5TH INTEGRATED PRODUCT DEVELOPMENT WORKSHOP
IPD 2004 SCHÖNEBECK/BAD SALZELMEN b. MAGDEBURG
SEPTEMBER 23-24, 2004

IPD QUESTIONS OF THEORY AND PRACTICE IN HUNGARY

Balázs VIDOVICS, Tibor BERCSEY

Keywords: IPD, education, BSc

1 Introduction

Technology, more precisely the technology space involving machine design is, on one side, part of the human culture, on the other side, culture shaping potential. It is a characteristic of creative spaces that components of socio-cultural system can be found at the same time and are influencing the other's probability of genesis existence. Therefore, technology always has social, political, economical, and ecological interrelations, which are needed to be considered through the creation and application of technical works with all the influences; that needs a comprehensive knowledge in itself. Contemporaneously the paced-up development of technology, technological systems emergent from the separation of technology and its cultural evolution show an increasing complexity, which become perplexing not only for the spectators, the users, but for the creators, engineers of a specific field. Because of the partly new requirements demanded by the above mentioned and the products of the future, e.g. new technical function, saving consumption of material and energy, high specific performance, automatization, environment-friendliness, etc., and the changing of the resources of the design and the emerging of new product-production philosophies, the concept of the product and machine design has widened, its structure, approach, methodology, and necessarily its education has changed. The paradigm of differentiation and specialization, which was dominating until the middle of the 20th century in the engineering work was switched over to the paradigm of integration from the eighties.

The paradigm changing in design goes with the evolvement of new design theories and methodologies, the application of mutually matching new techniques and methods, and the evolvement of new forms of cooperation.

The paradigm of integration, conversely the classic design process, assumes the collective, goal-orientated work of the participants, their cooperative creativity, and assumes the achievement of the personal, informatics, and organizational integration.The actions taken on different fields remain insufficient if they do not couple with adequate methodology and modes, and if they do not become a common approach, a manner of working.

The Integrated Product Development (IPD) is not a monolithic system of design methodology, but a design philosophy consisting of a number of well known procedures, design tools, of different goals and approaches, elementary and complex ones, and the concept of the education of experts to have the appropriate competence profile for the accomplishment of that.

