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**Cognition in design
management. At the
intersection of conceptual
innovation and design
thinking**

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Cognition in design management.

At the intersection of conceptual innovation and design thinking

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Abstract. Design thinking has been a growing topic over the past years in management literature. The novelty brought by this approach to managing innovation processes is not simply due to an enriched set of phases and principles, but it rests on the way innovation opportunities are framed through design. We suggest that the design thinking approach helps to deal with an inner and deeper level of each innovation process, that is the conceptual one. Counterintuitively, we argue, that this process of conceptual innovation starts much earlier than the “concept generation phase” already enucleated within the design thinking process. Drawing on most recent contributions on the cognitive nature of innovation processes, the paper aims at investigating the conceptual innovation mechanisms that are at play in design thinking dynamics.

Through a multiple case study of three iconic design innovations in Italy, that revolutionized the way a scooter, a moka or a shop was conceived, and gave rise to a new generation of products and concept shops, we have identified the three phases of the design thinking in each innovation process and detected the mechanisms of conceptual innovation operating in each of them.

Keywords: design thinking, conceptual combination, innovation

JEL Classification Numbers: M13

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Introduction

Design thinking (DT) approach has been growing ‘voluminously over the past five years’ (Liedtka, 2014: 925) and the topic has become central also in management literature (Ravasi and Stigliani, 2012).

Two contributions are mainly ascribed to design thinking. First it is an approach that has been successfully applied to boost complex innovation processes, “where breakthrough thinking and disruptive innovation is required, or to address “wicked” problems (Rittel & Webber, 1973) where the nature of the problems and the system’s context may be unclear or highly complex” (Gruber et al. 2015). Second, it has been proved that design thinking can be applied in different sectors (manufacturing and service) and to solve a broad range of innovation problems (Brown & Martin, 2015).

These two features highlight the great potential of design thinking and suggest that the novelty brought by this approach is not simply due to an enriched set of principles and processes in managing innovation, but is related to the way innovation opportunities are framed through design. We suggest that the design thinking approach helps to deal with an inner and deeper level of each innovation process, that is the conceptual one. Counterintuitively, we also argue that this process of conceptual innovation starts much earlier than the “concept generation phase” already enucleated within the design thinking process.

Concepts are basic representations that organise our experience, they are cognitive tools by which we deal with reality and changes it (Tsoukas 2009). Creating a new concept, modifies, even radically, the way we see things and conceive reality. Concept innovation operates at semantic level and implies a significant reinterpretation of meanings carried out by a product, a process or by a business model. Research recently argued that conceptual innovation lays at the heart of the discovery of a new category of product (Seidel 2007), process (Comacchio and Warglien 2010) and business model (Martins et al., 2015; Aversa, Furnari, and Haeffliger, 2015; Mikhalkina and Cabantous, 2015; Bruni and Comacchio 2016). Most recent studies on product innovation, turned attention to product semantic and looked at design as ‘a combination of signs that gives meaning to a product’ (Ravasi and Stigliani, 2012: 472).

Notwithstanding the recognition that innovating at conceptual leads to fundamental transformations of the way we represent reality, still studies on conceptual innovation are limited, and not very much related to the debate on design thinking. Yet, the recent call to take a cognitive perspective on design thinking, suggests that is timely and theoretically sound to investigate conceptual change mechanisms underlying innovation processes driven by a design approach.

We suggest that design thinking implies mechanisms of conceptual innovation and drawing on most recent contributions on the cognitive nature of innovation processes, we aim at answering the following research question: what conceptual innovation mechanisms are at play in design thinking dynamics?

Our empirical research is based on a multiple case study of three iconic design innovations in Italy. Each of them revolutionized the way a scooter, a coffee moka or a shop was conceived, and gave rise to a new generation of products and concept shops. By looking at the process of innovation of Vespa-Piaggio, Bialetti moka, and 10 Corso Como, we identified the three phases of the design thinking in each innovation process and detect the mechanisms of conceptual innovation operating in each phase.

Our paper contributes to develop a cognitive view on design thinking shedding light to a yet underexplored aspect of design thinking that is the way it entails conceptual innovation.

1. Background

1.1. Design thinking dynamics

Design thinking has been successfully applied to boost complex innovation processes, “where breakthrough thinking and disruptive innovation is required, or to address “wicked” problems (Rittel & Webber, 1973) in different sectors (manufacturing and service) and for a broad range of innovation problems (Brown & Martin, 2015).

Design thinking has been analysed at process level to distil the essential principles that guide designers in their endeavour to create (Liedtka, 2014; Gruber et al. 2015: 1), the process steps are mostly based on the framework of the d-school of Stanford University (2010).

