INTEGRATED DESIGN OFFERS NEW PERSPECTIVE IN DESIGN EDUCATION

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ABSTRACT
Integrated Design Project is a course at the faculty of Industrial Design Engineering, in which the integrated product design team delivers a new product design concept for a company. The design team consists of six students, two from each graduation subject offered by the faculty Integrated Product design, Design for Interaction and Strategic Product Design. The team communicates with the company and a supervisor from the faculty.
"Embodiment Design, designing with materials, manufacturing and geometry to fulfill a new function or upgrading the function" can help shorten the design time in the front end of the product development. Design with X offers possibilities for supporting the design process.
The project teams receive an assignment from a company to design a product. The design team uses their preferred design tools. However, collaboration with the other design team member is of great influence on the quality and 'depth' of the ideas. These design tools include sketching, movie making, 3D modelling, etc. After the selection of the most promising design, a virtual prototype can be created but also a physical model to support the product concept.
The project teams finish their projects by a presentation of the product design by means of several models and the business plan. The project results depend on the communication, the design method and models which should lead to improving the efficiency, reducing the design time or improving the product performance.

Keywords: Integrated design team, stakeholders, embodiment design, design with X, functional model.

1 INTRODUCTION

Communication model is used for improving the communication between stakeholders of the Integrated Design Project vis-à-vis designing of the product which is based on framing product design. The improvement is achieved by effective use of the rules during the design project. One seldom reaches the maximum time saving up to 50%, it always comes out somewhere between 0 % and 50 %. The project teams are directed under the condition of optimal collaboration. Each team member should bring in their best capability during the project.
Embodiment design used in the conceptual phase of the integrated design project means mostly reducing design time by avoiding irrelevant product designs. Design with X is the method where the constraints are given for one design aspect. If the material is a biopolymer then it has the degradation time as a constraint in the given case.

A model overview is handy, because physical models cost time so you need to save more time during the rest of design process.
New perspectives are coming to the fore in development of the education model. Communication and design with X are the project aspects which offer to reduce design time and improve efficiency.
The conclusion may a reduction in design time, if communication is efficient and improving during the design process, and then new perspectives for integrated design projects are possible.

2 COMMUNICATION

Communication is becoming more and more important for shortening design time. In the past, the time that was spent on the integrated design project was open ended. Nowadays that time is limited to 520 study hours. So communication must be really efficient between the stakeholders in the project. The stakeholders are the product team, the company and the supervisor. To be efficient in communication one should formalize the method of communication on different levels. In figure 1 communication is established between the stakeholders at different levels as shown.

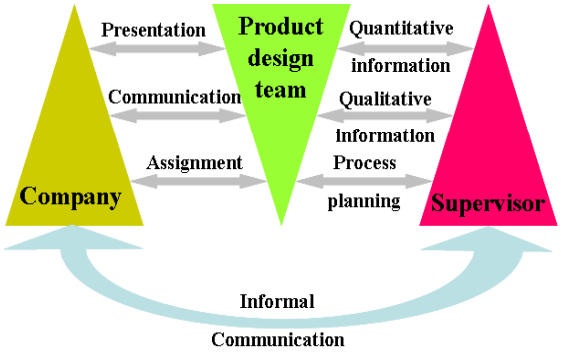

Figure1 The communication model between the stakeholders at Integrated Design Project

The product design team is the stakeholder who takes up communication with the company and supervisor. In principal there is no formal communication necessary between company and supervisor, because both have separate responsibilities. Only in a conflict situation does the supervisor mediates between the project team and the company to resolve the situation. The goal of mediation is to ensure that the student can finish the project and the company is also satisfied with the project results. Fortunately 99% of the projects are finished with excellent communication and with a good product concept, sometimes the company applies for a patent. The design team initiates contact with the company to arrange a visit to the company and to discuss the assignment. The supervisor accompanies only the design team as a representative of the university at the company visit. The team deliberates all the questions that they formulate by analyzing the assignment in the first week. After finishing the results of the company visit, they come to the supervisor with balanced process planning. Herein are defined the milestones and schedule in time. The milestones are also discussed with the supervisor to find out or the milestones are achievable. Communication is always the initiative of the product design team that can be asked at any moment of the project if the risen questions could not be answered by the company [1]. The supervisor checks on regular basis the progression of the design team and sometimes gives advice methods that the

team can follow. Qualitative and quantitative information is exchanged and discussed during these meetings. There are three formal meetings planned: the first one about orientation and establishing the assignment in the 7th week, the second one about concept development in the 13th week, and the last one about elaboration and implementation of the product design in the 20th week of the project. Communication at the right moments avoids stalling, so you can improve the performance of the design solutions and shorten the design time. In the ideal situation there is a saving of more than 50 % of the design time. Of course the time saving is closer to 25 %, the amount of time that is needed to do the project in the fixed time of 336 hours. Communication can be the key to optimizing the project effort by shortening design time of deepening the solutions to justify the decision in the design project. Gerard Smith [2] is using design communication for framing his product design description method to generate to new product designs.

3 PRODUCT DESIGN TEAM

The formation of a product design team is directed by the project coordinator. The project teams consist of 5 or 6 second year master-level students, two from each of the master course: IPD (integrated product design), DfI (design for interaction) and SPD (strategic product design) [3].

The different background at the bachelors-level should also balance the project teams. Never put two Asian master-level students in one group or two from a European country because they must be forced to communicate in English. The Bachelor of Engineering must also preside over the project team for minimizing the difference in the design approach. The project teams are balanced in background but not knowledge, skills and experiences. The first two meetings of the project team should be used at least for team building and planning the project. The team members can have an optimized participation in the team. Of course communication can be brought on at an understandable- and motivated-level in the group. But the external team communication shall be on the same level with the company representative and the supervisor of the design school.

