The E-Society Groupware Approach

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Abstract: New Economy, Knowledge Management, Knowledge Community, Intellectual Capital and .Com Enterprises are examples of terms currently used to illustrate the transformation of the social, economic, cultural and technological order. With this new "way of doing things" the work processes are completely reformulated and the vision of a single worker performing his own tasks apart from the tasks being performed by the others in the team is clearly being replaced by a more sinergistic group work approach. To support the demand for new technologies that enable a workgroup to perform tasks and to create a common process understanding, the Software Engineering Laboratory (LES) at the Catholic University of Rio de Janeiro (PUC-Rio) is developing groupware infrastructure for applications in different domains like e-education, e-commerce and e-business. In this paper, we will briefly discuss the transformation of work relationships that are taking place in our society and detail two technologies developed at LES to foster the adoption of the Web as an arena for business and education. The first technology discussed is the AulaNet environment for creation, maintenance, administration and participation in web based courses. Then we present the Scriba tool which facilitates the development of Java based Web applications showing its use in the AulaNet environment development. The paper shows some statistics of the AulaNet usage in PUC-Rio and the results of a initial analysis of the Scriba tool. Finally, we present some general research directions taken at the laboratory for the development of new e-commerce, e-business and e-education technologies.

Keywords: New Economy, Groupware, Team Work, Knowledge Management, Web Applications.

Resumo: Nova Economia, Gestão do Conhecimento, Comunidade do Conhecimento, Capital Intelectual e Empresas .Com são exemplos de termos usados atualmente para ilustrar a alteração da ordem social, econômica, cultural e tecnológica mundial. Com este novo "jeito de fazer as coisas" os processos de trabalho são totalmente reformulados e a visão de um único trabalhador realizando as suas tarefas isoladamente, sem o conhecimento das tarefas do grupo como um todo, está sendo substituído por uma abordagem mais sinergística de trabalho em grupo. Para satisfazer a demanda por novas tecnologias que permitam a um grupo de trabalho realizar tarefas conjuntas e criar um entendimento comum do processo, o Laboratório de Engenharia de Software (LES) da Pontifícia Universidade Católica do Rio de Janeiro (PUC-Rio) está desenvolvendo uma infra-estrutura de groupware para a criação de aplicações em diferentes domínios como e-education, e-commerce e e-business. Este artigo discute a transformação das relações de trabalho que estão ocorrendo em nossa sociedade e detalha duas tecnologias desenvolvidas no LES para incentivar o uso da Web como uma arena para educação e negócios. A primeira tecnologia apresentada é o ambiente AulaNet para a criação, manutenção, administração e consumo de cursos baseados na Web. A seguir, a ferramenta Scriba para o desenvolvimento de aplicações em Java para Web é apresentada. O artigo apresenta ainda algumas estatísticas do uso do AulaNet na PUC-Rio e o resultado de uma análise inicial da ferramenta Scriba. Para concluir, apresentam-se alguns projetos de pesquisas em andamento no laboratório para o desenvolvimento de tecnologias nas áreas de e-commerce, e-business e e-education.

Palavras-chave: Nova Economia, Groupware, Trabalho em Grupo, Gestão do Conhecimento, Aplicações para a Web.

I. Introduction

Reading the paper, accessing the Internet, watching TV or reading a magazine creates a clear understanding of what is happening in the world nowadays. The media presents a mix of confusion, amazement, delight, excitement and nonsense about the revolution in the way people live, work, learn and evaluate their priorities.

We are living a period of transformation, a kind of revolution called by some authors the information revolution. It is in the nature of revolutions to reorder how things are done which, consequently, brings a period of instability. On this unstable age nothing survives very long. We can remember how difficult it was to chat to people from other countries in real time by 1992. Now we have videoconferencing systems that give the opportunity not only to chat, but to talk and see the others. We are talking about a short time interval of just eight years for the huge improvement of this technology.

