

# **A MULTIDISCIPLINARY APPROACH WITHIN DESIGN AND ENGINEERING COURSE - THE POLITECNICO DI MILANO CASE STUDY**

**Serena Selva, Marina Carulli**

Dipartimento INDACO, Politecnico di Milano, Milano, 20158, Italy

## **ABSTRACT**

The findings emphasized by this paper are posited on the multidisciplinary design teaching, in particular about a method used within the Politecnico di Milano, Facoltà del Design, Inter-Faculty MSc Degree Course in Design&Engineering (D&E).

The new awareness of the importance of knowledge of the years when the Faculty of Design was born, was one of the crucial elements of the productive system, together with the reassessment of business organization [7], [14]. Consequently, the University was forced to reconsider knowledge conveyance, that doubted the potentiality of the “deductive method” and considered the new “inductive method” [4], [11].

The paper will further describe the new Inter-Faculty MSc Degree Course in Design&Engineering, that was born in 2004, with the idea to form designers able to solve technical problems of medium-high complexity products/projects.

The MSc Course in D&E is the only Design Course at the Politecnico di Milano structured including the participation of students and teachers from 3 faculties (Engineer Industrial Process Engineering, Industrial Engineering and Design) and for that the students have to attend a specific educational ground to uniform their knowledge [9], [12]. The heart of D&E course, as the other Design faculty courses teaching structure, is the Industrial Design Studio based on the idea of “learning by doing” [6]. In this case the Design Studio is structured to help students to manage the resources of different knowledge typologies, this peculiarity will be described by analysing the aforesaid idea.

*Keywords: multidisciplinary teaching, design engineering, teaching processes*

## **1 INTRODUCTION**

The nature of Italian products has mainly contributed to the success of the Made in Italy, but the product is merely the output of an original industrial structure. Italy differs from other European countries which demonstrate similar economic development: whereas many countries have established a production system based on large scale industry developed along the path of economies of scale, standardization, and serialization, Italy has been different. The reasons for this difference can be related to the handicraft shop tradition, typical of the Italian economy until the post-war period, in which a shop started to expand, eventually becoming a small 'firm' under family management. These firms were characterised by high specialisation in several production divisions, peculiarities that brought a production cluster, within an area, success, but which proved reductive if they were not linked to other

specializations/production systems. Due to this behaviour, networks of firms emerged, combining several specific competences to obtain highly innovative products.

The traditional handicraft skills have also required a high specialization, so the development of the Italian handicraft culture, the raw material requirements of which has led to geographic clustering in specific areas, has resulted in the development of certain specialized sectors, which subsequently turned into industrial sectors. (Maffei, and Simonelli 2002). After the post-war period the kinds of goods requested related to both personal and household products, such as furnishing and household appliances, fashion and especially footwear, clothes, and transport. These products, characterised by the evident relation between project, technique and production, arose and developed in industrial contexts with different production and market structures. In Milan certain specific production areas developed and this development accounted for the existence of a furnishing module at the Faculty of Architecture in Milan in 1950, the same period in which the Italian education system first began to think about design teaching. From that point Milan has been at the forefront of industrial design teaching in Italy (Bertola, P., Sangiorgi, D., Simonelli, G., 2002). As years went by, the exigency to train designers for industry was a consequence the first design module came out, and they were called 'Artistic design for industry'. This name was probably due to the planning/design, which derived both from a technical/industrial context and from an artistic movement, the Rationalistic Movement. Such relation belonged to the 30s, a period in which some Italian architects realized the existence of a discipline with its theory and the interactions between art and industry. In Milan it was necessary to train designers able to interact in the relation between 'artistic culture' and 'industrial culture' existing in Italy. According to the method of the above-mentioned module, the students of Architecture Faculty were not trained as industry managers, because it was crucial to let them understand the process through which the designer's creativity was linked to opportunities to make it real, as in that period (the 60s) facing the rooting of industrial culture was necessary. This concept was strongly emphasized by one of the first teachers of design at the Politecnico di Milano: Marco Zanuso that started as an architect, later he had to do with design and became one of the founders of the 'Made in Italy'. The ideas of this designer have emphasized into the Politecnico di Milano an unofficial method of teaching design within the modules of the product design, based on the concept according to which a design activity cannot be direct and individual, as it happened in the 50s, creativity could not be conveyed only through the isolated wit of an artist or an artisan, not through the direct interaction between material and content, workshop and production. Since the second post-war period the design activity has changed, it has been characterised by a greater amount of data and knowledge, where the usage of materials and speeches for the ideational and practical management and control are crucial. So the teaching in Italy was focused more on that stage between the planning and the execution of a process than on the design subject. This thought helped the students to understand what happens when they plan, emphasizing the concept according to which 'making a plan' means 'manage a process' and not 'to do a drawing', as this is only a mean of communication towards the client and the intermediate interlocutors (Zanuso idea in the 70s). Analysing the teaching approach used within the Design Studios (70s and 80s) and the stages faced by a student to reach the task of a project, it's possible to understand the reasons for some choices, both structural and methodological, used today within Facoltà del Design at the Politecnico di Milano. The used teaching approach stressed that theoretical contents - for example, previous similar projects to the brief introduced to students, properties of materials -

