

# School-Enterprise Integration through Final Course Projects in Electrical Engineering

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**Abstract** - This paper presents the partnerships established by FEI to shorten the distance between Industry and University. An overview of the Computer Network Laboratory, created and supported by FEI and several leading industries in the area is then given. The day-by-day process of the partnerships are then described, along with the Final Course Project best works. These are presented at ELEXPO - Electrical Engineering Exhibition, which is held at the end of each term, and is sponsored by the industry, whose representatives decide for the projects final selection and prize. A complete description of one of the best projects which is now being prepared, by one of the companies for international commercial use, is finally presented.

## Introduction

Some of engineering education concerns deal with adequate academic and technical scientific formation for the future engineer [Barn, 94], [El-Re, 97], so that he may become a sufficiently versatile, competitive and well prepared professional, and through this obtain a good job in the work market. For some authors [Barn, 94], [El-Re, 97], these characteristics can be obtained by proper systematic thinking exercising, and developing experience in oral communication, teamwork and ability in learning new techniques.

A serious drawback that we face nowadays, is the distance between School and Enterprise, because of the lack of communication [Haines, 1997], [Turner, 1997]. In this way, school fails to cover an important technical-professional formation, and enterprise absorbs the costly task of complementing part of the technological engineer formation.

With the intention of overcoming some of these problems, and above all to shorten the distance between the parts, FEI has long since been establishing partnerships and accords with several companies in different ways, depending on modalities and courses. One of the result of this integration became effective through partnerships in "Final Term Project", a two-semester course in Electrical Engineering, enabling the school, on one side, to prepare professionals potentially inserted in the work market, and, on the other one, allowing that companies transform both their needs into an object of study, and also participate in the students formation process.

## The Partnerships

Several technological and scientific partnerships, between the Electrical Engineering Department of the Faculdade de Engenharia Industrial - FEI/FCA and the leading computer and information technology industries, have been established, aiming at the formation of better qualified professionals, through an easy access to the most recent technologies. This enables the students to practice with the latest resources in the field and also to develop and implement Final Course Projects, which can now be more elaborated and relevant to the community. On the other hand, these partnerships provide the teaching staff with an important support material for constant innovation and upgrading of their courses. The project subjects are often suggested by students, working as trainees at the companies, or by the teachers who are in touch with the industry.

Some of the companies which participate of this partnership program in Electrical Engineering are: ALTERA - programmable microelectronics devices; Bay Networks -Local and Long Distance Networks equipment; Novell -network operational systems; Microsoft - operational systems, corporate servers, development languages and several types of computer software.

These companies take part in several different ways, such as the suggestion of subjects for Final Course Projects, and support for their realization, training of faculty members, constant updated donation of the company technical publications. They also help to set technical events, bringing the press and other media, sponsor ELEXPO, the Electrical Engineering Final Term Project Exhibition, which is held at the end of every semester, with proper award for the best project and indicate students, involved in the projects, for industry jobs as qualified professionals.

Besides that, some of the partnerships agreements have specific clauses, related to the field of excellence of the company, such as supply and maintenance of the latest equipments for the Computer Network Laboratory (Bay Networks); the supply of approximately 100 EPLD units, with all the equipment needed to build a laboratory specialized in this kind of processors, as recorders, computer interfaces and development software (ALTERA), delivery of updated complete software line produced by the company (Microsoft and Novell).

The integration of the partner companies with the Final Course Projects in the Electrical Engineering course was initially devised to have two meetings a month, so that the students could be in contact with professionals of the area.

In these meetings, each group of students briefly presented their work, reporting improvements, progress and problems found during the previous month; after this presentation, discussion groups were formed. This helped the students to solve their problems and clear out doubts about the systems provided by the partners. In these discussions, all suggestions and hints in design and implementation evaluation, problem characteristics definition and the provision of new software versions were most valuable to the students.

### **The Computer Network Laboratory**

One of the targets of the partnership with Bay Networks was the creation of a Computer Network Laboratory, which is available not only for Final Course Projects, but also for regular classes and undergraduate and research projects. This laboratory is part of a pilot project which will grow to become a “model laboratory”. This will be part of the Center for Excellence at FEI which gives support to the industry and other areas of the productive sector. With this objective FEI provided the physical infrastructure of the laboratory, classrooms with air conditioning and elevated pavement and Pentium PC's completely equipped. On the other side, Bay Networks provided the installation of last generation connectivity equipment, the cable infrastructure and network management software. Microsoft and Novell also took part in this project offering all their line of software products.

### **The ELEXPO**

At the end of each semester, the best Final Course Projects are presented to the community at the ELEXPO - the Electrical Engineering Final Course Project Exhibition, held at FEI Campus, in S. Bernardo do Campo. The main purpose of the exhibition is to improve contact and communication between School and Industry. At the ELEXPO, a committee composed of professionals from more than 20 companies is responsible for the judgment and awarding of the best works. This committee evaluates each work considering some aspects, such as presentation, user interface, assembly, maintenance easiness and market potentiality, and finally gives suggestions for future implementations. The awards consist of software packages, courses or study travels, and are provided by the partner companies.

