The issue 69 of **diid** opens reflections on the current relationship between Design and Science. It aims to observe whether Design, leaving its consolidated areas, leans to denaturalize itself and lose its disciplinary skills or if, rather, it leans to acquire new ones by investing in the dialogue with Science not only the technological skills, but also the germinating ones from the relationship with Biology, Chemistry, Medicine, etc.
The open dialogue between Design and Science seems to prefigure a new sphere of knowledge which, alongside that of humanistic and scientific culture, today offers interesting spaces for action and interaction: real experimental laboratories, see the white coats of scientists in contact with the designer work overalls. So, scientists discover the envisioning ability of design, designers, for their part, change their approach by becoming "homo faber" and manipulators not only of matter, but also of living organisms.

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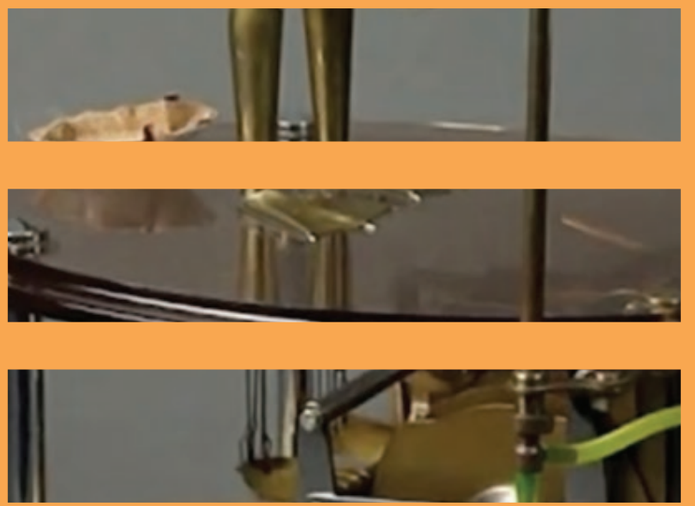

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The scientific nature of Design

The debate on the relationship between Design and Science is not new.
Nigel Cross reminds us (2001) that the question has already emerged in an evident way two times in the modern design history: in the 1920s, when the emphasis was on the development of products considered the result of a "scientific" design (or better technological) and therefore linked to innovation; and in the 1960s, where the accent was given to the methodological dimension to guarantee a "scientific" design process, precisely, and therefore rational and objective. Moreover, being, in his opinion, this type of cyclical reflection, Cross expects that this beginning of the new century would have seen a reappearance of attention to the relationship between Design and Science.
Today, after the first twenty years of this new century, it seems that attention to this relationship has become essential again to understand the very nature of the present and near future design. Moreover, if according to a more mediatic dimension this attention seems to want to fascinatingly redesign the figure of the designer – who leaves the artist's shop attentive to the dimension of beauty to attend the alchemist's cabinet who experiments with the nature of things – in a more structural way, the urgent question is understanding design as a discipline and therefore as a science among other sciences has reopened today.
This contemporary reinterpretation of the scientific nature of design refers to the collapse of knowledge as it had been conceived and structured in the 20th century, to the complex dimension of increasingly interconnected knowledge, to the fluid nature of the information made accessible to all.

[knowledge, methodology, design for science, design science]

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Design and the "scientific" issue