should be compared with the practical technical knowledge. In detail the above-mentioned approach has never been applied until the 80s by Italian University - but also most of European universities - as it used a teaching approach called 'deductive'. In this case training was seen as an orderly systematic process in which theoretical contents, knowledge, were the basis of a process of training and they were thought before practical technical contents, the know-how, considered as a consequence and left at the end of this process. In most of disciplines this part was faced when the trainees started work. The clear division between "knowing" and "knowing how to do" and the sequence of stages reflect the arrangement of production sector, typical of Italy until the 80s, characterised by a strong top-down business administration, a strong division in the distribution of tasks, a distinct individuation in technical management and administrative roles. It was at the end of this decade that this organizational system showed its frailties, so a reassessment of the business system, in which roles and tasks have been modified, hierarchies have been simplified and processes streamlined was necessary. Through this conversion manpower and knowledge were considered as a distinguishing mark, as a consequence not only of the opportunities to enter the market and to find material goods. The new awareness of the importance of knowledge, as one of the crucial elements of the productive-economic system, together with the reassessment of business organization, made the University reconsider knowledge conveyance so much, that it doubted the potentials of the 'deductive approach' and it considered a new one, the 'inductive approach', as it is called now. This approach supports the parallel between "knowing" and "knowing how to do", theory and practice, consequently it connects the two different sources of Italian design: art and industry (the former is certainly based on theory and history, the latter on knowing how to do). Tasks derived from teaching through an inductive approach join these elements in order to let the new designer to grasp features of Italian design (Penati and Seassaro 2000). Being aware that knowledge was becoming a crucial element within industry, in the 80s it was necessary to separate the discipline of industrial design from architecture, to subordinate industrial design to requirements and schemes of industry.

## **2 POLITECNICO DI MILANO - FACOLTÀ DEL DESIGN: MAIN FEATURES**

The first Master degree course in Industrial Design was launched in Italy in 1993, joining key elements of the faculty of Architecture (centred on an artistic point of view) and Engineering (centred on a technical standpoint), in which the training process was inductive. The inductive process is considered crucial and this is mainly due to the existence of teachers within the Faculty conveying the knowledge, businessmen and visiting professionals conveying the 'how to do'. The choice of having 3 different figures (academic lecturers, professionals and entrepreneurs) as lecturers makes the student's journey to the outside world different from an academic context, providing them with the necessary skills and competencies to enter in industry. (Bertola, Penati, Seassaro 2001). The courses are numerous and they meet the needs of Milanese industry as it was for the first courses at the Faculty of Architecture. The Master degree courses that take place today are Product Design, Fashion Design, Interior Design and Communication Design together with the recent Design & Engineering. Each course has its own training program but the structure is the same and the subjects involve some specific tasks of practice, considered as the teaching centre at the Faculty: "knowing" and "knowing how to do". Students attend courses characterised by knowing, as they are characterised by theoretical contents, like Mathematics, History and Marketing

called Thematic Courses and others focused on both the area of knowing and knowing how to do, offering the overviews of ample issues that play a particularly important role in the contemporary context. They cover more than one discipline or specific context and this is the reason for calling them Integrated Courses like “Technology & Environment” or “Society & Communication”. This teaching approach establishes some project activities for students, who conduct activities both to familiarize with the tools of design as in the case of Drawing and Visualization Studio and the Computer Graphic Studios, and to learn professional routines as in the case of Design Studio.

### **3 THE MASTER DEGREE COURSE IN INDUSTRIAL PRODUCT DESIGN AND ENGINEERING**

“European industry and in particular Italian industry is facing a particularly critical moment in its evolution: it needs to remain competitive compared to low labour cost countries by introducing more design, technology and sustainability in traditional products and in production processes. Educational institutions are faced with new challenges as growing competitiveness, market globalisation, rapid technological evolution and consequent rapid product obsolescence, etc. The Italian small and medium-size industry system is today in need of professionals with the skill to combine the heritage from the past with the most evolved sources of scientific culture and research” (Facoltà del Design 2005). To meet this emergent need of Italian industry system in 2004 was created the Inter-Faculty MSc Degree Course in Design & Engineering (D&E) within the Politecnico di Milano. In this crucial period of important changes, in fact, industrial designer’s figure is no more only manager of a limited part of the concept generation process, but is becoming a figure capable to manage every phases of industrial product development process. The shift and the extension of industrial designer’s area of expertise has led to modify and amplify his typical knowledge, above all about technical knowledge useful within the development process and engineering phases. “These graduates are designers capable of combining design and product engineering innovation with the needs, potential and constraints of the economic, social and market situation.” (Facoltà del Design 2005)

The formative objective of the Inter-Faculty MSc Degree Course in D&E is, consequently, to form professional figures capable to manage every phases of the industrial product development process, from concept phase (Design) to engineering phase (Engineering), in order to manage independently the process, maintaining the possibility and the capacity of relating himself with different area experts.

