TEAMWORK AND GALLERY METHOD IN ENGINEERING DESIGN PROJECT

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Abstract

In MAK 422E Engineering Design course, the objective is to present a comprehensive, consistent, and clear approach to systematic engineering design. At the very beginning of the semester students in the class divide in to groups. All groups consist of 5 – 7 persons with a group leader. In the course, in order to give an opportunity to a senior students, are making a practice of theoretical knowledge, projects are given to them. All projects are related to the product development process, starting with problem identification until detail design. At the end of the semester, groups prepare a report and represent it.

As a course policy, students are encouraged to use computer and, adapt it to team work. At the end of the course, design and computer skills and self-confidence of students were improved.

During the spring'03 semester, students were asked to use a computer aided gallery method for assigned projects. The Gallery method is suitable for embodiment problems in engineering design projects because solution proposals in the form of sketches are easily included. It enables both a good collaboration in teams and encourages the individual ideas. This method is implemented to Project Data Management (PDM) software. So, an effective exchange of ideas was possible and documentary records are easily assessed and stored in an organized environment. The most important reason this method that was chosen was to analyze "if the method is suitable for the team members that are placed far from each other".
In this semester, group members worked individually and communicated with each other by computer. All documents that were prepared individually were shared in the internet so that other group members could reach the documents.

During project preparation all groups were observed carefully and every week they were required to make a presentation so that the problems caused by this kind of collaboration study could be noted. This also allowed the supervisor to evaluate the performance of the students.

At the end of the semester, it was observed that the method is also suitable for this kind of online collaboration.

This paper presents the use of the computer aided gallery method and its effect on the team dynamic and resulting problems.

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Introduction

Competitive business environment increase the importance of marketing. It is known that decrease in design time frame will cause the improvement in marketing period. There are many important studies, such as concurrent engineering have been performed about this subject and these studies have been successfully integrated to the conventional design process[1]. As a result of the growth of the companies, departments could be located in the different places and far from each other, so that the professionals have less and limited opportunity for face to face communication and brainstorming. Therefore, it is a necessity to modify and adapt classical methods to the current situation. Developments, especially on the communication and information technology, increase the adaptation possibility of conventional methods to the new situations. It is very well known that, the computer is an important device for engineer. Since engineer can perform the ordinary design procedures with less money and time by using computer[2]. Beside that, by the expanded usage of the computer all over the world, engineers have powerful tools, like finite element analysis software to calculate the endurance of the designed parts[3].

However, the usage of the Internet, as a supportive tool in product design and development is still in starting phase. Collaborative integrated design environments are settled on multiple-user systems that has provide an environment for design teams who are geographically distributed, and they can work together concurrently and synchronously with the coordination of the tool, on the design of a the product[4].

The main objective of this paper is, analyze the potential combination of the "Gallery Method" with modern communication tools, and analyze if the on-line Gallery Method is suitable for design projects, which their team members are located in different places. There are plans to establish a course about collaborative product design in both countries Turkey and USA.

Solution Findings Methodologies and the Gallery Method

Solution methodologies can be divided as classical methods, intuitive methods, and discursive[5]. The Gallery Method is one of the intuitive methods. The other intuitive methods can be listed as brainstorming, 635 methods, Delphi Method, and Synectics. The Gallery Method was developed by Hellfritz[6], it combines individual work with group work, and it is particularly designed for embodiment problems. Because the solution proposals in the form of sketches, they can easily included in the main solution. The method consists of following steps:

- *Introduction step:* The group leader presents the problem and explains the context
- *Idea generation step:* For 15 minutes the individual group members create solutions intuitively and without prejudice using sketches supported, where necessary, by text
- *Association step:* The results of idea generation step 1 are hung on a wall as in an art gallery so that the group members discuss them. The purpose of this 15 minute association step is to find new ideas or to identify complementary or improved proposal through negotiation and reappraisal.
- *Idea generation step2:* The ideas and insights from the association step are further developed individually by each of the group members,

- *Selection step:* All generated ideas are reviewed, classified and, if necessary, finalized. Promising solutions are then selected.