The critical attention to the scientific dimension of Design arises within the modern culture of the 20th century according to the desire to produce pieces of art and products based on objectivity and rationality values considered at the base of any scientific approach.
The Modern Movement, which in the field of Design found its full expression in the experience of the Bauhaus, searched in scientific reasons the vision of a human condition and finding in mathematics the expression of new geometric forms, in psychology the expression of new aesthetic values, and again in physics the expression of new artificialities.
The need for scientific reasons adhered to the positivist impetus and absolute confidence in the ability to generate knowledge and progress. Which then found its maximum expression in the reconstruction of the second post-war period.
In the sixties of the last century, when it was consolidated the most objective vocation of doing Design, aspiration and will move towards considering Design as a scientific discipline with paradigms, methodologies and intelligible approaches to transfer universally, and abandoning the aesthetic and subjective dimension that had previously characterized Design as a form of art, albeit applied.
This expectance was going through the debate on an international level, although it is in the Anglo-Saxon culture that the highest interests or at least the most evident systematizations develop.
The Conference on Design Methods organized in London in September 1962, where, for the first time, the community focuses on the methodological question under the push of the new-born Design Methods Movement. This new movement aimed to structure the design process on a rational dimension. The most radical exponent of this trend was certainly Buckminster Fuller (1960), who called for a "science design" revolution based on science, technology, and rationalism to overcome human and environmental problems that he believed could not be solved by politics and economics. Likewise, Herbert Simon (1969) developed the theory of "a science of design" to be introduced into universities as a new discipline: an intellectually hard body dedicated to the design process, analytical doctrine, in part formalizable, in part empirical, teachable.
These are the same year when, in the school of ULM chaired by Tomas Maldonado, a scientific dimension of the Design education has also experienced, according to which every design process had to start from scientific thought arrive at a synthesis of multiple factors.
Soon, however, the various crises that invested the modern thought became the ground for the first counter-reactions to the methodological push in Design. In the seventies, even by the same proponents of the previous movement, there was a refusal to drift to the excessive behaviourism that demanded a Design based on consequential logical frameworks, but which in fact could not breach the design practice still linked to more informal dynamics (Jones, 1977).

Rereading what some of the authors who had addressed the question of the method had already postulated, in recent years, Design has recognized a synthetic dimension compared to the analytical one of Science.
Design recognizes the ability to model the components of new structures (Alexander, 1964), to invent things (Gregory, 1966) and to understand and imagine how things should be (Simon, 1969), in the face of the Science that identifies the components of existing structures (Alexander, 1964), implement a model of behaviour to discover the nature of what exists (Gregory, 1966) and deal with how things are (Simon, 1969).
In these same years, new elements come into play in the Sciences, especially in physics and biology, which undermine the objective and rationally logical dimension that had guided it since its first steps. These were also the years of the rediscovery of "cybernetics" as hybrid knowledge with an exploratory approach, free from linear thoughts of engineering matrix, and which also involved philosophers and sociologists. For years Fritjof Capra has published his "The Tao of Physics" (1975), where he demonstrates the profound convergence between relativistic and quantum physics and Eastern religious philosophies, both far from the mechanistic view of classical physics.
From a cultural point of view, the counter-reaction to the methodological and scientific approach of Design was also the result of the late 1960s cultural climate made of revolutions on university campuses, radical political movements, new liberal humanism as a rejection of consolidated values.
The same culture informed the Papanek's thought (1972) collected in his book "Design for the real world; human ecology and social change": a manifesto about the radical rethinking of Design abandoning any effort to theorize this branch of knowledge.
Despite this change of trend, the debate on the "true" nature of Design continues to be alive and finds a phase of enrichment in the different forms of local cultures in response to the modernist internationalization of knowledge.
Moving on Italy, with evident differences and with an approach close to the semantic dimension, our Bruno Munari (1963, 1966, 1971, 1981) ventured into the formulation of a design process both objective and potentially transferable and applicable by anyone definitively dismissing the figure of the "artist" designer, a man only illuminated by a creative vein, towards a "worker" designer in the sense of the one who works according to known and repeatable phases. But even in those years, always in Italy, the radical culture developed definitively taking away any deterministic aptitude from Design (Pettena, 1977; Pettena, 2004)
Then, in the 80s, we witnessed a renewed attention, albeit with a different approach, to the scientific dimension of Design, through the birth of research journals, theory, and methodology of Design. In 1979 Design Studies was born and in 1984 Design Issues. It is possible to affirm that, with these magazines, Design has consolidated as a discipline and definitively and autonomously became part of the body of knowledge, no longer as handmaid of others who sometimes saw it as a form of artistic expression, albeit applied, to a declination of architecture on a small scale, other times still only a phase of industrial engineering design.

