

TECHNOLOGY-ECONOMY-DESIGN: TED INTEGRATED PRODUCT DEVELOPMENT IN CROSS DISCIPLINARY TEAMS

Jan-Gunnar Persson, Professor
Lisbeth Svengren, PhD, Assistant Professor
Jan Landqvist, Professor

Abstract

Integration of engineering and non-engineering elements in applied product development projects, as well as co-operation in cross-disciplinary teams, are essential features in the training of engineering students. Teamwork is a key factor for success in industrial work. During the last decade, this has been formalised by establishing Product Development Process models based on the principles of Integrated Product Development in many corporations. It is of utmost importance that persons with different background and representing different specialities can communicate and work closely together. This is not only a matter of formal communication. A deeper understanding of other professions “language” and a capability of accepting views and opinions of persons with a different educational background and frame of reference will be essential for success. This ability to work cross-disciplinary should be trained already during the sub graduate education, to support future co-operation in industry, between different specialists. In particular, our experience from joint student teams for product development, in co-operation between engineering students from KTH (Engineering Design), students from University College of Arts, Crafts and Design (Industrial Design) and students from Stockholm University/Market Academy (Marketing) will be discussed in this paper.

Keywords

Education, industrial design, integrated product development, cross disciplinary teams

1 Introduction

Interdisciplinary teams are today the self-evident form for organising projects in corporations. In academia, however, this is neither easy nor self-evident to do, over faculty or university borders. There are several universities that try to establish cross-disciplinary schemes within one university. These universities are often young, newly established universities without any old established faculties. Hence they can build the university from a new perspective with a new philosophy regarding different subjects. We know that it is difficult for old, established universities to change the structure of faculties. Hence many of these universities try to build up new courses to catch up with new ideas and concepts. Collaboration with other universities could be a support for this. Very often though, different time schedules, accounting systems, etc, make it difficult to establish co-operation in the undergraduate programs.

Hence, it is interesting to note that recently this kind of co-operation has been established at many universities [1]. One such project, the TED project, started already in 1994 and has now been going on for ten years. Technology-Economy-Design (TED) is a collaboration between the Department of Machine Design at the Royal Institute of Technology (KTH), the Market Academy (MA) at Stockholm University School of Business and the Department of Industrial Design at University College of Arts, Crafts and Design (Konstfack) in Stockholm [2], [3]. The experience from TED is very positive, both from faculty and student perspectives. The project is generally based on an informal agreement between the involved teachers but over time we have developed both the objectives and the methods for running the projects. The issues to be discussed here are the pedagogical methods, the structure of the collaboration and how the project can be further developed.

The objectives for “TED” (Technology-Economy-Design) co-operation are:

- To provide mutually basic knowledge of the roles, working methods and constraints in Industrial Design, Engineering Design and Marketing, as a basis for team formation and co-operation in industrial product development
- To get engineering students acquainted with industrial designers’ techniques for visualisation: sketching, physical models, etc, in applied project work
- To get students of Industrial Design and Marketing aware of basic phenomena and constraints in natural sciences and engineering
- To give students of Engineering Design and Industrial Design a basic understanding of economy, market analysis, market introduction and marketing, in applied project work
- To train students in co-operation within interdisciplinary groups, to avoid too narrow views

2 Participating schools and TED collaboration

Since long, several non-engineering courses are given at KTH, both as compulsory and optional courses. Besides KTH courses in economy and business administration, work science, industrial design, environmental protection, foreign languages etc, students can also select courses given at other Universities and Schools. These courses are usually of introductory character, giving a broad overview of each field. In addition, integration and application in product development will be addressed in the TED projects, established at KTH since 1992. Originally, this was a co-operation between the Department of Machine Design/Engineering Design and Stockholm University College of Art, Crafts and Design /Industrial Design. In 1994 this co-operation was extended also with the Market Academy at Stockholm University/School of Business. This was a logical extension since the marketing perspective of product development is important in a market economy. For the 25 Engineering Design students, TED is a separate project, in parallel to their Product Development & Engineering Design projects (in co-operation with industries, running over the entire fourth year of studies).

The industrial design education focus on the balance between functional, aesthetic, ergonomic, technical, environmental and market requirements when developing physical products. The industrial designer’s competence is based both on an artistic and a technical skill. In recent years the development of CAID programs have made the integration between engineering design and

industrial design easier and a necessity. The education is mainly project based and the students follow the same class during the entire bachelor program. The TED project is carried out during the beginning of the spring semester in the third year, just before the students start with their bachelor exam projects.

The Market Academy (MA) is a bachelor and master program within the School of Business for those with a major in marketing. There are 20 students starting every semester. Normally the students attend courses sequentially and with duration of five weeks. MA is kept together with different themes, sometimes for a week, sometimes for five weeks, with seminars and projects that run cross the whole semester. Hence, it was quite easy to join the TED co-operation and adjust the timing to the other universities.

