Balance in…Forms

The Dance of Design

Giordano Bruno and Massimo Ciafrei

We present some projects carried out by students attending the second year of the bachelor's course held at *ISIA Institute* in Rome and in the seats in Pescara and Pordenone for the joint workshop combining the course *Mathematics for Design* and the course *Theory of the Form*. The topic explored is balance in its broadest sense. The workshop "*Balance in…Forms*" is an experimental workshop where students have been invited to investigate the different aspects of the relationship between maths and design. By developing new, ambitious and original solutions to the problem of the formalization of space structures with analytical control, students have learned to work with languages, principles, techniques and elements of various nature. The artefacts have been created by integrating industrial design with ideas and experiments on languages, which were elaborated by young design students in the scientific, artistic, technical and speculative field using their sensibility and rationality, intuition and imagination. The projects range from complex space structures to different forms of creative investigation and try to develop an aesthetic-figurative and culturally diverse production keeping in mind their potential use in future design and scientific applications.

Mathematics and Balance

Undoubtedly, there is a strong link between these two terms. In mathematics, balance refers to the calculation of balance points, to dynamic systems, to Poincaré's and Thom's theories, to applications for financial markets and so on. But we also have mathematics of balance, that is, a science which has found a way to bring us closer to and make us understand reality in the relation between its forms: geometric shapes and algebraic and analytic formulas. How fascinating the Fibonacci sequence is to us—to know that when n increases, the ratio between the previous term and the

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M. Emmer, M. Abate (eds.), *Imagine Math 6*,
https://doi.org/10.1007/978-3-319-93949-0_14

next one in the sequence tends to that extraordinary number referred to as *golden ratio*, which nature has *produced* and human intelligence has tried to comprehend! And what about the balance (and therefore the elegance) of an algebraic formula such as the well-known $e^{i\pi} + 1 = 0$? The same is true of music, ballet, and artistic gymnastics, which are expressions of structural and body balance and owe it all to mathematics. That is why we wanted our students to investigate and look for old and new balance relations between forms and shapes, giving birth to a sort of dance of design.

Course in Theory of the Form

Professors: Massimo Ciafrei, Claudia Iannilli

Learning to investigate and express
the untapped potential
of biological and artificial
structures of materials
and technologies to
trans-form them in new spatial
and complete organisms
through a design approach

The course in *Theory of the Form*, characterized by a didactic methodology based on research and experimentation, aims to bring students closer to the world of design by stimulating their ability to define logic processes and to handle complex systems of relationships. The didactics of metadesign, the scientific-cultural area in which the course is rooted, informs the designer's identity and includes the morphological disciplinary aspects necessary for the investigation of and experimentation with the formal features of projects. The course content deals with the study and modelling of single structures as well as of formal sets which build the contemporary visual and spatial landscape. The course focuses on the evolutionary processes of the forms and illustrates the significant syntactic systems obtained and the maturation of functional properties in a functional organism. The course's aim is to develop cultural, aesthetic-figurative and compositional works by conceiving the right use for them in relation to future design applications.

Course in Mathematics for Design

Professor: Giordano Bruno

The course in *Mathematics for Design* is taught in the first and second year of the BA syllabus in *Industrial Design*. The course purses several goals and aims at combining mathematics and its richness with design. Firstly, we have approached the topic of "uncertainty", which is common in every design project. The approach to uncertainty follows the methodology defined by Bruno de Finetti and based on

the "coherence" of probability assessments (starting with qualitative ones) and the way to properly update them with new information. Learning this way of thinking based on probabilistic logic, now regarded as primary by neuroscience, strengthens the analytical and critical abilities needed for design. Secondly, we have chosen to explore at least some of the many relations that exist and overlap between mathematics, science, art and design. Approaching these fields of creativity and human knowledge has the purpose of contributing to raise awareness about the fact that design is basically a cultural phenomenon which finds its formal expression—and other expressions—by drawing on these and other disciplines. All this has been possible thanks to Michele Emmer's films on Art and Mathematics: from platonic solids to combinatorics, from perspective to golden ratio, spirals and helices, from knot theory to the Möbius strip, from *Flatland* to the fourth dimension, from Escher and his impossible worlds to soap bubbles, from fractals to complexity and chaos. The imaginative and artistic aspect that illustrates these themes along with the mathematical concepts that accompany them—expressed in qualitative rather than quantitative terms—have allowed students to develop their own cultural production to be applied to their projects, as I have witnessed over the past thirty or more years in which I have had the opportunity and honour of teaching at *ISIA* in Rome.

