INTERACTIVE TUTORIAL ON THE TOOLS OF COLLABORATIVE DESIGN OF A CAD PLATFORM

Carlos RODRIGUEZ[1], Camilo ESTRADA[1], and Ivan E ESPARRAGOZA[2]

[1] Universidad EAFIT, Medellin, Colombia

[2] The Pennsylvania State University, Media, PA, USA

ABSTRACT

Because of the globalization of economy and the rapid development of new technologies for communication, it is becoming more common for the industries to participate in global design projects involving multinational teams. As a result, it is very important for the engineering students to start developing global competencies very early in their career. This paper describes the interactive course tutorial developed for undergraduate students on the use of the tools for collaborative design using a 3D CAD software. This work is complementary to the collaborative multinational design projects initiative started three years ago among students in different institutions in the Americas. The course is currently in Spanish and it will be translated into English in the future.

Keywords: Collaborative design, tutorial, CAD

1 INTRODUCTION

The industries involved in the development and design of new products understand the importance of reducing the time of these activities in order to have the products in the market in the shortest possible time, while improving the quality and reducing the costs. Additionally, many industries are multinational in essence and have teams geographically disperse around the world working on projects, and developing new products as a means of reaching new markets and being more competitive in the global economy. Almost all major corporations now operate globally, and engineers are being challenged to design and develop new products that will impact a global market. These factors have brought new challenges for the designers who have to develop new skills, beyond the technical knowledge, to be able to successfully work in collaboration with other co-workers in multicultural teams. The world is rapidly changing and the engineering education should also change to identify and facilitate the experiences to educate world class engineers. The future engineer should be prepared to work in multicultural teams in multinational corporations by developing global competencies and knowledge in information technology, teamwork, global collaboration, and communication. Engineering design and global design collaborative projects, which can be easily incorporated in the engineering curriculum, have been identified as excellent means to allow the students to develop creative engineering abilities and global skills necessaries to be competitive in the world-wide market.

CAD software is a fundamental tool in engineering design and CAD developers have been including more and more collaborative tools in the new releases to facilitate collaborative design processes. This paper describes the interactive tutorial developed for undergraduate students on the use of the tools for collaborative design using a 3D CAD software, as a way to approach the students to the collaborative design practices.

2 BACKGROUND AND RATIONALE

Recognizing the importance of diversity, worldwide market, multicultural teams, and global design for the future engineer, a group of instructors, members of the Latin American and Caribbean Consortium of Engineering Institutions (LACCEI), decided to join efforts and incorporate multinational design projects for undergraduate engineering students at different locations. During the 2nd LACCEI conference in 2004 in Miami, Florida, a group of professors from the U.S., Colombia and Brazil started discussing the need of collaboration in the area of design through multinational design projects. The objectives of the projects are not only to develop important skills such as project management, teamwork, global design, creativity, innovation, and problem-solving abilities but also to foster cultural awareness, understand diversity, and master the use of technology for communication. The students participating work with partners abroad from institutions in the Americas members of the consortium. The global design projects collaboration started in Spring 2005 and by the end of 2007 more than 300 students from ten different universities in seven countries (U.S., Brazil, Colombia, Peru, Honduras, Ecuador, and Dominican Republic) have participated in this initiative.

This collaborative network requires that all students have access to similar educational material and collaborative tools. The tutorial reported on this work is a direct result of the interaction between the students from different countries and the necessity of having a clear, simple and easy to use tutorial for the collaborative tool embedded in the Alibre design 3D CAD package. The tutorial is available on-line for the students participating in the collaboration and can be downloaded from any computer around the world.

3 COLLABORATIVE DESIGN DEVELOPMENT

The collaborative design study can be seen from two perspectives: the human factor, that includes the behaviour of a person while interacts with others in order to face a design challenge, and the supportive CAD tools that refers to all the CAD elements used to facilitate the interaction between designers.