Discovery is the first step of design thinking process. It starts from the observation of human experience and is characterised by exploratory moments of data gathering to identify user needs. According to Gruber et al. (2015: 1) it involves an ‘acute observation of the users and of the system’s context and constraints’. The search for insights about the relevant use and usability needs of the customer, embraces also the meaning-based needs (Beckman and Barry 2007: 30). The reflective observation of the usage context plays a pivotal role in the discovery process of the user’s experience, to discern which meanings are attached to a product and its usage. The embeddedness in the usage environment that ethnographic research methods provide, the opportunity to empathize with the customers and see the world through their eyes (Beckman and Barry 2007: 34) is appreciated and exploited, in this phase.

Define is the second stage of design thinking and it involves a process of developing insights and synthesizing data collected, for problem understanding and framing. In this phase the generation of a problem space large enough to generate a rich set of alternative solutions is preferred. As suggested by Carlgren, Rauth and Elmquist (2016) diversity is a key theme of DT. Formulation process thus can benefit from the integration of different perspectives, for instance by gathering together a diverse team and putting together divergent views coming from distant fields.

The third key steps are ideation and delivery. Ideation explores, through prototypes and visualizations, alternative potential solutions and how different types of users and stakeholders might interact with those solution concepts. Visualization is another key theme of DT according to Carlgren, Rauth and Elmquist (2016), they describe it as “making ideas tangible by means of low resolution representations or mock-ups of ideas or solutions” (Carlgren, Rauth and Elmquist, 2016: 47) but also delving on role-play and storytelling. In the delivery phase, the prototype is tested to identify “inner” (technical) robustness and also “external fit” with users’ needs and the usage contexts. Experimentation through an iterative process, allows to try a prototype several times, get early feedbacks, and learn what does work and what does not.

We suggest that the design thinking approach helps to deal with an inner and deeper level of each innovation process, that is the conceptual one. Thus DT implies mechanisms of conceptual innovation and their investigation help a deeper understanding of the design thinking dynamics at

cognitive level. Thus, we aim at answering the following research question: what conceptual innovation mechanisms are at play in design thinking dynamics?

1.2 Conceptual innovation dynamics

Research on innovation at conceptual level has identified two fundamental cognitive processes: analogical thinking and conceptual combination (Martins et al. 2015; Gassman & Zeschky 2008; Gavetti et al. 2005). In order to understand how design thinking unlocks the capacity of creative innovation at cognitive level, we turn attention to the fundamental mechanisms that operate in both processes. Both analogical thinking and conceptual combination are recognised as apt to generate a deeply innovative concept, according to innovation literature (Gassmann and Zeschky, 2008), organization and strategy literature (Tsoukas 2009; Gavetti, Levinthal, and Rivkin, 2005; Gavetti and Rivkin, 2005), cognitive psychology (Fauconnier and Turner Thagard 2012) and business model studies (Martins et al 2015; Bruni and Comacchio 2016).

We do not sustain that these are the only mechanisms at work to tackle the complex creative challenge of design, another process together with analogy and combination, is abduction (Dorst 2011; Tsoukas 2009). While abduction has been more in depth analysed in relation to design (Dorst 2011), conceptual innovation brought by analogical thinking and conceptual combination is still less unknown, and we suggest it is central in design management practices. Conceptual innovation is a cognitive process of integration of different conceptual inputs through different mechanisms. While there are fundamental differences between analogical thinking and conceptual combination, literature has also identified some basic mechanisms characterising both processes.

The generation of a new concept, implies the creation of a new conceptual structure by adding components (attributes), and by creating new predicates (causal relations) among them (Gentner, 1983; Fauconnier, 1997; Thagard and Verbeurgt, 1998; Gärdenfors, 2000). Conceptual innovation thus generates a novel network of components and relations carrying new meanings and ways of viewing things (Fauconnier and Turner, 2002).

A first mechanism at the basis of conceptual innovation is the recognition of similarities between different conceptual domains. In the process of searching for sources of solutions, detection of similarities among elements, and/or structural features of two concepts or conceptual domains, act as a trigger for the identification of potential candidates for a conceptual integration. Corresponding components might be recognized also due to some dissimilarities, that capture the attention and lead to a more in depth observation and analysis of a conceptual domain. Direct experience of a specific field or domain eases the recognition of similarities or dissimilarities.

A second mechanism is conceptual mapping or composition . By the mapping mechanism, elements of a single or multiple conceptual inputs, identified through similarity recognition, are selected and transferred to the new concept. In analogy the conceptual structure of the source is transferred to the target concept. In conceptual combination a set of conceptual elements and their relations is projected from input domains to create the new emerging conceptual structure that characterize the new idea-solution.