We have to deal with the constant postponing of our technological frontier and things that can be done with the fast improvements of the technological potential. This facet of constant and fast modification of the world order and short life cycle of things can be sensed in every aspect of the human life.

The social values are changing and people are evaluating their social relationships and quality of life in new ways. People do not have to travel to be immersed in other countries social structures. One can talk to people from other countries, learn about their history and figure out the way people see life. The access to information about any topic is easier than in the past combined with the flood of new information daily.

The possibility of exchanging ideas over geographic boundaries allows the creation of a new cultural aspect of the human life, leading to two visions: the regional culture and the global culture. We see the formation of a global culture for example when we take part in meetings that use the Internet as a medium. We can identify certain behaviors and ideas that are shared by all the participants in spite of the culture they are inserted in. Of course the existence of a regional culture shapes the interaction and must be preserved and respected, but for the first time we are moving into a global society.

The technological frontiers are always being expanded in a day by day competition between technological providers. The Internet is a definitive contributor for the development of this new e-society, reshaping and in many cases accelerating the processes. Who could imagine that a cellular phone could be used to conclude a financial operation over the Internet? It is important to further the relation between research institutions, universities and business organizations that permits this fast improvement in the technological infrastructure.

From the economic point of view, all this transformation shows how fragile is the structure of the companies that emerged in the past. There is not a regional market anymore, but we have a global one, with a lot of businesses and consumers with different ideas and values. It is much more difficult to act in this market and retain your client and your profit without a completely reengineering of the company and its processes. One has to be fast and not restricted to ones business, providing ones client a full time relation and tracking. To achieve this goal and survive in the new Information Market the enterprises identified the importance of workers that aggregate value to the business and discover new methods to perform the tasks based on their studies and experience. The enterprises are now evaluated based on the people they have and not only on their capital and assets. This kind of evaluation is disturbing and can provoke distortions as we can see in the valuations given to the DotCom Enterprises. The economical evaluation of businesses must evolve, but we know that it has to take into account not just numbers but also people.

This change of values has lead people and organizations to administrate and increase their learning objectives. The workers and their organizations must be active and engaged in a constant knowledge discovery to "make the difference" in the market. This is why the enterprises are searching new ways of capturing the knowledge dispersed through their workers and processes, i.e., how they can capture and manage the organizational knowledge and increase their intellectual capital.

II. Knowledge Management and Intellectual Capital

The concept of Capital is changing. Nowadays, when we talk about Capital we are talking about Intellectual Capital, Relationship Capital and Information Capital. We are worried about the benefits our intellectual capital could produce in the future, instead of just measuring our current amount of assets to establish some evaluation index.

The intellectual capital is divided into two groups: the human capital and the structural capital [1]. The human capital means the knowledge, the experience and the creative potential of the workers in performing their daily tasks. This is very difficult to measure and retain inside the company. The other part of the intellectual capital is the structural capital which means the organizational capacity of the company in terms of software, databases, patents, that is, everything that stays in the company office after the workers go home. This part of the intellectual capital is easier to capture and evaluate.

Since the human factor of the intellectual capital is very difficult to measure and preserve, most enterprises are offering their workers stock options and profit participation as an alternative to commit them with the company. In this scenario it is apparent that capturing the knowledge and experience of these workers is essential to the survival of the enterprise. The enterprise has to invest in the transformation of human capital into structural capital.

Knowledge management is intimately related to this attempt of capturing the knowledge produced by a group of workers and managing it to foster the production of more knowledge. We are moving to a paradigm based on the group intelligence and not on the individual intelligence. The interaction and creative elaboration of ideas among the members of the group is very difficult to capture, but very important to understand. The work itself turned into the ability to create and manage ideas, to connect to other workers and to the clients.

In this world of group work, intellectual capital and knowledge management, groupware [2] technologies and applications play an important role to foster the knowledge capture and the achievement of this new concept of work based on the interactions and creativity of people.