3.1 Human Factor

In the last few decades, many researchers have been focusing their attention in the behaviour of a person during a teen interaction and its effects over the team performance. Some of those studies include personality and group performance [1]; effects of group size, problem difficulty, and sex on group performance and member reactions [2]; team composition and staffing [3]. Most recently have appeared some studies that include the team performance in relation with the design process for engineering applications, like organization of teams in concurrent engineering [4]; the big five personality factors and team performance: implications for selecting successful product design teams [5]; and The role of personality in new product development team performance [6].

These studies are actually showing an increased industry interest to build more effective teams to get the highest performance on the new products designs.

The propose of this paper is not to empathize in the human factor of the collaborative design, but it is necessary to mention some of the most relevant aspects that can affect the performance of a team; according to the observations made during three years with smalls, short-terms, trial collaborative design projects among ten different universities in seven countries in the Americas.

- In first place, while working in groups, the creativity of the designers can be affected by a widespread tendency to use designs whose functionality has already been broadly proven and not to take risks proving new ideas.
- The second inconvenience is the difficulty that for some designers represents having to consider aspects that are on the outside of its speciality.
- Finally, the strong interrelation that exists among some of the decisions that takes for a design makes difficult to converge in a single solution that satisfies to all the parts that intervene.

However, these difficulties are less frequent as the experience of the participants increases; just as it was appreciated in the performance of the students that participated in projects of collaborative design during several academic periods.

3.2 Supportive CAD Tools

Nowadays, it is very common to find industries geographically disperse around the world, working on projects and developing new products as a means of reaching new markets and being more competitive in the global economy. New designs are not longer limited to the local needs, the products specifications should respond to international standard, and factors like energy saving, sustainable development and the environmental impact have to be considered in the design of new products.

The new challenges of the design congregate designers located in remotes geographical positions with the purpose of obtaining more efficient and profitable products. Given the geographical limitations that make impossible to put together a design team in a meeting room to discuss a certain project, numerous tools have been developed to facilitate the work of the designers, while working in collaborative design projects. Three of the most common tools are:

3.2.1 Web-based visualization

Based on the use of Internet like interconnection platform among the members of the design team, this tool uses a simple protocol such as the HTTP (HyperText Transfer Protocol) to share the outstanding information of the designs. By this mean, the designer can participate in discussions, share files and 3D visualizations of the designs using a variety of very popular formats like VRLM, X3D, JAVA3D and MPEG-4.

3.2.2 Streaming Technology (3D)

This technology allows the users to have access to the files as these are downloaded of the net. This way, the visualization of the CAD model is more agile for the members of the design team who are not subjected to long waits while downloading the CAD files. 3D Streaming allows the users to see and manipulate the part of a pattern without having to download the pattern completely. With complex models, the algorithms of streaming simplify to the maximum the geometries trying to conserve the basic forms of the pattern between acceptable parameters. When the user concentrates on a specific region of the pattern, the quality of this part is refined, acquiring a higher level of detail and leaving intact the quality of the rest of the pattern.

3.2.3 Co-design Systems

Co-design systems are CAD platforms with modules dedicated to facilitate the collaborative design work. The CAD software use net connections (intern or external) to allow the exchange of files and information. The users can make modifications in real time to a model that is being visualized by the whole team during a virtual meeting.

4 TUTORIAL FOR THE USE OF COLLABORATIVE DESIGN TOOLS IN ALIBRE DESIGN

Due to the importance that collaborative design has for product design engineering students and others related academic programs, and taking into consideration that collaborative design is a relatively new concept, undergraduate students from Eafit University developed a tutorial on the use of the tools for collaborative design included on Alibre Design. Alibre Design is a low-cost parametric mechanical design application with CAD-neutral data sharing and online collaboration tools. Alibre allows the design teams to work simultaneously through Internet to create, visualize, and modify designs, also allows managing and sharing all type of files with other users through Internet.

The tutorial was developed using Microsoft PowerPoint and consists of 32 slides, 21 lessons that include 49 minutes 22 seconds of videos that show how to use the collaborative tools in Alibre Design.

