DESIGN BETWEEN ART, TECHNOLOGY AND SCIENCE

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1. Introduction

The word design literally refers to the planning which forms the basis for the construction / realization of a complex (not trivial!), material or conceptual object (from buildings to garments) and in its more recent history, it was initially most often used to define industrial design or design in view of future industrial production. Design is also used to define the aesthetic profile of an artifact (e.g. an object can have a minimalist design, characterized by clean essential lines) or the artistic current (or style) when applied to the industrially produced object. Over the years it has acquired other meanings deriving from the significant role it has gained in different fields: social, cultural, technical, economic and others.

Today, the term 'design' has also come to be widely associated with art and creativity. More specifically, perhaps erroneously, design is linked to quality products or those with much sought-after aesthetic characteristics. The 'misuse' of the word design has consequently caused much confusion around its exact definition, since it is often used outside its initial context of design or industrial design, such as in referring to a restricted category of manufactured goods belonging to a well-defined category of sophisticated design. A prime example is that of designer products often of high quality, also in terms of cost and is frequently found in a variety of combinations which include, fashion design, industrial design, graphic design, car design, building design, urban project design, interior design, etc. As such it is linked to many creative sectors in a multitude of ways.

The primary definition of design is, therefore, no longer valid.

Nevertheless, design and creativity represent an indivisible binominal.

The mix of meanings dates to the very beginning of industrial design itself with the advent of industrial production and the appearance of the first leading companies and first distinctive features. This led to the immediate parallelism between the anonymous and the designer signed, in other words the cheap and the expensive. The "blame" can be attributed, for the most part, to cases of branding, such as *Made in Italy,* with its highly developed search for quality and remarkably noteworthy aesthetic taste, which

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has spread the term design, wrapped in high aesthetic and productive quality, through-out Italy and the world.

It is therefore difficult to formulate a universally unanimous definition of design, also because its history has become more and more complex with the passing of time, enriching the subject matter with multiform and cross-sectional theories (technology, sociology, anthropology, etc.). The main point is the meaning that it is given: "Design has become a sort of slogan, especially in marketing and in mass media, which seems to have a positive value in itself, transforming, with its eclectic and discriminatory use, commonplace products into exclusive and fashionable objects." Thus, for example, "design furniture" can be contrasted with the industrially (not aesthetically) designed product [1].

2. History of industrial design

There is no well-defined date for the birth of industrial design: its progress has been smooth, marked only by certain historical events, so the only way to define it is to associate it with these events. It is enough to think about the transformations that have invested the fields of technology, manufacturing structures, and techniques of representation.

Some argue that one can begin to talk about industrial design with the early industri-al revolution of the eighteenth century which took place in England and then expanded throughout the western world. Indeed, with the first industrial revolution, the figure of the industrial-oriented designer came into being, but the image of industrial design as we know it today was not yet clearly defined. that is, a conglomerate of stylistic, con-ceptual and design knowledge transposed to ideologies and values (as well as stylistic personality and originality) that one wants to display with an industrial design product.

Other critics argue that the date attributed to the birth of industrial design is that of the first universal exposition, the Great Exhibition that took place in London from 1 May to 15 October in 1851. In this exhibition, for the first time, one of the most important themes of industrial design was touched upon: the identity of the products that surround us. A considerable multitude of objects were collected for the Exhibition, especially of common use. As countries from all parts of the world participated, there was an immediate comparison between the diversities and similarities of everyday products which during the years had taken on forms and structures that sometimes re-sembled each other even in cultures that had never crossed each other's paths. Many artists and new companies also took part, to present their products for the first time in an internationally important exhibition event and to an audience that had come from different parts of the world. However, though industrial design had a solid foundation, other important events were needed to complete its formation and the development of industrial design also had to experience the influence of many artistic-cultural move-ments and design schools.