III. The Aulanet Environment

AulaNet is a Web-based groupware knowledge management environment developed in the Software Engineering Laboratory (LES) of the Department of Computer Science at the Catholic University of Rio de Janeiro (PUC-Rio). It is currently being used in the educational domain for creating and attending distance courses through the Web. The objectives of AulaNet in the educational domain are to adopt the Web as an educational environment; to foster a workable transition from conventional classrooms to virtual classrooms, giving the opportunity to reuse existing educational material; and to create knowledge communities [3].

AulaNet differs from the majority of digital learning environments available (e.g., [4]–[7]) because it is based on a groupware approach while most of the other related environments incorporate traditional physical metaphors: corridors, blackboards, general office, classrooms, library etc. We believe that learning and the intellectual aspects of working are becoming one and the same thing, based on the idea that in order to cooperate, people have to become coordinated, and in order to become coordinated, people have to communicate. Hence, the key words of our approach are *communication, coordination* and *cooperation*. Furthermore, AulaNet makes a clear distinction between content and navigation.

The main beneficiary of this environment is the content provider. We believe that a provider should master his subject domain and not necessarily be obliged to know a lot about the Internet. The provider's task is to create good quality instructional content, leaving the Internet programming to the environment. With AulaNet the provider does not need to know any kind of Internet programming language to create, update and give distance courses. AulaNet fosters the separation of content from navigation releasing the provider from the programming task. Therefore, in principle, there should be no burden migrating content developed for AulaNet to any other similar system.

A. Mechanisms and Services

AulaNet offers a set of communication, coordination and cooperation mechanisms, so that the provider can customize his course according to the intended goals of the knowledge process.

The communication mechanisms provide the features that allow information to be shared or sent to providers and consumers. These mechanisms include e-mail tools (a simple e-mail tool and a discussion list tool) and an asynchronous text based conferencing tool (newsgroup facility). AulaNet has also a synchronous text based conferencing tool (chat) and a peer-contact tool (a simple message tool that allows synchronous communication between connected participants).

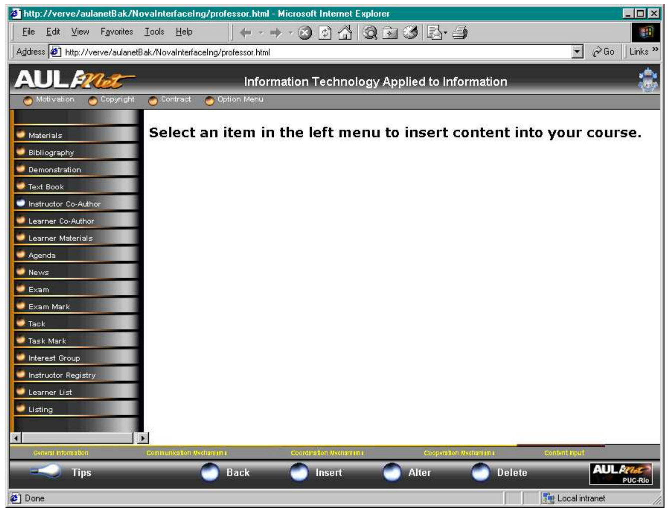

Fig. 1. AulaNet Provider Interface.

The coordination mechanisms provide the means to make sure that the participants (team) work effectively and meet their goals. The environment offers basic scheduling tools (calendar management) such as an agenda to set up events like chats and to announce deadlines, and course news to serve as a billboard about developments on the course. These mechanisms also offer competency based coordination tools (assessment), such as tasks and a tool to create and correct on-line exams, named Quest [8]. Another competency based coordination mechanism is the participant tracing, which allows the tracking of their interaction with the environment elements and the evaluation of their contributions.

The cooperation mechanisms provide the means for joint cooperation in working, solving problems and undertaking tasks, i.e., the means to share ideas and information and create a shared workspace. Among these mechanisms there are tools for material upload and provider and consumer co-authoring assignment.