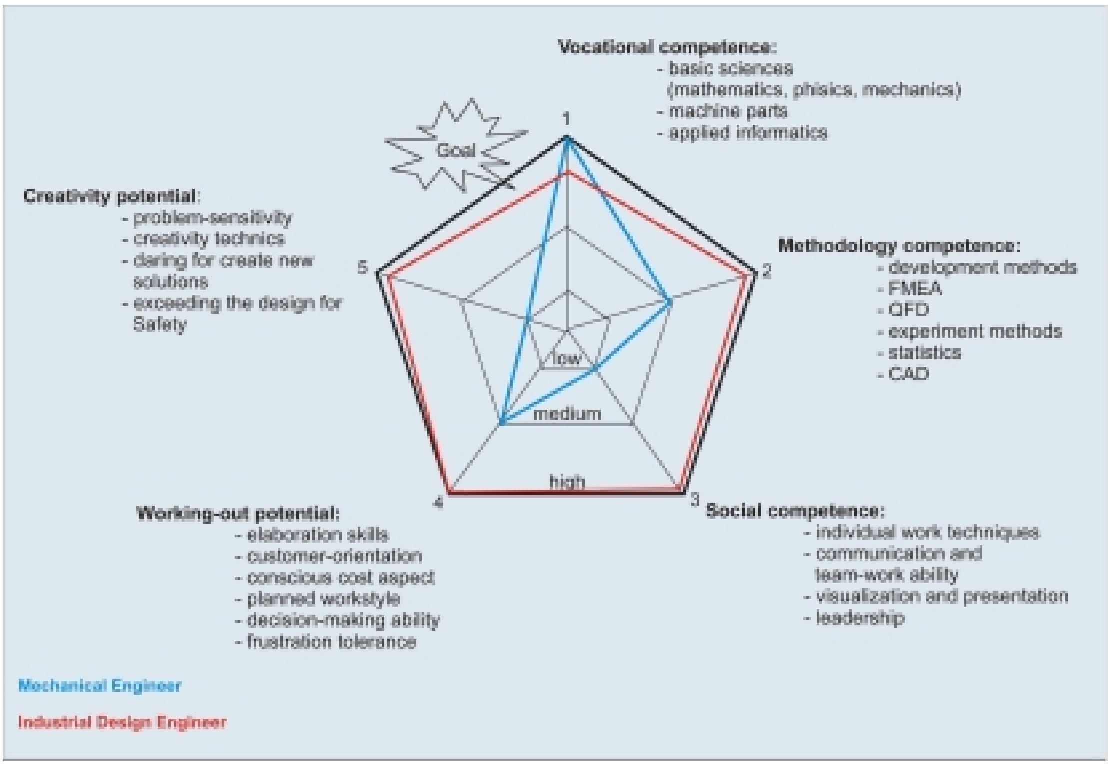

Figure 1. The Competence Profile of a Product Engineer

2 IPD in university level education

Product development plays a determinative role in the product producing process, which the efficiency of is determined by numerous factors. Out of these, considering both the creation and application of the support tools and methods for the design process, and the competitiveness and novelty of the borning product, the designer having the appropriate competence profile has significant importance. The expectations required of the designer can be divided into five categories (Fig.1.), which the achievement of, in most cases in traditional engineer programs, is not guaranteed on even levels. By the experiences of almost 10 years on the Industrial Design Engineer program of the Budapest University of Technology and Economics, the graduates of this program are approaching the needed requirement profile, implied by the philosophy and concept of education distinct from the conventional engineer education.

The Industrial Design Engineer program was founded in 1995. The creation of this program was motivated by the recognition, that Hungarian industrial products, though in many cases they are not behind the foreign competitors considering the technical parameters, they have a market lag for their unfinished exterior. The industry and the cultural government recognized that this problem cannot be solved successfully involving designers, who do not have knowledge about manufacturing, market positioning, management aspects of the product. That was the reason why this – incomparable in the Hungarian technical higher education - program was come into existence.

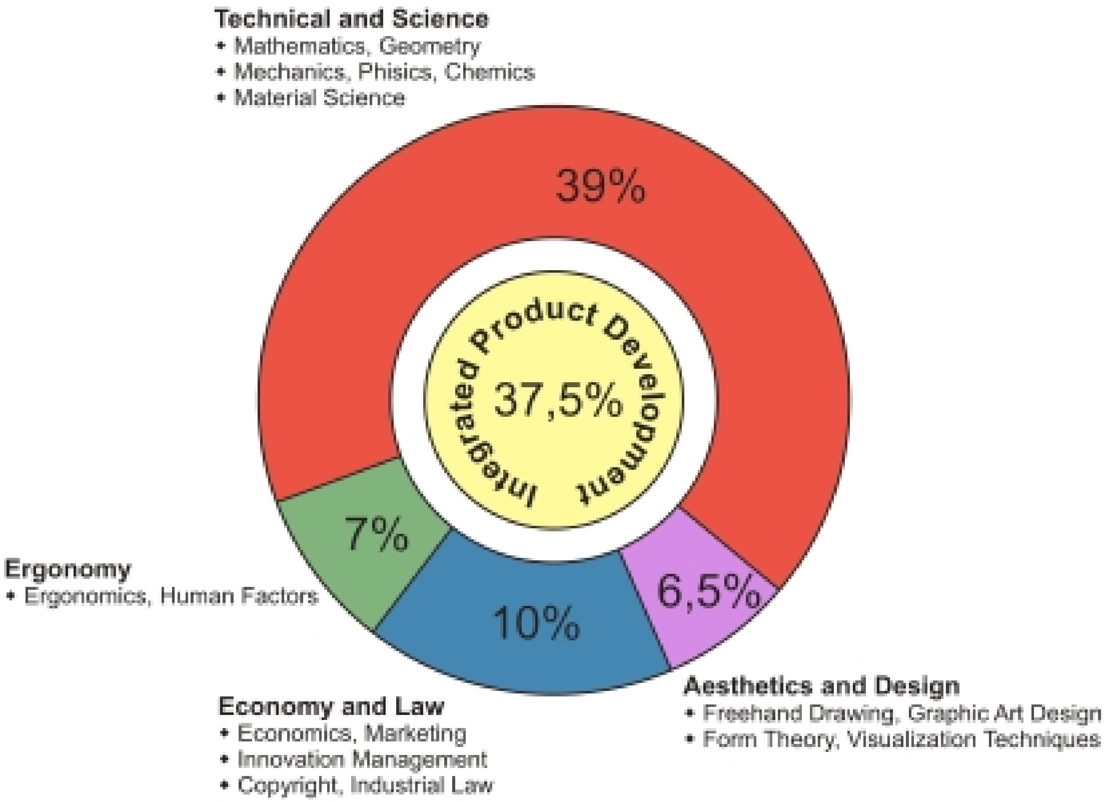

Figure 2. The Pillars of the Industrial Design Engineer Program

During the program students acquire knowledge of four fields: technical design studies, product and system ergonomics, industrial design studies, product planning and management. These fields of knowledge are integrated vertically and horizontally, through the whole duration of the program, in Integrated Product Development projects.