In those years, besides these scientific journals, more and more frequently, International Conferences were organized to build the disciplinary corpus of Design.
During the Design Research Society Conference titled "Design: Science: Method" (1980), several experts agreed to overcome the simplistic distinctions between Design and Science, because Design was no longer in need of acquiring or learn other scientific methods but, instead of development of its own. (Jacques, Powell, 1981)
So, the reflection shifted from understanding what Design could learn from Science to understanding and recognizing the differences between Design and Science, putting them on the same no longer antithetical level as had always been done for Art and Science.
In fact, in the practice of science, the method is vital to validate the results. While, in the practice of Design, the method takes a less stringent and less objective character, because the results do not necessarily have to be repeatable.
So, the epistemology of Design has the task of developing the logic of creativity, of innovation, of the invention. Matters, these, considered by the classical philosophers of science as elusive and, therefore, as extraneous elements. (Glynn, 1985)
These are the same reflections at the base of what will become the key theme of the Design debate at the end of the 20th century.
Design, recognized as autonomous and self-determined knowledge, claims a field of knowledge linked to the dimension of innovation and creativity, definitively dissociated from technology that, left as a prerogative of the engineers, Design does not determine but uses.
Away from the efforts of the Design Methods Movement, now the debate seeks drawing on ethnography, philosophy, sociology, and psychology, with a more humanistic and cultural approach. That is to explain and regulate those nature of Design previously rejected because it is too associated with artistic subjectivity. Creativity, as a distinctive element of Design, becomes the theme also trying to shorten the distance between discipline and practice. Designers become theorists of themselves, and Design theorists use designers as case studies.
In these years, Frayling (1993) theorized the three categories of research in Design – into, through, for – defining definitively that Design does research and therefore is a science itself; Manzini (1990) defined Design as a "weak" action; Maldonado (1991) definitively opened the field of action of Design from the technical-formal dimension to the systemic-environmental one.
The relationship between Design and Science thus seems to disappear from the debate, and even the concern to sanction methods for Design no longer seems to be a priority, at least if by a method we mean the set of rules, directives, and conventions used to set and conduct research. In short, the effort to bring Design back to a scientific dimension seems to lose all legitimacy while a reflection on the social meaning of Design as human action begins.
Bruce Mau (2004) was the first to reflect on this updated "nature" of Design with the exhibition and book "Massive Change: Expanding design's role in the world" opening

the debate towards the future of Design, putting its sphere of competence in crisis, widening it. Immediately after John Thackara (2005), with "In the Bubble: Designing in a Complex World", also theorized a rethinking of the responsibilities of Design (taking up the criticism opened 30 years earlier by Papanek).
On the same trend, even if with a less severe and more open approach to solutions, the posthumous work of Rich Gold (2007) arrives, where brings into play, albeit mixing the factors, the question between Design and Science saying that the first, together with engineering, has the task of transforming the visions of Science, and the Arts, into concrete "stuff" for the real world.
So, in those years, having reversed the question, the relationship between Design and Science completely changed and became a question of complementarity.
Design is therefore no longer a "science" for anyone – meaning by this a knowledge, doctrine, set of ordered and coherent, logically organized knowledge – but an attitude is a thought, understood as a cognitive process often not easily definable on a descriptive level, an intelligence that informs a specific act.
In the same years, at the Moma in New York, the anticipating exhibition "Design and elastic mind" (Aldersey-Williams, Antonelli *et al.*, 2008) was inaugurated, to demonstrate that Design is an attitude of the human ability to evolve adapting to the context, stimulating research and imagining new combinations of knowledge.
Moreover, Tim Brown, with his "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation" (2009), crystallizes what will become the mantra of the last decade, Design Thinking.
At this point, the fascination between Design and Science reopened. However, this time it is Science that discovers to can take something from Design. Something that, in scientist logical doctrines, seems to miss: the ability to create new connections, of looking at things (and problems) with what many years earlier someone had defined "lateral thinking" (Bono, 1970) and which today Brown has called precisely "planning thinking" (and indeed not "design" method).
Moreover, Design rediscovers Science with new eyes and no studies it to learn its rules or to seek confirmation but listens to it for stimuli and pollinates it to try to build new scenarios.

