

## International Collaboration on Cyber-linked Engineering Projects

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### Abstract

This paper describes the collaboration between The University of Tennessee and two international universities on cyber-linked engineering projects. This activity has been incorporated into a senior-level course entitled *Introduction to Maintenance Engineering*, which is one of the four courses being developed at The University of Tennessee under a NSF-CRCD grant. The course is designed for seniors and first-year graduate students in engineering. The cyber-linked student project is an academic experiment to determine the feasibility of joint Internet-based work in maintenance and reliability engineering by students separated by great distances and coming from diverse cultural and academic environments.

### 1. Introduction

A cooperative learning experience between The University of Tennessee and two international universities is being developed as part of an NSF-CRCD course entitled *Introduction to Maintenance Engineering*. The course is designed for seniors and first-year graduate students in engineering. The objective of the course is to present the fundamentals of maintenance and reliability engineering. Students learn the principles of various maintenance technologies as they are practiced by U.S. industry. The cyber-linked student project is an academic experiment to determine the feasibility of joint Internet-based activity by students separated by great distances and coming from diverse cultural and academic environments. The premise is that the Internet has the capability to make this possible. Furthermore, in the current global commerce, the engineering activities of a multi-national company continue *round-the-clock* as the project tasks are shared by its affiliates in countries at different time zones.

The international universities cooperating with The University of Tennessee on cyber-linked projects are *Universite de Technologie de Troyes, France* and *University of Sao Paulo, Brazil*. Both these universities have strong educational and research programs related to maintenance and reliability engineering. The paper presents the challenges and rewards of *long-distance* cross-cultural student teamwork. The following issues related to cyber-linked projects are presented.

- Development of a mutually agreed upon procedure in order to achieve the objectives of cyber-linked projects during an eight-week project period.
- Periodic video-conferencing, web-based discussions, and sharing of technical information between international teams.
- Presentation of project report.
- Preparation of the joint final report.

## 2. Development of Guidelines for Cyber-linked Projects

The following is a set of procedures that any two cooperating institutions are expected to follow in order to achieve the objectives of cyber-linked projects.

- Students, with the assistance of their professors, must define the project topic and the tasks to be performed in order to achieve the project objective. The collaborating teams must mutually agree upon the topic and the tasks.
- There shall be an initial, get-acquainted session in which the student groups will discuss project plans. All instructors shall be directly involved to monitor and guide the discussions. Internet-based conferencing shall be used if possible.
- During the first two weeks of the project, students shall mutually agree on sub-tasks to be undertaken by each individual student, and the assignments shall be reported to the instructors. These assignments may be modified if approved by the instructors.
- Students must submit weekly status reports to the instructors, and copy them to all students working on all the projects. (These may be short reports, but they *must* be submitted weekly).
- Students must have Internet communications and a face-to-face meeting with other students in their groups at least weekly (this is in addition to the weekly status reports).
- Students must acknowledge any messages (such as e-mails) and respond to questions or requests for information within two days of receiving the messages. ***It is important to remember that prompt communication is crucial to the success of the projects.***
- All e-mail communications must be copied to all the instructors.
- Instructor shall meet with or communicate with students at least once per week to discuss the project status.
- Students may communicate by posting information in sufficient details on a group page (on the project/course web site) or by e-mail with attachments. The mode of communication that results in the fastest and easiest communication shall be used.
- Professors shall monitor student communications and take steps to increase communications if they are insufficient or inadequate.

- Students shall collect information needed to complete the project from the literature, from discussion with professors who are teaching the course or who are experts in the topic of interest, from discussion with people from industry, and by Internet search. Students shall report any useful information to other students in his/her team within two days of obtaining the information. The main points of the information and the source (reference, web site address, etc.) shall be passed to the group members.
- Any student-to-student or student-to-professor communication problems must be reported to all instructors within one day.
- There shall be a project review at the mid-point of the project. All professors shall participate in the discussion and give recommendations and instructions for completing the projects.
- Students shall mutually agree on the division of responsibilities for writing the Final Report. A sample report from earlier student work shall be posted on the course site by the instructors to illustrate the contents, style, and format expected in the Final Report. It is recommended that the work on report preparation begin as soon as possible in the project. For example, some of the introductory sections of the report can be written before the technical results are known. All students in the group will review and approve the report before it is submitted.

The instructor at each institution is responsible for the progress of the team at that institution and the evaluation of the students. The grades for the project are weighted with three factors: technical content, report quality, and performance in handling Internet-based collaboration.

### **3. Challenges and Rewards**

One of the challenges of cyber-linked projects is to synchronize the activities so that the international teams have at least eight weeks of overlapping semester time. Because of the short duration of the project it is crucial to monitor the progress of students and ascertain that they follow the schedule as laid out at the start of the project period.

The rewards far outweigh the hardship. Students learn how to communicate with their distant counterparts and learn from each other's experience. They also understand the importance of meeting deadlines and find out how students work in different cultural settings. This experience adds to the capability of students in dealing with international counterparts during their professional life. Some of the students at The University of Tennessee have the opportunity to travel overseas, meet their counterparts, and discuss the progress and plans for completion of the cyber-projects.

The following projects have been defined for cooperative student projects:

With the *Universite de Technologie de Troyes*, France: (a) Lubrication Oil Analysis Technology and Recent Developments, (b) Reliability of Computer Networks and Impact on E-commerce.

With the University of Sao Paulo, Brazil: Fault Monitoring in Gearbox Systems.

As part of their projects students are encouraged to perform limited experimental studies. A discussion board is created on the course site for all the project participants to post information relevant to respective projects. All students have access to this discussion board. Weekly progress reports and information acquired for the projects are also posted.

#### **4. Concluding Remarks**

The concept of cyber-linked projects among students from The University of Tennessee and students from international universities (France and Brazil), and the activities related to these projects are presented. A set of guidelines has been developed in order to carry out the projects successfully. The challenges and rewards of such an activity are also outlined. The key to a productive participation is to maintain constant communication among all the team members. Instructors are responsible for monitoring the progress of their students and help coordinate activities among team members.

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