The aim of the course is to train such engineers, who:

- are flexible and effective in reacting for the challenges of the market, especially in little and middle company frames,
- have the ability for individual and creative working in any phases of the product development process due to their knowledge and skills on technology, aesthetics, humanities, economy,
- have the ability to manage the innovation process of the product development, to manage the material, organizational, human resources needed for the product development, and to manage certain periods of product life cycle,
- are conformable for formalizing products, services, systems in a way that expresses its complexity and coherent with it,
- on the fields of design, manufacturing, sales of industrial products.

The Industrial Design Engineer (IDE) is a technical expert who can basically be characterized by the features sketched above. Mainly they use their knowledge and skills successfully on a variety of industrial products, through their activity they embrace the whole innovation process, the product life cycle, from the origination of the product idea, through the planning and realization, to the market launching, even to the recycling.

The Industrial Design Engineer is not an Industrial Designer. The industrial design studies are just a part of the knowledge and skills that an IDE is supposed to acquire. In the IDE program a strong emphasis is put on those subjects, which establish the 'engineer approach', furthermore all those information, which bear upon the product's technical construction, manufacturability, quality, user and environment friendly feature, economy, competitiveness, etc.

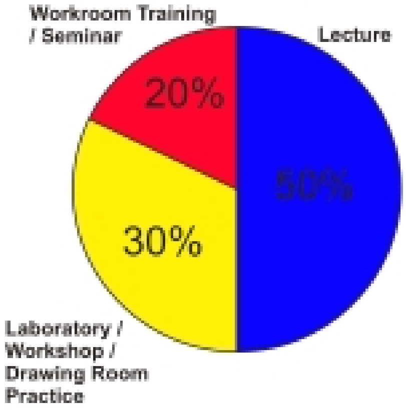

Figure 3. Proportions of Theory and Experience

One basic feature of the IDE course is its strong experience-orientation, built upon the so called 'learning by doing' principle. According to this the students work on individual projects (including planning, designing, modeling, even prototyping) from the beginning of the program, they work out the strategy of market introduction, make economy studies, etc.

The methodology basis and background is given in the first semester in a subject called 'Methodology of Product Engineering', which overlooks the whole product development process according to the 'Reference Model of the Product Development Process' (Fig.4.).

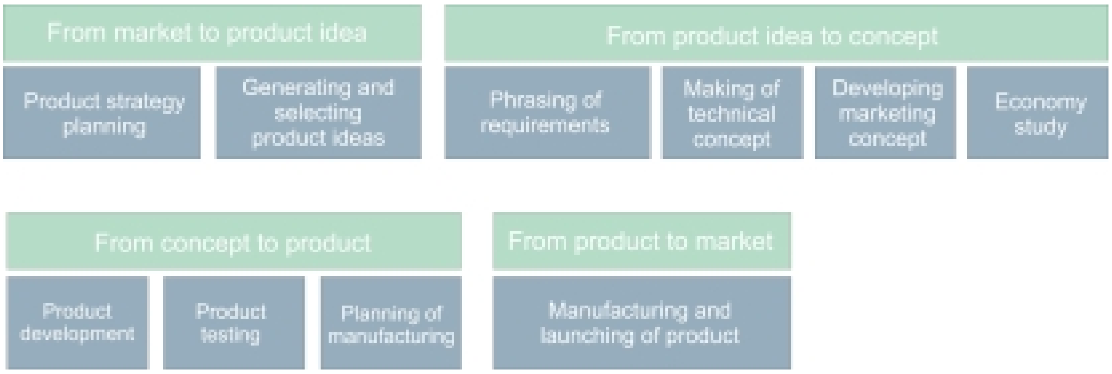

Figure 4. Reference Model of the Product Development Process

3 Examples of IPD projects

The drilling and integration of the acquired knowledge is ensured by the IPD I to VIII. projects and the diploma piece project. Through the working-out of the projects the members of teams of 3 or 4 have to trace the complete development process each time. In differently marked IPD projects, the emphasis is laid on different development phase, depending on the educational purposes. In the following we show a few outcomes of those IPD projects.

