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1. Behind Material Design

If objects remain important as a symbolic location of experience (V. Margolin; R. Buchanan, 1995) it is thanks to the materials they are made up with that they mark the difference in terms of perception, usability and communication. This has been always a clear evidence for the Italian approach to Material Design. In fact, Italian designers have never faced materials “solely as elements of a problem of constructive correctness.” Instead, materials have always been “used as a creative input and part of the linguistic and poetic palette of a project,” which can be interpreted with their inherent potential for expression and use. (Ferrara, Lucibello, 2012; Ferrara, Lecce, 2015). This can be properly named as “creative approach to technology” by design (Ferrara, Lucibello, 2012). The design approach to materials can be recognized as one of the principles of European industrial design. To this concern it is possible to recall Gottfried Semper’s theory, where the function of materials acquires predominant importance at the service of the idea, which is defined as “the quality of the content and purpose”, in other terms, the qualities of a given material are brought into close relationship with both structural and symbolic roles that materials acquire in a project. However, no materials have any intrinsic meaning. They rather acquire meanings by being used in specific objects and contexts according to the design vision. Also French poet and writer Paul Valéry reminds in his essay Introduction to the method of Leonardo da Vinci the impact of materials starting from the creation process in architecture, which can also be deduced from a design perspective: “Constructing takes place between a project or a particular vision and the materials that one has chosen”, highlighting that kind of alchemy attaining when projects and materials literally fuse: “The wonder is that we sometimes receive an impression of accuracy and consistency from human constructions made of agglomeration of seemingly incompatible elements, as though the mind that arranged them had recognized secret affinities” (Valéry, 1929). The mechanism of producing associations in terms of affinities, and then generating different timbres, able to evoke, provoke, reassure, rather than calm or disturb, can be linked to the sphere of perception that works through the specific symbolic values we tend to assign to material things. According to Nelson Goodman, for instance, and more specifically to his theories expressed in his work *Ways of Worldmaking* (1978), art masterpieces are not the only things that symbolize in terms of philosophical approach. That is to say, even objects of common use can turn into symbols, evoking, recalling, amplifying the specific function they were designed for, turning into more complex entities, even able to generate aesthetic experiences. Approaching the theory and the history of Material Design, especially in the specific context of its Italian determination, implies dealing with a deep knowledge in terms of around-the-world renowned method and strategy. Indeed, in Italy, a specific design method, still attested as a true Italian way of approaching design, led to a generation of designers collaborating with remarkable manufactures, considered of great impact in terms of the use of sophisticated materials and techniques, as well as for the elaboration of ideas. They broke up with a consolidate knowledge, introducing elements of discontinuity –in relation to common thought– and anticipating social aspirations and supporting the growth of new life styles (Bosoni, Ferrara, 2014). This “Italian way” of doing innovation, has been constantly revived, acquiring a mighty role especially during some specific times. Such an Italian approach to technology has been broadly communicated through exhibitions, the finishing of visual artifacts, papers and communications diffused by media, gradually turning into a sort of mythology, still supporting the image of Italian design. However, in the last decades, only few researchers have gone deeper into this topic, trying to understand the motivations at the base, or enhancing this given Italian peculiarity (Bosoni, Ferrara, 2014). Relevant historical

issues provide a documentary evidence of the particular attention of Italian Design to materials, technologies and productive processes (Bosoni, Ferrara, 2014). During the 40's and the 50's, for instance, Italian design was still emerging, but thanks to the synergy between designers and the raising industries, especially those in the field of new plastic materials, it was possible to launch new products that also determined remarkable aesthetic innovations, opening up new markets. This is, for instance, the case of those companies founded with the specific intent of focusing on a new material challenge, such as Pirelli (Ferrara, 2014), Arflex, Kartell, B&B (Ferrara, 2012), Gufram, Abet laminate (Lecce, 2014), and many others. They were capable to turn into practice a true rising of the material, such as rubber, polypropylene, foaming polyurethane, and plastic laminates that became the core of their whole production in terms both of products as well as added value. Several design practices of these previously unknown materials, lacking of a proper heritage. Using material in a new direction and addressing new problem, instead of only substitute the old materials, designers have allowed them to acquire a true identity to be renewed at every new application to functional objects.