The Projects

Tin tan **(Tin tan)**
Dynamic Vibration

Designer: Aleksandra Mehmetaj

"Tin tan" is a cylindrical frame containing some spring steel plates to which small metal balls are attached. When rotating on itself, the object generates a sound due to the contact between the balls and the metal plates. The experience is complemented by the vibration of the spring steel, stressed by the impact of the various components.

Equilibro **(Balance Book)**
Small Guide to Visual Balance

Designer: Irene Caretti

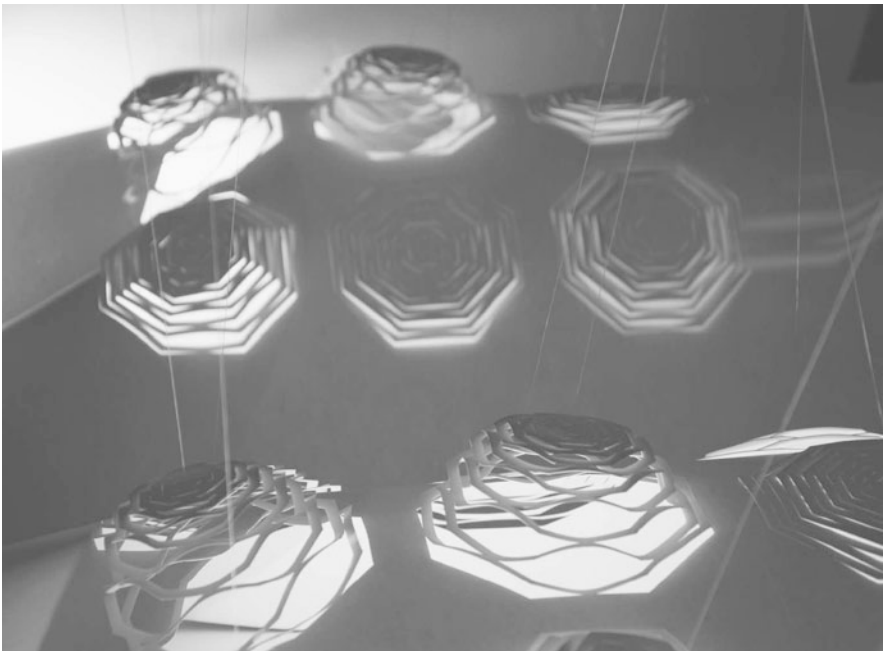
"Balance Book" stems from a research study on graphic-perceptive mechanisms. Such mechanisms are responsible for the achievement of visual balance in the composition of a work of art or, more generally, in the creation of graphic features. The purpose is to explain this dynamic to children through illustrations and very simple texts so that they can learn to consciously apply them in their drawings. As a matter of fact children draw by applying these mechanisms from a very young age, but they do it unconsciously.

Conscrict **(Conscrict)**
Interaction between Complex Elements

Designer: Flo Casco

"Conscrict" is a project that investigates the balance of some neoprene rings of different sizes subjected to compression and decompression. A transparent box houses these elements, presenting graphic features inside them to better observe their behaviour when compressed. The rings are forced into the box and compressed by a transparent cover. When the box is closed, it is possible to observe their behaviour under compression; when the box is open, the elements are released into space in a sudden and unpredictable manner.

