The 9th International Conference on Engineering and Product Design Education E&PDE07 was organised by the School of Design at Northumbria University, Newcastle upon Tyne in participation with the Design Education Special Interest Group (DESIG) of the Design Society and the Institution of Engineering Designers (IED), in collaboration with the British-HCI Group and endorsed by the Design Research Society (DRS).

This Engineering and Product Design Education conference has brought together representatives from education and industry who have an interest in shaping the future of design education. The conference provided a forum for educators and researchers from product development, engineering and industrial design, together with industry and government representatives to discuss current educational issues and the nature of design education in the future. The conference theme 'Shaping the Future?' provided the opportunity for participants to exchange ideas and build collaborative relationships.

'Shaping the Future?' may be understood in multiple ways, and authors were encouraged to present varied interpretations of the theme, by topic. Following an extensive review by the Organising and Scientific Committees a total of 99 papers have been included in this publication under the following topics:

The list of Proceeding Topics are:

Assessment
Creative Thinking
Curriculum
Design Motivation
Experiencing Design
Industry Links
Global Issues
Learning Environment
Learning Technology
Pedagogy
Responsible Design

Vital reading for educators and students of design from: industry, higher education, further education, schools and training establishments, 'Shaping the Future?' has provided an opportunity to share in the experiences of others, and makes an important contribution to the body of knowledge in design education.

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E&PDE07 Shaping the Future?

Erik Bohemia, Kev Hilton, Chris McMahon and Anna Clarke

DS 40

Shaping the Future?

9th International Conference on Engineering & Product Design Education
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Erik Bohemia,
Kev Hilton,
Chris McMahon
and Anna Clarke

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Institution of Engineering Designers
Courtleigh, Westbury Leigh, Westbury, Wiltshire BA13 3TA, United Kingdom
+44 (0) 1373 822801
www.ied.org.uk

The Design Society
University of Strathclyde, 75 Montrose Street, Glasgow G1 1XJ, United Kingdom
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Table of Contents

Chapter 6 – Learning Environment

Chapter 7 – Creative Thinking

Chapter 8 – Assessment

Chapter 9 – Learning Technology

Chapter 10 – Industry Links

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Foreword

Shaping the Future?

The 9th International Conference on Engineering and Product Design Education Conference was organised by the School of Design at Northumbria University, Newcastle upon Tyne in participation with the Design Education Special Interest Group (DESIGN) of the Design Society, the Institution of Engineering Designers (IED), in collaboration with the British-HCI Group and endorsed by the Design Research Society (DRS).

The call for papers resulted in receiving 157 abstracts from 231 authors who were from 29 countries. These abstracts were reviewed by the conference committee and authors of 140 abstracts were invited to submit a full paper. We have received 104 papers. These full papers were double blind reviewed by the International Scientific Review Board members. Finally the conference committee assessed and cross-checked the finally submitted papers with the recommendation from the International Scientific Review Board members.

The joint Engineering and Product Design Education conference series began in 1999 Glasgow. The event has continued on annually with conferences at Brighton (2000), Derby (2001), Coventry (2002), Bournemouth (2003), Delft (2004), Edinburgh (2005) and Salzburg (2006).

This 9th International Conference on Engineering and Product Design Education (E&PDE) conference has brought together representatives from education and industry who have an interest in shaping the future of design education. The conference provided a forum for educators and researchers from product development, engineering and industrial design, together with industry and government representatives to discuss current educational issues and the nature of design education in the future. The conference theme 'Shaping the Future?' provided the opportunity for participants to exchange ideas and build collaborative relationships. In keeping with the inclusive ethos of the E&PDE conference participation in the conference took a number of forms such as paper, poster, workshop and exhibition presentations.

We would like to thank a number of people who have been helpful in organising the conference and preparing this set of proceedings. These include the team from the Institution of Engineering Designers; Alison Parker and Nadine Pearce; Louise Taylor who created and maintained the conference website; Jamie Steane who encouraged his students to provide artwork proposals for this conference, Liam Connor whose design proposal was adopted; Tracey Urwin, Wendy Hutchinson and Suzanne Stelling who organised the local events; and every member of the International Scientific Review Board who provided their time and expertise during the review process.

