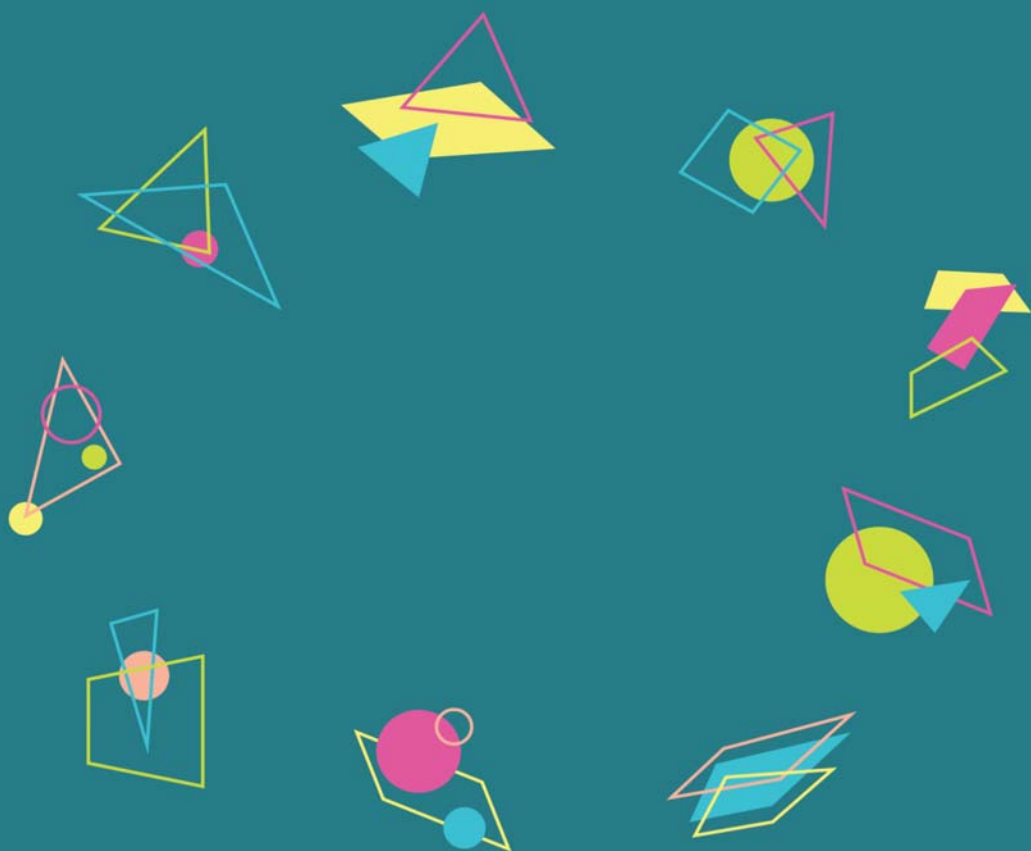


POLIMI DESIGN

PHD_018

9 PhD theses on Design as we do in POLIMI

edited by Alessandro Biamonti, Luca Guerrini and Ilaria Mariani



Direction: Silvia Piardi

Scientific Board:

**Alessandro Biamonti, Ezio Manzini, Carlo Martino,
Francesca Tosi, Mario Piazza, Promil Pande**

Over the last few years the international design research network has become an important reality, which has facilitated the sharing of ideas and opinions, improved understanding of the subject and increased awareness of the potential of design in various socio-geographical contexts.

The current expansion of the educational network allows teachers, students, researchers and professionals to meet, both online and in person.

It would seem therefore that the time is now right to propose a new series of books on design, contributing the construction of the international design community, helping authors bring their work onto the world scene.

The Design International series is thus born as a cultural setting for the sharing of ideas and experiences from the different fields of design, a place in which you can discover the wealth and variety of design research, where different hypotheses and different answers present themselves, in an attempt to draw up a map of Italian design, though in a continuous comparison with the world scene.

Different areas of design will be investigated, such as for example: fashion, interior design, graphic design, communication design, product and industrial design, service and social innovation design, interaction design and emotional design.

Books published in this series are selected by the Scientific Board and submitted to two referees for peer-review.

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Cover by Ilaria Mariani

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One Step Beyond. Outcomes of Doctoral Research in Design, Year 2017

Luca Guerrini and Ilaria Mariani

This book collects the outcomes of the research work carried out by nine PhD candidates of the doctoral programme in Design of Politecnico di Milano, who completed their three-year commitment and discussed their thesis early in 2018. It furthers the effort, started in 2017, of documenting our research production and sharing its results with a wider community of design scholars (Biamonti and Guerrini, 2017).