***Amiens* (Amiens)**
Interplay on solids and voids



Designer: Elisa Cavezzan

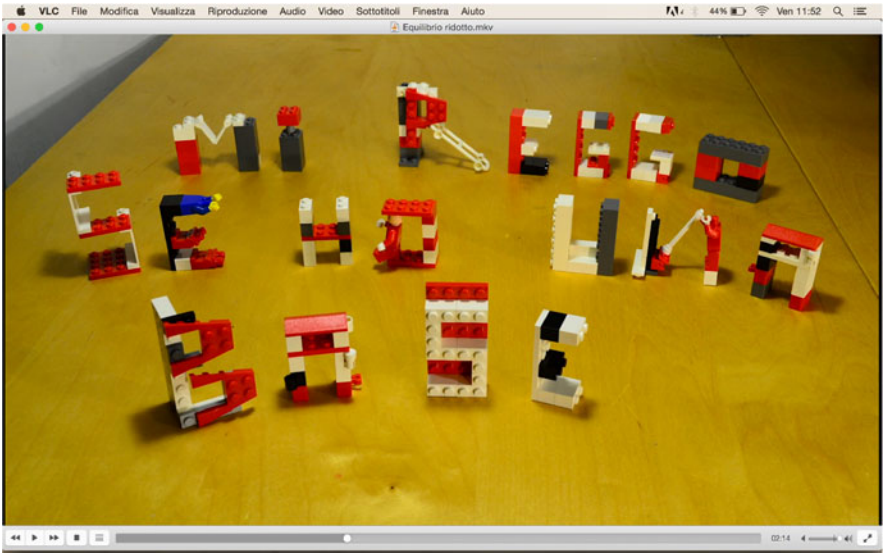
Amiens stems from the idea of finding a correlation between the solid and the void within a single element. Thanks to cuts on the surface of the objects, it is possible to move from the two-dimension regularity to a three-dimension irregularity. The transition between these two moments of the objects is the founding element of the project. It is also possible to catch the reverberation of light in the surrounding environment.

***Anemoi* (Anemoi)**
Natural Connections

Designer: Matteo Ciafrone

Anemoi is the Greek name of the wind god. The project was born out of the need to investigate the concept of balance in the natural world, where man is not at the centre and cannot have any control. The shape of the single elements, which is inspired by the marine world, is decontextualized and set into a new environment. The project wants to create a sensory experience, an invitation to loosen up in order to find your own balance, guided by the sound and dance of the small elements moved by the wind.

Equilibrio, come giocarci **(Balance—How to Play with It)**
A short lesson on Balance (Video)



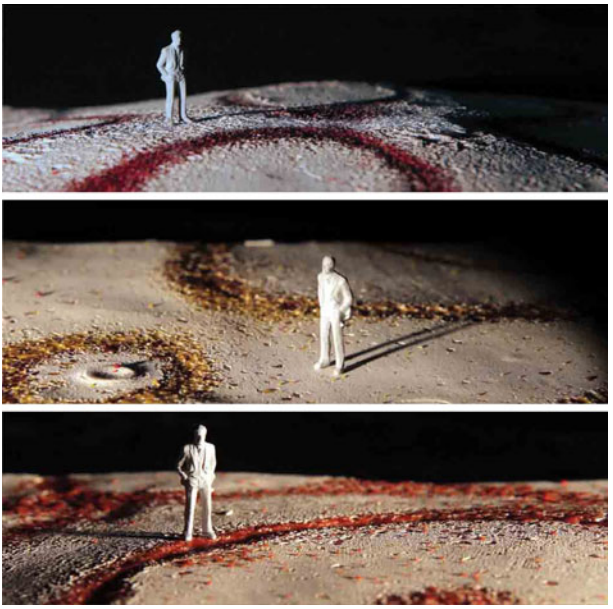
Designers: Giacomo Fabbri, Alessandro Fiorentino

"Balance- How to Play with It" was our way of designing balance. And in order to design it, you need to know it and to understand it. The challenge therefore became: let's explain it! To everyone and in the best possible way. And who can be the best judge if not children? They are impossible to deceive, always ready to get distracted and beyond any speculation attempt. Everyday objects have come to life and balance has taken over and led the way. Three points are stable, two need a push and what about a single one?

Morfologia del suono (Morphology of Sound)
Cymatics

Designers: Laura De Paolis, Sara Gentili, Valeria Gallo

The universe is an energetic whole that manifests itself in vibrations where every individual part is attracted by the resonance to similar sounds. Cymatics is the science that studies frequencies and the forms they produce: vibrations regarded as true entities. Their limit is indeed the perfect balance point; this is the generative energy in constant transformation. From this point of view cymatics can be interpreted as a dynamic holism that explores disintegration as a point of strength and rebirth.



400.000 years after the Big Bang, as space became denser and denser, it reached the optimal physical condition for sound waves to propagate. Today we can detect these ripples on the "surface of the universe" and, by analysing the traces of the initial sound waves, we can trace back the nature of the material that carried them during the early phases, thus obtaining information on how the universe was born and has evolved. Sounds from space are therefore the embodiment of previous cymatic experiments. The aim is to transform their mark into a permanent graphic element. The result is the impression of the sign through silica on the ultimate material—clay. Each shape matches the colour and the surface of a planet in our solar system, described thanks to three literary texts.