A third type of mechanisms is the process of elaboration (Fauconnier and Turner, 1998). In the elaboration operation, the newly generated concept is run through mental simulations (Fauconnier and Turner, 1998: 144). A new concept, made by projected attributes and relations has to be tested and adjusted. Simulation provides useful information to reach a coherent and stable structure, by adding or deleting components and relations. In this testing process need to be improved both the

internal consistency of elements and the external fit of the new concept with the usage environment. This might imply reiterated cycles of simulation with further conceptual structure refinements, and the possibility for multiple successive combinations (Fauconnier and Turner, 2002). In the following sections, through a multiple case study we will analyse in depth three key examples of conceptual innovation design driven. We selected iconic cases of new ideas generation characterised by a truly creative endeavour driven by design and developed across different sectors. They have not been developed explicitly following the design thinking principles, still we think they are very powerful instances of phases and mechanisms at work during the creative steps of a standard design thinking process. We will detect whether the central phases are recognisable in the three innovation processes and identify which conceptual innovation mechanism are at work in each phase.

2. Research design

Since the complexity of the research question we decided to rely on a qualitative approach (Yin, 2003; Eisenhardt and Graebner, 2007), and in particular on a case study methodology that involves an interpretive lens and rests on different data. We decided to develop a multiple case study to obtain more generalizability across different cases (Eisenhardt, 1989). We selected the three cases as three icons of the Italian design, and three radical innovations: innovation at product level – Moka Bialetti, Vespa and a service innovation as 10 Corso Como. The three cases help to illustrate our idea that the design thinking unlocks the capacity of creative innovation at cognitive level. They are all Italian successful ideas with a long history in the market (the oldest is the Moka with its launch in 1933). They are also known at international level and they are illustrative of a certain Italian style and design. Two of them – Moka Bialetti and Vespa – have been mainly studied in the industrial design field and they are still neglected by management literature. The third case – 10 Corso Como – is instead a concept store which has been largely copied across Europe and North America and, to our knowledge, has never been considered by management scholars. As argued by Ravasi and Stigiani (2012: 465), design does not only involve the design of an object, but it ‘may include a variety of ‘objects’, such as products, visuals, environments and interactions’.

Data collection and analysis

Our data, synthetized in Table 1, consist of a variety of sources: newspaper articles, scientific publications, interviews, and information retained by companies’ websites. We undertook extensive web searches, including examining the historical materials retained by companies’ websites that gather relevant information about their own foundation and their evolution. We also collected photographic material (historical print advertising and pictures, e.g. industrial drawings from Moka Bialetti and Vespa websites), video materials (historical advertisements and company documentaries) that allow us to reconstruct the longitudinal trajectory of the three concepts and to trace how they developed over the years. From a methodological perspective, we used multiple sources to reinforce our data analysis and to constantly triangulate our coding (Strauss and Corbin, 1990). As it is a longitudinal and retrospective analysis, the variety of data helped us to mitigate bias errors (Eisenhardt and Graebner, 2007).

In analysing the data, we used method for case analysis (Pettigrew, 1990) and for grounded theory building (Glaser and Strauss, 1967; Strauss and Corbin, 1998). We thereby relied on an inductive approach built on a constant comparison and a back and forth to our sources to build more robust insights across multiple and heterogeneous cases (Glaser and Strauss, 1967; Strauss and Corbin, 1990; Miles and Huberman, 1994).

We built a chronicle of the key events to establish and identify the specific moment in which the concept has been created and modified; we then proceeded with a separated open coding (Miles and Huberman, 1994; Saldaña, 2013), highlighting fragments of text that specifically referred to the process of designing the new concept. The two authors regularly encountered to compare insights and emerging themes; disagreements were resolved by discussions among the two authors to reach a common consensus. Findings were finally aggregated into first and second order categories, by juxtaposing data and emerging themes with existing theory to generate more-abstract aggregate dimensions (Gioia, Corley, and Hamilton, 2012).

Insert Table 1 about here

3. Findings

3.1 Designing new concepts: three historical cases

Moka Bialetti

Between the I and II World War, the aluminium metal was widely used in aeronautics and the Fascist Italian government considered this material as the ‘national metal of Italy’ (Schnapp, 2001). It was promoted as one of that embodied the traditional Italian values, especially of those that of craftsmanship and fine design (Lidwell and Manacsa, 2009). The famous designer and architecture Giò Ponti in 1931 had issued a call in his magazine ‘La casa Bella’ (The Nice House) to promote a public debate about this metal among designers, architects, and manufactures.

The inventor engineer of Moka, Alfonso Bialetti had a long experience in aluminium industry in France. In 1918 Bialetti had returned to Italy and founded a small metal and machine shop in Crusinallo, in his native Piedmont, a region with a long tradition of metal work (Schnapp, 2001). Bialetti started with a ‘small industrial oven, an anvil, and a milling machine’ by adopting a technique that he had observed in France: ‘that of gravity casting aluminium in reusable cast iron molds’ (Schnapp, 2001: 252). Around 1933, by watching his wife doing the laundry with a machine called lisciveuse, he got attracted by its system: a fire, a bucket, and a lid with a tube coming out of it. The bucket was filled with a soap, sealed with the lid, and then brought to a boil over the fire. The vaporized soapy water was pushed up through the tube and expelled on to the laundry.