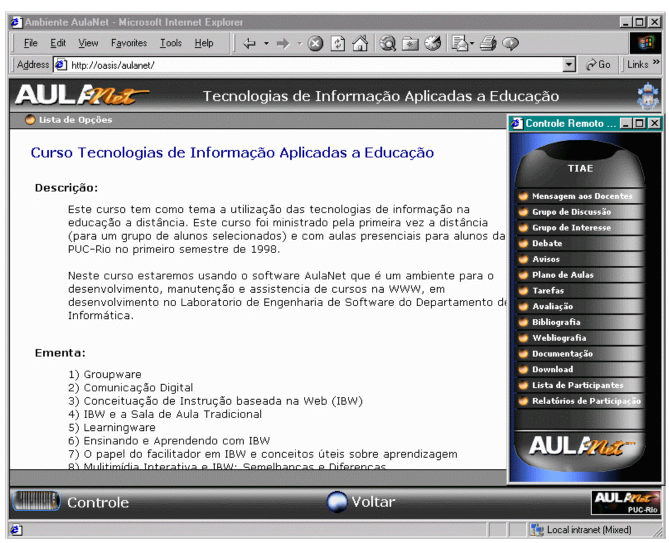

Fig. 2. AulaNet Consumer Interface.

The consumer's empowerment is epitomized by the remote control. It offers a menu of services—high-level navigation facilities—tailored by the provider's previous selection of the communication, coordination and cooperation mechanisms. People are very familiar with remote controls for their pervasiveness in home electronic appliances. Using the remote control, consumers choose between different services like contact with the author, discussion lists, interest groups, and agenda etc.

Currently, AulaNet version 2.0 is available in Portuguese <www.les.inf.puc-rio.br/aulanet> and its English version will be available soon. The Aulanet server located at PUC-Rio has over 3400 registered participants (≈ 3% of those with provider privileges) and it is being used to offer 81 Web courses. There are other servers installed worldwide in various universities and companies being used as a complement to face to face courses and for training workers. The environment was developed with Java Servlets [9] technology, using the Scriba tool to generate the dynamic contents of the HTML pages.

IV. The Scriba Tool

Scriba is a tool for creating dynamic HTML pages and defining Java classes to process Web applications. Scriba offers a basic language that allows one to consult relational databases, exchange values stored and invoke user defined classes for the realization of functions specific to the application's domain.

Users who wish to implement Web applications using servlets and Java find the necessary elements in Scriba for the implementation of the whole application using HTML pages and Java classes. HTML pages can have the Scriba code embedded in them that carries out, among other things, data searches in any ODBC database. The Java user defined classes bring together the specific functions of the application in development. Scriba deals with all the control operations and creation of objects for the functioning of the servlets, communication with ODBC databases and operations referring to interpretation and execution of the commands of its language.

One of the main characteristics of Scriba is the possibility of configuring its functions through the user redefinition of its components. The structuring of Scriba in software components interrelated with well-defined interfaces allows its users to rewrite most of its components. They can adapt Scriba to interpret any other language. There are two types of configuration of the Scriba functions: users can extend the basic language supplied through creating new commands in the interpreter or they can define a completely new interpreter for Scriba.

Scriba is made of three basic components: a token divider, a command interpreter and an HTTP request receiver. The token divider is made of two classes: *Parser* and *CodeParser*. This component is responsible for reading HTML templates and for checking the existence of its language's tags. When a language token is found within the tags $* and *$ the divider passes this token to the interpreter so that the actions referring to the language command contained in the token may be taken.

The command interpreter is composed of the following classes: *InterpreterInterface*, *InterpreterException*, *Interpreter*, and *UserClassInterface*. For users to write specific interpreters for their languages, the *InterpreterInterface* class supplies a pattern that a new class should follow in order to be defined as an interpreter in Scriba. The Interpreter class obeys the *InterpreterInterface* specifications through inheritance and implements the actions corresponding to each of the language commands. The *InterpreterException* class deals with all the errors created in the interpreter, standardizing the messages and explanations about the problems found in the interpretation of the commands. *UserClassInterface* is the class of this component that defines the format that all the user-defined classes for processing form values should present.