<table>
<tr><td rowspan="2"></td><td>“This product-idea is for reserving liquid soap and dispensing it in measured amounts through a dispenser system. When infrared sensor detects movement, toggle circuit connects engine with batteries. Engine moves clip, which interacts with pump, then mechanic pump valve, draws a measured amount of liquid soap from reservoir. Economic, good cleanability, and environmentally sound (refill - lockable lid for top filling). Materials: ABS plastic, PMMA, polystyrene sight gauge, rubber suction-cup / metal mounting screw. Digital interface: sight gauge of liquid level, set measured amount of liquid soap, set movement-detection sensibility.”</td></tr>
<tr><td align="right">Methodology of Product Engineering
2003
Touch-free liquid soap dispenser
Zita Farkas
Csilla Erdõs</td></tr>
<tr><td>TASK: Product proposal</td><td></td></tr>
<tr><td rowspan="2">
</td><td>“We choose the footbag as a product to advertise, which is a popular communal game. The fact of this game, which a few people stand in a small circle and kicking the footbag to keep it in the air. The Display is designed to place it on the counter. Its function is simple: 14-15 footbag can be placed on the sloping track, if we take one, the others roll down. Knowing the human playfulness, many people will make a try, picking a ball from the bottom, the others would roll down, and once you have a footbag in your hand you will never put it down!”</td></tr>
<tr><td align="right">Integrated Product Development I.
2003
"Fundango" footbag display
Márton Bartos, Miklós Szentkirályi, András Radnóczi,
Péter Horák</td></tr>
<tr><td>TASK: Design of mobile product display</td><td></td></tr>
</table>

	"During designing this product we had to keep the children's' mental and physical abilities in mind. Novelty and skill-developing, as well as joyfulness were the main concerns. The product shapes a ladybird, and is made of hard wood. The belly of the ladybird holds construction elements made of wood too. As an accessory a textile bag contains additional construction items. Using the bits different 3D objects can be built either on the flat side of the toy, this needs good skills, or on other flat surfaces." Integrated Product Development II. 1999 Ladybird construction set Nóra Juhász, Andor Kovács, Róbert Paróczai, Sára Till, Balázs Vidovics András Varga
TASK: Design of skill developing toy for children	
	"The shape to use the tap with is a frame of a cube. This shape makes feel the tap lightweight. The edges are rounded, the overall shape is cubic." Integrated Product Development III. 2003 Tap Xénia Milassin Csilla Erdõs
TASK: Design of a simple industrial product, model and technical documentation	
	"The dish-rack offers room for 14 plates. Special holes are designed for cutlery. Design for safety and ergonomics were important guidelines in the design process." Integrated Product Development IV. 2004 Dish-rack Xénia Milassin, Milán Balogh, Tünde Tatai Csilla Erdõs
TASK: Design of equipment, object of metal	

"Nowadays the average flat is not big enough to make an American style kitchen. This problem can solve by a compact module kitchen. The main designing aspect was the maximal use of a relatively small volume, with using built-in equipments, and changeable modules. Approx. size: 900x900x900 mm. The entire top is openable; the stool is also a store stall. The divided recycle bin is to aid selective garbage collection. The kitchen equipments are holding by the shelfs fasten to the skeleton. On this places any type, and brand of machines is allow to use, the only term is the size. The shell elements can choose in any combination of colors, the shells sold in different sets."

Integrated Product Development V.
2003
CurioCubeKitchen
Noémi Gaál
István Lõrinczi

TASK: Design of furniture, interior objects

"The subject of the redesign task was an outmoded kid bike. The main concern was the renewal of the shape and the further anthropometric adaptation. Simplicity and the ability of adapting extras were prime requirements. Redesigning the shape playfulness and dynamism were emphasized. The outcome meets the users' ergonomic parameters, as well as the different levels of safety."

Integrated Product Development VI
2000.
Kid bike
Andor Kovács; Balázs Vidovics
Péter Lelkes; András Varga

TASK: Redesign of a vehicle

"Our job was to design the shape therefore I didn't deal with working out the minor details. However the appearance has to refer to the function. But what can one do with a clock? You can symbolize time with a pair of interlocking arrows. Simplifying this idea, I get to this double spiral. Some of the drawings resemble snail or sepia shell, so I decided to leave the body white, like the shell itself. Another, more relevant similarity with the windmill reminded me to name the clock 'Twister' which takes you away like time."