One of these was the *Staatliche Bauhaus*, which operated in Germany in the period between the two world wars (1919-1933) and was a decisive factor in the history of industrial design. This German state institute was born from a merger of the former Grand Ducal School of Arts and Crafts and the Weimar Academy of Fine Art, bringing together the Fine Arts and the Applied Arts (a section for architecture was added later). The aim was to approach design in an integrated way and so bring together all forms

of art and design, including architecture. Its students studied mass production, art and craft, as well as new technologies. As a result of the all-round approach to design it publicized and taught, design came to be considered a real and proper discipline in itself for the first time, influencing future developments in art, architecture, graphic design, interior design, industrial design, and typography.

Heir to the pre-war avant-garde, it was a school that also represented a fundamental point of reference for all the innovations in the field of design and architecture linked to rationalism and functionalism, part of the so-called modern movement. Its teachers were of different nationalities, the foremost figures in European culture; the school's didactic experience has profoundly affected teaching in the artistic and technical sectors until today [2].

After England and Germany, the third pillar of industrial design was Italy. The country contributed significantly to the world of design, especially in the field of furnishing, automobiles, motorcycles, navy and clothes, making Italian design a brand of quality: *Made in Italy*. Indeed, at an international level for the first time, particular attention was given to planning, detail, imagination and form and durability, giving greater value and importance to the design phase.

3. The different areas of industrial design

The fields of industrial design, though manifold, can be fundamentally linked to three, often closely related to each other.
- Product design

This is the largest industry since it deals with any physical object (but is sometimes limited to the conceptual phase, prototype or simply to a stylistic exercise) found in human surroundings and is generally part of the décor of different architectural or urban spaces. It includes all the disciplines inherent in the design of an object (furniture design - automotive design - naval and nautical design - fashion design - packaging design: product packaging makes it more inviting or easier to transport and use).
- Design of environments and spaces

This branch of industrial design often works parallelly to two branches in architecture: interior and urban. The design of spaces deals mainly with the planning and layout of indoor and outdoor environments.
- Communication design

Communication design is developed alongside other branches of industrial design, as the design of a finished product also includes its presentation. It intensifies and enriches the product with many other technical particulars and the ever-increasing use of communication systems, images (television, internet, mobile devices, social media) and so on. The communication designer deals with the multiple presentation systems of various industrial design products (e.g. graphics), as well as services and marketing through advertising and web site building; making the best use of their knowledge they "reach" the target group and increase the attractiveness of the product for sale or the service offered or succeed in transmitting a given message. As it is the branch most influenced by innovative virtual and graphic technologies, communication design encompasses several subcategories, including, web design, interaction design (the activity of designing interaction between human beings and mechanical and computer systems), food design, etc.

It is worth taking into consideration the meaningful and significant definition of design given by Antony Bertram in his book which, although dating back to 1938, still holds true:

> *"Good design is not a matter of wealth, much less of the chic, the latest thing. It is not a matter of novelty for the sake of novelty, but of the production of cities and houses and goods which will best satisfy the needs of people; their need of practical, honest, inexpensive, lasting and beautiful things to use and see in their everyday lives"* [3].

•   Agriculture / permaculture design

A more recent declination of the "design" concept is used in the context of biological agronomic/crop systems managed in a natural way. To achieve the goal of minimizing agronomic inputs and maximizing the capacity for resilience of the system, it is important to design sustainable human settlements and preserve and extend natural systems through continuous and adaptive design processes. It means implementing design aspects to maintain a cultivated ecology in any climate by studying principles of design and design methods; understanding patterns in nature and climate; examining water, soils and aquaculture; and the social, legal, and economic design of human settlement [4]. This set of practices is called permaculture (**perma**nent agri***culture***) and one of the main assets of the sector is design [5].

4. Merchandise promoted to works of art

After the reform of the Ministry of Cultural Heritage Activities and Tourism, which modified the old Ronchey law of 1994, liberalizing the categories of products that could be sold in museums, hotels, large stations, cruise ships, airports and historic hotels, goods could be sold that were souvenirs, such as clothes, commonly used and designer objects, jewelry, food, small pieces of furniture, fabrics, respecting the identity of the place. Such marketing recognizes the design of the objects as a "value" that goes far beyond the economic one, transforming them into cultural goods themselves, seen as "materially testifying to a value for civilization"[6]

It is therefore possible to propose some of the *Made in Italy* symbols by valorizing them as museum objects. More specifically, they are designer objects, expressed by the "civilization" that created them, that "testify" to the union between merchandise and works of art.