As with any picture of an ongoing process, it shows a slightly blurred image: pushing some figures into the foreground light and leaving others in the background shade. In 2014, when these students began their work, more than twenty lines of research were suggested, covering all aspects of industrial design, from object to urban space; investigating a variety of communication techniques; envisioning new services and strategies; promoting sustainable behaviour and social change; digging into the theory and history of design; and exploring the potentials of cultural heritage, which is a fundamental concern in the Italian context. In this respect, the book does not cover the whole range of topics currently investigated within the doctoral programme, as it rather provides the reader with a partial yet clearly defined viewpoint, the one embedded in theses completed in the current academic year.

In the light of this reasoning, and acknowledging the considerable amount of literature written on design research and on design practices, and how they feed each other, this book aims at investigating the ongoing practices in a specific context, that of doctoral studies, as dynamic as multifaceted.

Since 2009, when it was established, the doctoral programme propelled the manifold research activities conducted in the Department of Design, a community of almost two hundred scholars, research fellows and PhD students focused on both probing the disciplinary foundations of design and increasing its fields of application. The programme and the whole design com-

munity inherit the legacy bequeathed by worldwide-known masters of Italian design such as Gio Ponti, Alberto Rosselli, Achille Castiglioni and Marco Zanuso, who were trained and then lectured for decades at Politecnico. Their work constantly aims at merging two intellectual attitudes into the design process: on the one hand, a “humanistic” approach focused on the cultural and social complexity of any man or woman, on their being crossroad of personal identities and collective traditions, which distinguish them both as users and as consumers; on the other, a “critical-constructive” perspective that identifies each design outcome, each product, as a “question” – in an anthropological sense – about the value of human needs, even before providing these needs with an appropriate “answer” (Guerrini and Gerosa, 2016). The contribution these masters made in shaping the design community at Politecnico is not only in their ideas and in the numberless list of valuable products they designed, but also, and especially, in their approach to human events: as ironic and disenchanting, as playful and affectionate¹.

With regard to doctoral research, the PhD programme in design is grounded in a sound tradition, dating back to 1990, when the first doctoral programme in “industrial design” was established. At the start, the doctoral faculty acted as think-tank and core of the rising design community. In the following years, many scholars and research teams from different disciplines joined the group. Bringing a variety of cultural backgrounds, research interests and personal experiences, they contributed to enhance the community and to create a lively, open-minded context. Particularly in doctoral research, the exploration of forefront topics has been encouraged regardless of the disciplinary foundation, methodologies not yet formalised have been welcomed, and innovative research tools have been designed and tested.

This informal approach to research still qualifies the PhD programme. It stimulates disciplinary discussion on various topical subjects, accrediting design research as a multifaceted practice that relies on multiple methodologies and crosses different domains. In this respect, the programme is committed – as any design community at present – to building a design research culture able to push further knowledge boundaries, and to contribute towards gaining a deeper understanding of design itself (Manzini *et al.*, 2000).

The nine design perspectives presented in the book explore the design field reaching out to such topics as material and finishes (A. Piselli, G. Galimberti), gender equality (M.I. Reina), design activism (A. Poshar and P. Volonté), design pragmatisms (F. Domingues), sustainable energy (E. Bacchetti),

¹ From an interview to the Head of the Department of Design, prof. Silvia Piardi: <http://www.dipartimentodesign.polimi.it> and <https://www.youtube.com/watch?v=Wh0zW-WKr3SY&feature=youtu.be>.

innovation within makerspaces (R. Saint-Clair), social responsibility (M. Corubolo), and design thinking (X. Pei). Nine design perspectives that stem from different philosophical assumptions, characterised by their own aims, contents and processes, outlining a research frame that is varied and dynamic by nature. As a matter of fact, designers are continually expanding their field of investigation (Buchanan, 1999), confirming «that design is by nature an interdisciplinary, integrative discipline» (Friedman, 2003: 508), intrinsically capable of entering into a dialogue with other disciplines and research areas.

As a common thread, the topic of innovation runs through the entire volume. Each chapter makes an attempt to push the contemporary design knowledge ahead, showing awareness of the issues and constraints arising when theory goes into practical application. Moreover, when reading the chapters it clearly emerges how these doctoral researches find a key field of experimentation in the activities of both the School and the Department of Design. Courses and workshops become valuable venues for constructive design practices, where research insights and their outcomes can be tested and where research potentialities and constraints can be fully explored.

