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COLLABORATIVE STRATEGIES IN DESIGN-INTENSIVE INDUSTRIES: KNOWLEDGE DIVERSITY AND INNOVATION

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ABSTRACT

Customers pay increasing attention to product design (i.e., to the aesthetic, symbolic and emotional meanings of products). Designers can support companies in the exploration of customers' needs and the appropriate combination of signs (such as form, colours, materials, etc.) that give meaning to products. Managing collaborations with designers is therefore a critical issue for companies that operate in design-intensive industries. This paper analyses how a firm may develop a proper collaborative strategy by identifying an effective portfolio of designers. Rather than focusing on a project-level collaboration with a specific designer, we explore the impact of the overall portfolio of collaborations that firms use in different projects. What are the characteristics of the designer portfolios that allow companies to be more innovative? Are the designer portfolios of innovators and imitators different in their breadth, educational and cultural backgrounds? How do these elements impact company innovation? We analyse more than 650 different collaborations between Italian furniture manufacturers and designers that are responsible for about 1,800 products. We describe the relationship between knowledge diversity in the designer portfolio and company innovation. We show that innovators collaborate with a broad range of external designers. In particular, collaboration with international designers makes new semantic contexts available and continuously enriches the knowledge of global socio-cultural phenomena. In collaborating with designers from different backgrounds, innovators combine different approaches and mindsets in order to propose unique and original products. More effectively than their competitors, they exploit creative resources to translate products and languages among different sectors. Most important, innovativeness does not depend on diversity brought by an individual designer, but on diversity brought by the entire portfolio of designers of a firm. In other words, the value of a single collaboration benefits from externalities generated by other collaborations. The bottom line implication is that firms should not focus only on the characteristics of single external parties when developing a collaborative innovation strategy, but, rather, manage carefully a balanced portfolio of collaborators.

INTRODUCTION

In today's business and academic arenas, design is increasingly viewed as an important strategic asset. This growing attention to design has led scholars and executives to investigate and understand the link between design and company performance¹. Several studies demonstrate the fact that consumers increasingly make brand choices on the basis of the aesthetic and symbolic value of products and services². The role of the "look and feel" of people, places and things demonstrates that the aesthetic and symbolic dimensions of a product are increasingly relevant in many industries³.

As design becomes increasingly relevant, executives are looking for ways to improve their capability to manage design processes and resources. A major challenge in particular is how to identify the right talent who can participate in design processes. A diffused practice in many industries is to collaborate with external designers, in order to source fresh insights, creativity and new knowledge⁴. This perspective is in line with a general tendency towards open innovation and the development of business ecosystems: in today's economy, where firms recognize that most of the valuable knowledge for innovation resides outside their boundaries⁵. To be innovative therefore requires finding ways of accessing that knowledge⁶. Recent studies have underlined the importance of external designers in the innovation process to the point that some of them are considered "superstars"⁷: Jacob Jensen and David Lewis for Bang & Olufsen, Michael Graves for Target, Philippe Starck for several furniture companies, as well as for Nike and Puma⁸. Case studies including Alessi, Apple, Bang & Olufsen, Kartell, Philips, Sony and Swatch, demonstrate how designers are becoming key actors in terms of product innovation and strategic renewal⁹. In the 1990s, Kartell's strategy and economic results were revitalized by collaborations with designers such as Philippe Starck and Ron Arad. The Italian company revamped its brand image and introduced iconic products such as Bookworm (a library designed by Ron Arad in 1994) and La Marie (a chair designed by Philippe Starck in 1999). The increasing relevance of design is also demonstrated by the

corporate roles of designers in certain leading companies. In 1990, Nokia's corporate strategy emphasised the relevance of design through the appointment of chief designer Frank Nuovo as Vice-President for Design.

Despite the rhetoric of design magazines, however, the success of firms seems not necessarily related to the choice of a specific designer, but rather to the capability to identify and manage an articulated portfolio of designers (interpreted as a set of creative competencies accessed by companies). Alessi, for example, has a network of more than 200 external designers. An indication that Alessi's innovativeness cannot be traced to an individual external talent, but to the firm capability to build such a complex portfolio. Similarly, single designers that work with Alessi seem not to provide an analogous value when working with other firms¹⁰. Rather than an individual spark of creativity, the value of the contribution of each designer is hardly identifiable if not seen within the context of the knowledge sourced from the entire array of external collaborators. And vice-versa, knowledge developed through the collaboration with a specific designer can be exploited in several projects (eventually developed with other designers). In other words, the value of a single collaboration benefits from externalities generated by other collaborations. The innovation literature lacks an empirical analysis of the nature of designer portfolios and their impact on company innovation. The purpose of this article is to provide insights, through an empirical analysis, on effective practices to manage the designer portfolio: which characteristics of designer portfolios allow companies to be more innovative? In particular, given that access to external designers is justified by the need to appropriate new knowledge, which is diverse than knowledge already mastered by a firm, how the diversity of designer portfolios can affect innovation performance? Do parameters of diversity, such as number of designers in the portfolio, and their combined educational and cultural backgrounds impact company innovation?

