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> "Design engineers are called to play a very important role in innovation"

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The opportunity in Industrial Design Engineering

A profile that matches the challenges of contemporary design

The current context of industrial design stands out for the substantial change in the challenges it faces, including environmental recovery, connectivity with associated technology and sustainability. With innovation as its essence, design is responsible for defining the built-up environment and objects in relationship to people—and it has to meet the new demands. In this scenario, the Industrial Design Engineer profile showcases the skills and creativity required for integrating technology and developing top-quality solutions.

Introduction

The story of civilisation is, to a certain extent, the story of engineering. In its various facets and dimensions, it has contributed to humankind's achievements. Part of these achievements are the various products and services which we enjoy today, born in the brain and transformed by designers into reality.

The Degree in Industrial Design Engineering and Product Development (GIDIyDP) at the School of Design Engineering (ETSID) at the Valencia Polytechnic University (UPV) trains professionals scientifically and technically so they can be able to coordinate and manage the entire life cycle of a product, from the generation of ideas (market analysis, marketing, basic design, etc.) to production, manufacturing and product launch, all the way to studying the environmental impact of disposal.

The basis for creating this degree was the experience of 17 years offering Industrial Design Technical Engineering and the White Paper of Undergraduate Degrees in Engineering in the Industrial Branch. This document depicts the approach to industrial design as part of the marketing (design management) as at MIT; its orientation toward processes and technology as in Westminster University; its alignment with specific industries as in Central Saint Martin's School of Art and Design; and its emphasis on communication as in the Milan Polytechnic.

Under the quality management policies of the European Higher Education Area (EHEA) official university studies must be subject to a process of periodic accreditation [Royal Decree, 2007]. The GIDIyDP degree offered by ETSID at the UPV has been subject to this evaluation to obtain the re-accreditation that ensures its continuity. It has also obtained the EUR-ACE© quality seal for engineering in the European area, which equates it as a title with other industrial branch engineering profiles (although it does not include professional competencies). The EUR-ACE© seal is a certification granted by an ENAEE-approved agency to a university with regard to an undergraduate degree or master's degree in engineering, evaluated according to a series of defined standards, according to the principles of quality, relevance, transparency, recognition and mobility foreseen in the EHEA.

It is important to underscore the uncomfortable situation of design engineering, which has been undervalued ever since its implementation in the engineering framework. From the engineering side, the degree is perceived as excessively creative and imprecise due to the many different types of project it encompasses. And from the design side in general (product, services and/or experiences) it is seen as not sufficiently addressing the sensibility or the communicative dimension with regard to the people and culture associated to the business.

It continues to be surprising how the attempts at defining the specific profile of industrial design trigger such permanent debate throughout its short life and the discrepancies with regard to design/social responsibility and design/science/technology which are carried over since its inception, well-summarised by authors such as Maldonado [Maldonado, 1977] and Bonsiepe [Bonsiepe, 1985].

However, it is commonly accepted that design requires multidisciplinary knowledge which makes it strongly integrated with economic, technological, aesthetic and cultural demands. This wide scope of aspects covered by the term "design" has given rise to different profiles which no doubt may be seen from the training point of view for achieving objectives and always under the time constraints intrinsic to a syllabus. In this case, the perspective of engineering focuses specific aspects which characterise this profile and underscore specifically significant technical skills in the context of the post-consumption society and technological advances. According to the International Council of Societies of Industrial Design (ICSID)[4], design represents a key factor in the innovative humanisation of technologies and a crucial factor for economic and cultural exchange [ICSID, 2015].

In this situation, the technological development witnessed in the last decade, and the inherited absurd consumerism—which has had virtually irreversible impacts on the environment—have confirmed the idea that Ortega y Gasset considered in his reflections on technology: "technology, which aims at solving problems for humans, has suddenly become a new and enormous problem"[1] [Ortega y Gasset, 2004]. With this situation as our starting point, the training received by design engineers provides an intelligible vision of technique and technology which gives them familiarity with the details of many products and services. This training—more robust in analysis methodology, industrial process and materials mastery—steer design engineers toward less speculative and original but more critical and sustainable design projects in some types of project.

This article posits that the design engineer is ideally suited to the challenges of design and society, as an engineer who is permeable and conscious of the critical value of the emotional aspects of a product (aesthetic, formal and symbolic elements), familiar with creativity and cultural factors [Rasoulifara, Eckertb, Prudhomme, 2014]. In particular, two new wide-ranging and versatile product scenarios are observed: the so-called Smart products in which new technologies are a substantial part and products that address environmental issues and new laws, where material engineering and nanotechnology play a key role and must meet the expectations of more demanding and well-informed consumers.

The hypothesis we propose is that these areas are opportunities for industrial design and product development engineers. Capable of recognising the key importance of the product's communicative dimension, these engineers acquire versatile and cross-cutting training. They are trained to apply the principles of green engineering [Anastas, Zimmerman, 2013], building skills to undertake complex projects, integrate quantitative research with qualitative tools and serve as a go-between in work teams where technological, economic, functional and style aspects overlap in defining the industrial product.