The course was made with the help of the following tools:

- Microsoft Office PowerPoint 2003 SP2
- Alibre Design 9.2
- Screen Recorder Gold v2.1

4.1 Objectives

The objective of the tutorial is to provide a working knowledge of the use of the collaborative tools included in Alibre Design 9.2. In addition, a second objective is to serve as an introduction to the collaborative design practice. Alibre has three tools specifically focused to facilitate the collaborative design.

4.2 Repository for Integrated Data Management

Provides a location to organize and securely store data on a local hard drive, a network drive or a secure server. Files created outside of Alibre Design like documents, slides presentations and images can also be stored in the Repository to manage related project data. The topics for the lessons on this module are summarized in Table 1.

The main objectives of this module are:

- Store, recover and share designs and drawings created with Alibre Design and other files related with the project.
- Manage files in easy and secure form.
- Use version tracking for model history changes.

4.3 Team Design Session for Collaboration

Alibre works with peer-to-peer technology, allowing the users to spontaneously communicate and work directly on the same sketch, model or drawing in real time. The peer-to-peer architecture sends simple lightweight commands between users' systems that are then executed locally for optimal performance during team sessions. The topics for the lessons on this module are summarized in Table 2.

The main objectives of this module are:

- Work with others in real time to create, edit or review designs.

- Use text chat or voice over IP technology to communicate.
- Insert redlines and mark-ups during sessions; save the mark-ups with the design including the time, date and author.

Table 1. Repository for Integrated Data Management lessons

TITLE	TIME (mm:ss)
Generalities	1:01
Creating a local repository	0:56
Creating portfolios	1:01
Adding and moving away files	2:36
Opening files	0:49
Checking and adding notes	1:39
Previewing files	0:41
Renaming files	0:53
Tracking versions	1:14
Undoing revisions	0:52
Sharing Repositories	5:13

Total Time: 16 minutes 55 seconds.

Table 2. Team Design Session for Collaboration lessons

TITLE	TIME (mm:ss)
Opening the Team Manager	0:43
Creating and to deleting teams	0:56
Assigning roles	5:08
Publishing a team	1:55
Leading a work section	6:34
Going in/out of a work session	1:40
Programming work sections	2:55
Work in a team design session	8:10

Total Time: 28 minutes 01 seconds.

4.4 Adobe Acrobat 3D

Alibre Design 9.2 incorporates Adobe Acrobat 3D as tool to share files CAD files in a quickly and secure way. Adobe Acrobat 3D facilitates the collaboration allowing the design team to use PDF documents to share designs in 3D. This format allows the users to rotate, zoon in/out and insert notes to the model without having Alibre installed (just Adobe Acrobat PDF reader is needed). Several models can be included inside a document to be shared. The topics for the lessons on this module are summarized in Table 3.

Table 3. Adobe Acrobat 3D lessons

TITLE	TIME (mm:ss)
Saving files as a 3D PDF	02:48
Inserting notes in a 3D PDF file	01:38

Total Time: 4 minutes 26 seconds.

5 CONCLUSIONS

The tutorial was completed and tested in collaboration with a local industry in Medellin, Colombia. The tutorial structure is user friendly and the material included in the lessons as well as the examples presented are appropriate for students at all levels. Currently the tutorial is available in Spanish and the next step is to translate it into English. The final goal will be to have it translated at least into French and Portuguese also to cover all the main languages spoken in the Americas.

It was discovered during the preliminary research for the design of the tutorial that the collaborative tools included in the CAD packages are not being used in all their potential by the industry, and the academia in the Americas. It is extremely important to promote the international collaboration among the students through global design projects and also the training in the use of the collaborative tools of the CAD packages. These learning opportunities will help the engineering students to gain the necessary skills to be competitive in the global market.

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[1]Carlos RODRIGUEZ, Camilo ESTRADA
Universidad EAFIT
Carrera 49 7 Sur -50 Medellin, Colombia
carodri@eafit.edu.co, estrad5@gmail.com
57+4+261 9545

[2]Ivan ESPARRAGOZA
Pennsylvania State University
25 Yearseley Mill Road, Media PA 19063
iee1@psu.edu
1+610+892 1420