The method has following advantages:

- Intuitive group working takes place without unduly lengthy discussions
- An effective exchange of ideas using sketches is possible
- Individual contributions can be identified
- Documentary records are easily assessed and stored.

This method encourages individual work in teams and results are ready to archive. Instructor believes that this method is a suitable method that can be integrated with modern communication tools. As a result of this integration, although the departments of the companies located far from each other, all departments can participate in the solution step at the very beginning of this procedure. Additionally archived design data are ready to use by any of the CAD/CAM/CAE Software.

Effective Teamwork

In the semester 2002-2003 at the very beginning of the course instructors wanted to students submit their CV's like an engineer applying to a regular job. According to their CV's the group was assigned by instructor, so that equally skilled teams were generated. Of course an effective team work is much more important than their formation.

A team is a synergistic group that uses an agreed upon process to reach an agreed upon goal. The critical aspects of this definition are consensus and synergy. In order to reach consensus a team must establish an effective communication plan, a task that is more difficult when team members are not at the same location[7]. Furthermore, the communication between team members must be based on openness, trust, and fairness. As a result, there should be little or no criticism of people on the team. Synergy is achieved by identifying the strengths of each team member and then capitalizing on those strengths. Rather than arbitrarily splitting up tasks or responsibility, the team should determine the required skills to handle the task and delegate accordingly. An important aspect of this approach is that consensus is reached on how the tasks are handled with input from different perspectives.

Procedure and the Sample Example

In the Engineering Design course, projects are assigned to students. This project is the main assignment to evaluate the students' performance at the end of the course. In general projects that are assigned to senior student are related to household equipment. The objective of the projects is to let the students be familiar to the redesign procedure for special wishes in specs for example easy assembly or disassembly for recovery at the End of Life (EOL) in the product Life Cycle. In the 2002-2003-spring semester, washing machine, dish washing machine, hand vacuum cleaner, printer, mobile phone, and mixer were assigned to the students as projects. In

the previous semesters, students used the Gallery Method at the solution finding procedure, but at the 2002-2003-spring semester the procedure was changed a little bit to exanimate if the method is suitable for supporting geographically separate design teams. First, like previous years, students divided into groups that consist of 6 or 7 members including one group leader and one group spokesman.

The European Commission has published a draft directive, the Waste from Electrical and Electronic Equipment (WEEE) Directive[8] that proposes obligating manufacturers to take back and recycle very significant percentages of their EOL products. Students studied the environmental legislation for the Electrical and Electronic Equipment so that, they could be familiar with the products market. The reason for this study was making the project in more realistic platform and preparing the students the problems that they will face with in the near future as an engineer. Again at the same time, groups' members prepared a customer survey to analyze the needs and future expectation from their device, and evaluated this survey. By using these data and information from literature survey, groups prepared a short requirement list. It was expected that, this was the last face to face group session.

At the third week, in a meeting group leader represented group reports to instructor and coordinator (assistant of the course). At that meeting by using group reports, it was decided that which part of the device would be redesign. It was also decided that, this redesign process would be performed for what special wishes. The redesign process, however left open ended in order to not to limit personal creativity. After this meeting all necessary devices for communication of the group member were presented and the rest of the whole project was performed on the Internet. All groups are forced to use a computer aided collaboration tool especially the Pro-Collaborate[9]. Group leaders introduced the problem by uploading the parts to redesign to the server with an explanation. At the first netmeeting, teams prepared a timetable and defined the personal privileges to access the design data. At that point the idea generation step was started. After the first meeting the members started to find their concepts. This took almost 3-5 days. The period seems a little bit long, but it should be noted that although this first drafts are very rough in the classical method, at this application they were parametric solid models that could be changed or modified. So that, the drafting time increased, but the modification of the drawings was easy and the altering time was shorten in an important manner. The solutions were shared on the Internet using a secure web server (Figure 1).