Alfonso Bialetti selectively used the knowledge he acquired from aluminium industry with the observation he had of the washing machine. Moreover, he examined other espresso machines companies such as La Pavia, Cremonesi, and Gaggia that were experimenting to produce something less expensive and less troubled coffee machines (Schnapp, 2001). Bialetti opted to produce coffee machines by using cheaper and less prestigious materials but that would have resembled in shape and design to silver coffee services: the metal.

Thereby, Bialetti blended the modern technology of aluminium, a rudimentary and not sophisticated material, with the concept of Italian tradition for elegance and craftsmanship. Bialetti transferred the flared, symmetrical eight-faceted design of Hoffmann, Puiforcat, Genazzi, and Hénin that were silver coffee services present in the luxury emporia of Milan (Schnapp, 2001). Differently from these coffee machines and from the well known Neapolitan, he thought of one self contained aluminium unit, divided in three pieces: the lower part served as a boiler, the second portion sealed off the first one that, when heated, the increased pressure forced the water up through a conduit and basket packed with ground coffee that surged up into the upper chamber and spill over to fill a pot (Schnapp, 2001; Instruction Manual of Bialetti). The entire process, prompted by that of the rudimental washing machine, it was splitted into two phases (Navarini et al., 2008). The first one is the regular extraction phase, when the liquid–solid extraction occurs. In the specifics, ‘the lower tank of moka air–vapour mixture and the evaporating water can be considered a closed system, whose pressure, increased by sensible heat and water evaporation, drives the extraction of the coffee. [...]’. In the washing procedure, women used to fill the bucket with soapy water, sealed with the lid. In the Moka, the first phase is followed by the second one, named the strombolian phase, ‘when the water level in the tank reaches the end of the funnel, there is a short-cut between external ambient and internal air–vapour mixture, which no more drives in-tank water out of the tank. At this point, the remaining water undergoes intense evaporation’ (Navarini et al., 2008: 1000). In the washing machine procedure, the bucket was brought to a boil over the fire and the vaporized soapy water was pushed up through the tube and expelled on to the laundry. Finally, as shown in Table 2, after the observation phase and the definition of the concept through the mapping of conceptual components of both two inputs, Moka has been adjusted in terms of technical and design issues to finalize the proper prototype and stabilize the concept (Fauconnier and Turner, 2002). The following images (Figure 1 and 2) illustrate how Moka changed, after its first prototype designed by Bialetti in 1933. From a more technical point of view, the need to ‘achieve the proper flow of coffee through the apparatus and to overcome the tendency for boilers to crack under pressure or blow up’ was solved by modifying the alloy used, the wall thicknesses, and by adding a safety valve (Schnapp, 2001: 253). The maker, made by aluminium, helps in maintaining heat in a uniform way (Navarini et al., 2008). The handle was initially made by wood. However, it was quickly replaced by bakelite, a material that helps to minimize heat conduction. Its ergonomic shape was changed with sharp angle that keeps the pouring hand clear of the hot metal lid (Lidwell and Manacsa, 2009: 120).

 Insert Figure 1 about here

Vespa Piaggio

The well known motorcycle Vespa was created in 1946 and it is a result of the conceptual combination of three inputs: bicycle, motorcycle and aircraft sector (Fauconnier and Turner, 2002). Relying on the design of the engineer Corradino D'Ascanio, Piaggio created the first model of the category, Vespa 98. As described in the Table 2, the antecedents of Vespa are two models that can be considered prototypes: MP5 Paperino and MP6. Enrico Piaggio had the idea to design both of

them after having experienced the launch of the small olive-coloured Cushman Airborne motorcycles dropped by parachute during the II World War into the Italian industrial heartland of Milan and Turin. At the beginning of 1944, Enrico Piaggio was driven by the desire to start up the production of vehicles for the widest market at a low-cost production. In the post-second world war, Enrico Piaggio then ‘entered the complex business of restructuring Italy with a precise idea – he wanted to build a simple means of transport that would be cheap, consume very little petrol and could be ridden by everyone, women included’ (from museum Piaggio archive).