The HTTP request receiver receives the parameters passed by the HTTP server when a page is requested using the GET and POST methods. This component carries out all the necessary operations to implement the Java servlets and trigger the token divider to search the HTML template indicated looking for language tokens. This component is made up of just one class: *Scriba* that deals with GET and POST type of requests.

Figure 3 presents the execution flow provoked by the *Scriba* class for each request made to Scriba. After being created by the *Scriba* class, objects of the *CodeParser* class inspect the HTML template supplied and pass the tokens found to an object of the *Interpreter* class that will take the necessary action according to the language commands.

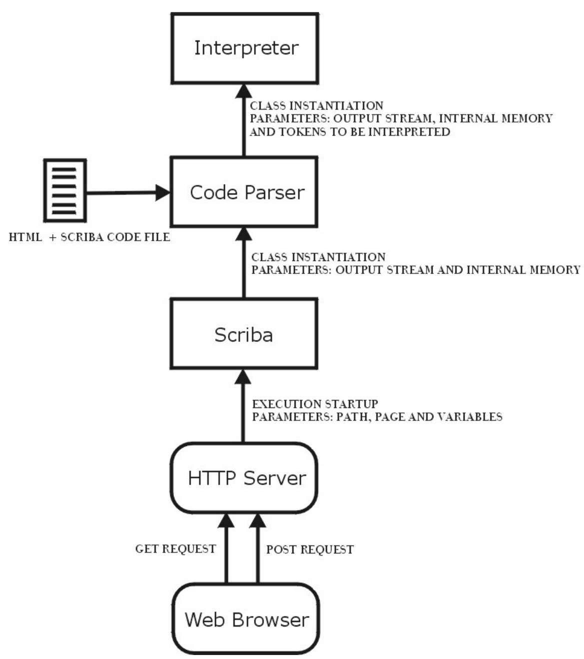

Fig. 3. Scriba Execution Model.

The basic language commands defined to implement AulaNet were: *database.open*, *database.close*, *database.select*, *database.select.set*, *database.select.set.pattern*, *class.new*, *variable.define, variable.get, variable.set, form.parameter, language.expand*. We give a brief explanation of these commands bellow.

The *database.open* command is responsible for creating a reference to an ODBC database. The *database.close* command closes a database previously opened by *database.open*. The *database.select* command allows the execution of a SQL SELECT statement in the database previously opened by *database.open*. Its argument is the SELECT statement and its return value is composed of one unique field returned by this statement.

The *database.select.set* command creates a table with the values returned by a SQL query statement internally in Scriba. The *database.select.set.pattern* command accepts as its argument any text that will be repeated for each line in the table of values returned by a *database.select.set* command. Within the argument of this command, the user can indicate to Scriba one of the fields to be changed dynamically by the values in the table through the *set.name_of_field* syntax. The command database.select.set and database.select.set.pattern are often used together to show with a given text formatting lists of items stored in a database.

The *class.new* command creates a class object whose name is indicated in its argument. The object is created dynamically by Scriba to carry out Java based user defined operations. Using this command Scriba users can program sections of Java code to make specific processes with its application.

If it is necessary to define variables that will be passed through different HTML pages and Java classes, a programmer can use the *variable.define* command. To store new values in the variables and to retrieve the values previously stored, a programmer must use the *variable.set* and *variable.get* commands respectively.

If a user wants to have access from his page to some variable declared on a previous form, he can use the *form.parameter* command. If it is necessary to expand the Scriba language, the user can use the *language.expand* command. This command allows users to create a class that implements the *InterpreterInterface* interface to interpret a proprietary language expanded in relation to the tool's original language. This class should have an action method that will receive a token and process it, identifying the command involved and carrying out the corresponding action. There is no limit for creating classes of this type.