Due to different course and examination structures it is often difficult to achieve collaboration across faculty and university borders for this kind of short projects. It cannot be compared with research programmes. In this case there is no formal agreement, just a personal engagement from the involved teachers. The engineering and design students are used to work in product development projects, which makes it easy for them to join forces. They are also used to work in laboratory settings. On the contrary, marketing students are not familiar with developing “physical products” or to work in laboratories and their course structure is very different compared to the engineering and design students program.

3 TED project tasks

The purpose of the TED projects is to let the students experience an interdisciplinary teamwork and the tool for doing this is to have them develop a product. The aim for the students is to develop a product by working closely together in interdisciplinary teams.

The TED project is an activity over eight weeks. 25 fourth year students of Engineering Design, 20 third year students of Marketing and 12 third year students of Industrial Design are participating. Six or seven project groups are formed, with equal mix of the students from the participating schools. Each group runs a separate project. Two different models have been used for the project tasks:

- Very open thematic projects, where a business idea and a product concept should be developed within a fairly wide sector in the society. Typical examples of themes have been: Design against crime; compact living; equipment for daily maintenance in buildings; rehabilitation and training of disabled people; parents with small children; safe shopping;....
- Project tasks based on specific company contacts, often with smaller companies. Company contacts were in these cases initiated by the School staff, by using their normal industry networks

With the exception for three years, when companies participated with project tasks, the students have worked together around one theme. Despite the advantages with working with companies we decided that with the resources we have it is more efficient to give the students a theme and then – depending on what they come up with – they can attract a company as they like, if feasible. This has happened in some projects when a team found a problem that they considered should be of interest for one particular company. This led to collaboration between the two parties within the project.

4 Organisation

During the first day of introduction, the participating schools and students from last years' projects give brief presentations. Project themes are then presented and teams are formed. An informal party, to initiate the important social contacts, will conclude the first day. Introductory lectures from the three schools are given during the beginning of the TED period. Group discussions together with the staff are also scheduled early, to discuss formulation of the projects. Different methods for organising the project work have been tried. Currently, the project groups are primarily self-organising, the teams plan their meetings and activities themselves, but staff from the schools is available as supervisors, when needed. A formal mid-time presentation is given. The final project presentations are usually given externally, e.g. at the House of Trade and Industry in Stockholm, or at a participating company. Besides Power Point presentations, videos and display of prototypes and mock-ups, each group has to write a report. After finalisation of the TED projects, a feedback meeting and written feed-back from the staff will be given.

5 TED project results 2002 - Design Against Crime

Last years (2002) theme was "Design Against Crime" (DAC), inspired from of a comprehensive programme in the UK. The DAC programme and the results of the seven TED projects that were carried out last year will be briefly described. Crime is a problem that affects us all. Most of us have experienced crime, small or large, from the bicycle or the wallet being stolen to robbery or worse. As the crime scene seems to worsen, and to change – the police and the criminal justice are not very effective, less crimes are brought to court, etc. Some of it is left to insurance companies to settle, with an increase of insurance fees as a result. Criminals are younger – young people robbing other youngsters – and so on. Initiatives are taken in order to prevent or even change this trend. The British Home Office and Department of Trade and Industry (DTI) who commissioned the Design Council to run a research programme as part of the British Government's Crime Reduction Programme took one such initiative. The research programme was called Design Against Crime (DAC) and led to several research projects, among them with Salford University and Sheffield Hallam University. The aim is "to influence those involved in the development of new products to design in crime resistant features before products are launched on the market". Within this project Stockholm University carried out two case studies in 2001. We all have an interest in preventing crime and there is both a public and a commercial market for it as this year's TED projects show. To have Design Against Crime as a theme for the TED projects was therefore something that could engage the students and should be a challenge for finding both "smart" solutions and a real market. The subject is also truly interdisciplinary – there are social as well as technical, commercial and design aspects. Results from the seven 2002 TED projects on the theme "design against crime" were presented at the exhibition in London, September 2002 (Figure 1).



Figure 1. TED exhibition in London.

These projects are briefly described:

5.1 The Beemor project

Children who feel insecure, excluded and lack good relationships with other children in school are exposed to a potential risk of committing criminal acts in the future.

The objective formulated by the project group was to create a preventive solution that should help children to develop their social skills, encourage learning and team building.

The concept consists of a web site and small handheld units that will be used by the children as a physical link to the imaginary world of the alien Beemor. The school provides the units and the children use it as a complement to ordinary teaching



Figure 2. The Beemor project

5.2 The CU project

Many people avoid being outdoor at night, e.g. travelling by public transportation or walking through parks, because they feel insecure and fear to be robbed or raped.