He firstly left the project to Renzo Spolti who designed a load-bearing scooter with a large protective shield and a headlight applied to the front mudguard. Despite the central installation of the engine gave the vehicle some stability, the tunnel between the saddle and the handlebar – intended to accommodate the engine – inevitably took away some practicality in taking the seat to the women. Then, Enrico Piaggio decided to commission the project to the aeronautical designer Corradino to ‘develop a vehicle that will put Italy on two wheels’ (Lidwell and Manacsa, 2009: 202). Piaggio commented that since D’Ascanio knew very little about motorcycles, he was in the ‘ideal position to create a vehicle without precedents’. According to Piaggio, D’Ascanio was the only one who can ‘tackle the problem with a wholly new outlook’ (Lidwell and Manacsa, 2009: 202). D’Ascanio had a long experience in designing parts of aircraft. He had been collaborating with Piaggio since 1931 to develop a new mechanical component that had revolutionised aviation history: the variable-pitch propeller. Before the outbreak of World War II almost all the aircraft produced in Italy were fitted with propellers designed by D’Ascanio. The aeronautical engineer Corradino D’Ascanio took the challenge to design a simple and economical form of urban transportation. He brought concepts from his aircraft knowledge and decided to combine them with the idea of a typical motor on a hard wheel with a comfortable seat. Moreover, he mapped the concept of practicality by looking at bicycles:

I followed intuitive criteria, I felt that the machine ought to serve those who, like me, have never ridden a motorcycle and hated the machine’s lack of manoeuvrability. I thought it over for a while and on Sunday the basic idea came to me. The most important factor was being able to mount the vehicle comfortably, something that had already been resolved with the ladies’ bicycle. So I started out with the concept that is fundamental in the ladies’ bicycle. I felt a seated position was more comfortable and rational than having to straddle the frame (D’Ascanio from Lidwell and Manacsa, 2009: 202)

Vespa was then conceived as a motorcycle that had to be used by everyone and everywhere, especially to ‘get around the bomb-damaged Italian cities’ (Lillie, 2014). D’Ascanio hated motorcycles because he considered them as ‘too cumbersome, difficult to repair and dirty’, and he leveraged on his expertise as airplane engineer and he used light materials. He moved the gear lever onto the handlebar for easier access, as if bicycle for women, and he replaced the typical fork support with an aeronautical-style arm to make tire-changing easier. Moreover, the seat position was moved to obtain a safer motorcycle and a more comfortable one, just like an armchair. By employing light materials used to construct airplanes, D’Ascanio designed an engine that was mounted beside the rear wheel. The wheel was driven directly from the transmission, eliminating the drive chain and the oil and dirt associated with it. He also designed a body that would protect the driver so that he would not get dirty or dishevelled (Lieback, 2010). The design included handlebar-mounted controls, forced air cooling, wheels of small diameter, and a tall central section

that had to be straddled. The final vehicle's body shape ended up to resemble a wasp: the thicker rear part connected to the front part by a narrow waist, and the steering rod resembled the antennae of the animal. The final concept of a typical motor locomotion of hard wheels was taken from motorcycle input. However, most of the traditional engine parts were deleted and conceptual elements from aircraft domain were employed to obtain an 'absolutely original and revolutionary compared to all the other existing means of two-wheeled transport' (Lieback, 2010).

In terms of refinement and searching for a coherent concept (Fauconnier and Turner, 2002; Thagard and Verbeurgt, 1998), Corradino D'Ascanio took a few days to fine-tune his idea and prepare the first Vespa project, with the help of his designer Mario D'Este. The absence of the engine cooling fan, the brake lever on the left side instead of the right, the horn under the saddle, the footboard's aluminium laths, and the aeronautical symbol on the front shield are the most important differences between the MP6 and Vespa (from museum Piaggio Archive). In the MP6 project the team decided to suppress the central tunnel, introducing the in-line transmission, a solution that eliminated the chain, making the engine a unique complex with the rear wheel. Instead of the fork traditionally used in motorcycles, D'Ascanio adopted a cantilevered one-pipe that would allow for quick tire removal in case of drilling: that was a clear aviation solution, widely used in aircraft landing gears (from museum Piaggio Archive). On February 1946, Piaggio decided to start to produce the "Serie Zero" (Series Zero), the first real production of Vespa.

Insert Figure 2 about here

10 Corso Como

In the case of the concept store 10 Corso Como in Milan, her founder Carla Sozzani, a former fashion editor and publisher combined the idea of shop retailer with that of a gallery for art, culture, and photography (Table 2). In 1989 she had met the American artist Kris Ruhs and in 1990 she decided to found Galleria Carla Sozzani at 10 Corso Como in Milan. As stated in the website and confirmed by direct interview, since the beginning the "store" was meant as a 'radical new union of culture and commerce', where 'space plays a fundamental role. The concept of Corso Como starts with the very definition of a place that is born as a concept store [...] it is like a blank page of a magazine'. In 1990 she converted a garage into a gallery for art and photography. She was inspired by the space of big lofts in New York City. She was fascinated by 'their semi-industrial origin. They are open' (extract from direct interview). Carla Sozzani, as a fashion editor, decided to put together books on art, architecture, literature, design, graphics and fashion, and music, clothes, objects, as part of a 'living magazine', where the various sections are equally important to the creation of the concept. The commerce concept of the shop was mapped and declined as a slow shopping 'through a succession of spaces and events that reflect lifestyle over object acquisition' (from 10 Corso Como website). The notion of culture was combined with that of business in order to orchestrate memorable events for their customers.