The sands of Mars by Arthur C. Clarke
A fall of moon-dust by Arthur C. Clarke
Lucky Starr and the big sun of Mercury by Isaac Asimov

***Discordante* (Discordant)**
The Hybrid of Sounds

Designer: Simona Girardi

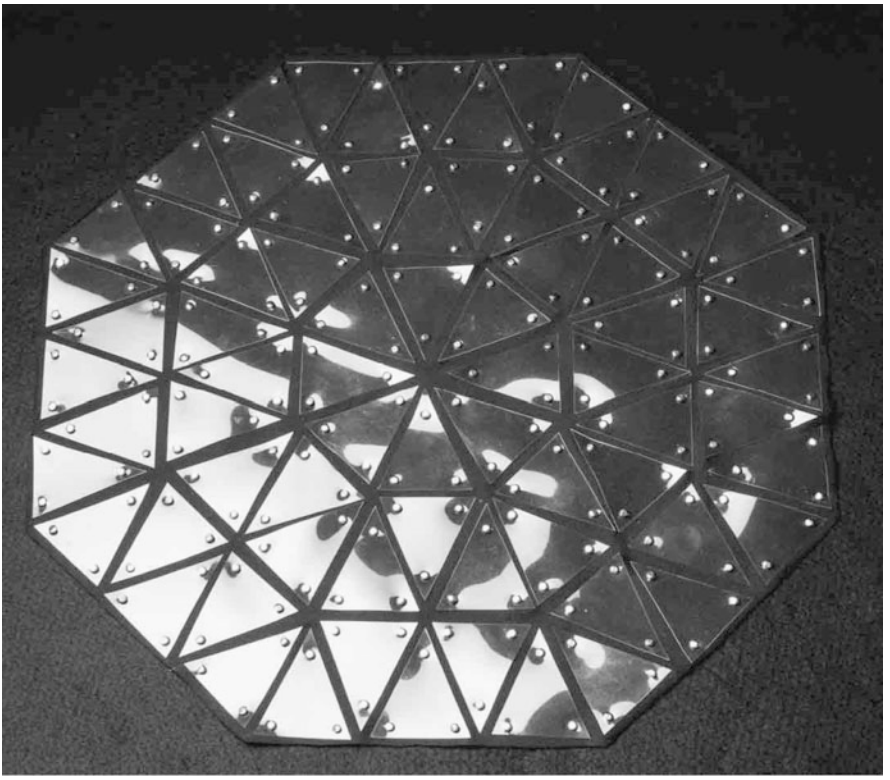
Discordant is a dynamic structure designed to produce sounds through motion. The aim is to create unexpected confusion thanks to the use of different materials, while elastic threads trigger the movement. The intensity of the sound depends on the speed released by the potential energy of the object. *Discordant* loses and finds back its stability simply through movement.

***Riccio* (Sea Urchin)**
Magnetic Balance

Designer: Jovita Kaulinyte

Riccio (Sea Urchin) exploits the characteristics of iron powder when subjected to a magnetic field. Metallic powder creates structures within the cubic space thanks to the influence of different magnets. The disposition of magnets characterizes the arrangement of powder grains within the circumscribed space of the cube, thus creating constantly new configurations.

***Umihotaru* (Umihotaru)**
Luminescent Structure



Designer: Daniela Lucci

The light blue bright stripes that give their colour to the Okayama beach rocks are not a strange special effect, but small, luminescent beings called *Umihotaru*. These crustaceans emit a powerful light beam that makes the Japanese sea a real multi-coloured sensation. "Umihotaru" consists of a modular surface made out of a series of triangular plastic elements. The surface creates fascinating games of reflection due to the action of natural light.