This recognition establishes a new technical and scientific field: one relating to the preservation of design objects which entails implementing activities that are "necessary to ensure their conservation and to prevent deterioration" as reported in the "Code of Cultural and Landscape Heritage" (Legislative Decree No. 42/2004) and so: "a coherent, coordinated and programmed activity of study, prevention, maintenance and restoration" [7].

5. Industrial design between art and science

Recalling what Sergio Pininfarina, certainly one of the most significant and significant personalities of *Made in Italy* design, was able to describe industrial design as a synthesis between art and science:

"Throughout the world today, the market demands a synthesis between beauty and functionality, between style and efficiency. This synthesis has therefore become the main professional challenge that a successful designer has to face. But that has not always been the case. When I started working - I speak of 50 years ago - projects mainly took into account economic and technical factors: the size of investments, ease of construction, production methods and the level of performance to be achieved: little value was given to aesthetics. Designers had very little say in anything, they only had to improve the look of what was prepared by the technicians; it is true that certain body builders created beautiful cars, but without any real influence on large-scale productions. Only later, in the 1950s, did aesthetic appearance, then called styling, become more significant."

There are many factors, all of them equally important, that determine the success of a product: from price to service, from technical characteristics to advertising. But if we look at the essential reasons why some products have such a huge success which lasts over time, one factor that is decisive and makes the difference, is their aesthetic character.

This applies to all products, such as cars, buses, trains, boats, planes, coffee machines, shoes, skis, phones, just to name a few. Nowadays every creative work has a decisive artistic connotation: in modern society *designers* can be considered artists.

Nowadays, styling is the most important and aggressive element in promoting sales.

This, however, necessitates the aesthetic renewal of the product due to its obsolescence, eventually determining the absence of one of the significant features of an industrial project: its duration across the years. Design has to favor functionality (production costs, accessibility, aerodynamics, ergonomics, ever-increasing safety standards), including in this term all aspects of a project: aesthetics, technique, production and use requirements.

From a marketing point of view, an interesting aspect related to *Made in Italy,* can be found in the well-known fact that it is one of the world's most recognizable brands. In fact, from the Made-In-Country-Index (MICI) 2017 published by Statista (The Statistics Portal), *Made in Italy* came out 7th in terms of reputation amongst consumers worldwide (with Germany at the top of the list, Spain twentieth and China in position number forty-nine) [8]. Furthermore, according to a market study conducted in 2010 by KPMG, a network of professional business services, *Made in Italy* is the world's third-best-known brand after Coca Cola and Visa [9].

6. When Design joins ICT: an Italian centre

CETMA (www.cetma.it), a European Research Center for Technologies, Design and Materials, is a Research and Technology Organization (RTO) based in Brindisi, Italy. It operates in the field of advanced materials (composites, polymers, bio-based and recycled materials), ICT (development of specialized software for innovative applications in engineering, in the field of production and services) and product development with non-profit activities, reinvesting all profits in research, training and technology transfer projects.

Design methods made possible by the computer industry have made an essential contribution to manufacturing processes, even though it is human beings who have

retained the noblest part: knowledge, creativity, judgment and acceptance. Until today, machines have provided answers to many questions posed by people.