Insert Figure 3 about here

Carla Sozzani refined the concept of 10 Corso Como along the years and this fine-tuning revolved around the concept of a physical space that embraces concepts of slowness, pace, and beautiful objects to touch and admire: ‘this space has been gradually modelled, like a modular element. [...] it stratified’ (extract from direct interview). This adjusting process went along the years, with a careful attention on keeping the core identity of retail and the gallery. In 1996 a shop was opened next to the gallery with the aim to host cultural and commercial events. Two years later, a cafeteria was inaugurated and in 1999 a fragrance was launched under their brand. In 2003 three hotel rooms were opened ‘that looks out onto the 10 Corso Como gardens below’. The hotel was thought as an intimate hotel, with few rooms to ‘offer to a weary traveller a personal hospitality. [...] each [room was] reached by a private entrance, furnished in homage to the vision of many mid-20th and 21st century designers and architects from around the world’. In 2010, the building was enriched by a new flowering terrace roof garden, where art and nature were combined together to host contemporary sculptures and ceramics, and public events. The garden became also an urban space for birds both sedentary and in migration, so people urban citizens could experience nature in a different way. The concept of 10 Corso Como has been also implemented in Seoul (2008), Shangai (2013) and it will be displayed in New York in 2018.

Insert Table 2 about here

Insert Figure 4 about here

4. Conclusions

The paper aims at contributing to the debate on design thinking, providing theoretical and empirical insights on the cognitive mechanisms that underlie its phases.

The power of design thinking is not simply due to an enriched set of principles and processes in managing innovation, but it rests on the way innovation opportunities are framed through design. We suggest that the design approach helps to deal with an inner and deeper level of each innovation process, that is the conceptual level.

Our cases illustrate that conceptual innovation is central in the design management dynamics, and they show how mechanisms of conceptual innovation operate when a new concept is elaborated along the process of design thinking.

One aspect at the intersection of conceptual innovation and design thinking is the relevance of observation as an explorative tool that helps to activate the similarity detection mechanism. In depth understanding of human experience with artefacts and services provides insights useful to recognise resemblances between different input frames, this the identification of conceptual sources for a new conceptual integration, by which targeting the consumers problems. As it happened when the Vespa was conceived as a comfortable vehicle, resambling ladies' bicycle, or when Carla Sozzani identified similarities between a photogallery and a magazine, and combined the two concepts to "create a magazine that came alive, where people would be able to interact with the content".

Second, the search for a "working" concept is central in design thinking as it is in the conceptual innovation. A new artifact or service concept needs to prove to be robust as components satisfy inner constraints and are able to pass the test of usage contexts. The search for a stable and coherent concept is supported by a simulation process. Experimentation means that the conceptual prototype and the physical prototype have to be run in the usage environment.

Finally, another aspect at the intersection of conceptual innovation and design thinking is the iterative nature of both processes. As the design process, that moves backwards and forwards through the phases, conceptual innovation implies reiterated cycles of simulation of the prototype concept and further conceptual structure refinements, activated by searching similarities or by other elaborations of the concept to find out new coherent attributes or relations.

In summary, this research is the first attempt, to our knowledge, to bring together design thinking literature and cognitive studies on innovation. Our paper contributes to literature on design thinking pointing to its inherent process of conceptual innovation. Operations at conceptual level start as the entire design thinking process is activated, not just in the concept delivery phase, and different cognitive mechanisms unfold as the design process progresses. We provide preliminary and original findings on this dynamics, and we call further research to better understand how actual process of design thinking might boost conceptual innovation mechanisms.