Given the exponential integration of technology in products and services and the growing complexity of mechanisms and structures, the exact level of impact of design is enhanced. In this context, designers need scientific and technical knowledge that will help them develop products and optimise their use, in addition to inserting them in the technical and economic conditions required by developed industrial production.

1 The author considers technique as the factor that mediates between people's entrepreneurship and better quality of life and the risks stemming from excessive protagonism.

Design Engineer or Designer? A matter of academic depth

According to Löbach, design is the process of adaptation of the object environment to the physical and psychological needs of people [Löbach, 1976]. To be even more specific, the designer's task will focus on the products which a user experiences in everyday life — products with an interface, as Bonsiepe would say [Bonsiepe, 1985].

Their direct relationship with the industrial process is what makes it industrial design and designates that industry-related productive dimension of design and as a result the development of a production model from which we cannot currently sidestep. Continuing with Löbach's description: Industrial design is used to mean the process of adapting consumer products which can be manufactured industrially to the physical and psychological needs of users and groups of users [Löbach, 1976].

The essential marks of design in its current sense emerged with industrial considerations: prior design, mechanical production, repeatability. The industrial procedures and serial production marked the limits between industrial design and applied arts or crafts, erasing the distinctively manual skill of the "crafter" or creator together with the concept of "uniqueness" at the root of the value attached to art objects. Industrial design appeared on scene and developed as a result of the division of work. What defines it intrinsically is not so much the type of specific objects or the various ways of producing them but the methodology involved in making them[2]. Industrial design constitutes therefore the design activity that defines the formal properties of objects which can be produced in series. In this definition, formal properties are understood as not only the external features of objects but, especially, the functional and structural relationships which define an object as a coherent unit, both from the manufacturer's and the user's point of view. So the formal properties are always the result of integrating various factors: functional, cultural, technological and economic.

It may be stated that the implementation of industrial design in consumer society in the second half of the 20th century has been to some extent the core factor of the economic dynamic and one of the main causes of environmental impairment. The current situation is so influenced by the presence of this enormous amount of industrially manufactured products and the use of materials, processes and technologies without appropriate control, that there is a need for reviewing the design/engineering paradigm.

It is obvious that both approaches need to participate and work with technology, to a greater or lesser extent, in the "humanisation" of solutions. However, the focus of engineering in design can tackle the resolution of problems in a language which is closer to the rest of engineering fields involved in design and product improvement. This results in greater perspective and knowledge to point towards primary objectives that are currently in full expansion as we note below.

The role of the Design Engineer in the use of new technologies and new materials

The impact of technology on modern society stems from the application of scientific knowledge and IT which has become predominant—especially in

2 This issue was clearly exemplified by Dorfles more than half a century ago when he said that "There may therefore be a small or even very small series (locomotives, high-precision instruments, etc.) where a few or very few units are made and yet the serial character at the heart of production remains the same. On the other hand, we'll see very large series of objects (crockery, appliances, china, transistors, etc.) where the volume produced can reach many thousands, and each item will remain true to the prototype, thanks to the production system, which has no tolerance for deviation in the series". [Dorfles, 1968].

developed countries—in all areas of everyday life. These applications are driven by engineering and its different branches, and are sometimes inextricably linked to design. In industry, design engineering and manufacturing has been transformed. In management, the exchange and control of information has accelerated. And in the last decade, it has invaded homes and individual use through real-time mobile communication technologies.

In addition to the various specific IT applications available to people in the various stages of the design process, the technique and implementation of technology constitutes a demand to be satisfied, directly at the service of users.

There can be no doubt that connectivity has the capacity of transforming the lives of individuals in the same way as vehicles transformed society in the early 20th century. In the same way as then, whole series of products and services are disappearing and giving way to others which are increasingly more powerful and versatile. A striking example is the mobile phone. In a period of under two years it displaced an entire series of products for storage and playback of music and photos (iPods, CDs, photo and video cameras, messaging devices, etc.).

The development of the *SmartCity* concept also needs approaches that holistically capture issues of various types and materiality intrinsic to the design engineer. In this new context bits and atoms are converging with the aim of making cities into increasingly more intelligent and sensible grids.

Current pioneering applications—such as interrelating connectivity, energy efficiency with public use products, generation systems and energy load for citizens, and reducing pollution via innovative devices—require unavoidably the principles of *green engineering* [Domínguez Rubio, Fogué, 2013].

Other approaches in full expansion, such as biomimetics, take solutions inspired by nature at different levels (forms, processes and structures) as a benchmark for innovation. These efforts tie together biology and technology [Benyus, 2002], resulting in various applications for architecture and design. Another ideal area for design engineers is the value added potential and functionality of the new materials and nanotechnology. Thanks to these, product functionality can be expanded, its appearance can be maintained with less maintenance and therefore be more environmentally friendly.