However, technology has taken a significant revolutionary step forward. The emergence of CAS - Computer Aided Styling - machines have not only helped the design process, they assist the designer's creativity. Computer Aided Styling currently offers designers incomparably greater possibilities, allowing a project to be viewed from different angles without even having begun to build a model (e.g. in its natural environment and using numerous reference points, such as people or things). With the help of a purely mathematical model one can approach a design project in a way that would have been unimaginable in the past by presenting sensations similar to those that the end product will give us. This is possible as it provides the opportunity of seeing objects moving virtually in a natural environment thanks to dedicated frameworks for discrete event simulation (Fig. 1a - d).
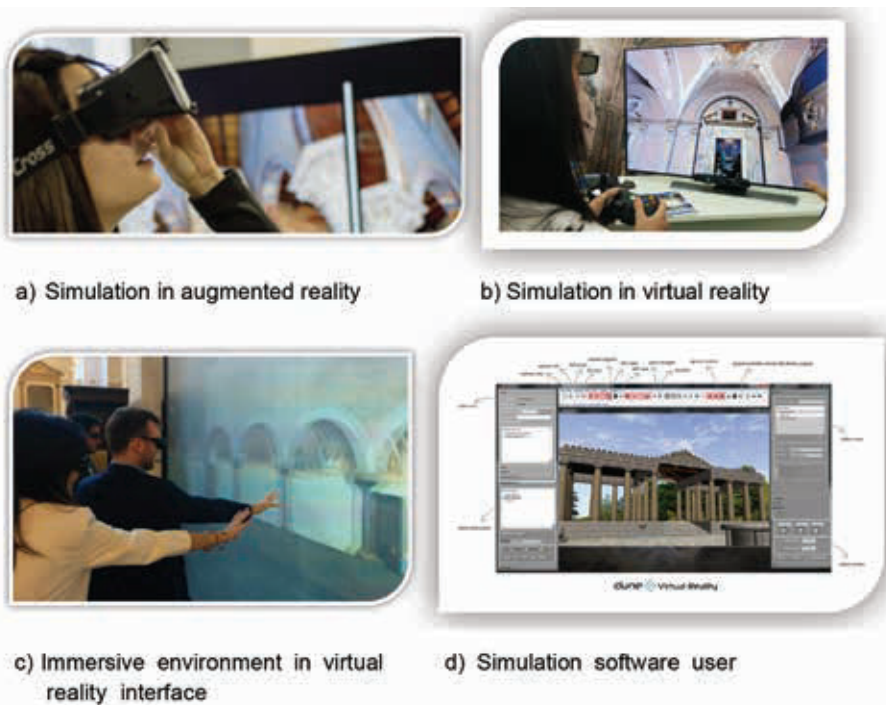

a) Simulation in augmented reality

b) Simulation in virtual reality

c) Immersive environment in virtual reality interface

d) Simulation software user

Figure 1. Virtual and augmented reality.

This is the field of virtual and augmented reality. The differences in method between today's creative process with respect to those of the past are therefore immeasurable, even though the fundamental principles have not changed. The guidelines in the design of a project are always aimed at achieving the following features: simplicity in its lines, function optimization, proportion of the masses, harmony between solids and voids, a technical-aesthetic ideal. All these aspects, naturally, combined to respect the functionality and composition of the materials used [10].

With this perspective in mind, CETMA orchestrates the skills of its three divisions, namely Computer Engineering, Design and Materials Engineering and includes, within its organization, Product Development, from concept generation to engineering, virtual and physical prototyping, initiating production and assisting in the protection of the innovation.

More specifically, design-driven innovation is a strategic tool for any industry wishing to engage in a context of growing competition. The application of research, therefore, aims to interpret and develop new technological and productive opportunities so they become new functional, formal and communicative qualities, to be transferred to the "product system". Cetma also uses its competences in graphic design and multimedia production for application in a variety of different fields. Being aware that industrial design contributes concretely to the technological and industrial culture of the territory, the Territorial Delegation for Puglia and Basilicata (*Delegazione Territoriale Puglia e Basilicata*) was set up and promoted as part of the national Association for Industrial Design (ADI).

The question then arises as to how a work of art (or a design object) can be conceived and realized through Computer Aided Styling (CAS), that is, virtually, rather than being executed using artistic techniques. This is especially true when referring to contemporary art, where alternative and innovative materials and products are often employed. A work created or reproduced in this way is still the result of creativity however: but at this point, aspects regarding ethics, unreproducibility and economic-financial issues come into play.