Tables

Table 1. Details on data collection and analysis

Data Source	Use in the analysis
Press articles from Italian and American newspaper between 2010-2017 (e.g. <i>New York Times</i> , <i>Corriere della Sera</i>)	Establish a timeline of the events through media coverage
Publications on design history: <ul style="list-style-type: none"> • Lidwell, W. and Manacsa, G. 2011. <i>Deconstructing product design</i> • Lees-Maffei, and Fallan, 2014. <i>Made in Italy. Rethinking a Century of Italian Design</i> 	Gather information from the design field
Scholarly publications on technical aspects of Moka Bialetti and Vespa (e.g. engineering, culture, physics): <ul style="list-style-type: none"> • Arvidsson, A. 2001. <i>Journal of Consumer Culture</i> • Kreuzbauer, R. 2007. <i>Advances in Consumer Research</i> • Rindell, Pinto Santos, de Lima. 2015. <i>Journal of Brand Management</i> • Gianino, C. 2007. <i>American Association of Physics Teachers</i> • Navarini L., Nobile E., Pinto F, Scheri A., Suggi-Liverani F. 2009. <i>Applied Thermal Engineering</i> • Schnapp, J. T. 2001. <i>Critical Inquiry</i> 	Gather academic insights about our cases and to get specific information about the mechanical structure of two products (Moka Bialetti and Vespa)
Historical advertising of Moka and Vespa	Field-level data to retrace the cultural impact of the two cases
Video and documentaries: Moka Bialetti: <ul style="list-style-type: none"> • La Moka in mostra a Milano - Gli 80 anni del mito Bialetti (Televisione.tv): oan overview in case of the exhibition of Moka in 2013 • Historical videos from Bialetti Group website (<i>Carosello</i>, a series of the popular advertising campaign promoted by Renato Bialetti) Vespa Piaggio: <ul style="list-style-type: none"> • Vespa History. European and Italian pride (History Channel documentary) 10 Corso Como: <ul style="list-style-type: none"> • An interview to Carla Sozzani from <i>The New York Times</i> (26 September, 2011) • An interview to Carla Sozzani attending the Future Vision Workshop in Milan (1 December 2011) 	Historical perspective on the three cases. Triangulate of observation
Historical images	Field-level data and visual artefact of the three cases
Archival information and history from companies' web site and a publication donated by 10 Corso Como about Carla Sozzani history and her idea of creating the concept of 10 Corso Como "A-Z. <i>10 Corso Como</i> . Ed. Rizzoli, 2014"	Historical details on the foundation and evolution of the three cases
Direct Interview to key figure in 10 Corso Como	Interview was conducted by two authors. It was all recorded and transcribed verbatim for a total of 25 pages double-spaced pages. Questions were mainly focused on understanding the process of creating 10 Corso Como concept

Table 2. Phases of designing a new concept

PHASES	QUOTES AND RELEVANT EXTRACTS		
	MOKA	VESPA	CORSO COMO
<p>Discovery <i>Observation of users and system context through ethnography and visual anthropology</i></p>	<p>“My father Alfonso <i>had the intuition</i> to build a coffee machine <i>by observing</i> the women of Omegna doing the laundry on the shores of Lake Orta. At that time there were no washing machines and the women used a basin whose bottom there was a hole: under the cane, in another container, they put ash and soap, called “<i>lisciveuse</i>”, in contact with the water “boiled” by making foam and climbing to the top where the cloths were. It was the operating principle of the coffee maker” (Renato Bialetti, <i>La Stampa</i>, 6 June 2013 [our translation from Italian])</p>	<p>“Enrico, <i>unlike his brother, was looking for</i> an all-new business idea, and dreamed of helping Italy solve its post-war transport problems. Enrico Piaggio <i>entered</i> the complex business of restructuring Italy with a precise idea – <i>he wanted to build</i> a simple means of transport that would be cheap, consume very little petrol and could be ridden by everyone, women included” (from Piaggio Museum Archive)</p> <p>“In Biella, where Pontedera’s manufacturing paraphernalia had been transferred, technicians and engineers (among them Vittorio Corsini, Renzo Spolti and Carbonero) <i>had been experimenting</i> during the long months of inactivity in the warehouses of Count Trossi, their host, with a small scooter based on a sample they had seen” (Piaggio Museum Archive)</p> <p>“Not knowing motorcycles, I was in the ideal position to <i>create</i> a vehicle without precedents. [Enrico] Piaggio was counting on this. ‘Only you [D’Ascanio] can tackle the problem with a wholly new outlook’, he told me. I <i>followed intuitive criteria</i>. I felt that the machine ought to serve those who, like me, have never ridden a motorcycle and hated the machine’s lack of manoeuvrability. <i>I thought</i> it over for a while and on Sunday the basic idea came to me. The most important factor was being able to mount the vehicle comfortably, something that had already been resolved with the ladies’ bicycle. So I <i>started out</i> with the concept that is fundamental in the ladies’ bicycle. I felt a seated position was more comfortable and rational than having to straddle the frame” (Lidwell and Manacsa, 2009: 202)</p>	<p>“I wanted to open only a coffee bar, <i>make it</i> a meeting point and <i>show</i> the things I love [...] At that time <i>I was fascinated</i> by lofts. While I was leaving a restaurant called <i>Le Langhe</i>, in the neighbourhood, <i>I saw</i> a sign “For rent” on the 10th Corso Como”.</p> <p>(Carla Sozzani, from cinquantamila.corriere.it [our translation from Italian])</p> <p>“My fascination with New York City in the 1980s <i>pushed me towards</i> this garage at a time when using a garage was completely wrong” (Carla Sozzani, <i>Interview Magazine</i>, 3 June 2013)</p> <p>“An Italian piazza <i>was my vision</i>—a place where people <i>would come and meet</i>, see an exhibition, browse through books, have a drink, eat, rest, shop (Carla Sozzani, <i>Interview Magazine</i>, 3 June 2013)</p> <p>“I’ve always been passionate about photography; a passion which kept evolving throughout my years as a magazine editor. <i>I would collect</i> photography I bought in New York and London. 10 Corso Como started out as a photo gallery” (Carla Sozzani, <i>Forbes</i>, 20 February, 2015)</p> <p>“When I worked in publishing, I always <i>wanted</i> to do more. <i>I wanted to create</i> a magazine that <i>came alive</i>; where people would be able to <i>interact</i> with the content and get the 360 degrees’ experience. I look at 10 Corso Como as that type of <i>living magazine</i>” (Carla Sozzani, <i>Forbes</i>, 20 February 2015)</p>
<p>Define <i>Developing insights and framing the problem</i></p>	<p>“Bialetti <i>imagined</i> a similar mechanism for coffee [of primitive washing machine], one in which a lower chamber filled with boiling water would force steam up through coffee grounds and then condense in</p>	<p>“<i>Reinterpret</i> a light aircraft as a wingless two-wheel vehicle, and you get the Vespa” (Lidwell and Manacsa, 2009: 202)</p> <p>“<i>Unlike motorcycles</i>, the engine of Vespa <i>is completely concealed</i>”</p>	<p>“Creatively, with artist Kris Ruhs, we <i>build</i> each of these environments together. These stores are all built on my growing interest for <i>sharing and communicating and mixing</i> different cultures”. (Carla Sozzani, <i>Interview Magazine</i>,</p>