On behalf of the Conference Organising Committee

Erik Bohemia
School of Design
Northumbria University, UK

they are often offered their first opportunities in management at the end of the KTP programme.

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Matthew LIEVESLEY
Northumbria University
Centre for Design Research, School of Design
Northumbria University, Ellison Terrace
Newcastle upon Tyne
United Kingdom, NE1 8ST
Matthew.lievesley@northumbria.ac.uk
+44 (0) 191 227 4128

EDUCATING DESIGN STUDENTS TO DESIGN RESEARCH FOR INNOVATION

Dr. Lucia Rampino, Dr. Matteo O. Ingaramo

INDACO Department (INdustrial Design, Art, COmunication and Fashion), Politecnico di Milano, Italy

ABSTRACT

The paper investigates the importance of creating a stronger link between University and Industry: this link should be based on companies' collaboration to both teaching and research activities.
The Research Unit ProgettoProdotto of the Indaco Department (Politecnico di Milano) has been trying to identify a systematic modus operandi to offer new knowledge to companies through Design Research. This knowledge is the result of a structured design research activity that uses a design process made up of phases based on multidisciplinary contents, research and design activities.
Such process was first developed within academic research activities; then it demonstrated to be very useful also in teaching activities, to make students better understand how action research can be a fundamental source of knowledge for an applied discipline as Design and how this research can have an important role in companies' innovation processes.

Keywords: Design Research, Product Innovation, University-Industry collaboration

1 INTRODUCTION

Considering both the turbulence and fierce competition of global markets and the reaching of a global equalization of New Product Development (NPD) processes quality, the authors assume that nowadays, in education activities, it is always more important to stress the important role of Design as an innovation driver in NPD processes.
The best way to make design students understand this role, not just in theory but also in practice, is via a direct collaboration with companies. Thus, the focus of the paper will be on the application of a process developed for Design Research to teaching activities in collaboration with companies; such application will be shown by a case history derived from the two authors experiences.

2 THE DESIGN PROCESS

Many are the definitions of design that underline its process nature. Bürdek, for instance, affirms: "Every design object is to be understood as the result of an evolutionary process whose course is affected by different conditions and choices, not only creative." [1, p. 118]
The term design refers therefore to a process that always has a tangible result (outlines, sketches, prototypes, a product, a logo, a graphic interface, a service....).

The aim of the designer is to explore, to experiment, to compare alternative solutions in order to choose the best; the ability typical of the designer is to give both sense and form to new ideas.
The starting point of every design process is the existence of a problem to be resolved through a project.
First of all, it is necessary to clearly identify the problem trough a research activity; once done, the designer follows a logical succession of steps. [2] Thus, the three-main phases of every design process typically are: Research, Concept generation and Concept development.
According to the authors, it is important for design students to understand the process nature of the design activity and to learn how to manage such a process, above all when the generation of an innovative product is their final goal.

2.1 Definition of a Design Research process

The Research Unit ProgettoProdotto has been trying to identify a systematic modus operandi to offer new knowledge to companies through Design Research.
The driving idea, at the base of RU ProgettoProdotto approach to Design Research, is that product innovation finds its natural cradle inside the design activity and that design, as an ideal place for experimentation, is a valid tool for reorganizing data coming from reality and obtaining new knowledge.
Regarding the importance of experimentation, Roberto Verganti says: "Experimentation is the engine of a process at elevated rate of innovation: for exploring innovative paths, for developing knowledge and for reducing uncertainty" [3, p. 170].
Thus, the RU ProgettoProdotto has defined a process to make aware, organized and systemic the creative approach typical of industrial design; the process proposes a possible solution to translate the bits of information related to complex and turbulent contexts (technical and socio-cultural knowledge), at first in aspects related to consumer needs (subjective aspects of knowledge), thereafter in knowledge inherent to the project (design knowledge) and finally in strategic knowledge useful for the enterprise to innovate [4].
Such process was first developed within academic research activities in collaboration with companies; then it was adapted to teaching activities, in the form illustrated in the following chart.