Il corpo in movimento (Moving Body)
Space, Time, Effort
Designers: Marzia Lupi, Gaia Stirpe

The purpose of the project is to illustrate body positions during movement through a visual code. The outlined visual code allows to correctly interpret sport gestures, which are explored in the immediate search for balance caused by muscular effort. Some body points have been taken as reference to graphically convey body movements. Among all anatomical markers considered, two were the funda-

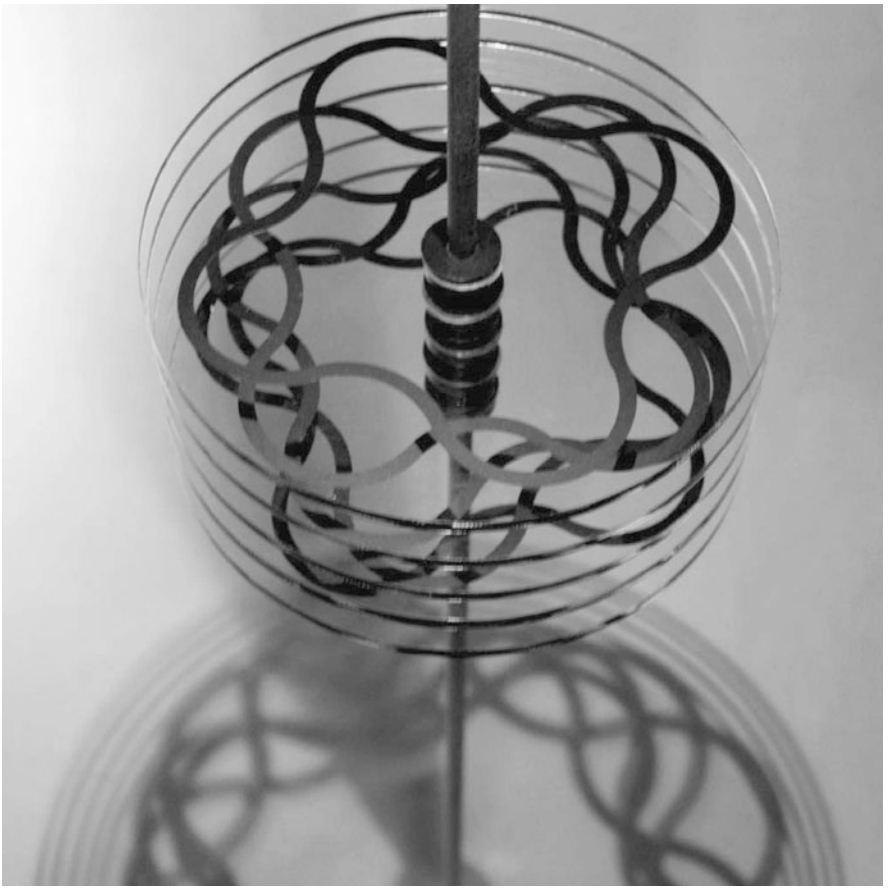
mental elements chosen to analyse motion: leg and arm joints. The most spectacular and scenographic movements of sport gestures were explored through the technique of motion capture and it was possible to obtain an expressive synthesis of the movement in the space-time-effort relationship thanks to the visual code developed. The visual language created is expressed through light signs that vary according to certain differentiation criteria. These allow to identify the evolution of the athletic gesture while searching for balance. The criteria are:

Colour: the five main shades refer to physical effort, from the minimal to the maximum effort (blue, light blue, green, fuchsia and red);

Deformation: the sinuosity of curves refers to muscular intensity in a given time span;

Size: the circles around the light signs indicate effort intensity- the greater the force exerted, the greater the size of the circles.

Aum **(Aum)**
Vibrations in Mechanical Form



Designer: Marcello Migliore

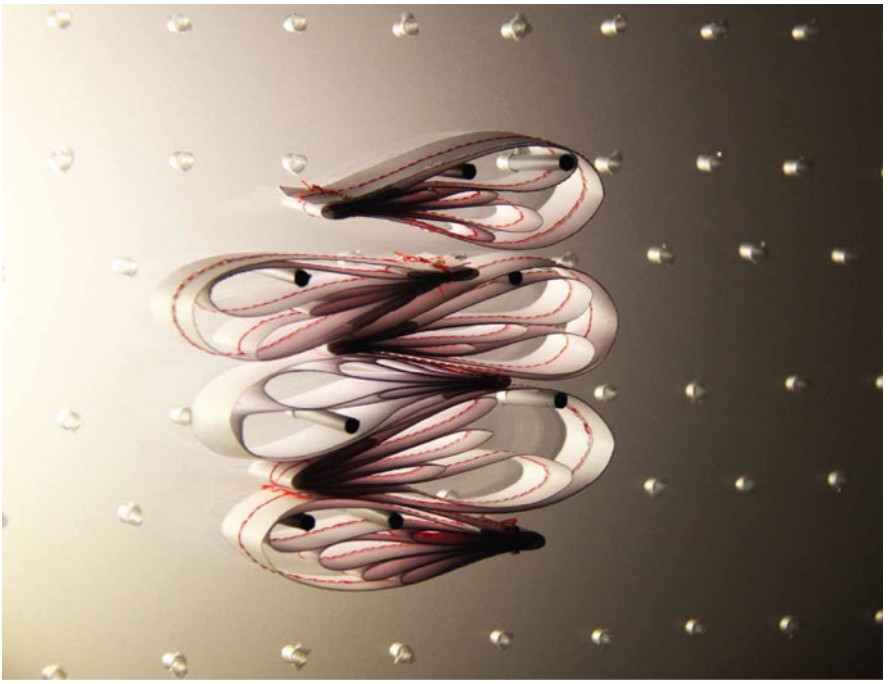
Aum is a system that combines forms, shapes, signs and structures in a precise and balanced relation to each other with the aim to capture the attention of the observer through the mechanic reproduction of marks and perceptions found in nature.