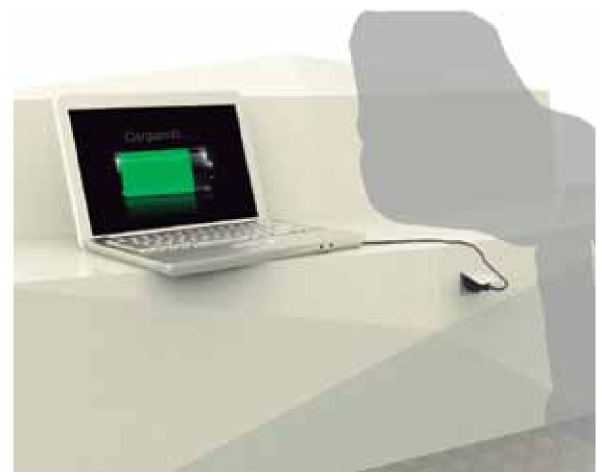
“Given the growing interest in user participation and co-design techniques, the focus of design engineers facilitates the integration of field work, applying quantitative tools that can streamline the interaction with user groups as well as synthesise data and obtain interesting results”

Although, as noted by Ventura in “Illimited Nanotechnology” [Ventura, 2012], the main applications are currently polymer reinforcements and nanoparticle coating (which result in special and surprising finishes), only the rigour of scientific research and *green engineering* will successfully control the possibility and manage their use safely for the environment and people’s health. Understanding the chemical and technological properties of these new materials is vital for application in designing products and spaces. For development and optimisation, mastery of the most advanced physical-mathematical concepts is vital.

Contributions of design engineers to creativity, innovation and entrepreneurship

Another aspect that can be underscored in the preparation of the design engineering is their methodological training which prepares them to face various types of problems and boosts their entrepreneurship.

Their position is excellent for communicating the importance of creativity, and they are empowered easily to think of how to create new ways of sharing their points of view with others and inspiring others to think about how they can apply creative methodologies to all aspects.



▲ INDURAIN_Energía a pedales by Anne Baraja Rodríguez. Eco-friendly urban furniture element for the Smart City. It is powered by the electricity produced via kinetic energy generated by pedalling and offers users the chance to charge their electronic devices and connect to the internet. Mención Productos de Uso Público, ETSID (2014).

Design engineers are called to play a very important role in innovation because they are already branded as innovators, as key stakeholders in the knowledge economy.

Their ability to create observation and measurement tools, applicable in many fields and multidisciplinarily, constitutes a feature of these engineers which makes them analytical when it comes to focusing on studies and comparative analyses and the results obtained following a methodology akin to scientific research [Pedell, Vetere, Miller, Howard, 2014].Likewise, they have a favourable arrangement and appropriate skills for the analysis of a solution and alternative creation, the validation of results obtained and the informed implementation of environmental regulations [Kudrowitz, Wallace, 2013] [Ping Ge, Wang, 2007].

Given the growing interest in user participation and co-design techniques, the focus of design engineers facilitates the integration of field work, applying quantitative tools that can streamline the interaction with user groups as well as synthesise data and obtain interesting results.

Design engineers have much to contribute to creative processes because they have another way of thinking, and they are very valuable when it comes to detecting business opportunities and set new goals because they tackle problems differently. They will help to pose the basic questions and the entire process of product design and their continuity in society. It is vital for them to be involved in work groups from the very beginning because the way a problem is approached from the beginning is very important.

A bright future

Everything around us is design, so having a designer’s mentality is important. The demand of contributions that ensure the sustainability of products

▲ Currently, the development of new materials and their application to design are linked to various production technologies [Materfad, Barcelona]. Materfad showcases all material families (biomaterials, ceramic, composits, polymers, etc.). Its transversal character makes it a catalyst for innovation amongst universities, technology centres, companies, designers, industrial practitioners, engineers and architects.

▲ Application of locally produced recycled materials in on-demand urban furniture elements. WAW What a waste! Project E. Vento, M. Kurz, M. Sarv, E. Mutlu, R. Evans and N. Christer. European Project Semester ETSID, 2011.

▲ "Activamente", interaction platform for learning and accessibility. Belén Reig Segrelles. ETSID Final Degree Project, 2013.

in an eminently technological context requires a permeable and flexible focus of industrial design engineers.

Technological advances and the awareness of environmental requirements require a multidisciplinary focus on design with a relevant technical background.

The development of multiple IT applications geared toward various parts of the design process, and the implementation of new IT technologies is clearly affecting the conceptualisation and development of products and services. The availability of immediate information in the market and the recipients of products facilitate and speed up the involvement in preliminary formal definition stages for product design.

In closing, the development of multiple design techniques in virtual presentation and display of products such as 3D printing for multiple application areas has opened the area of collaborative design in which interdisciplinary teams work at the international level and have been implemented in complex and wide-ranging product sectors such as aerospace engineering and biomedical engineering.

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