2. A truly Italian Material Design Story: the case of G.B Pirelli & C and the intersections between technical and humanities competences

A notable case of radical innovation is indeed that of the rubber industry and company G.B. Pirelli &C. founded in Milan in 1872, with the intent of taking advantage of a new challenging material, like rubber, launching a production on the Italian market. Compared to other Italian companies, instead of going through a transition from an artisanal to an industrial identity, since the very beginning, Pirelli started to be driven by a fully industrialfocused policy with rubber. During Post world war II period, though the company was already provided with an internal design office, dealing with new products implementation, relevant collaborations with external local designers started to be encouraged, besides the constitution of a Communication office, giving equal relevance to technical as well as communicational and marketing issues, with a significant impact on company policy and identity. Pirelli successfully applied a redesign of a growing differentiated production, conquering new market segments, implementing technology as well as the functionalaesthetic issues related on how making new products look more and more appealing, taking into account several aspects of products differentiation and consequently the company catalogue, such as shape, color, texture, smell and elements of affordance. In this way, Pirelli overtook the old and tough question concerning the separation between science/technology and humanities (one of the core questions of the time at Politecnico di Milano), encouraging and fostering a constructive and highly productive dialogue. On such a fertile ground, design started to play a main role, mediating between technology and communication, providing solutions and enhancing perception-focused issues for unusual user experiences while company identity got stronger and effective thanks to the launch, in 1948, of the Pirelli magazine. It was called Pirelli. Rivista di informazione tecnica and it soon became a tool of propaganda, a true House Organ created on purpose to let the company name gaining in consistency and effectiveness, also by grouping among the contributing editors some of the most reputed intellectuals of the time, who applied a sort of "inter semiotic translation" (Jakobsón, 1987) from technology to cultural values. The Pirelli's magazine and other visual communication artifacts (posters, brochure, etc.) had then a central role in generating a new consciousness of objects that started to be defined as design products, being at the core of the aesthetization of the new rising society as, while seizing the technological meaning of new products, they captured, at the same time, their very essence in terms of deep sense and interpretation (Ferrara, 2014). Profitable exchanges between intellectuals, engineers and designers turned out to characterize the production of

Italian company Pirelli, that launched several products highly defined by a strong narrative value and enriched with metonymical and metaphorical meanings¹ (Ferrara, 2014) (Fig.1).

This practically announced what Umberto Eco theorized in his work *Experiences in Translation* (Eco, 2003), according to the process of translating from one system of signs to another, generating symbols and new values scale. In addition, the role of the industrial designer started to become central and freelancers, between tangibility and intangibility, started to be more and more involved in the company. Already in the 50's, as well as later on in the 60's, designers, thanks to their intuition, indeed detected and opened new market opportunities to implement plastic materials and their use in relation to design, generating new aesthetics experiences. By designing amazingly shaped products, designers translated into 3D objects all the desires of the new born Italian society, slightly opening up to new life styles, increasing the demand for industrially produced furniture and houseware appliances. So that, the true scenario taking shape between the 50's and the 60's can be described as the very beginning of "l'Age Transaesthétique" (Lipovetsky-Serroy, 2013), literally the Trans Aesthetic Age, basically a new era, the era in which we are still living, where design objects melt with the "star system", generating a sort of Communicational Hyper Culture (Lipovetsky, Serroy, 2013). Indeed, Umberto Eco in his essay *Function and Sign: the Semiotics of Architecture* had already introduced the idea of architectural objects, that is to say design objects, which are not designed to communicate, but rather to function, though they end up to work in everyday life as true communicational tools (Eco, 1997), and Vilém Flusser had gone even further, saying that design should be considered and approached as all the other media (Flusser, 1989).