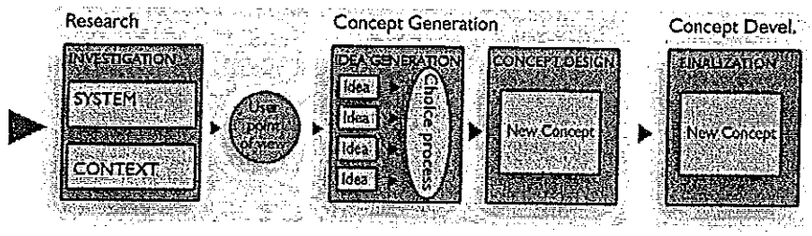

Figure 1. The design process

Every phase is explained to students as follow.

2.1.1 The Research Phase: to analyse the system and the context

The first step to be done when starting a design process aimed to obtain innovation is to understand both the industrial system in which we are getting in and the cultural context surrounding the product we want to innovate.
We intend the system to be "the industrial sector under study" (e.g. the household appliances field). Thus, students are asked to analyse the competitive environment of the company they are collaborating with.
At this stage, students should learn that every system has its own features; thus, if from one side there can be approaches valid for all the systems, from the other side there is always the need to adapt research tools to the specific product we want to innovate.
We intend the context to be "all elements that are not part of the system but still have a strong influence on the product we want to innovate" (e.g. if we want to innovate an oven or a refrigerator, the new feeding life styles are a fundamental part of the context).
Here, we want students to understand the importance of the cultural context that surrounds the product. In every culture, people have developed patterns of behaviour that are based on their experience and influenced by their environment: this means that within a culture, particular values are built into products without questioning. These implicit values are often the qualifiers according to which products are bought. As such aspects are implicitly expected, they may not be mentioned in traditional market research: it is so obvious that no one will mention it. But if not understood, they can prove to obstacle innovation [5].
We teach students that in order to define the context, it is necessary to identify the experiential universes to which a product belongs and to understand what influences its interaction with the user. Students are thus asked to identify and analyse real and potential product users referring to two categories: trends about life styles and consumption habits; daily and extraordinary situations of use.
The general aim of the Research Phase is to make students identify the main industrial, technical and cultural factors that influence the product they are asked to innovate.

2.1.2 The Research Phase: the User Point of View

Since we want students to understand that the distinctive feature of the design profession lies in the designer ability to analyse a product putting their selves into the user's shoes, we ask them to systematize the data resultants from the System and Context Analysis using the "user point of view" as a filter.
In other words, students are asked to tell (in a visual form) to both teachers and company representatives all the subjective and objective aspects that, according to them, characterize the user-product relationship in the different contexts in which such relationship can take place.

2.1.3 The Concept Generation Phase

At the beginning of this second stage, the challenge for students is to translate all the bits of information gathered in the previous phase in real innovation opportunities: "an innovation opportunity exists when what is currently on the market leaves a gap for the introduction of a product that is either new or significantly improved" [6, p. 9].
Students express the opportunities they have identified for the introduction of new products as a visual design brief, using pictures, sketches and images. In the brief, students are asked to declare their design intentions and expectations; then, they start generating a number of product ideas. Afterwards, during a "choice process" to which students, teachers and company representatives take part, the most promising ideas are selected; to each selected idea, a concept creation will correspond.

At the end of this phase, every student (or group of students) presents to both teachers and company representatives a product concept that is their creative interpretation of the analysed issues.

2.1.4 The Concept Development Phase

In this final stage of the design process, students are asked to translate their concept into a feasible industrial product, deepening both the product's aesthetic and the technical aspects. What we do ask at the end of the process is a final design, with both mechanical drawings and photo real renderings. Again, the final design is presented by students to company representatives, simulating a real professional relationship.

