ADVANCED TEACHING IN DESIGN

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ABSTRACT
The world socio-economic structures are going through some radical changes. In parallel we witness an exponential growth of technology. In this contest, design and design education are undergoing an impressive evolution process. The paper focus to the components that are acting as major elements of change (e.g.: open source design, self-fabrication, knowledge integration, remote teamwork, etc.). The paper aims to document what the School of Design at Politecnico di Milano is doing in order to face these changes. A description of third year Laboratories will be provided. Moreover, essential requirements to fulfil, in order to achieve a Design Bachelor's Degree at the Politecnico di Milano, will be described. The School of Design has financed a base research program on auto-production. Goals and organization of the research will be shared in the paper. Open questions for discussion are: how to update teacher's knowledge regularly and how this process could become a standard procedure in design education.

Keywords: Design, education, future, advanced, teaching, Politecnico di Milano

1 INTRODUCTION AND SCENARIO CONTEST

The development of human civilization is showing its limits. The issue of the environmental question was precociously brought to international attention in 1972 by the Club of Rome's analysis, titled Limits to Growth [1]. Today we are facing serious environmental crises and we put in danger the natural resources of the planet [2]. Ray Kurzweil has predicted [3] in the next thirty years overtake of artificial intelligence over human mind. To keep the process under control recently philosophy professor Huw Price, cosmology and astrophysics professor Martin Rees and Skype co-founder Jaan Tallinn, have formed the Centre for Study of Existential Risk (CSER) at the University of Cambridge, UK. They will study key developments in technology, assessing extinction threats to humanity.

1.1 Collective intelligence

Since 1990, Pierre Levy, a most brilliant "media philosopher", worked on the idea of collective intelligence. He gained popularity since he published a book on the effects of Internet wide spreading on human society [4]. The wide use of digital technology and the interconnection of computers worldwide for Levy is a favourable area for collective intelligence. It improves the sharing of mental abilities, imagination and skills that allows people to collaborate, to work and learn together.

2 EVIDENCE OF CHANGE

Overcome crises threatening human existence is a common worry. A worldwide movement based on *degrowth* [5, 6] of western civilization is radically changing our perception of future development. Serge Latouche is proposing an exit from consumerism [7], Maurizio Pallante describes degrowth as a positive process [8]. There is a need for rethinking about mankind activities, from major economic and political issues to simple questions, such as planet preservation, waste management, pollution prevention.

2.1 Third Industrial Revolution

We need clean and free energy. We need to share and collaborate rather than compete. Promoting his view on how we will be able to stop our decline and the possible end of our civilization, Jeremy Rifkin in his 2011 book [9] proposes an alternative way to manage energy. He imagined millions of people self-producing green energy on their homes, offices, and factories, and sharing it in a global energy internet. Vehicles will be moved by electric engines, powered by the new solar energy-net. He

describes how the Third Industrial Revolution will impact the way we run business, we govern society, we educate children, and participate in social and civic life. This will give thinkers and designers new perspectives to think about: working habits, product uses, social attitude, will drastically change. Design, designers and design education will adapt to follow this evolution.

2.2 Open source design

We already see consistent signs of this change. Net-working is more and more present in our daily activities. We collaborate on line to develop open source software. We can find for sale a complete car designed with the contribution on line of designers, engineers and technicians [10]. Clients are invited to build the car themselves at the company site in two weeks. Complete and incomplete projects are available on line for public reuse. This means that designers can work on existing projects. It is possible to improve someone else's work and make it available to others. This of course poses radical questions about intellectual property, labour retribution and legal responsibility.

2.3 New copyright protection

About private covering of rights related to a commonly developed object or to materials been published on the internet, Lawrence Lessig has started to imagine new forms of protection. Ten years ago Lessig, at that time law professor of Harvard University, founded Creative Commons [11], a worldwide organization destined to help share knowledge and creativity dealing with a strong interaction tool as the Internet. Creative commons give individual creators, as well as large companies and institutions, legal protection tools that makes creative, educational, and scientific content compatible with the use of the Internet. This will create a pool of content that can be copied, edited, remixed, and built upon, under protection of copyright law.