Scriba allow users to rewrite the main parts of two of its components: the token divider and the command interpreter. In order to guarantee compatibility between the Scriba component parts and the parts created by the user, two classes are supplied: *Parser* and *InterpreterInterface*. The *Parser* class should be inherited by the user defined class that will substitute the *CodeParser* class. The *CodeParser* class is useful to break the HTML template tokens. If the type of template or the language markers of the user need to be changed, all that has to be done is to rewrite the *CodeParser* class according to its new definition, inheriting the characteristics of the *Parser* class.

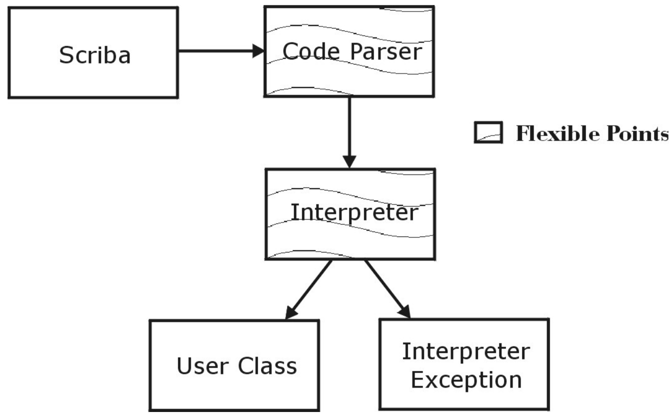

Fig. 4. Scriba’s Flexible Points.

If the language to be interpreted is completely new, the user can define a new *Interpreter* class with the language commands and their respective actions. This new class should implement the *InterpreterInterface* class, inheriting its characteristics. The new interpreter should receive tokens from the *CodeParser* class and identify the statements of its language within these tokens, creating a convenient return value for each type of command interpreted. Figure 4 shows a view of the Scriba architecture, identifying its flexible points.

Scriba was developed with the philosophy of creating Web based cooperative software environments that use databases to store their information. AulaNet is a case of the application of this technology.

AulaNet previous version was made of HTML pages, CGILua scripts [10] and an MS Access database. The CGILua tool allowed the creation of dynamic HTML pages and the processing of HTTP requests. The strategy adopted to replace CGILua with Scriba was guided to reduce the number of files in the software. The programs that had been executed in the templates were transformed into one or more Scriba commands, as they only use database functions. The Scriba functions map out the majority of the actions performed to search for data and exchange parameters in the templates.

The version of AulaNet created using the Scriba tool benefits from some improvements brought about by the use of Java technology, like the portability of the programs developed. Another improvement brought about by the use of Scriba is the access to databases. As AulaNet uses the Access database, some concurrency problems were identified when simultaneous queries were performed in the database. The use of JDBC to access the database reduces the problems of concurrency, because all the access methods used are synchronized by the monitor mechanism implemented by the Java language.

There are plans to create a software documentation pattern, benefiting from the reduction of files brought about by Scriba. The number of files in the Scriba based version of AulaNet is approximately 50% less than the number of files in the previous version. We now have HTML pages embedded with Scriba code and Java code grouped in user defined classes organized so that we can identify without to much effort where a problem has occurred and the actions necessary to correct it. Figure 5 shows a graph that illustrates the decrease of program files necessary to implement the version 2.0 of the AulaNet in contrast with the number necessary in version 1.2.

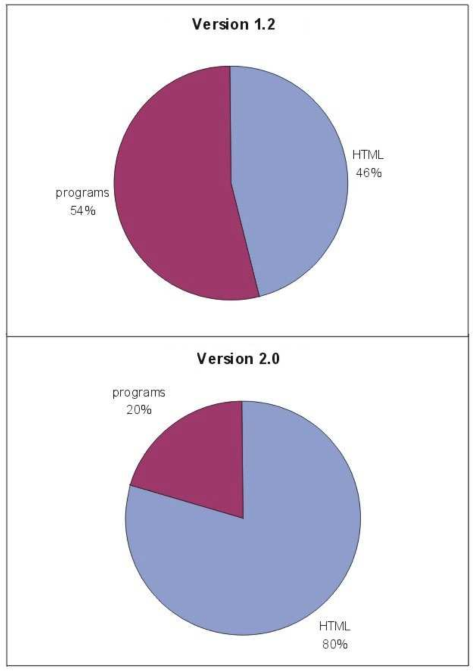

Fig. 5. Comparison of number of files used in versions 1.2 and 2.0 of the AulaNet environment.