3 THE ROLE OF THE RU PROCESS IN NPD PROCESSES

The approach we teach to students has been elaborated starting from the state of the art about both Design and NPD processes and it has been constantly updated thanks to the interaction with companies.
We want our design students to learn how both design research and design activities can contribute to each phase of the NPD process; thus, we present to them a standard NPD process, which identifies three main stages: Product Planning, Strict Development and Realisation [based on 7].

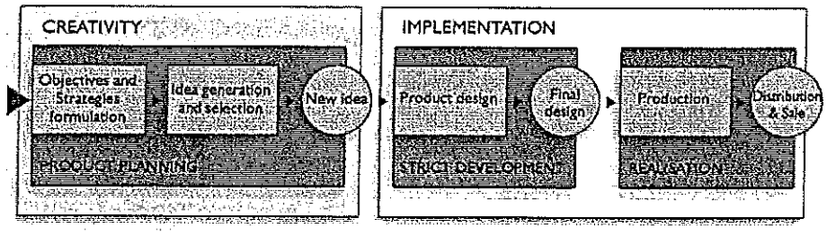

Figure 3. The standard new product development process

In order to achieve a product innovation, the Product Planning phase is the most critical one: this is the Creative phase, where creativity is intended as the act of coming up with new product ideas. According to our research experience, the design activity is generally not involved in this phase: its role is typically relegated in the Strict Development phase. Instead, we firmly believe that design should be a part of the Product Planning Phase, with the same role of the widely used strategic marketing tools. What design can offer to companies is the definition of a new idea, namely the definition of a clear strategic direction to follow in order to generate innovative products: "The development of product concepts is surely the most effective tool for envisioning the future and gaining reactions from other departments in the company and outside markets." [2, p. 255].
Moreover, the early visualization of new product concepts, allows the partner company to experiment and, by doing this, to deeply understand the nature of the innovative problems and to solve in advance the elements of uncertainty related to every NPD Process [2].

4 CASE STUDY: BRICOASPIRA VACUUM CLEANER

Students: Riccardo Colombo, Matteo Moroni, Alberto Zuchelli
Course: Design Workshop within an Industrial Design Master Course
Academic Year: 2004-2005
Company: Polti

Bricoaspira is a concept developed by a group of three students in collaboration with Polti, an Italian manufacturer of small household appliances.
Polti gave to students a starting brief, asking them to develop a vacuum cleaner for the do-it-yourself people. The students performed their Research Phase analysing all the categories of vacuum cleaners already on the market, with their pros and cons, and gathering the main technical information (they focused on the different suction and filtration systems, but analysed also the materials and manufacturing processes of both the functional and aesthetic product parts); then, they performed an analysis of all the unconventional places where vacuum cleaners are used (cars, garages, potting sheds and so on) and the kind of dirt they are used for (dust, filings, cobwebs and so on).
At the end of the Research Phase, in accord with the company, the students decide to focus on a vacuum cleaner to be used in garages, with a set of specific accessories for the do-it-yourself needs and for cleaning cars.

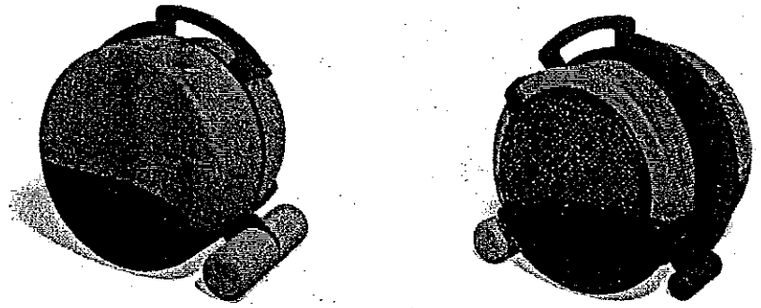

Figure 4. The two main views of the BricoAspira vacuum cleaner

Thanks to this design experience in collaboration with Polti, the students understood two important reasons why is important to perform a structured and exhaustive Research Phase.
The first reason is that the gained knowledge gave them the possibility to collaborate with the company to better pin the design brief down.
The second reason is that gaining a good knowledge of the product's System and Context helped them to be more creative: in fact, any creative process, even when it seems coincidental, is based on a deep knowledge of the issues faced and is always an extension of what is already known [9].
The aim of Polti, in collaborating with these three students was to explore an innovation opportunity that the company had been thinking about for a while but without having enough human resources to really invest and experiment on it.
In our experience, this is often the case when a company agrees to participate into teaching activities: to explore new product ideas that are non-overriding in the company agenda, but still can become interesting innovation opportunities.