3. Humanities and Material Design: a consistent and open dialogue

In order to investigate where such a deep osmotic exchange between technology and humanities applied by Pirelli originated from, it is necessary to look back in history and in the cultural background of the booming economy. If an open dialogue between industrial design and humanities had already started with the Avant-garde Movements of XX century, the new wave that hit the 50's and the 60's was essentially linked to the cultural landscape of the time. In 1957 Roland Barthes wrote *Mythologies*, stressing on the importance of looking at the semiotic process of myth creation through the objects produced by modern capitalist society; in 1963 French Art Critic Pierre Restany started his long lasting collaboration with Italian magazine *Domus* and in 1968 Jean Baudrillard published the first edition of his essay *The system of objects*, showing how

Only a semiological model can decipher the meaning structure of the modern commodities. (...) in commodity the relation of word, image or meaning is broken and restructured so that its force is directed, not to the referent of use value or utility, but to desire (Poster, 2002).

Baudrillard's attention focused also on materials that, according to his analysis, can impact on different environments determining values, symbols, status, meanings. As for materials as for colours, once they reverse the traditional perception based on associations like "warm colours" or "cold colours", they penetrate different layers of society even in terms of symbols, morale, and habits. Once accepted by large groups of people, they automatically turn into cultural signs. Basically, the provocative sense produced in the early '60's by the replacement of "matière naturelle" by plastic objects, previously realized in metal or wood, naturalizes its effects only once plastic became one of the consolidated aspects of everyday life and part of people's routine. Inspired by the atmosphere of those years, designers –also working for companies like Gufram or Kartell– used plastic materials to make items and furnishing objects that drastically shook up everyday imagery, in term of both form

and materials. This generated not only a new way of looking at design objects as communicational tools, in a kind of “rising matter” process (Ferrara, 2014), as previously mentioned, but also generated a sort of sensory displacement. However, the Italian material approach to design generated, during the sixties and early seventies, a remarkable selection of products, while creating a specific identity that looked new, colorful, lively, easy, light and democratic, in the sense of broadly affordable by people. This identity was the new Italian landscape that was subsequently part of an exhibition at MoMa NY in 1972.

4. Design Primario paradigms and around

The Seventies represented another crucial timing for Italian Material Design Culture and its upgrade of knowledges, thanks to Design Primario, literally “basic material design”. This approach was first started within the Montefibre Design Centre (Montedison Group) between 1974 and 1977 by Andrea Branzi, Trino Clini Castelli and Massimo Morozzi, with the Montefibre Fibermatching 25 Project, a method for the partitive colours definition, applied to polypropylene fibers and generating a perceptive colors definition, without any physical mixture of pigments through polypropylene filaments. Montefibre Design Centre obtained notable success at the point that design primario became the central theme of sophisticated industrial strategies of products differentiation in a saturated market, like in the case of the automotive sector. Design primario shifted the focus from products structural aspects to finishing and soft qualities (including color, texture, transparency, smell, sound, all the surface elements and their response to light variations), that is to say the expressive identity of materials, not considered as essential by Modern Movement. The sensorial, communicative and emotional quality of materials, compared to the seductive aspects of shapes became design’s references, clearly destabilizing the functionalist approach (from Sullivan to Loos), according to which, the material is chosen only subsequently to design definition. This definitely inverted the paradigm, letting inspiration deriving straight from materials themselves. In other terms, the relation among form, function and materials still keeps the same value throughout the design process, though not necessarily in the traditional sequence. Here the roots of CMF (Colors, Materials and Finishing) Design, that starting from the 90’s turned out to be a new professional profile specialized in the qualitative dimensions of products, and one of the most reputed specialist was Italian designer Clino Trini Castelli, who spread out a new consciousness for a systemic vision of design process, also deriving from Pirelli experience (Ferrara, 2014). CMF has been applied to products emotional definition, especially in the automotive sector for the paint and coating realization, according to a method first implemented in Italy and then exported in US and Japan. The innovations enhanced by Design Primario found a fertile ground also within the Italian company Abet Laminati, already established in 1946, but significantly blooming only in the seventies, thanks to the design collective grouped around Ettore Sottsass, through which it was possible to realize one of the most interesting cases of material design in collaboration with designers (Lecce, 2014). Among the newly created materials we can recall Lumiphos, a luminescent laminate by Clino Trini Castelli, still part of the Abet Print Catalogue though after 40 years. No more just products then, but situations, emotional and sensorial empathy between people, surfaces and surrounding space, as in the reactive surfaces, based on no-form products, no longer based on a formal value (Fig. 2).