The objective formulated by the project group was to create a solution that should give people a feeling of security and an alarm system with a possibility to get in touch with someone when help is needed.

The concept consists of three parts: the CU (“See You”) unit, the Central Communication Unit and guards. The CU unit can include a ”friendly” light that goes on when someone passes it, a

camera, and a communication unit to get in touch with the Central Communication Unit and, if needed, guards that are available near by.

5.3 The GasIT project

Car drivers that fill up their cars at gas stations and drive away without paying, have become an increasing problem. Thefts at petrol stations in Sweden amount to more than SEK 40 million (with a UK population it would be equivalent to GBP 20 million). Research shows that many people just forget to pay without having the intention to steal.

Station owners want a solution that does not prevent the car drivers to go into the shop and buy other things, because margins are higher on these goods compared to the fuel.

The car driver shows his/her personal bar code at the back of the driver's licence, to a scanner that checks the driver's previous payment record before filling the car. If that is OK, the driver gets a green light and can start filling. Payment is made as normal. If the driver has been noted for non-paying before, there is a red light and the driver can either talk to the station personnel – if there is a mistake – or will just drive away.

5.4 The Pandora Box Project

More than 700 million tourists travel every year in the world and up to ten per cent are victims of a crime. Most crimes are burglaries, bag-snatchers, and pickpockets. People who are travelling have often no safe place to put their valuable things, like money, checks, passport and smaller jewelleryes.

The aim is to make stealing more difficult; to scare the thief off and to design an attractive product that protects valuables like money, passport, smaller jewelleryes, and the like but also a product easy to handle and bring on the trip.

A box with space for 5 passports, a bunch of bank notes, travel checks, tickets and smaller jewelleryes, was developed. The box is very difficult to break and when violent use on it an alarm goes off that scares the thief to stop. The box is able to fix in the hotel room or to bring along to the beach or on a tour.



Figure 3. The Pandora Box. The Pandora's box has a rather aggressive look with diodes on each side to signal that the alarm is on. Fingerprint scanner for identification.

5.5 The Quicklock Project

One of the more common problems in today's society is the theft of personal belongings. After starting to look into this issue the project group decided to focus on the problem of bicycle theft, as bicycles are used throughout the world and by huge numbers of people.

The aim is to make stealing more difficult; to scare the thief off and to design an attractive product that locks the bicycle quick and easy.

A flexible, quick to attach and fix lock with an effective defence mechanism that scarcest the thief off, was developed.