***Kujaku* (Kujaku)**
Wind is Blowing Outside

Designer: Stefania Moscatiello

Kujaku, changeable in its appearance, looks like an animal: it may be the metaphor of a peacock with a filamentous tail which creates complementary or splitting optical effects during its motion. *Kujaku* is inspired by the oriental taste and made of wood cylinders and spring steel. Its appearance is light and thin. *Kujaku* is a structure composed of threadlike elements and moves thanks to air currents. The object, free to roam around, marks its passage and traces unpredictable paths. It is a meta-design project based on experimentation on the helix and embraces the geometry of forms and the rotating and oscillating dynamics generated by the wind and random movements. It is made of spring steel and has a fixed axis and four independent screws that revolve around it. This creates a particular shape that favours the movement of rotation and oscillation depending on where it is located. *Kujaku* will react differently to wind thrusts and other external agents.

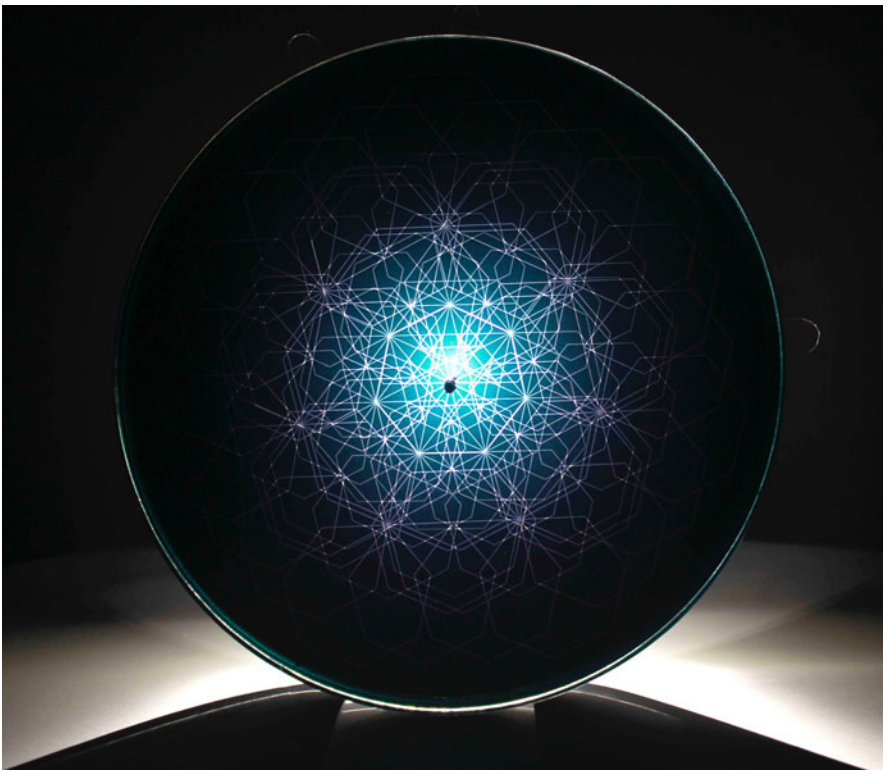
***Drop* (Drop)**
Drop of Light



Designer: Ileana Nuzzi

The simple harmony of *Drop* and the ephemeral shape of drops have inspired not only the name but above all the origin of the project. The composition of the modules and the delicate reflections of light on the folds of the object create light and shadows on a modular matrix. Depending on the aggregation of the elements, light permeability can be intensified or decreased. The characteristics of the paper employed allow light to spread, while cotton finishing gives daintiness and colour to the elements used.