7. Using design to valorize cultural heritage: value systems to connect history, culture, places, knowledge, communities, businesses

The valorization of cultural heritage today is a privileged asset for the sustainable development and innovation of the country. The collective enjoyment of culture has evolved, alongside the tertiary sector of services and experiences, towards increasing the moments and opportunities for appropriation and access to cultural goods, products, services and activities.

Keeping in mind this line of reasoning and in agreement with recommendations laid down by the European Union and UNESCO, culture-oriented development models promoted by design projects aim to generate, activate and increase the value of cultural assets in their historical, civil, symbolic and social functions and are directed toward developing platforms and connectivity. This will in turn aid territories and communities to communicate effectively through culture and knowledge, as well as redefining relations between local and global tradition and innovation, whether public or private.

The opportunity to valorize cultural heritage provides a strategic objective for design to revive the image and international competitiveness of *Made in Italy*. This can be achieved through networking and strengthening the "cultural heritage" chain which involves the producers and users of technologies who participate in the various phases of the life cycle of the cultural assets, from knowledge to conservation, economics and management to safety and security and fruition.

For these aspects to converge positively, the following points should be implemented:
• the transformation (or rather broadening) of the concept of "cultural good",

understood as a complex cultural system of a territory and community, from a cognitive, social and symbolic dimension: from traditional cultural artistic, monumental, demo-anthropological, archaeological and environmental heritage to territorial and urban systems, to immaterial cultural heritage (knowledge, practices and expressions), to cultural sites and venues for events. It is possible to identify in this model, the different functions of the cultural asset: institutional (in terms of institution and inalienability), civil (in terms of formation and identity), social (in terms of integration and participation), development (as a dimension of development rather than leverage and therefore generate, as a consequence and not as an objective, economic and social growth) (Fig. 2);
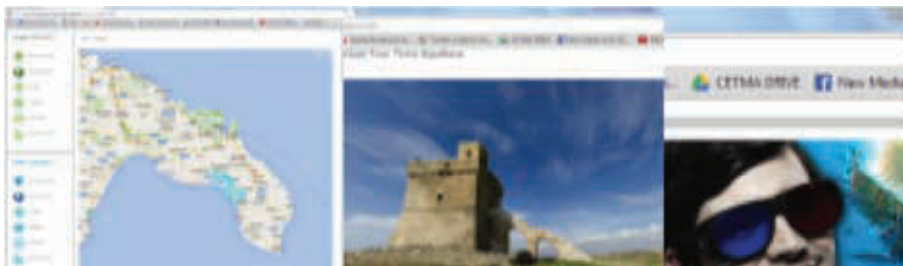

F*igure 2. Web technologies for connecting cultural heritage and territorial resources.*

- the evolution of design practices: design, traditionally associated with the concrete design of technological, performance, aesthetic, communicative components of common use, has, in relation to the transformations that have taken place in the context of consumer goods, progressively expanded its range of skills, refining its strategic vision of consumer scenarios and its sensitivity towards the significance of consumer behavior by configuring what is now termed as a system-product, i.e. service and communication components associated with the product. Design, apart from simply designing objects, suggests interpretations, meanings, procedures relating to social, economic, technological, and productive systems. This means it has also progressively drawn closer to the "immaterial" component of processes that underpin the world of design and cultural goods, developing unprecedented synergies.
- Information technologies, the Internet of Things (IOT) and Design as tools for emotional visits.
  Tourist guides are now realizing that it is no longer possible to conceive a visit to a cultural container simply as a walk-through, where an expert conveys facts about the art works on display. These elements of knowledge are now available in all smartphones connected to the internet. Using design, information technologies, connectivity, visual systems, interactivity, all integrated opportunely to sell an emotion and connect it to personal interests in a sort of visit that extends elements of knowledge to the surrounding area (food and wine, cinema, theater, environment, etc.), today represents an important lever to give cultural heritage a more significant position in creating value for a nation [11].