2.4 Personal fabrication

Other forms of networking have been created focusing on the execution of tasks related to design development. FabLabs [12] are an example of fabrication laboratories diffused around the world and interconnected to operate jointly. Their goal is to prototype and to build any working machine or product, tailored on specific uses. Neil Gershenfeld [13] started the FabLab program at the Media Lab of Massachusetts Institute of Technology (MIT), in collaboration with the Grassroots Invention Group. Target of the study was: how the content of information relates to its physical representation, and how a community can be powered by wide spread technology tools. A FabLab is a small scale workshop specialized in digital fabrication. It is generally equipped with an array of flexible computer controlled machines that cover several forms of application, with the aim to build "almost anything". This allows the construction of highly technological products generally perceived as limited to mass production. The concept of personal fabrication empowers individuals to create smart devices for themselves, giving anyone the possibility to create products with eventually the on line contribution of others.

2.5 Makers

More and more "makers" are creating, building, reusing, sharing, and selling new products. The maker is a new emerging character and has been identified and described by Chris Anderson in his last book [14]. In his text he describes the radical changes that product manufacturing is undergoing. Makers have the ability to dismantle, adapt and reuse components of existing products. They will not be in competition with large scale industry; they will rather cover the request for customized and small series products. There are also sites where it is possible to present a creative idea and ask for a financial contribution, starting from a few coins up to a real partnership in the project [15].

3 EVOLUTION OF DESIGN PRACTICE

All mentioned activities are related to design, but they require integration of knowledge from different fields. A whole new way of designing and producing is taking shape. New forms of collaboration on line are organized and run by remote team work. The concepts of open source design and open source innovation are increasingly present. Design used to provide formal ideas and designers had to rely on technical offices to be able to carry on complete projects. With time, designers work grew to become supplier of the complete design process, including technical drawings, 3D modelling and finished virtual surfaces. More recently design professionals have also developed concern for the strategic aspects of product development. Design is increasingly participating in marketing related activities,

definition of commercial aspects, brand value transfer, technical opportunity choices, etc.. The competence of designers now it is extended from the identification of a good idea to the research of new ways to sell a product. Undoubtedly we assist to a massive growth of the design profession, the designer role and, accordingly, of the parameters on how design practice must be taught.

3.1 Teaching praxis at Politecnico di Milano

Prerogative of the Politecnico di Milano [16] is "poli-technicity". At the School of Design [17] teaching work is based on multidisciplinarity and the organization criteria of III year Laboratories follows this principle. They are finalized to prepare perspective bachelor graduates to their thesis work. We proceed along steps, here described by development phase content and relative final output:

DEVELOPMENT PHASE	OUTPUT
Analysis of possible contexts	Decision of the scope of the project and partner identification
Pre-project planning	Mission statement (briefing), statement of intent and P.E.R.T.
Analysis of the existing	Goals specification
Generation and selection of hypotheses	Brainstorming results and concept identification
3d testing (mock-up)	Definition of project details, dimensioning
Product pre-engineering	Materials and technologies of components parts
Representation of the final product	Sketches, drawings, physical and virtual models
Final presentation	Communication of competitive advantages
Research and industrial partner definition	Possible prototype construction and testing
Testing with users and institutional partners	Possible adjustments, debugging and tune-ups
Thesis preparation and drafting	Summary of the design process

We consider these elements essential for the innovation process. It is indispensable to own a variety of competences to properly face the execution of these development phases. Most relevant are at the beginning of the project the application of principles of strategic design finalized to focus on the meta-project and the acquisition of data to identify more precisely the final goal. To better define content, the following list shows in detail the activities to be performed:

- Project setting and pre-project planning
- Brief definition, briefing mission, statement-declaration of intent
- Contextual analysis set up
- Definition of market opportunities, breakeven point and brand values
- Preview of amount of units foreseen for production
- Analysis of leading companies market position
- Check positioning of competitors for the specific product

In the phases of product definition, we have improved the definition of processes, production methods and product performances. These are the major steps:

- Definition of the elements of the product as a system
- Identification of product materials by component
- Performance goals definition
- Defining of chemical and physical properties
- Modes of assemblies design

In terms of human interaction, we keep in strong consideration the following factors:

- Interface design and product identity communication
- Investigations related to final users
- Dimensional factors, anthropologic and ergonomic studies
- Verification of the suitability of target anthropometry
- Biomechanical testing
- Qualitative factors definition

- Analysis of usability needs and interactions
- Cognitive and ethnographic identity definition

At the end of the Laboratory, a project report is presented and structured in major areas of distinction:

- Contextual analysis, commercial sector, reference products
- Design requirements (Briefing)
- Concept description
- Project execution, morphological and functional refinement
- Visual representation of proposals (physical and virtual model, sketches, technical drawings).