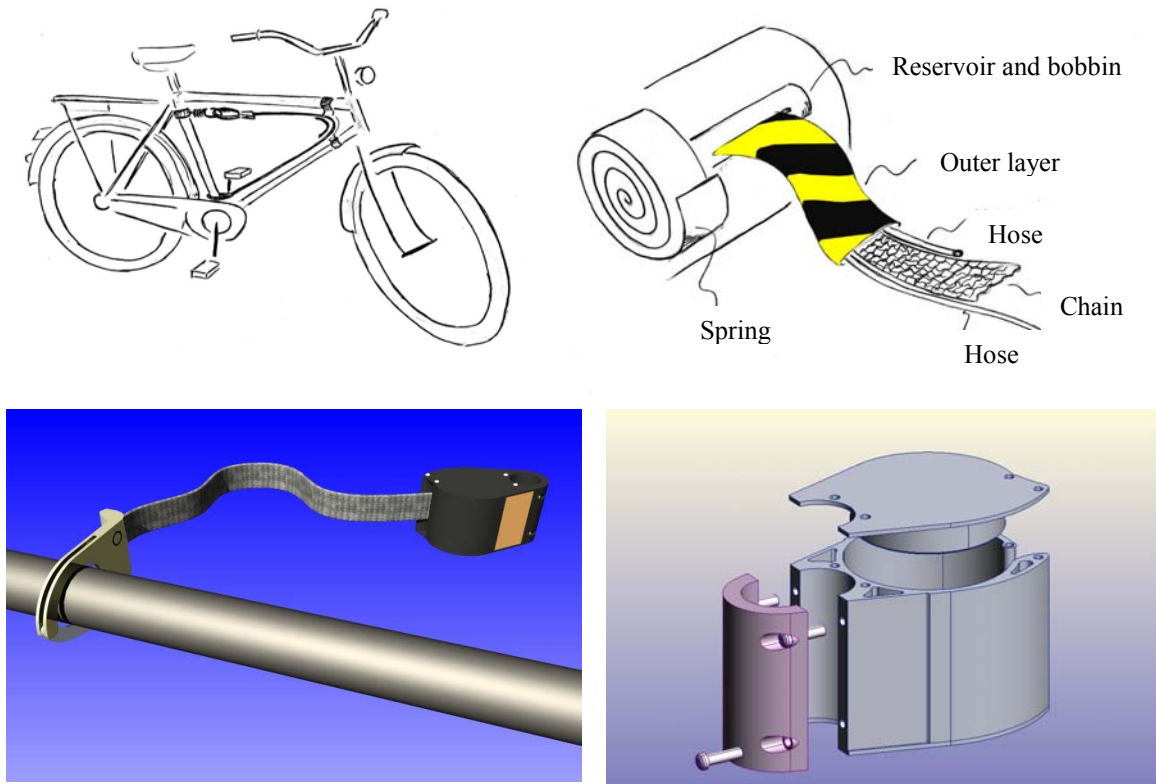


Figure 9: The Quicklock product and components –made according to the norms of the insurance companies.

5.6 The SkiFree Project

Ski theft is a big problem not only at the Swedish ski resorts. The ski thefts annually amount to almost five million SEK at two of Sweden's most popular Ski resorts. Presently, the dominating solution that exists at the slopes is a fixed ski rack with a personal portable locking device. This device works well when used, but due to the hassle and difficulties most skiers don't use it.

The objective formulated by the project group was to develop a durable ski rack for skies and snowboards that is safe and flexible to use, and can provide space for a large number of skies.

The solution is SkiFree, a fixed lockable ski rack, designed to secure both skies and snowboards. It is ready to be used instantly without any complementary locks. The rack is equipped with a

cylindrical lock with four digits combination for easy use without any hassle neither with money nor keys. The payment is included in the lift card. The code is set by the user and can be changed when the lock is open. All these features make SKIFREE very user friendly, a product superior to other solutions on the market today.

5.7 The TAG Project

Thefts committed by youth have increased dramatically the last years, but young people being robbed have a tendency not to report because of fear of the criminals and distrust of the police. Young people today wear more expensive things, both electronic items and clothes, and the differences between social groups rise.

The objective formulated by the project group was to develop a product that should help people to protect their things, especially jackets and mobile phones. The solution should prevent young people to steal, to make them feel uncomfortable when using a stolen object, but yet making the user (and owner) comfortable. It should also make adults alert on kids who are on a wrong track, who use products with TAGs that the parents do not recognize.

The concept consists of a TAG system, The Active Guard, which is attached to the possessions that are to be protected. The TAG should be as small as possible but yet large enough to be noticeable. The TAG cannot be removed without destroying the items it is attached on. If the jacket is stolen and the thief removes the TAG, there is still a part left on the inside of the jacket that is glued on to the fabric and impossible to remove without destroying the jacket. This part will be activated when violated and will set off alarms in certain locations where there are gate controls, for example at arcade halls, youth clubs and schools. It works in the same way as ordinary store security tag but uses another frequency.

6 General results and possibilities for further development

Despite the limited time and some frustration among the students in the beginning – especially with the broadly formulated tasks – very good project results have been obtained in virtually all groups. In some cases, patents or pattern protection has been applied for and student co-operation has continued. Students from all schools should participate in all types of project activities, e.g. market analysis by interviews in Focus groups. With a broad thematic task, it usually takes some time for the groups to converge towards a specific product idea. On the other hand, with a task from a company, there is some risk for too little degree of freedom and innovation. Group dynamics is an essential part. Conflict solving and turning possible conflicts into positive actions is usually handled within the groups, with assistance from the staff whenever needed. During the years, there have been only very few “disaster” groups, as exceptions. Normally, the co-operation goes very smoothly.

For the current TED projects, carried out during the spring semester 2003, we follow the internal processes within the project groups more closely. Project groups are also requested to document their meetings and other activities (interviews etc) more in detail. We plan to make use of these and future TED project groups as interesting cases concerning group dynamics and the interrelation between different professions, in integrated product development work. Hence, we are not only interested in the project results, but also, to a considerable extent, in the process.

The TED cooperation has now also been extended to research [4]. So far, research within Industrial Design and its integration into the product development process has been fairly limited in Sweden. However, results from some research projects at Chalmers University of Technology have also been published, e.g. in a number of recent PhD thesis's [5], [6].

7 Key conclusions

Most students have considered the TED-projects "the most stimulating part in our education". Also, the co-operation between the schools is based on informal co-operation between enthusiastic teachers. No specific funding for initiation, development or carrying out of the TED project activities has been available.

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Corresponding author

Jan-Gunnar Persson

Royal Institute of Technology – KTH

Engineering Design

Department of Machine Design

SE-100 44

Stockholm

Sweden

Tel. Int +46 8 790 78 68

Fax. Int +46 8 20 22 87

E-mail: jgp@md.kth.se

URL: <http://www.md.kth.se>