The last session of ELEXPO was held in December, 1997, and among the supporting companies were: Icatel Telemática, Novell/CNT, Bay Networks/Telsyst, Microsoft/Brás e Figueiredo, ALTERA/União Digital, HP and ACER. Out of the 13 works presented, 7 were a result of partnerships. Among these works, two were awarded a prize by the ELEXPO judging committee and deserve to be distinguished as a practical result of the partnerships. They are the “Automated System for Consumer Flux Control” and the “System for Specification and Dimensioning of ATM Networks based on Bay Networks Products”.



*Fig.1 - View of the XII ELEXPO Exhibition*



Figure 2.a: "Automated system for client flux control", winner of the Microsoft Award. The sensors can be seen at the left side of the photograph.



Figure 2.b: "System for specification and dimensioning of ATM base on Bay Networks products", winner of the Bay Networks Award .

The "Automated System for Consumer Flux Control" (figure 2.a) is a completely automated system for monitoring the flow of clients (entrance and exit) in the TendTudo Stores, a general department store of Alcoa Group.

The work arose as a necessity of Alcoa do Brasil to control the client movimentation in its 14 stores, spread all over the country. It was developed by the students, who were trainees at the company, after a market research which concluded that there were good equipments for such task in the market, but they were extremely expensive. The project is based on a PIC microprocessor for data acquisition, an Assembler, Visual Basic and Cobol programs for data analysis, and a Novell network for the information transfer between the company units.

The project aimed at developing a low cost equipment, which had the same, or better, performance and reliability of the existing ones, in order to occupy its space in the market. At present, the system is being implemented at the Alcoa Stores. Besides Alcoa, Microsoft and Novell cooperated with the project, providing all of the software and specific training.

### **A Description of a winner project**

The "System for Specification and Dimensioning of ATM Networks based on Bay Networks Products", is one of the outstanding projects that received the Bay Network sponsored award. (figure 2.b)

The system was developed based on a suggestion given by the project advisor in partnership with Bay Networks, which provided the students, cooperation, knowledge and training related to ATM networks on a daily basis.

The project goal was the creation of a Decision Support System which enables the network designer to find the best solution for the specification and dimensioning of an ATM (Assynchronous Transfer Mode) based network [Cereda et al., 1997], and with this obtain a better composition, standardization and organization of the projects. In this way, based on the number of sites that must be connected, the distance between them, the number of departments, workstations at each location and the definition of the virtual LANs for each department, the system defines several items, such as the number of switches needed, the composition of each switch modules, the number of cables at each location and the type of connection between them.

It was verified that the knowledge for the development of local area networks based on the Ethernet, Fast Ethernet and Token Ring technologies was wide spread among professionals, and it is hard to find professionals with a good knowledge of the ATM technology. Because of this, the time spent in the implementation of ATM networks is most of the times, much more than the one that was initially established. This project, implemented with Bay Networks products and cooperation, enabled great integration for the acquisition of knowledge related to the specification and dimensioning of the ATM networks. It turned out to be a system designed for users without much technical knowledge, which enables them to project and detail the structure and all the components needed for an ATM Local and Wide Area Network.

### **The System Description**

The system is composed of 3 modules, that is the Data Base, where data related to the ATM networks are stored, the Evaluation Mechanism, responsible for the search of information in the Data Base, and the User Interface, which connects the Evaluation Mechanism and the user. The project development was divided in three main stages: the first, which was the research about ATM technology and problems needed to create the Data Base; the second, when the user interface, the evaluation mechanism and algorithms were implemented; and the last, for testing and debugging.

During the first part of the development, the students interacted with Bay Networks and Telsyst (Bay Networks sales representative) professionals, who gave full support, to collect and analyze practical knowledge related to the design, project and installation of ATM networks. This knowledge was transformed into a script, for the data input, in the form of a graphical user interface. Each dialog box was defined to collect an important technical information related to the dimensioning of the ATM backbone, which is the



core of each ATM network. During the second stage, the evaluation mechanism and user interface were defined.

During the program execution, after data are entered by the user, through the graphical interface, the evaluation mechanism, starts its process to define the components and the structure of the network. As the evaluation process finishes, the definition of the network is ready to be presented.

### Example of the System Utilization

In this section the main menus of the system for ATM network dimensioning are presented. This figures illustrate a practical application example, and the sequence shown here is the same as the one presented by the software during its execution.

As the program starts, the presentation screen on figure 3 is shown.



Figure 3: Presentation Screen.

As the operation begins, the software presents the menu. In it, the user must provide the number of backplanes to be used. The limit for the number of backplanes is set to 5. The dialog box prompts the user for the name of the sites where the backplanes will be located. It is repeated as many times as the number of backplanes. The user inputs the characteristics of speed and distance between the backplanes.

SSD - ATM  
Sair

TELSIST  
NETWORK COMPUTING

A localidade Depto. Mecânica está conectada a quais localidades relacionadas abaixo e a qual velocidade?

A localidade Depto. Mecânica está a que distância da localidade selecionada?