This material, prepared for the end of the Laboratory, will be integrated by a detailed description of product development process:

1. ***PERT execution.*** It provides the development of a Gantt diagram finalized to project planning, including timing and deadlines, for the thesis work delivery. Here are also considered economic feasibility of the project, any external support, and the way to manage planned activities.
2. ***Relationship with external companies, building of models or prototypes,*** essential for completion of the model or prototype to be used for testing. Production prospects, agreements with partners and test users protocol with evaluation indices, have to be defined.
3. ***Testing, test users, patents.*** To be completed jointly with tests execution on the field and final validation. If there is a need to patent any of developed products, submission of complete documentation will be required.
4. ***Delivery thesis texts***. The texts must be paginated according to the template provided. It should include all phases of the research as described above.
5. ***Final delivery.*** Revision of all the material prepared for the thesis and optimization of the presentation. Search for any shortcomings and the need for any additions.

4 PERSPECTIVE VIEW OF FURTHER DEVELOPMENT

From this description it is easy to deduct how students are engaged in problems related to product industrialization. The sequence of phases and the required knowledge goes along with the tendency of design profession to encompass several activities directly related to product development and production. To improve our own awareness and to update learning opportunities, the Design Department of the Politecnico di Milano, have financed a "pure research" program on this subject. The project aims to explore the role and potential of design (and research design) in a new emerging production scenario in which the new practices of making and "fabbing" interact with the worlds of industry, crafts and self-handling. Research has been divided into two main areas:

1. ***Relationship between design and new construction technologies***, aimed at focus new design processes and new technologies for representation, production and distribution.
2. ***New models of relationship between design and production in traditional and emerging networks.*** Searching new collaborative processes and new connection services between design and business. Identification of new places for design and production in urban areas. Preset goal is the creation of a network of international research. Networking activity will be carried on connecting with national and international networks of FabLabs, maker labs, universities and design factories, the main community for open design, research centres, and centres for urban manufacturing.

A first output will be the organization of a series of meetings, presentations, seminars and the connection with other academic conferences, providing the opportunity to enable a multidisciplinary debate. The themes will focus on issues of interest on an epistemological, phenomenological and methodological point of view. Specific objective is the identification of areas of experimentation that can be implemented in the proposed research. A direct experimental test to verify new modes of connection between design research and production networks with two types of initiatives: a study on making (Make Session), to define how design relates to the world of production, test fabrication processes changes and identification of specific places and technologies, and a temporary laboratory of making (Make Lab), as alternative resource to departmental laboratories, in reference to the world of production. This will experiment new creative-productive praxis with researchers, technicians, craftsmen, technology manufacturers and designers. A publication activity focused on the development of two instruments:

1. A site/blog for the enhancement of research and networking, and for sharing documents related to seminars and tests, collection of case studies and creation of on-line survey;
2. A scientific periodical (magazine/bulletin) for publication of articles on the subject and open to participation of the scientific community. Some issues and problem areas identified by the Make Factory could be presented at international conferences as Crafting the Future [18].

