be designed in a modular fashion to allow student access to many of the elements of the DETC. Moreover, we need to provide portholes in the DETC for the students while still enabling the DETC to still operate effectively. Therefore to effectively implement the DETC a suitable framework has been developed and is shown in Figure 5. The framework provides a modular implementation of the DETC. Each layer is provided independently so that we are able to change certain aspects of the DETC without effecting its overall operation. Importantly, each layer of the DETC will be used by the students to illustrate the building blocks of electronic commerce.

A. Application Layer

The primary role of the application layer is to provide a window into the DETC for the student. At this layer, the instructors is able to use the development tools from the lower layers of the framework to develop concepts, schemata and portholes for use in the DETC. At the application layer the DETC framework provides computer mediated communication application, CMC, for students working in the DETC. This allows the students to interact with each other while they are using the DETC. The application layer:

- Provides a friendly and consistent interface to the DETC necessary to present information in a convenient and comprehensible manner. This is achieved by using a World Wide Web browser, Netscape or Internet Explorer.

- Provides intelligent support to users with suitable porthole views of the DETC.

- Supports learning between students both on an individual and group basis. An important element in the development of the DETC is CMC. By allowing students to interact in this manner they are able to *"construct"* their knowledge of the DETC from the interaction between the students and staff while using the DETC [1].

B. The Implementation Layer

The complexity of the DETC is found at the implementation layer. The implementation layer contains all the basic programming tools that will be used to develop the DETC. Similarly, this layer provides all the basic mechanisms needed to develop the electronic commerce systems for the DETC. Importantly, the tools available at this layer are studied by the students enabling them to:
- understand how to use the mechanisms of the software to develop electronic commerce systems;

- understand which of the software tools are best utilised for each task in the implementation, design and development of electronic commerce systems; and

- discover the complexity of each software tool.

C. The Distributed Processing Layer

The major element of the distributed processing layer is the operating system. The initial development of the DETC is being constructed using PC UNIX, Linux 2.0. However, the continued development of DETC will involve its implementation in a Windows NT environment.

D. The Infrastructure Layer

The DETC will initially be developed on a single, centralized server. The server will initially be located on one campus with students logging in. However, with the further development of the DETC the final version will be developed as a distributed system over a number of geographically disperse campuses.

VII. STUDENT DEVELOPMENT OF THE DEAKIN ELECTRONIC TRADING COMMUNITY

A central concept of the DETC is the involvement of the students in the development of the DETC. As student progress through their electronic commerce studies they are asked to develop clearly defined sections of the DETC, as part of their subject assessment. This has a twofold effect for the students. First, students are able to develop a realistic section of an electronic commerce system that could be used by an organisation in the selected industry. Second, it provides students with a chance to test their knowledge of the subject area. For example, in the Motor Vehicle Trading Community of the DETC students have developed car dealerships that sell the Deakin Motor Car, the D-Car. The development of the dealerships tests the students understanding of basic HTML coding and how to setup an effective World Wide Web site. The advantage of this to the DETC is the students are helping develop the Motor Vehicle Trading Community and feel that they have some ownership of the DETC. Similarly, it provides a library of examples of basic HTML coding for future students to examine when studying this section of the electronic commerce.

VIII. EXPECTED OUTCOMES OF THE DEAKIN ELECTRONIC TRADING COMMUNITY

A major factor in developing this approach is the ability to have direct control of every element of the Deakin Electronic Trading Community. This has three effects:

- It guarantees that the site will be available for students to examine;

- It provides access to the basic electronic commerce system mechanisms of the site that otherwise would not normally be available to us; and

- It allows us to provide extra functionality to the sites to assist student in understanding the seminal points of electronic commerce that each site is showing.

The modular design of the DETC also allows the concurrent development of Industries. The important next stage of evolution of the DETC will be the collaborative of industry by partner universities. Swinburne University and University of Tasmania in Australia will be providing input into its further development.

IX. ASSESSMENT OF THE DEAKIN ELECTRONIC TRADING COMMUNITY

An important element of the Web-based tutorial enabled by our Scenario Manager is an effective means by which instructors can assess what students have learned as a result

of using the DETC and can provide the students with feedback. The DETC and the Scenario Manager in particular achieves this goal through the use of Examination Portholes, which are effectively on-line quizzes or questions (which can be closed and/or open-ended in nature) designed to test what the student has learned..

An essential element of the DETC is the assessment and evaluation process of the DETC by the students and staff. Central to the assessment process are the examination and navigation portholes and to a lesser extent the computer mediated communication between the students and staff. By using this data we will be able to develop metrics to establish the effectiveness of the DETC. A systematic evaluation of the DETC project will be completed as an ongoing exercise, to investigate:

- the overall impact that the DETC has on the effectiveness of student teaching and learning;
- the impact that the DETC has on students understanding of the business processes involved in electronic commerce; and
- the efficiency of delivery of the electronic commerce courses using DETC as the core.

The next stage of the DETC is a collaborative stage involving Swinburne University of Technology and the University of Tasmania in the development of three new industries. This is hoped will provide a large pool of electronic commerce system and tours within the DETC providing students and staff with an exciting environment for the teaching of electronic commerce in a virtual environment.

X. CONCLUSION

In the design, development and implementation of this virtual teaching environment, the Deakin Electronic Trading Community, we have been able to test many of the open questions of on-line teaching. Central to this work has been the development of the "guided tour" allowing instructors to direct the student through a course of inquiry. This has required the development of suitable tools, e.g., the scenario manager, to enable an instructor to quickly and easily develop educational material. Interwoven in this approach is the porthole. The porthole provides the student with a virtual view or insight of a very element of the electronic commerce system the instructor is attempting to highlight. The next stage of this project is the further development of several key industries within the virtual teaching environment by a consortium of Australian Universities: Swinburne University, Deakin University and University of Tasmania.

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