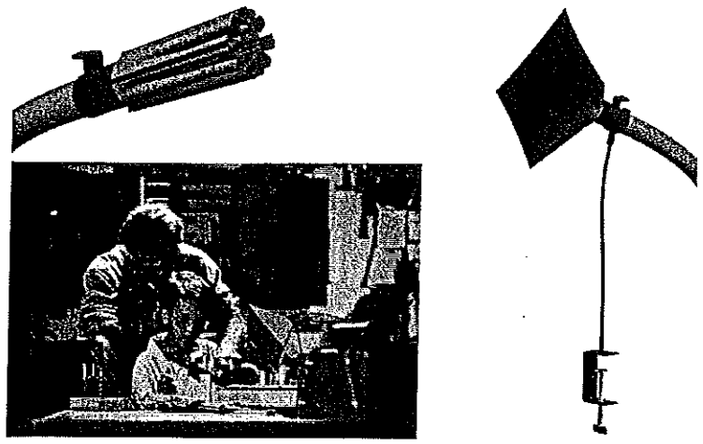

Figure 5. One of the accessories for the do-it- yourself

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[1] Dr. Lucia RAMPINO
Politecnico di Milano
Via Durando 38/a – 20158 Milano - ITALY
lucia.rampino@polimi.it
+39.0223995986

[2] Dr. Matteo O. INGARAMO
Politecnico di Milano
Via Durando 38/a – 20158 Milano - ITALY
Matteo.Ingaramo@polimi.it
+39.0223995980

INTERNATIONAL CONFERENCE ON ENGINEERING AND PRODUCT DESIGN EDUCATION
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FORECASTING OF INDUSTRIAL NEEDS AS A GUIDELINE FOR ENGINEERING EDUCATION

Ryszard Rohatynski
University of Zielona Gora

ABSTRACT

The demands set to the engineering designers nowadays have been discussed. After the world industrial trends and foreseen developmental industry tendencies have been presented, the forecast of demands for engineering design are formulated. The questionnaire example for identification of the industrial needs and a matrix for evaluation of correlation between the contents of design science and industrial needs have been shown. The need for taking into account future industrial needs in education of engineering designers has been emphasized.

Keywords: Engineering design, requirements, engineering education, technological forecasting

1 INTRODUCTION

Modern education of design of machines and mechanical devices should prepare the future engineers to work in a production enterprise operating in conditions of sharp competition. The principal condition of the success of the enterprise is ability to design the products which, at the outside, cover the market requirements, the products with the bottom line, manufactured within a short time. Without a properly prepared engineers the manufacturing company, sooner or later, will stop to exist as a competitive one.

The present education process at the mechanical faculties (from the Polish perspective) does not ensure the graduates the knowledge and skills which are necessary to undertake innovative tasks in engineering design. Among others, students do not familiarize (or do insignificantly) with the principles of design for all the product life cycle ('design for life'), with multi-aspect design ('design for X'), as well as with methods of 'concurrent engineering' and with the principles of team collaboration.

In particular, in the process of design of a product, an engineer ought to cover:

(1) Current and predicted market requirements, as well as obligatory to particular product class formal canons ('product design');

(2) Realization possibilities of the production system, where the design will be realized ('design for manufacturing');

(3) Requirements of the assembly process ('design for assembly');

(4) The need to provide the product with required values of its features ('design for quality', 'quality function deployment');

(5) Necessity to minimize financial input to activate the production.

Basic problems of mechanical engineering industry are: improvement of manufacturability, reliability and ability to repair (serviceability) of machines and mechanisms. Assessment and evaluation of reliability of mechanical devices, seems to