In the late 80s the silent revolution of compounds led design towards a new previously unthinkable challenge of technology. Designers transferred technology from production sectors supported by big investments in research (like automotive sector) to others with small investments (like furniture sector). They worked exploring the combination of several materials and consequent innovative materials’ new performances and went beyond technological boundaries that materials were pushed to their technical and expressive limits, giving

unprecedented and surprising visions of their nature, creating an “increased sensory displacement” effect captured by MoMa exhibition *Mutant Materials in Contemporary Design* in 1995 at New York’s MoMA, curated by Paola Antonelli, as well as appearing from 2003 in the *iMade* exhibition, curated by Frida Doveil. Those exhibitions were centered on new products performances and they were focused on how materials could adopt unexpected characteristics thanks to researches lead by designer with composite materials. That marked a time of “breaking up with a consolidate knowledge, introducing elements of discontinuity in relation to common thought” that would announce the changes and the essence of late society, as described in “Liquid Modernity” (Z. Bauman, 2000).

5. Fostering Next Italian Material Design approach

Starting from the late Eighties, researches from different branches, from chemistry to physics to engineer got more and more involved in developing new advanced and smart materials. In the design sector Ezio Manzini was the first scholar who started to get involved since 1986 in exploring the new perspective of designing with advanced materials. He zoomed on the fact that design process was undeniably getting more complex and that it was necessary to keep control of technical complexity, no more manageable only by designers. This led to a sort of new chapter in the history of design, envisioning a new framework and even a method, involving also other actors in order to reach a concrete innovation and outlining a new interactive nature of objects (Ferrara, 2015). These premises strongly impacted outside Italy, especially in The Netherlands, where the successful combination of technologies and humanities, typical of Italian design, was highly appreciated. Dutch design collectives like Droog Design, developed their first projects already in the late nineties in collaboration with some departments of Delft University of Technology, in order to stick to a sort of dry (droog in Dutch) tech design, where materials and new emerging tech could be the core of the project itself, or design schools like the Eindhoven College of Design turned them into challenging philosophies of approaching contemporary design. Droog Design approach, for instance, remained faithful to their first steps, leading to accomplishments like those showed at the *Material Matters* Exhibition during DDW Dutch Design Week in 2010 and in 2012, enhancing research and design focus on traditional models of recycling/upcycling, to new and speculative ways.

Today it is possible to state that the “creative approach to technology”, this Italian way, spread out all over the world, and especially throughout Europe, where it drove researchers’, designers’ and other professionals’ attention towards materials transformation in order to tell stories. Several European cases, all belonging to the same sector, and all pooled by the same current environmental awareness, pushing to conduct researches in order to turn wastes into raw materials for new productions, were collected in the book “*Material Revolution 2: New Sustainable and Multi-Purpose Materials for design and architecture*”. Below we give some examples that can be included as significant in the material design research that has been developed since the 90’s (Fig. 3-5).

Designers’ skills in creating new material visions, which turn into high added value products, got recognized even on a political side. Indeed, EU Institutions started promoting the diffusion of the creativity-driven material innovation within small and big sized companies. As in the case of the integration of D-DMI methodology (Ferrara, Lecce 2015 and 2016), developed within MADEC Research Center at Politecnico di Milano and then spread around the 28 EU countries’ small and middle sized companies, starting from 2015, thanks to “*Design for Enterprises*” Program, aiming to enhance companies’ innovation skills through a design-driven innovation approach.

What's the next step? The current frontier in product innovation is based on nanotechnologies and applications for material inventions. These are often far from obvious in the context of microscopes and lab benches and, at the same time, are quite distant from every freelance designer resources, usually working on a DIY basis and with a traditional, instead of a strong technical, background. For this reasons, one of the biggest challenges about innovation for the future times of European industry is that of filling the gap between fundamental material science and its applications, anticipating design contribution in the material innovation process, while gearing towards developing product ideas based on scientific work with materials. These setting process will be based on strong interaction and hybridization between science (rational-deductive-analytical) and design (empirical-inductive-synthetic) methods, in order to generate disruptive innovation, based on materials both in terms of performances, aesthetics and meaning. Following up to the "transition from the atom to the bit" the development of nanotechnologies, smart materials and biomimetic, what turned to be the core of material design research is the concept of "interactive material system", or "computational composites" which implies material components, considering the application of compound material systems, as well as behaviour and the theoretical function of the system. That is to say that the project defines the complex reciprocity between materiality (form and structure of the material-product and the related processes of assembly/production) and the various performative effects. It is required a deep understanding of the material shape and structure, as well as of the environment in which the material itself is put, not just as an external component, but as an interrelated aspect, following to all the action-reaction complex relations, that activate changes within the system itself.