Due to the variety of topics investigated, the fields of application and the expected outcomes, it is hard to categorise these works under neatly defined groups. If we adopt a sharp distinction between “what” these research works are about and “how” they reach their goals (Rampino and Colombo, 2010), some clues may be found. As for the “what”, only two theses address theoretical problems that may fall under the field of Design Studies (Margolin, 2010), thus emphasising the preference these young researchers demonstrate for operational issues rather than for theoretical speculation. From a viewpoint of the type of problem addressed (Buchanan, 2001; Friedman, 2003), theses dealing with operational issues are equally distributed, between *clinical* and *applied* research. The variety of topics tackled within the doctoral programme does not prioritise between clinical and applied research, rather, it supports investigations that may be seminal for expanding disciplinary foundations.

Finally, we may adopt the distinction, suggested by Cross (1999), about the sources of design knowledge: *people*, *processes* and *products*, considering the last-mentioned ones not only as objects – as in Cross interpretation – but also in a broader sense (product, services and systems). In this respect, the candidates focus mainly on «the tactics and strategies of designing» (6 out of 9) – that is, on processes – thus confirming design methodology as a major area of doctoral investigation.

Other clues about the doctoral programme training strategy may come from the research approach, the methods, and the tools employed – the “how” of research.

As for the research approach (Creswell, 2014), all theses adopt, in a broad sense, a qualitative one. They largely draw upon research paradigms and methods of human sciences, implicitly acknowledging that «when we study design, we study a form of human action that arises from a social situation» (Margolin, 2010, p. 71). However, when the field of engineering is concerned, as in the case of Galimberti and Piselli, a generalisation of results (quantitative approach) is suggested or other definitions due to specific disciplinary reference (holistic approach) are taken into account.

A categorisation largely employed within the doctoral programme to classify research contents is the one suggested by Frayling (1993) about research *into*, *through* and *for* design. In this respect, we can acknowledge that the vast majority of theses falls under the central category (eight out of nine). Only Felipe Dominiques' work specifically addresses theoretical issues, although in some cases, particularly those of Marta Isabella Reina (*Gender issues*) and Marta Corubolo (*Social innovation*), research outcomes may be partially seen as extending the disciplinary theoretical framework (research *into* design).

None of the theses copes with the «thorny» type, viz. that of research *for* design. As a matter of fact, this category has been rarely explored by PhD candidates at Politecnico. In a survey conducted a few years ago on 36 theses in design discussed between 1994 and 2008, only three of them fully fell under that category². However, time has passed since Frayling outlined this category for both artists and designers as a matter of «autobiography and personal development». Design as a discipline and as a research practice has significantly changed in the last three decades, consequently a definition of what we might interpret as research for design should be revised and updated, although Frayling's overall interpretation still sounds effective. Particularly when procedural aspects are crucial, as in Service Design, it is hard to split the process from the outcomes sharply, even in a research context, as they are indeed bound together as such. In this respect, Elisa Bacchetti's thesis on distributed energy for all could fit into a revised version of research *for* design.

The fundamental role of social and economic actors emerges as a common trait among many theses, particularly in respect of research strategies – procedures, methods, and tools – adopted in tracing the route that connects the research question to its final outcomes. Increasingly more often, PhD candidates conceive their theses as a collaborative process involving every actor and stakeholder. Interviews for getting first-hand information and workshops for shaping and testing specific design solutions are becoming

² The survey was conducted by Fiammetta Costa and Luca Guerrini; it involved about 1/3 of the more than one hundred theses discussed in the period and was presented at the *Swiss Design Network Symposium '09* (12 - 13 November 2009, Lugano, Switzerland).

shared procedures. The action-research model (Villari, 2012) is frequently adopted to merge design theory and practice. Final users in particular perform an essential role as counterparts of the researchers in every stage of the research process. In this respect, an increasing awareness of the social, economic – and even political – value of design research is rising among PhD candidates, thus reshaping and reframing many theses toward a participatory paradigm (Sanders, 2013).

The rich variety of topics covered by the PhD candidates suggested structuring the volume into sections and gathering the chapters around four main fields of investigation: manufacturing, design culture, technological shift, and social impact.

The first section, devoted to *Manufacturing*, highlights the close link between design research and its application to industrial production. The theses in this section have been developed as targeted doctoral projects, in an interdisciplinary context combining design knowledge with engineering, particularly chemical, mechanical, and materials engineering.