Integrated Product Development VII
2003
'Twister' Wall-clock
Gyula Tiszai

TASK: Design of dynamic equipment

“A few years ago the METRO newspaper was published in Hungary. Unfortunately the newspaper cannot be read by lot of people, because early in the morning some people take lots of newspaper. This container keeps the papers in a locked place, it is easy to refill, and the people can take only a few newspaper at a time because of the gap. Robust street furniture, resist vandalism. After opening the door, you can put a bundle of newspaper in it.”

Integrated Product Development VII
2003
Outdoor newspaper container for METRO
István Á. Bense
András Varga

TASK: Solving industrial design problem in virtual/real company environment

“The design goal was a trailer for pleasure time, shopping and carrying purposes. The main concern was to create such a trailer to provide security not only for the luggage, but for the bike itself. The product consists of two hulls made of glass fiber reinforced sandwich composite. The trailer is easy to attach and detach. A special lock helps to secure the bike and the trailer at the same time.”

Degree work
2003
Multifunctional trailer for bikes
Andor Kovács
Dr. Péter Gara, Dr. Károly Váradi, András Varga

TASK: Solving industrial design problem in real company environment

4 The concept of the bi-level IPE education

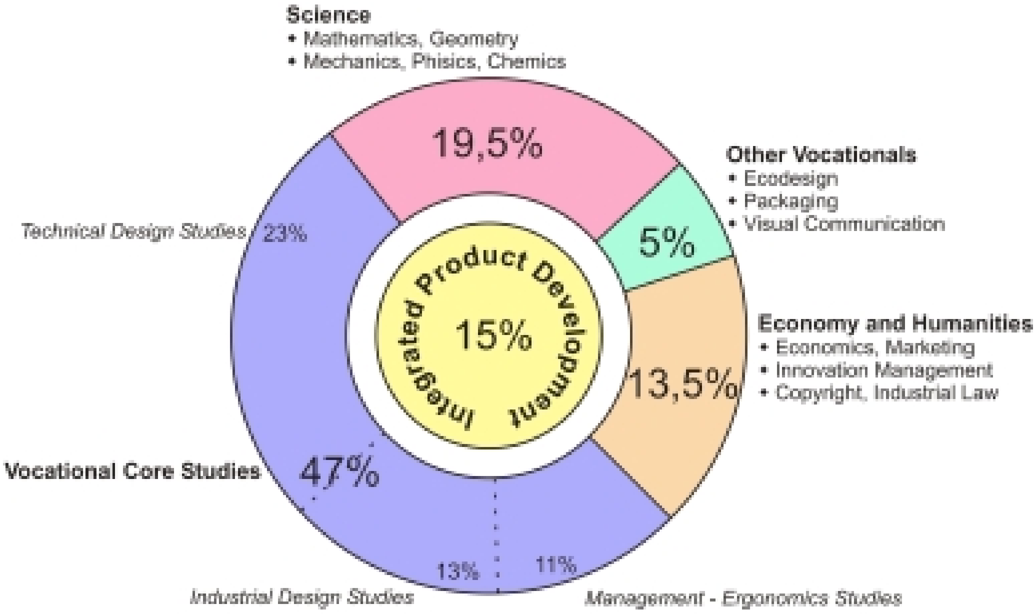

Figure 5. The Restructured Curriculum on BSc Level IPE Education

Consequent upon the Bolognian procedure the 7 semesters (210 credit points) BSc, and the 4 semesters (120 credit points) MSc programs begin in 2005. Leaving the purposes of the education settled – according to the Hungarian regulations – on the BSc level, the architecture of the curriculum is restructured (Fig.5.), beside the changeless amount of theoretic education, by advancing virtual product development, the ratio between the seminars and the laboratory practices is changing in the unacademic field of education (Fig.5.).

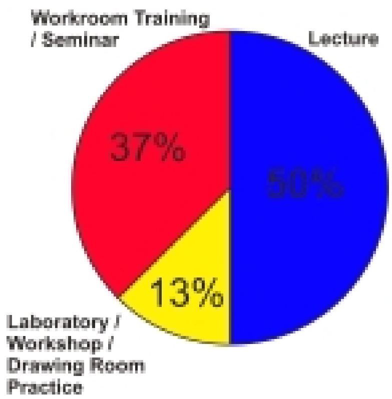

Figure 6. BSc; Changing Proportions in Unacademic Fields

The structure of the Bachelor curriculum is shown on Fig.5. The typical domains are:

- within the Science core studies students are familiarized with mathematical basics of engineers' work, basic physical effects connected with product development, basic chemical, thermodynamic, hydrodynamic, and mechanical laws, paying special attention for measuring them;

- in Economy and Humanities students gain knowledge on micro- and macroeconomics, basic innovation, marketing, industrial law studies, considering their expected jobs mainly in small and medium enterprises;

- the Vocational Core Studies imply the following main areas, according to the interdisciplinary character:

- science and technical design,

- industrial design, aesthetics, communication,

- economics, humanities, ergonomics, management studies.