In order to obtain this goal the Inter-Faculty MSc Degree Course in D&E was born by the integration of three of the Polytechnic Faculties: Design (that is the promoter and has the role of manager), Industrial Process Engineering and Industrial Engineering.

The involvement of these three Faculties at this MSc Degree Course is characterized of three different contribution levels:

- curricular and disciplinary planning, through the analysis of companies’ needs and in order to reach student’s complete education and training;
- active involvement in the didactic activities, both within monothematic courses and design studios;
- involvement of students derived from Bachelor Course of every of the three Faculties.

This peculiarity requires that the first propedeutical semester, at the beginning of the educational career in D&E MSc Degree Course, is devoted to uniform students’ typical knowledge. For example, one of the most important difference among students is about

knowledge and skills: usually designer's role is closer to the conceptual design stage, while engineer's role is strongly linked with the product development phase. This division, even if not rigid and precise, indicates planning's areas of the two different figures and is linked with their typical knowledge. Designer, working about conceptual stage, is usually focuses on "system's architecture" and "core concept", that is "developed during conceptual design and fundamentally differentiate one product form other competitive products." (Ulman, 2003). Engineer's role, instead, is more focused on product behaviours and features, and for this reason his work is closer to the product development phase. The authors highlight that the attempt of this first semester is not directed to eliminate students' specific characteristics, but aims to improve them providing new, supplemental stocks of knowledge. At the end of this first semester the students chose among three different specializations, that partially characterize their educational careers. The authors define this characterization as "partial" because only some courses (usually monothematic) are differentiated by specializations, while Design Studios attended in the two years of the MSc Degree Course are common and integrated for all specializations. Another moment during which the specialization can be influential is the graduation thesis, that can be, although not necessarily, dedicated to student's specialization. The three specializations are:

- "Virtual". The objective of this specialization is to provide appropriate methods and instruments to manage design process of industrial product and building its digital prototype meant as simulation of reality in all its aspects (aesthetic, functional, structural).
- "Manufacturing". The objective of this specialization is to provide methods and techniques to manage and build the value chain relating product research, industrial innovation, product life cycle and related processes.
- "Materials". This specialization aims to train professional designers with specific competences in the area of materials and surfaces. The graduated from the master will strongly know the physical, mechanical and chemical characteristics of materials relating to different applications. They will be able to apply materials managing all the perceptual and sensorial qualities required in a product.

The heart of Design & Engineering course, as the other Design faculty courses teaching structure, is the Industrial Design Studio based on the idea of "learning by doing". In this case the Design Studio is structured in several modules, each of which comes from a disciplinary area and is linked with the Studio topic, that usually is a medium-complexity appliance. In the Design Studio the design teams, composed by three-four students and in which engineers and industrial designers are mixed, are faced with a complex project, that have to be developed from conceptual to engineering phases. In particular, from the process definition phase the Design Studio becomes as a simulation of the typical professional process, because it is structured with a main module (about design disciplines) and other linked advices from the engineering disciplines (about virtual, material and manufacturing areas). These modules are available for every design teams, without differences between students' specialization, and led the students to manage the resources of different knowledge typologies within their projects, comparing their decision about the project with the technical issues derived from company's parameters.

In particular this is the main feature of D&E MSc Degree Course compared to the other Design Faculties MSc Degree Courses, because the typical design knowledge and experience are integrated and improved by engineering contribution, enabling students to interact with technical issues. In fact, these experiences form a deeply stock of

knowledge, enabling the graduates in D&E MSc Degree Course to manage projects with high-medium complexity, facing their selves with experts of several technical areas and acquiring skills useful at the integration in companies' typical structures.

#### 4 CONCLUSIONS

This paper discusses what occurs within the MSc in D&E in the Politecnico di Milano and in particular within the Design Studio integrated in the Course. In detail the authors intention is to understand the approach differences between the Course in D&E and the other Design Courses in the Design Faculty. They understand that the main difference is the relation between the modules and the Design Studio because in the firsts design Courses, born in Politecnico di Milano before the D&E Course, the Design Studio was (and today is exactly in the same way) at the end of a didactic process where the modules were the support for it but there was not a connection and a knowledge exchange between them during the project development.

Instead in the D&E Course the Design Studio is the heart of the didactic process where there is a continuous knowledge information exchange and a structured connection with all the modules and the Design Studio. In this way the D&E Course has a multidisciplinary approach because it links a number of different disciplines that have to "speak" between each other in particular during the project development within the Design Studio.

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Serena SELVA  
Politecnico di Milano, Dip. INDACO, UdR  
ProgettoProdotto  
Via Durando,38/a-20158 Milano-Italy  
serena.selva@polimi.it  
+39 02 2399 5933

Marina CARULLI  
Politecnico di Milano, Dip. INDACO, UdR  
ProgettoProdotto  
Via Durando,38/a-20158 Milano-Italy  
marina.carulli@polimi.it  
+39 02 2399 5933