	<p>an upper chamber” (Lidwell and Manacsa, 2009: 120)</p> <p>“He adapted the principle of <i>lisciveuse</i> to coffee extraction with the help of his expertise in aluminium forging that Alfonso Bialetti created the prototype of the Moka” (<i>The Huffington Post</i>, 29 September 2014 [our translation from Italian])</p>	(Lidwell and Manacsa, 2009: 202)	<p>3 June 2013)</p> <p>“<i>I took the top floor</i> because there was a repair shop of Renault below. On the street there were artisans, laboratories, fruit and vegetable shops: it seemed to be in another dimension” (Carla Sozzani, from cinqantamila.corriere.it [our translation from Italian])</p> <p>“At the time, Via Monte Napoleone was considered the only street to do shopping. On top of that, <i>we started working out of a garage with a concrete floor and no store window</i>. In those days every store in Milan had marble floors, so people didn't even understand they were supposed to enter.” (Carla Sozzani, <i>Forbes</i>, 20 February 2015)</p>
<p>Ideation Explores, through prototypes and visualizations, alternative potential solutions</p> <p>Delivery Prototypes are tested not only in terms of technical robustness and effectiveness, but also of their fit with users' needs and the broader context of their lives</p>	<p>“<i>To achieve</i> the proper flow of coffee through the apparatus and <i>to overcome</i> the tendency for boilers to crack under pressure or blow up’ was solved <i>by modifying</i> the alloy used, the wall thicknesses, and <i>by adding a safety valve</i>” (Schnapp, 2001: 253).</p>	<p>“In a few weeks time <i>he[D’Ascanio]had come up</i> with a design for a vehicle with a load-bearing body, a 98cc direct drive engine with gear change located on the handlebar to facilitate riding, without a fork but using a lateral support arm to make tyre changing easy.</p> <p>The frame was meant to protect the rider, who would be seated on the scooter as on a chair – so much so that <i>the engineer first sketched</i> a person sitting comfortably upright and <i>then drew</i> the vehicle under him” (from Piaggio Museum Archive)</p>	<p>“In the beginning, it was not obvious why I was putting together books and pictures with clothes and jewels, or furniture with shoes and candles. <i>But more and more the attitude</i> that people have toward shopping has gone in this direction. People mix and choose, following an independent point of view: their own. [...] <i>what I call the “slow shopping” experience</i>; and then the second, of course, is e-commerce, which is contrary to the first but as enjoyable. So <i>I am working on</i> our e-commerce, because I would like to find a way—which has been very difficult—to transfer online the same slow, peaceful environment of the physical 10 Corso Como” (Carla Sozzani, <i>Interview Magazine</i>, 3 June 2013)</p>

Figures

Figure 1 The prototype of Moka in 1933 , three generations and the nowadays model

(The prototype of Moka in 1933 and the nowadays model)

(Three generations of Moka Express coffeemakers (1930s, 1950s, 1960s)

Source: Schnapp, 2001: 254)

Figure 2 Mp5, MP6 and Vesta 98

MP5 Paperino (from museum Piaggio Archive)

MP6 Vespa Sperimentale (1945) (From museum Piaggio Archive)

Vespa 98

Figure 3 The gallery, the core of 10 Corso Como (picture taken 19th June 2017)

Figure 4 Conceptual mechanisms in design thinking

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