The purpose of the subjects is through their store of learning to establish and support the projects of Integrated Product Development in practice, and also to support the communication, cooperation, the effective teamwork with co-professions, e.g. mechanical engineers, designers, technology managers.

- In the center of the Differentiated Studies, as in all directions of specialization, there is the series of Integrated Product Development projects in the case of the Product Design and Development Specialization. The projects, which are mainly built on economic and vocational knowledge, are aiming the integration and achievement of practical application of the studies according to the curriculum. The most important character of the major is the consistent achievement of the 'learning by doing' principle by the projects accomplishing the forming and developing of skills needed for the IPD through 5 semesters. The major maps the process of product development in a didactic way, and represents the most work in credit points. The complexity of the design tasks is getting higher from semester to semester, and in different semesters the emphasis is put on different elements of the innovation process.

By the above mentioned and the specific capabilities and potentialities of each institution the other subjects of the Vocational Core and the Differentiated Studies are supporting the characteristic, e.g. wood industry, silicate industry, etc. product design and development projects.

The studies of the Product Management Specialization are built on the formerly achieved knowledge of economics, management, marketing, and ergonomics, and the specialization deepens the knowledge of the students in human and organizational aspects of product development. Furthermore, workroom and exterior trainings, and the projects of the Integrated Product Development major help in developing the skills, which are necessary in a real company environment to manage the product development successfully, for the proper interpretation of the user information (interactions), or the practical usage of which might increase the competitiveness of the products.

The knowledge and practices of the Design Specialization support efficiently the aesthetical outcomes of the IPD projects.

As a result of the BSc level education on the three - Product Design and Development, Product Management, Design – specializations it is expected from the BSc graduates to be able:

1. to efficiently use the known analyzing, synthetizing, design and surveying techniques on their academic fields;
2. to critically analyze the arguments, assumptions, the abstract concepts and data, to form an estimation and assist solving complex problems;
3. to understand the concept of the work on their specific field in an unforeseeable environment, to have the ability and skills to describe and judge the special aspects of a given task;
4. to use the learned methods and techniques to revise, strengthen, expand, and apply their knowledge and understanding;
5. to initiate and carry out projects in teamwork, primarily in multidisciplinary environment;
6. to get information, ideas, problems, and solutions across both to expert and non-expert public, even in international environment;
7. to study, having the gained knowledge, further, at a higher level (e.g. MSc), to extend their learning.

Beyond the expectations above, they have the special competences of the Industrial Design Engineers, namely they are:

1. able to design a product at a relatively complex level, taking requirements of aesthetics, usage, market, durability, safety, and manufacturability, etc. into consideration;
2. able to define, document, visualize, and present the object;
3. able to reason the decision made in connection with the designed object, to test them, and to support them with results and methods of technology and applied scientific research;
4. able to analyze their design projects using design methods and to methodologically reason the applied routes;
5. able to elaborate a design project (planning, distribution of tasks, teamwork, cooperation, etc.);
6. conscious about the historical, cultural, socio-economic and industrial environment of industrial design and product engineering; and
7. able to incorporate the manufacturing aspects.

5 Conclusion

Due to the development on the fields of culture and technology, an evolutional change eventuated on the fields of design science and education, too. The change in design’s objects and resources, the satisfaction of requirements towards designer’s activities, the philosophy of the integrated product development, and the need of global computer aid for design and for virtualization caused a palpable paradigm shift in the education and the designer practice. The real accomplishment of the integration would need the methods and tools to be developed in an expedient way, would need the features of the design process to be analyzed further, and would need the education to be revised and modified according to the changing of the environment.

VIDOVICS, Balázs
Ph.D. student, Institute of Machine Design,
Budapest University of Technology and Economics
H-1111 Budapest, Muegyetem rkp. 3.
Tel: +36-1-4634081

e-mail: Vidovics.Balazs@gszi.bme.hu

BERCSEY, Tibor
Head of Institute, Institute of Machine Design,
Budapest University of Technology and Economics
H-1111 Budapest, Muegyetem rkp. 3.
Tel: +36-1-4631473

e-mail: Bercsey.Tibor@gszi.bme.hu