V. Conclusion and Future Work

The current version of AulaNet is free of charge and there are more than 1200 downloads. But this version of AulaNet is extremely focused in the educational domain and has some specialized features to fit different educational needs. A newer version of AulaNet is being designed to better accommodate different groupware concepts. Its architecture is being restructured in three major frameworks that will be integrated to provide the flexibility necessary for adapting the AulaNet environment to other group work activities.

Some additional features are being elicited for the new version of AulaNet as:

Workflow based coordination - the use of such a mechanism will allow coordination of group tasks, checking the trace left by the users' interactions with contents and other users. This can be helpful to analyze the users' knowledge building process. It will also reduce the problems of hyper-space disorientation and communication overload.

Distributed content use – to allow the reuse of contents published in different servers, AulaNet is being remodeled to incorporate the EDUCAUSE-IMS [11] standard. AulaNet will have two tools to implement this feature. The first tool will be responsible for creating the meta-data information about a material. The second tool is a content search engine, which will be able to locate the several existing AulaNet servers and look for a specific material based on some meta-data.

Simulation and virtual reality - to provide users engagement with simulation, a parallel project named CLEW (Cooperative Learning Environment for the Web) [12] is under development at LES. CLEW combines the presentational format of the Internet with MUD's interaction style and the coordination mechanism associated to workflow management systems. The objective of CLEW is to create a cooperative platform for users to interact and work in a 3D virtual environment. This new platform will be integrated with the AulaNet environment, giving the users the possibility to act in an environment structured to engage them in their work tasks.

The Scriba tool is also being reformulated to incorporate new features necessary in Web-based groupware applications. The architecture of the Scriba tool will be structured in layers to provide an increasing abstract composition, allowing developers to join self-made components and to customize the tool for their needs.

By the time Scriba was developed, Sun Microsystems hadn't released its JSP [13] technology for embed scripting in HTML pages yet. We are now comparing the JSP features with the Scriba features already implemented to measure what are the main advantages and disadvantages of using JSP or Scriba tool in application development.

The idea for the next generation of the Scriba tool is to simplify the development process, providing a visual composer for scripting and some ready to use components like an e-mail sender and a TCP/IP based client-server module.

There are other projects being developed at LES to accommodate the new e-society demand for application software. All projects are oriented to the development of frameworks [14] that can be specialized depending on the domain where they will be applied. We give a brief explanation of three of these projects currently under development bellow.

The VMarket [15] is a framework for creating virtual consumer-to-consumer market places. The applications generated by this framework represent virtual markets where users can buy and sell items based on the interaction of their agents. Their agents can negotiate items automatically or semi-automatically depending on the users needs. Another project related to VMarket is the CommercePipe, but its main focus is the business-to-consumer market.

The ContentNet [16] framework allows the use of meta-information in the contents published in the Web and the search of contents based on the meta-information provided. In the ContentNet architecture, Content Search engines can find all the contents that matches a given meta-information pattern and request these contents to the Content Servers that stores the information.

This New Economy wave creates a good opportunity for people to rethink the work and educational processes and to find better ways of doing the "old" things. The relation between universities, research institutions and enterprises must be increased since one needs the others in order to achieve clear results and stay alive in this competitive market.

Our society is changing and we must be prepared to adapt our lives to this new “e-everything” paradigm and not to wait for things to happen, but to contribute to this transformation aggregating value and improving our future.

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