In *Materials Selection in the Professional Appliances Industry*, Agnese Piselli describes methods and tools for evaluating sensorial properties and durability of materials and finishes. This doctoral research, funded by a multinational professional appliances manufacturer, stems from spotting a current industrial problem to solve in the company's Research and Development department. Engineers and industrial designers select materials in different stages of the product development process, following specific, sometimes diverse purposes. The thesis presents the concept, the design and the implementation of a systematic, holistic method for material selection and the operational tools designed for facilitating and smoothing the decision-making process. Providing original insights into the field of materials selection, Piselli's thesis bridges the disciplinary gap between materials engineers and industrial designers. It especially shows how, benefitting from the twofold perspective of industry and academy, this investigation opens up new scenarios for industrial design, where users' experience on products and their behaviour towards material and finishes are crucial for successful choices.

Acknowledging the most recent technological developments about rapid prototyping and manufacturing methods, the thesis *From Metallic Powder to Object*, by Giorgia Galimberti, explores how metal objects produced through additive manufacturing technologies are perceived by customers in order to expand the range of application of this new technique. Additive manufacturing functionalities and capabilities have been increasingly applied in industrial production, resulting in new customized products, in the use of complex geometries, and in discovering unexpected material properties. Although

powder bed-fusion techniques, such as selective laser melting, have been receiving a widespread industrial acceptance, how users perceive such objects is still a matter of investigation. Accordingly, Galimberti uses selective laser melting techniques to 3D printing icons of design, and investigates how users perceive such rapid-prototyped shapes. The research makes use of quantitative methods, involving more than six hundred participants. The analysis of collected data brings us to the definition of a set of design rules that makes use of statistical models to recommend plausible shape and surface finishes meeting the appropriate user perception.

Through three contributions, the section headed *Design Culture* investigates how design mediates contents, shares perspectives and comes up with tools and methods for empowering designerly practices. The first two theses point out how the mainstream, as well as a specific subculture, could benefit from including a design perspective that is more aware of its attitudinal and behavioural effect on society; the latter expands the theoretical boundaries of design to support designers in products and services development.

The first thesis taps into gender as a pervasive aspect of design research and practice. An aspect that is often involved implicitly, following non-representative, stereotyped associations with sexes. Marta Isabella Reina's *Communication Design for Gender Cultures* deals with a controversial, sensitive topic of societal relevance: gender issues. Acknowledging that design practices and research activities are unequivocally in need of an in-depth understanding of gender needs, behaviours and attitudes, Reina's thesis presents models and tools for raising awareness and opening critical reasoning on gender equality in Design Education. In a designerly way, it investigates the relationship among design, gender and representation, drawing attention on the designer's role and responsibility in amplifying social conventions and in feeding gender-role-related behaviours. The aim of this research is providing designers with the necessary knowledge and tools, and empowering them to harness their capacity of vision and anticipation, for rethinking formats and rules of communication in a gender equality perspective.

Investigating the role and responsibilities of the designer from a different perspective, in *Engaged Designers as Cultural Commuters*, Andréa Poshar and Paolo Volonté address activism and activist movements as practices of communication design. Reaching out to Communication Studies and Sociology Theories, Design Studies and Design Practices, and grounding itself on a qualitative research conducted through in-depth interviews to well-known activists, this contribution is a case of research *through* design focusing on how contemporary activist designers foster, in an unexpected way, social and cultural change. The authors describe designers that engage with social

movements as vehicles connecting mainstream culture and counterculture. Having worked or still working for commercial purposes, they contribute to the transformation of counter-culture. Having engaged or being still engaged in activist groups and events, they are sources of cultural innovation for mainstream communication. They produce cross-fertilization when they physically move (“commute”) from one setting to the other. They do not even need to be particularly creative people, nor they need to be aware of the effects they produce on society. Social commuting is in itself a movement that creates symbolic cross-fertilization. Therefore, engaged designers, as commuters, are in a social position that enables them (often as “asymptomatic carriers”) to bring about cultural innovation in contemporary societies.

Finally, *Pragmatism within Design Practices: Proposal of Paradigm Shift in Design Semiotics Research*, by Felipe Domingues, digs into the mediation processes from a semiotics and design management perspective. It presents a method to tap into and to analyse the pragmatistic dimension of artefacts, aiming to provide designers with theoretical and technical support during the analytical stage of products and services development. Aiming to support both co-design practices and early stages of designing industrial goods and services, a full methodological research framework providing theoretical and empirical systematic contributions has been developed and tested. Embracing the perspective of Peirce’s notion of sense and Eco’s understanding of functions, and considering the ways users make and negotiate meanings of objects, the chapter presents a response to the current need of introducing systematicity into research processes within design semiotics.