Does the concept of interactive material system or "smart interface materials" imply a new approach to design? Certainly, new interdisciplinary approaches are needed to manage design technical side², as well as aesthetic one. According to Bill Verplank's definition of an interaction design process, we deal with three fundamental questions, dealing with design cross-fertilization with other disciplines:

1. "how do we do?" It is related to how we "touch", how we "poke" the world around us. This question is related to the integration of design with engineer world
2. "how do we feel?" It is related on how people/users perceive the world, how the world responds to people action. This question is related to the art realm and to the design on how to build the understanding of perception of the world by the user.
3. "how do we know?" It is related to how user understand the interaction and how they build a mental model in order to use the product proposed. This question is related to the integration of design with social science disciplines.

Bringing up to the already mentioned Italian design approach and to the metaphorical meaning, we agree with Ross & Wensveen (2010) that claim that if the use of metaphors³ and their representation is fundamental when dealing with static objects, it becomes even more important when dealing with smart interactive system and objects. Many authors (Schon, 1993; Lakoff and Johnson) have been examining the use of metaphors as tools of design process that support innovative products while generating new solutions. Some authors consider this an analytical tool in design, others more a communication tool to describe the characteristics of a new product and make it more approachable and usable, i.e. a tool for introducing new concepts to users. All this meanings and tasks of metaphor depend on the ability to picture the immaterial attributes of a material or product and its interaction and to create conceptual synaesthesia. This is a perceptual experience in which a stimulus in one

modality gives rise to an experience in different sensory modality. In other terms, by giving a description of the metaphor through text or images we are able to evoke the feeling of a sound or a movement which otherwise are difficult to describe – therefore to talk about (Cytowic 2002; Cytowic 2003).

If we want to deal with the complexity related to the material behaviour and product design in the “interaction paradigm”, taking into account principles of aesthetics experience and not only efficiency, and if we want to design the behaviour in a consistent way, we cannot avoid the use of metaphors. The metaphor turns into a key concept in the communicational process with the user. Within the design process, metaphors are used in order to design the behaviour of a material/product according to a consistent inner logic, and in order to nurture the communication of different actors/competences within interdisciplinary meta design teams and co-design framework. The need for appropriate innovation at all levels, includes the metaphorical language that serves to sustain a given paradigm, adding considerable complexity to the task of managing actions and outcomes. To do a set of verbally metaphors and other represented through mood-board, mind maps or other visual representation tools, are usually used by designers, we not only describe the thing, but we conceptualize it and we are able to associate to it a structure and a functioning. These metaphors accomplish the task of summing up and defining the borders for further development of the project, but at the same time represents a powerful tool to inspire different possible design solution in the successive steps of the thing we want to design. According to neuroscience, in the communicational process metaphors transfer the material/product meaning to the potential users. The use of metaphors get insight about how to communicate the designer intentions better with users and create more innovative design solutions. Designers can use metaphors to create pleasurable and meaningful products likely to build brand identities that convey company values and make consumers identify themselves with. Therefore, products can definitely tell stories while generating full-experiences, as in the best of the Italian tradition.

6. Conclusion

The osmotic process between technology and humanities is the core of the Italian Material Design approach. Focusing on relevant studies, the authors pointed out how communicating products' value turned into a central issue to create a link between enterprises and consumers, and how this led to the implementation of close collaborations between designers and intellectuals in postwar times. Those challenging exchanges spawned a production pay off and became an input for designers' creativity, opening a new communication channel with the users by metaphorical associations, likely to generate meanings and increase products' value. Leveraging this approach, Italian designers and the creative industries of post-war decades were capable to break up with a consolidate knowledge, introducing elements of discontinuity in relation to common thought. By using materials in a new direction and addressing new problems, instead of just substituting the old resources, they anticipated social aspirations and supported the growth of new life styles, inspired by a flourishing cultural background. The “Italian way” of doing innovation through materials interpretation has been constantly revived, acquiring a mighty role, especially during some specific times.