The different backgrounds of the team members should stimulate each other in knowledge, behavior, challenge, leadership and performance. The team members can grow to a level of commitment, which is correlated to an excellent product design or concept. The best test case is building the prototype where the group gets confronted with their own mistakes.

The work-load is different for every team member, but the contribution must be equal. The planning should be in contribution with a commitment time schedule. Most of the irritations in a team arise during the working and contribution. Informal communication between the project team and supervisor solved most irritations in the beginning. If a conflict arises in the team then the supervisor makes the communication formal to hear and deliberate on the meaning. He makes proposals to solve conflicts by taking away misunderstandings and explaining again the goals to reach.

Implementation of a product design demands a balanced contribution from all the team members. Even prototype building means dirty hands and long working days. Here the presence of all team members is important including those engaged in doing other jobs such as writing the business plan, 3D-modeling, market introduction, or writing the report. This is because the feeling of commitment must not disturb the team members; otherwise the project will overrun.

Teambuilding [4] could be stimulated by the supervisor as a new perspective at integrated design project.

4 EMBODIMENT DESIGN

Embodiment Design starts usually after concept development, with making the first rough layout of the product (Pahl and Beitz) [5] or defining the product architecture (S. Laquette) [6]. In the integrated design project they start mostly embodiment design just at the beginning of the synthesis. The FMPG-model (Langeveld and Kandachar) [7] give the place in the design process between the program of demands and wishes. The relations between the design aspects in FMGP model are called activities (Langeveld) [8], so design with X can be defined as the activity from aspect X to aspect function. If the material is known to solve the design problem in the conceptual phase then you speak about design with material. Now embodiment design is applicable in the conceptual phase that means mostly shortening of the design time.
Embodiment design in the conceptual phase gives a reduction of the design time by avoiding irrelevant product designs. Reducing design time or deepening product design are the new perspectives in the integrated product design.

5 DESIGN WITH X

You have finished the design brief as a result of analyzing the design problem. For instance, one point of design brief can be design with a biopolymer because of the environmental issue in agriculture [9]. The design solution is still open but the material is fixed. You are generating design ideas by sketching, brainstorming, mapping, etc. with program of requirements and wishes on your mind. The generated ideas should be selected to the most promising idea which is detailed to a product design and the prototype is built and tested. The prototype of a biopolymer product design is shown in figure 2.

Figure '2 The biopolymer product design

The project team did not follow the method of design with X exactly, so they lost design time in concept development by developing non-selected product designs. The team really saved time by going for the environmental issue with an innovative material in the agriculture automation. They have communicated the product design in the different stages; the company is really convinced of the product design. The communication of the product design saved design time but also by using design with X. These are the new perspectives for the integrated design project. This project team saved 25% of the

design time, so they could build the prototype and tested the working principle with success.

6 NEW PERSPECTIVES

The integrated design project has been going through periodical development. Every time you develop a number of project aspects. Otherwise the changes are too great for a successful adaptation. Special attention is given to communication of the project team with the client and the supervisor and design with X. The physical models which play an important role in the communication with client and supervisor should not be forgotten. In table 1, the development of the education model is given by elements of the integrated design project.

Table 1 Development of education model

Development of the education model			
• Design • Prototyping • Communication	• Design with X • Model Virtual Physical • Client and supervisor	• Life cycle engineering • Miniaturisation	• User centred • Design for Interaction • FMEA • Design for Assembly
Reducing design time	Improving efficiency	Improving environment friendliness	Improving feasibility

The communication model offers new perspective by reducing design time which is achieved by framing the product design. The teams communicate strictly by the frame so avoiding unnecessary communication about irrelevant designs and design with low potential of success. Design with X improves the efficiency by looking to the design task on concept level with constraints from the requirements needed at the conceptual stage. The improvement can be marked as new perspective. The virtual and physical models make sense if they are communicated at the right moment and accepted fully by the client, then you have the advantage of right first time. In this situation the time saving is maximised. The client asks for more depth or alternatives in most cases, because there are doubts about the shown models [10]. So the time saving reduces. It can also block the design progress and so costs more time. The improvement in efficiency or reduction in design time by use of models is pointed out as a new perspective but it can destroy the entire design progress.

7 DISCUSSION AND CONCLUSION

There are still new perspectives coming to the fore by development of an education model [11]. It seems that models need updates of new methods or tools on a regular basis. Models can always be refined with savings in time and/or costs. After two to four integrated design projects, the supervisor can measure subjectively the time reduction by the quality of the product design. In an evaluation of the project, there are many aspects which come under the guise of the team, by personal experiences in team and with the team. An evaluation on the design progress, the methods and tools the teams have used can give insight into reducing design time and improving efficiency. The

team should do time registration. With the time registration you can find the weakest point in the design project. This point can be researched for seeking improvements of all phases of design. An optimized design process depends on so many factors, but the effort is to come really close to it. Herein the supervisor has to play the role of design progress checker who discusses the quantitative and qualitative design information. Many aspects can be improved, but success is achieved by communication.
The conclusion is a reduction in design time and improvement in efficiency by using communication and design with X, which could lead to product designs of high quality, if communication is sufficient and efficient on the right level and moment. The new perspectives are reducing design time and improving efficiency. By use of the available design time the new perspective should lead to a higher quality of design.

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