5 CHANGE OF DESIGN TEACHERS ROLE

Well, until now we have made a remarkable change since design teachers were teaching how to carry on projects through sketching, drawing, modelling and the use of basic artistic and technical tools. Designers are now dealing with product development issues, strategic design and market placement.
Our third year courses are organized in form of interdisciplinary labs. At present we have oriented student work at creating useful devices in the medical sector. We have established a connection with five partner hospitals. A number of doctors came to pose questions and problems asking for substantial answers. Students produced about fifty solutions to be scientifically validated. Proposals were to be approved by doctors and tested on the field with patients by specific protocols. About 10% of the projects are now in the process of being patented. I was responsible of the group of teachers composed by a bio-engineer, an ergonomist, an expert of materials and technologies, an expert of user requirement detection, and a designer with experience in the medical field. Students were in the situation of running their projects as entrepreneurs. Once testing in the Hospitals had been completed, they had to search for an industrial partner in order to organize production of their products. We have forced them to practice professional independence. This anyhow is only half way through the process. Nowadays, other than identify a final utiliser, an industrial partner, an interdisciplinary development team, consultancies for patent certification, designers have to deal with prototype construction, self-production, and product placement on the market. We are making visionary designers to become competent inventors, innovators and makers, providing them with all the information that allows them to compete in the world of product design. The outlined scenario, which consist in an advanced form of design teaching, brings me to the conclusion that also teachers have to adjust and grow themselves constantly. Their role has to grow intensively in parallel with the growth of the discipline and the design professional requirements. A few facts are giving us useful indications. We witness in several Universities the Integration of knowledge fields. The basic form of aggregation is where design, engineering disciplines and project management merge in a single institution (Aalto University is a typical case). Networks among institution are more frequently established. The use of English language is becoming really common among the most prestigious schools. In Brussels, February 2010, EURASHE - The European Association of Institutions in Higher Education(1) has issued a document about future visions and strategies, titled “10 Commitments for the EHEA in 2020”. The fourth point, about education, research and innovation, indicates clearly the direction to follow: “We do see, however, a continuum between academic, professional and vocational teaching and training; and similarly we see a continuum between fundamental research, innovation and applied research”. And a few lines further: “Our vision for 2020 is that a greater balance has been established among the different sectors of Higher Education between teaching and research through the instruments of innovation; that academic and professional sectors have developed the means to make use of their complementary assets”; Moreover they state that the learning society in a globalized world requires a number of competencies that are universally accepted, such as “the ability to learn how to learn in different formal and informal settings, including autonomous learning processes with adequate support and guidance structures”. The new form of design education shell incorporates several factors. The challenge now is to integrate knowledge of different disciplinary fields, integrate teaching activity with research projects, and integrate University output with market (or better, users) needs. About the change of the teachers role in this changing context, Pierre Levy, in a published interview(2) explains how the diffusion of the Internet has radically changed the dynamics of the learning process: “Today, with the phenomenon of global interconnection of computers, with the accessibility of information online, you can get in touch with specialists who are on the opposite side of the planet, you can enter in virtual communities of people who are interested in this or that subject: the research community, learning community”, and more: “You can directly access to a space where there are no disciplinary boundaries, in which there are no hierarchical barriers or borders between countries”. “In this context”, Levy continues, “I believe that the role of the teacher is going to change into that of facilitator of collective intelligence in his students. He should encourage them to learn, to know how to

steer you in the navigation in this new area of knowledge, encourage them to cooperate, to stimulate their desire to learn, to arouse their curiosity. The teachers of the future will be knowledge managers and leaders, rather than people who hold and impart knowledge".

6 CONCLUSION

In conclusion we can now start to foresee how design teaching has to adapt to a new design praxis contest. Nevertheless we are in a process of continuous evolution. From this perspective view we still have an open question to answer: How constantly follow technical and professional evolution of the design sector? Many factors must be taken in consideration and probably we are facing in the next years changes that now we may not be aware of. Will we have remote teaching from spread out locations? Will network of universities and "centres for physical production" be the place where to create your own product? Will networks of universities become a huge world shared "knowledge centre", providing enough information to build anything and accessible by anyone? Anyhow, a point for discussion remains open: how to implement the update of teacher's knowledge in this always faster developing contest and what can be done to make this process become a standard wide spread procedure in the field of design education.

Notes: 1. EURASHE - The European Association of Institutions in Higher Education was founded in 1990 as an international association that promotes and emphasizes Professional Higher Education (PHE). Its members are Colleges, Polytechnics, University Colleges, Universities of Applied Sciences and Universities with their professional trainings.
2. Interview at MEDIAMENTE on RAIEDU, Venice, 07-03-1997

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