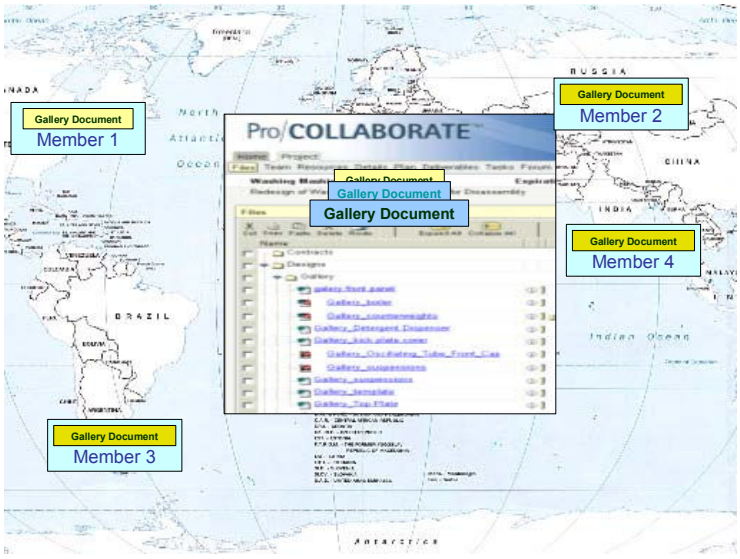

Figure 1 Online Collaboration using Pro/Collaborate

After that group made their second netmeeting and decided the most suitable 3 solutions. Groups' spokesman collected all individual reports and reorganized these reports. After that he/she sent this reports to the instructor and coordinator at the last day of the week. At the weekend, instructor studied this report. Since all procedure had been continued on the network all group members can enter the process whenever and wherever they wanted, if their privileges were enough. All data were ready to modify on the web server. All steps that are summarized above were performed till the solution complete.

The redesign for easy disassembly of the damper -washing machine component concepts is shown in figure 2.

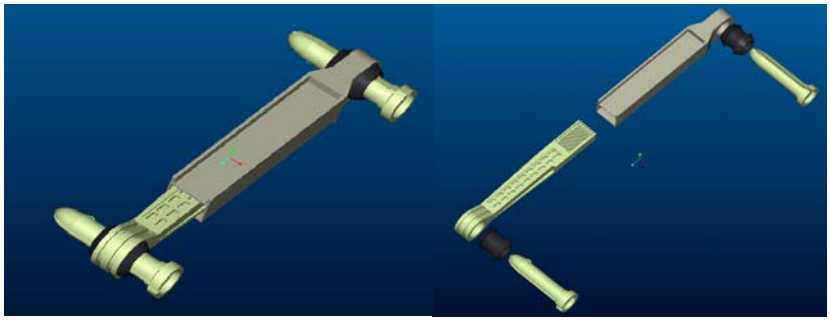

Figure 2 Original Dampers

The problems in original components were difficulty in disassembly and in the recycling. The selected concepts are shown in Figure 3.

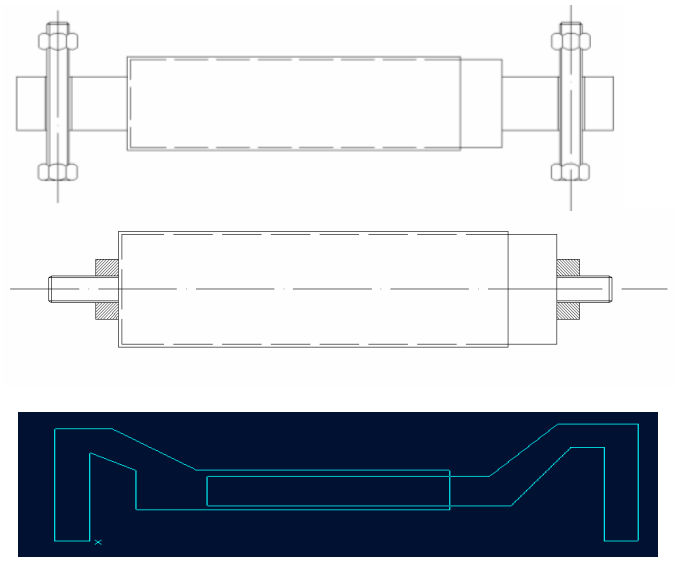

Figure 3 Generated Concepts by different team members

At the end of the study the final design is shown in Figure 4. This design consist of one unique material and it is easy to assembly and disassembly