***Hepta* (Hepta)**
Geometric Chaos



Designer: Dimitri Spagnulo

The study of the morphology of this light modulator is an attempt to find a non-trivial geometric construction that may convey visual and sensory emotions. The basic element chosen is a regular heptagon: it is a complex and interesting shape due to the disparity of the sides and the width of the angles, which are not compatible with simple systems. Several cases of interlacing, overlapping, colour changes, solids and voids were analysed in order to work on different levels interacting with each other. The result is intriguing and fascinating.

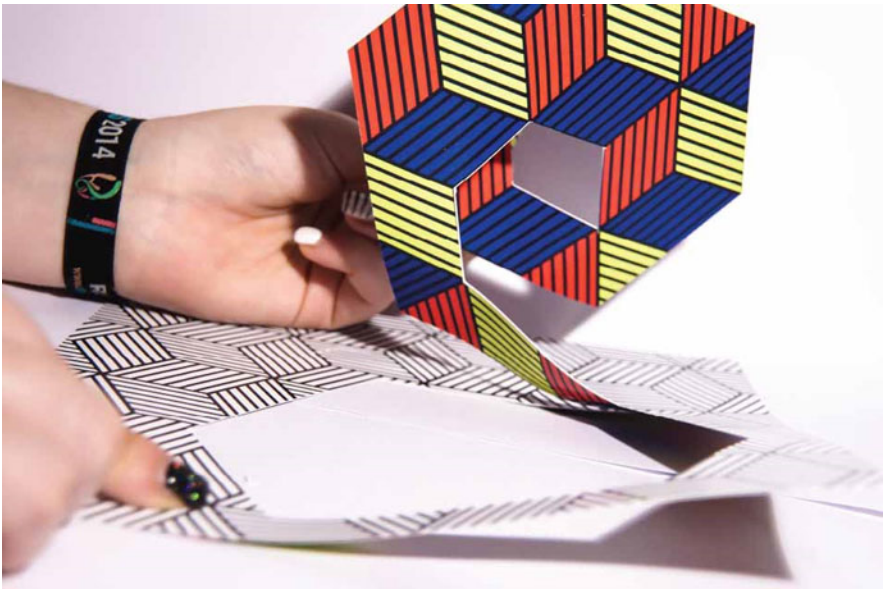
Where we see chaos, we see natural order.

***Zero waste* (Zero Waste)**
Natural Semi-Finished Products

Designers: Enrica Tartaglione, Adrienn Sasvári

The project idea is to focus on the manufacturing of industrial products that can find their way back into the decomposition cycle without any environmental impact. In line with this, natural elements deriving from everyday waste have been identified during the development of a kind of packaging that may ensure strength as well as may display remarkable aesthetic qualities. The main components are flour, pea peels and peanut discards. These have been added to binding materials, such as honey, water and corn starch. The material developed evaluates the interactions of the product with the environment, considering its entire life cycle, from pre-production, recycling to final disposal. It is about circular economy: this refers to a production system where the same resources are employed several times through re-use and re-cycling, thus resulting in remarkable efficiency gains. The system can be used in various fields depending on specific needs.

***Vertigo* (Vertigo)**
Colour and Shape



Designer: Francesca Tucci

The project was born with the aim of de-constructing the shapes in our mind in order to create totally different ones. *Vertigo*, as the name says, recalls both something that gives dizziness and something that gives a sense of rotational instability. It represents a new birth for unknowable shapes and colours. The fundamental element for this rebirth is the spiral that connects the monochromatic world, representing the scientific and rational part of the mind, and, dichotomously, the chromatic one that represents the creative and extravagant part of thought.

Acknowledgements We would like to thanks Lorena Luzzi (Pescara and Rome), Paolo Crescenti and Bruno Testa (Pordenone), industrial designers who have supported us during this didactic experience. We thank all colleagues involved in the *Image Workshop*, Enzo Agnello (Rome), Paolo Finore (Pescara), and Guido Cecere (Pordenone), for the photographs. We also thank Marzia Lupi, project coordination, Gaia Stirpe, video editing and Giacomo Fabbri and Alessandro Fiorentino, exhibition graphics and visual communication.

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