From the broad to the small scale, the section titled *Technological Shift* deals with new technologies and their contemporary application. The two theses presented share common social purposes, but result in two very different ways of dealing with technological innovation shaped to answer specific needs.

The section begins with Elisa Bacchetti’s chapter, *Towards Sustainable Energy for All*, describing the design and application of the Sustainable Product-Service System (S.PSS) model, providing distributed renewable energy (DRE) solutions. Her thesis is founded on the assumption that sustainable development and sustainable energy for all are inextricably linked. Recognising the urgent issues at stake, this research fits the concept of Distributed Renewable Energy (DRE), proposing a new framework of intervention based on adoption of a Sustainable Product-Service System (S.PSS). The chapter describes the design approach, the process, and the related tools that have been developed, as well as their on-field application. It particularly describes a design activity conducted in Africa for energy professionals, where the developed design approach and tools were employed and tested.

In addition to the many ways that innovation is defined or perceived, there is a growing understanding that the development of a «culture of innovation» is crucial to its progress, in many cases more pivotal than technological excellence. Ricardo Saint-Clair's *In the Interior of Innovation: The Makerspace Paradigm* investigates the complex social field of Makerspaces and FabLabs, in an attempt to overcome a current lack of specific literature, particularly concerning the analysis of built environment where these peer production communities meet, share and work. Going through the examination of 18 distinct locations in Europe, each characterised by its own dynamic ecology and adaptive attitude, this empirical study digs into makerspace rituals, protocols, topologies and layouts. Moreover, driven by the desire of understanding how such spaces can matter-of-factly encourage human agency and innovation, it explores the impact on people's behaviours and social interactions. The result is twofold. On the one hand, a conceptual framework based on the hypothesis that intangible qualities and behaviours from the digital workspaces are being transferred to the built physical ones. On the other, a mobile app that, working as a research tool, is a generative programme, a reflection of participants' needs and desires able to adapt and evolve continuously through the co-participation of members and users.

The final section, *Social Impact*, builds on the assumption that when design activities deal with organisational, social and cultural issues, the role of a designer is not limited to fostering organisational-economic performances: in fact, human-centred and social-oriented aspects of design impel designers to explore new perspectives and unexpressed needs that go beyond conventional business.

Marta Corubolo, in her *Design in a Collaborative Multi-Stakeholder Ecosystem*, covers the challenging ethical topic of social responsibility through a design perspective. Complex social needs, as the ones tackled by social innovation, require integrated and innovative approaches able to combine and manage the contributions of different actors. More specifically, the private sector is called upon to acquire an active role through a stronger recognition of its potential and by sharing all its resources – not only economic ones. Moving from the recent debate on the evolution of corporate social responsibility and the trajectories for scaling social innovation, the chapter discusses the contribution of the design discipline, and of strategic and service design especially, in bringing together the private and third sector in the co-design and coproduction of socially innovative services. A new systemic approach is needed to allow every actor and stakeholder to gain a common perspective on strategies, methods and tools to tackle shared societal issues, and to be empowered towards a more collaborative and structured way of operating,

thus restoring the awareness of the benefits of working together. The hypothesis advanced in this research is verified by a series of experimentations involving local communities, social enterprises and big companies. In particular, the chapter presents an on-going Italian project on communitarian and cross-sectoral welfare, reflecting on how the design approach could play a crucial role especially in structuring such multi-stakeholder processes.

Finally, Xue Pei reflects on how design thinking can offer an effective methodology and practical experiences in fostering third sector organisations, helping them to connect with their target communities and to establish new ways of operating and managing themselves. Her chapter *Developing Design Capabilities in the Third Sector* traverses the areas of both organisational design and social impact design. After a robust literature review on these areas, and a selection of successful case studies in which third sector organisations employed design thinking methods, the research adopts an action research strategy and a participatory design approach to scrutinize the fundamental issues under consideration, and to define the appropriate tools to tackle them, in a peer-to-peer discussion with all actors involved. Eventually, the research findings disclose new characteristics of the “designerly” organisational design approach specifically targeting the third sector and different types of organisational encounters that act as promising platforms to enable third sector organisations to reach their social mission and purpose.

Much collective work, particularly at present, is necessary to meet the needs and to face the challenges of a globalised society. Design culture is strongly engaged in these tasks. These collected papers provide an overview on how young researchers from all over the world contribute to challenging and questioning specific issues by adopting fresh perspectives for solving actual problems. They shed light onto clearly defined subject matters, extending disciplinary knowledge and reaffirming the designers’ commitment to transform existing situations into preferred ones.