The Seventies represented also another crucial timing for Italian Material Design Culture and its knowledge upgrade, thanks to Design Primario. The communicative, i.e. sensorial and emotional quality of materials, compared to the seductive aspects of shapes, became design's references, clearly destabilizing the functionalist approach. This Design Primario and no-form approach started the roots of the CMF (Colors, Materials and Finishing) Design, that from the 90's turned out to be a new professional profile of designer specialized in the

qualitative dimensions to products emotional definition. A new consciousness of the systemic vision of the Italian design process was spread worldwide, enriching the design processes pursued also in other countries with the consistency of values and meaning, deriving from humanities.

Nowadays the smartness of materials and the interaction paradigm add interest in the field of Material Design getting more and more aware of such a porosity and richness of a multidisciplinary approach, while also enhancing new concepts with a strong environmental and sustainable conscience.

Notes

1. A literature review (Antoniades, A. (1992) *Poetics of Architecture: Theory of Design*. Chapter 2, Metaphor. John Wiley & Sons: United Kingdom) indicates the use of metaphor in architecture beginning in the Renaissance. Leon-Battista Alberti in his discussion of the origin of building proposed a house is city metaphor. More than two millennia ago, Aristotle (Aristotle (1952) *Poetics: The works of Aristotle*, Vol. 11, W. D. Ross Ed. Clarendon Press: Oxford) had remarked, "midway between the unintelligible and the commonplace, it is metaphor which most produces knowledge".

2. Multidisciplinary research is getting to the highest level of excellence at the Harvard's Material Processes and Systems (MaPS) Group, which looks at materiality as a starting point for design research, with a special interest in robotic and computer-numerically controlled (CNC) fabrication processes as well as small scale work on Nano-materials. Another stronghold of contemporary research is the morphogenetic approach of Integrative Design Computation and Materialization, developed within Stuttgart University for ICD design research, according to which the design of the material system has to deploy the morphological complexity and the performative skill of material compound system, with no distinction between design and materialization processes. This allows a direct link between the ontogenesis and the chronology of structural modifications of a material - product and its interaction with external energetic strengths and last but not least its sustainable behavior.

3. As from this part on, we will refer to the concept of "metaphor", according to the sense expressed in neuroscience. We reserve to analyse and question more in details the relation existing between rethotic figures, as in Linguistics and Communication, and Design, in further studies.

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Abstract: This article deals with the Italian Design approach to Materials based on a long tradition of challenging exchanges between intellectual practices. Focusing on design and enterprises history, the authors, on the basis of their previous studies, explain the approach and the reasons of the osmotic process between technology and humanities in Italy, and how those challenging exchanges impacted on production as well as on further developments. An overview of European cultural landscape of the times helps to focus on the leading theories that still represent a stronghold of Design Humanities. Exploring the semiotic meaning of materials enhance the investigations on their applications as well as new, ongoing researches in the field of Material Design, also in terms of sustainability and interaction.

Key words: Italian Design Approach - Material Design - Design History - Creative Use of Technology - Design Metaphorical Analysis - Design Humanities.

Resumo: Este artigo discute a abordagem do design italiano de materiais, com base em uma longa tradição de desafios de intercâmbio entre práticas intelectuais. Com base em seus estudos anteriores, os autores se concentram no design e na história das companhias, explicando a perspectiva e as razões para o processo osmótico entre tecnologia e humanidades na Itália e como esses intercâmbios desafiadores afetam tanto a produção como os desenvolvimentos futuros. Uma visão geral do cenário europeu de todos os tempos ajuda a se concentrar sobre as principais teorias que ainda representam um bastião de humanidade do design. Explorar o significado semiótico dos materiais melhora as investigações sobre suas aplicações, bem como as pesquisas novas e em curso no campo de Design de Materiais, também em termos de sustentabilidade e interação.

Palavras chave: Italian Design - Materiais de design - história do design - criativo uso da tecnologia - análise de projeto metafórico - humanidade do design.

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