Figure 3. Virtual Reality Set – Ambient Museum – Lecce, Italy.

Following the evolution of the concept of cultural heritage as an asset belonging to a person/persons and/or having a place/places in society or has merit (i.e. that has a value in itself according to a typically capitalist conception) or as an asset to be exploited (of which a primary value is its recognized use), together with the innovation of theoretical-applicative experimental fields within the different disciplines, design focuses on processes that generate value from cultural heritage as a system and as an experience. Design within the context of cultural heritage therefore proposes a "systemic" vision, capable of transforming strategic choices regarding its protection, valorization and management, into concrete projects of knowledge, organization and experience of the asset and its incorporation and contextualization in the contemporary world [12].

8. Conclusion

In conclusion, in this case, design is fundamentally correlated to Italian creativity, due to a tradition of Italian artistic genius. Italy is a country that is particularly congenial to creative activity and draws strength from an ancient tradition that is deeply rooted in its culture and which produced the Renaissance workshops, as well as the many scientific studies carried out by the artists-scientists of that period.

The excellence of Italian design and style is universally recognized, becoming symbols of creativity and innovative quality, from which has emerged the myth of *Made in Italy*. At the Museum of Modern Art in New York, in the section dedicated to industrial design, many of the permanent exhibits are Italian masterpieces. For example, Mario Bellini's CAB armchair (1978), the "Atollo" table lamp by Vico Magistretti (1977), the "Valentine" typewriter (1969) designed by Ettore Sottsass for Olivetti, the "Mirella" sewing machine (1957) designed by Marcello Nizzoli for Necchi and lastly, the Cisitalia 202 GT(1946) - the first car to be exhibited as an art object.

In short, design has to endow an object with beauty and aesthetic personality, to improve the quality of life for the purpose of rendering objects more functional, to become an element of economic development, a decisive factor in the commercial success of a product.

Design has, furthermore, a highly valuable cultural function: it can help to not repeat the mistakes made in the past by the more industrialized nations when very often cultural and ecological values were sacrificed for the sake of progress to the development of cultural and ecological values and, consequently, principles of eco-sustainability,

ethics and aesthetics. Design is the precise meeting point between beauty of form, technology and functionality and therefore, between art and science.

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Biographical notes

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Lucio Colizzi is an Information Technology engineer. After many years of experience in ICT, robotics, Virtual Reality and data processing and modeling, in 2001 he became the ICT department Director of CETMA. He has co-ordinated important national research programs and in the last ten years has also been coordinator on several projects in the field of development of technologies for cultural heritage. He has obtained many post-graduate qualifications: BPR, Concurrent Engineering and Quality Function Deployment, STEP –ISO 10303, Simple ++, eM-Plant, eM-Planner, Informix Dynamic Server Administration and Performance Tuning, Design for Manufacturing & Assembly, Object Oriented design with UML, Microsoft certifications: C#, ADO.NET, ASP.NET; XML Web Services.NET; PROJECT MANAGEMENT (Bocconi University). As a result of his many interests he has taught "Project Management and Group Dynamics" as Adjunct Professor at the universities of Bologna and Lecce.

Summary
Design, understood as the planning and realizing of a project for a complex, material or conceptual object, has acquired diversified meanings over the years. Among them, designer objects, expressed by the civilization that created them, bear witness to the close relationship existing between goods and works of art. Consequently, design, as an expression of creativity, is a point of convergence for beauty of form, technology and functionality and thus, for art and science.

Riassunto
Si fa presente come il design, quale attività di progettazione e realizzazione di un oggetto complesso, materiale o concettuale nonché di un disegno industriale, abbia acquisito nel corso degli anni ben altri significati. E, fra questi, gli oggetti di designer, espressi dalla civiltà che li ha ideati, a testimoniare il connubio fra merce e opera d'arte. Ne consegue che il design, quale espressione di creatività, è punto di incontro di bellezza della forma, tecnologia e funzionalità e, quindi, di arte e scienza.