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Why do We Need a Design PhD Festival?

Alessandro Biamonti

If we really wanted to discuss the scientific dimension of design as a discipline, I think we could easily spend days among great beautiful sand castles. Among arguments that enhance the castles for their constructive rigor (perhaps a little ‘architectural’), and positions that analyze the sand very seriously exploring its material and aesthetic qualities. Personally I find that to insist on wanting to circumscribe our beautiful, vital, anthropologically indispensable discipline within the “scientific” domains, therefore wanting to use for it the methods, the approaches, the type of writing etc. that are used for science, is a very sad affair. There is always more to design than science.

I used the term “very sad” in an emblematic way, because sadness is not a scientific dimension, but an existential condition, and design has to do with existence.

Design uses techniques, technologies and materials as “means” to an “end”. The “end” has to do with the existence of men, with their intuitions, their desires, their needs, their desire to be happy. Let’s take note of it.

We do research also to learn about these ends, not only about the means. This is research at the highest level. Its results reflect the breadth of topics, approaches and methods that design faces. A research that has more and more need to deal with its thousand declensions.

This usually happens in conferences, which often follow the model of scientific conferences. At the Politecnico, we have tried a different path. Even in our case, it is a question of “ends” and “means”.

The presentations must take place not with the purpose of exposing results, but as a means of activating different levels of interaction. They are about disciplinary interaction that must necessarily take place through personal involvement. They are about knowing each other, appreciating, discussing, and sometimes perhaps even arguing on different positions. Up-

stream, there must be a deep esteem (otherwise you would not waste time even to fight), but to achieve the “ends”, it is necessary to activate situations that lead beyond the academic esteem.

In every society, community, social assembly, one of the tools used to gather around a theme is the celebration of the theme itself. From the great religious celebrations to the most intimate and domestic ones. So even for the research doctorate we want to offer the possibility of celebrating the result of a research path. The long path of the candidates’ thesis, but also to celebrate the work and studies of other universities in the world that are facing this aspect of the discipline. Moreover, for a number of years, design has been pursuing the search for its own methodology and its own methods to make and disseminate its research in an authentic, autonomous and effective way.

We wanted to propose a “frame” for all this. The frame is the Milan Design PhD Festival (www.phdfestival.com) within which the research, the chatter, the curiosity can find space. Sometimes there are disagreements, but always vis-à-vis, with the idea that behind (or in front) this research, these thoughts, there are people with their lives, and with these people we would like to make a toast at the end of each day. The Festival is a “means”. The “end” are the toasts and the potential interactions they embody.

That is why there was a need for a PhD festival.

Material Selection in the Professional Appliances Industry

Agnese Piselli

Materials selection in the design engineering field

In new product development, one of the central decisions is the choice of materials, finishes and manufacturing technologies. Materials selection is a multi-criteria decision making problem which involves seeking the best compromise between material properties and design requirements (Ashby, Shercliff and Cebon, 2007) such as functional conditions, design limits, user behaviours and environmental conditions (Ashby, 1992; Cornish, 1987). Several methods and tools have been developed to guide material selection over the last fifty years (fig. 1). Focused on technical property evaluation, engineering-based methods are the first and most commonly used approaches (Ashby, 1992; Budinski, 1996; Cornish, 1987; Farag, 2002; Lindbeck, 1995; Patton, 1968). Widely implemented also in industrial contexts (Chatterjee, Athawale and Chakraborty, 2010; Grujicic *et al.*, 2009; Javierre *et al.*, 2015), materials selection is considered a mature discipline for everything regarding material performance evaluation in technical applications (Wongsriruksa *et al.*, 2012). Other material features, known as sensory criteria or aesthetic properties (Ashby and Johnson, 2002), are embodied in the ‘skin’ of a product (Del Curto, Fiorani and Passaro, 2010) and can be related to users’ experiences with and through materials (Karana, Pedgley and Rognoli, 2013; Manzini, 1986). These properties are usually, but not always consciously, evaluated by product designers when selecting materials and finishes. The surface features that can be perceived by the human senses as linked to a material’s physical properties (Wilkes *et al.*, 2014), are named ‘sensorial properties’. On the contrary, if such features are linked to a greater extent to a product’s value and identity, or user experience and preference, they are identified as ‘intangible properties’ (Karana, 2009). Materials’ sensory and