☒ Depto. Eletrica

☐ menor que 2 Km ☐ maior ou igual a 2 Km

Velocidade: (Mbps)

155  
310  
465  
620

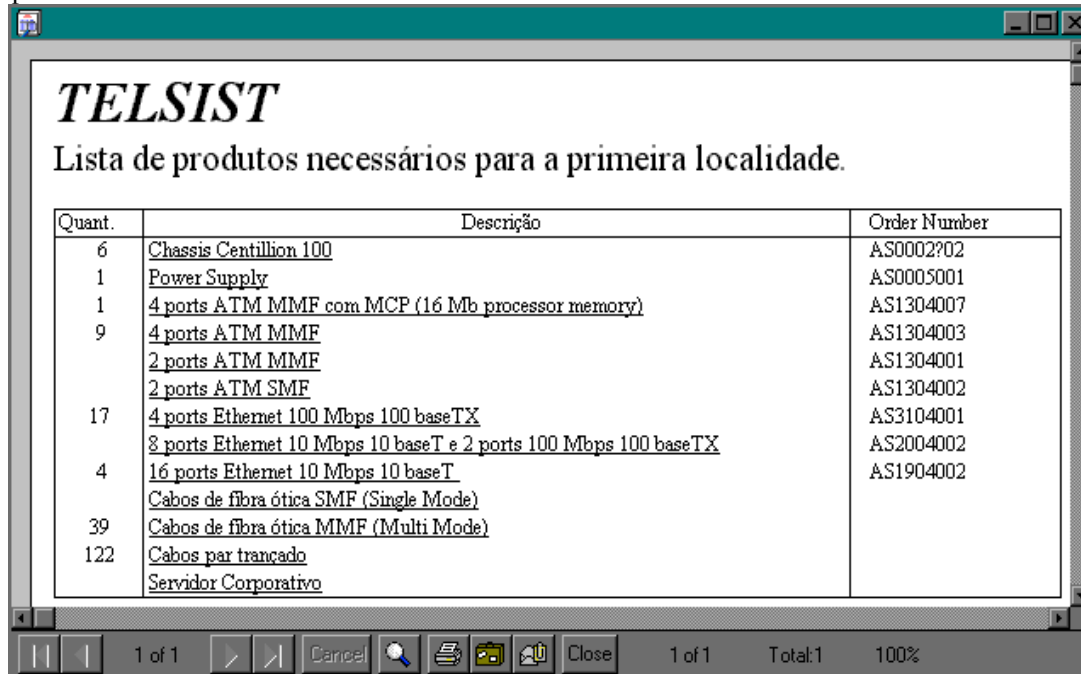
OK

Cancelar Continuar

Figure 4: Menu for the number of workstations available at each site.

In figure 4, the menu where the user defines the number of workstations available to each department at each backplane site is presented.

Figure 5 displays the report generated by the program, which presents the description of the equipment needed for the assembly of the first backplane, and their connections. A similar report is generated for each backplane



Quant.	Descrição	Order Number
6	<u>Chassis Centillion 100</u>	AS0002?02
1	<u>Power Supply</u>	AS0005001
1	<u>4 ports ATM MMF com MCP (16 Mb processor memory)</u>	AS1304007
9	<u>4 ports ATM MMF</u>	AS1304003
	<u>2 ports ATM MMF</u>	AS1304001
	<u>2 ports ATM SMF</u>	AS1304002
17	<u>4 ports Ethernet 100 Mbps 100 baseTX</u>	AS3104001
	<u>8 ports Ethernet 10 Mbps 10 baseT e 2 ports 100 Mbps 100 baseTX</u>	AS2004002
4	<u>16 ports Ethernet 10 Mbps 10 baseT</u>	AS1904002
	<u>Cabos de fibra ótica SMF (Single Mode)</u>	
39	<u>Cabos de fibra ótica MMF (Multi Mode)</u>	
122	<u>Cabos par trançado</u>	
	<u>Servidor Corporativo</u>	

Figure 5: The report generated by the program, for the first backplane.

## Conclusion

As a result of this methodology, it can be stated that all the students graduated in Computer Engineering, in December, 1997 are employed in good jobs, mostly in multinational companies.

The system has shown to be of great value to support ATM Network developments, helping real time definition of the client network, reducing the time needed to present a cost estimation, besides creating a better structured, standardized and organized network projects. The system is now being studied by Bay Network and Telsyst, to be come product to be launched in the international market and the students who worked in the project are now with Bay Networks. They are now experts in ATM Network technology and equipment, and are holding good positions in the work market. The good classification at the ELEXPO also guaranteed them a packet of specialization courses from Bay Networks, as a prize.

Two of the students who worked in the "Automated System for Consumer Flux Control" project are already successful professionals, since one of them is now Production Manager and the other one is Administrative Manager in a medium size computer spare parts industry in São Paulo.

As for the partner companies, they are all satisfied with the results achieved by the Final Course Projects, and have already renewed the partnership agreements with FEI.

School-Enterprise integration has allowed both partners to obtain good and practical results, and the students have been the greatest beneficiary of all.

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