The three scientific "natures" of Design

Today the "scientific" question of Design seems to have reached a new beginning. As Nigel Cross foreshadowed, a new cycle of reflections, studies and experiments seem to have begun, where Design is free to move in any direction its "thought", thanks to its disciplinary autonomy.
Perhaps, precisely because of this "freedom" of relationship, despite the various attempts to clarify the relationship between Design and Science, this is still something articulated, if not confused, which cannot be explained only through stories of more or less virtuous experiences. We still need (and here we return to a method problem) to investigate the Design approaches.

In doing this, we are helped by an interesting distinction, which although referring to a different context appears today equally valid and clarifying, between three different scientific "natures" of Design: the nature of "Design for Science", the nature of "Science of Design" and, finally, the nature of "Design as Science".
Not surprisingly, three natures which are linked to the three categories of Frayling by attitude.
The nature of "Design for Science", more than others, refers to the construction of the Design methodological apparatus and, therefore, with its modernist roots.
Design for Science refers to the contemporary concept of Design which bases not so much its knowledge but as its doing on scientific knowledge. It is a Design that uses reworked methods from time to time, making structured approaches converge with intuitive approaches towards a Design practice whose ultimate goal is certainly an innovation.
Design for Science has learned to dialogue, on the same level, with the scientists who discover things, with chemists of materials to change the nature of objects, with neuro-scientists to build new behaviours, with biologists for rethinking the ecosystem in which man is called to live, with geneticists to change man himself into a more advanced system.
Design for Science in order to act, more than others, rejects the rigorous dimension of Science, precisely to put itself on the different plane and thus be fertilized and fertilizing.
This nature links to "research through design" category, becoming a sort of non-scientific Design due to an antithetical sense of opposite.
So, this Design becomes able to postulate without following the logical paradigms of Science.
The nature of "Design Science", on the other hand, openly takes up what Buckminster Fuller wished in his time to define the pertinence and the boundaries of a different and autonomous branch of knowledge. The various currents that seek to clarify the purposes of Design are here expressed, by overcoming the simplistic taxonomy linked to the object of the Design that more appropriately pertains to professional practice.
In this context, Design turns to Sciences to understand, as in the beginning, scientific methods and tools to make them as own in order to specify its field of action. Studies and practices to bring Design closer to the historical studies to open up to the critical dimension (Design Studies). Those approach economic studies to discover the managerial dimension (Design Management); and, again, those who approach psychology or sociology to explore the behavioural dimension (Design Culture).
Therefore, Design Science addresses the problem of determining and classifying all the phenomena of the systems to be designed and the design process and is concerned with deriving from the applied knowledge of the Sciences appropriate information.
In this perspective, the Science of Design links to the "research into design" category, placing itself as a link between Design and other Sciences, becoming a corpus of sub-sciences that, starting from the principles and methods of other sciences, places Design as the subject of their cognitive interests.

Finally, the nature of "Design as Science" is the one that clarifies, by subverting it, the relationship between Design and Science.
In this case, the scientific nature of Design is no longer, as in the first case, attributable to the simple transfer of knowledge from the different Sciences, and it is not, as in the second case, concentrated on discernment through paradigms of other knowledge of its action.
This nature, adding the previous, transforms Design in Science.
In doing this, it rises to an almost autarchic dimension that considers Design as a scientific activity of its own, replacing, in some cases, the other sciences, or instead takes the baton, in the path that transforms scientific discovery into shared heritage available to society for its evolution.
Just like other Sciences, both exact sciences or humanities, focus on their forms of knowledge, Design as Science focuses on how Design knows, thinks and acts.
In this case, Design as Science links to "research for design" category, where the applicative and experimental dimension replaces the Design practice, and this is informed by its own intellectual culture that does not necessarily and in any case need to import knowledge from the other sciences (or from the arts).
Therefore, today, in this triple nature, and its different nuances, the relationship between Design and Science must be re-considered, becoming the only able to move towards a higher level, if compared to the relationship between Design and Technology and Design and Art.
In fact, in those, the epistemological dimension remains coherent and opens only to forms of possible development or envelope. While, the triple nature of the relationship in between Design and Science becoming is the only one potentially open to new knowledge scenarios in which Design can aspire to a real evolutionary process (Di Lucchio & Giambattista, 2017).

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