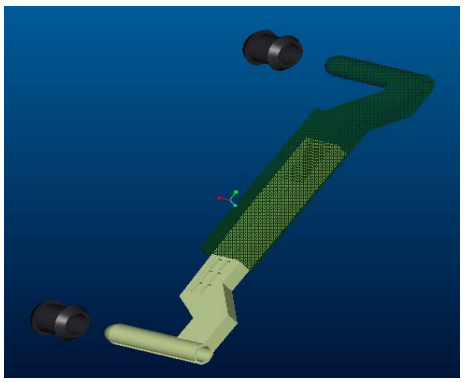

Figure 4 Final Design

Problems in the Course

Almost all problems in the study were caused by insufficient infrastructure. Slow and unreliable Internet connection was a serious problem for groups. For example they could not perform some meetings as scheduled, so that they had to modify their timetable. Beside they could not send their reports on time. Moreover all students were not equally experienced with the drafting software. Because of lack of experience, some of group members could not focus on the subject and they could not emphasis their good solution. The other problem is the online communication. Especially many 2002-2003 spring senior students said, “They feel much comfortable when performing face to face discussions”. Therefore in some groups,

communication between members was limited. Since the teamwork was a new experience for students, some group members could not well understand their responsibility. As a result of this load sharing among members became unequal and the processes were delayed.

Students had the opportunity to see each other and discuss the problem in the campus and they could prefer this kind of communication rather than through the internet. But Authors believe that today this kind of communication is also possible for people located far from each other.

Conclusions

At the end of the course it was observed that, groups were found more solutions compared to pervious semesters. Since they had great simplicity while documenting their study, modifying their models and simulating it, they could give more solution that are complex and ready to redesign of more parts. Moreover some groups, which were well organized, could concern about other customer needs. For example the group that worked on the dishwasher design, finalized their design with an integrated radio to the digital control on the cover of the machine (Figure 5).

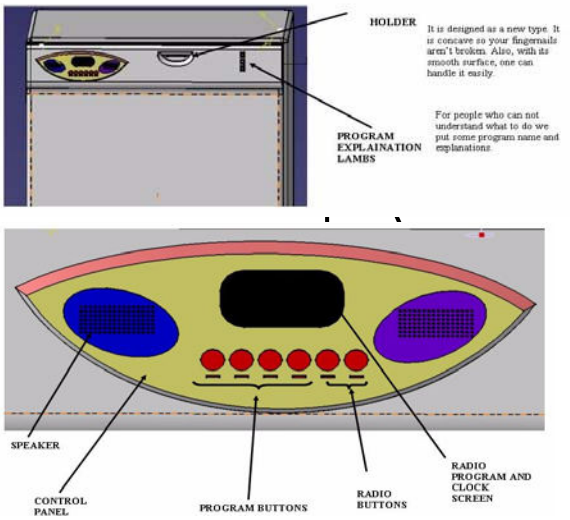

Figure 5 The Dishwasher with Integrated Radio in the Digital Control Panel

As a result of one semester study, it is possible to say that, the computer aided gallery method can be a powerful tool in the solution finding processes for the separately located people. Of course all technical supports should be well organized and the member should have some computer and teamwork skills. Improvements our teaching of teamwork skills is necessary to improve the student's teamwork.

For this study the customer needs have been collected in Turkey. For the next year, it is proposed to build one design team with students from both countries Turkey and USA. They will analyze the customer needs in both countries and share their results using online collaboration tool and find the differences. So, it is planned to design for variety of a unique product. They will generate a modular product family with small different components for the customer wishes in both countries.

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