In the following section, we synthesise the literature's main contributions concerning the role of creative resources in innovation processes. We also introduce our research questions.

After describing our research method, we present the empirical results. Finally, we discuss the principal managerial implications, underlying limits and directions for future research.

LITERATURE REVIEW

The contribution of creative resources in the development of design-driven innovations is particularly crucial, but largely unexplored. While the technology management literature provides frameworks and tools that support companies in the identification and collaboration processes with key partners and technology suppliers¹¹, researches about the collaboration with designers has still significant conundrums¹². Designers indeed provide access to a particular type of knowledge, that is different to the focus of studies of open innovation: knowledge on product languages and meanings. Design in fact deals with the meanings ascribed to products and with the language that can be used to convey those meanings¹³. Each product, alongside its functionality and performance, has a meaning, which is the deep reason why people buy it and use it. This meaning is related to symbolic and emotional values; product signs and languages allow products to speak and convey precise meanings¹⁴. The contribution of creative resources in the development of design-driven innovations is particularly crucial, but largely unexplored. While the technology management literature provides frameworks and tools that support companies in the identification and collaboration processes with key partners and technology suppliers, researches about the collaboration with designers can be improved.

In design-intensive industries, the diffusion and success of product signs and meanings are influenced by phenomena emerging in society and depend on interactions between several stakeholders: users, firms, products, communications media, cultural centres, schools and artists¹⁵. Knowledge of the subtle and unexpressed dynamics of socio-cultural models, and therefore of product meanings, is distributed and tacit, rather than codified in books or in

socio-logical scenarios of the future. Thanks to their capability to investigate user needs and the evolution of socio-cultural models, designers typically support companies in the identification and interpretation of “weak signals” that have the potential to become future trends. In addition, thanks to their knowledge of technologies and processes, they propose new meanings by embedding their insights on the changing culture of consumers into new products. The involvement of designers in the innovation process is a channel through which a firm can gain knowledge about its customers and their needs. Designers are able to interpret different cultures; they may be regarded as cultural gatekeepers. The advantages of working with consultants rather than relying on internal capabilities have been highlighted by many scholars.

Internal designers, though familiar with the company’s approach and products, tend to become complacent and, in turn, less innovative¹⁶. By contrast, external design consultants tend to provide fresh and more innovative concepts. Recent studies on the role of gatekeepers in the introduction of technological innovations demonstrate that lone inventors are the real sources of technological breakthrough¹⁷. The opportunity to collaborate with companies on different categories of products (i.e., chairs, kitchens, sofas, lamps, etc.) and in different industries allows designers to transfer languages from one sector to another¹⁸. In fact, product signs and languages are not industry-specific. The nature of product languages and their abstractions favour the transfer of a language from one product typology to another or from one industry to another. From a managerial perspective, this property implies great innovative and creative stimulus. There are many examples of how product languages have moved across industries. For example, the product line “Family Follows Fiction” launched by Alessi in 1993, several products developed by Kartell in the 1990s and Apple’s iMac introduced in 1998 all use similar materials, transparency and colours. By capturing, recombining, and integrating knowledge about socio-cultural models and product semantics in several different social and industry settings, designers act as brokers of design language and creators of

breakthrough product meanings. The designer must translate abstract knowledge into actual ideas and concepts. However, an obstacle arises in the translation of tacit knowledge into product design. Unfortunately, design language is not well-understood in a theoretical sense. How human needs can be translated into products and then interpreted by users has not been formalized¹⁹. However, styling elements can be used to accentuate a product's performance or to make sure that original qualities are noticed. Product signs are connected to specific meanings according to the culture in which people live²⁰. Designers of different nationalities can provide different viewpoints and support companies in the interpretation of product meanings to match the social and cultural needs of people that live in different countries. Similar to technology brokers, designers are able to transfer product languages and meanings across industries, exploiting their connections and networks²¹.

Building a network requires maximising the proportion of bridges (i.e., non-redundant contacts) to total contacts in the network²². In fact, a company's innovation is significantly affected by the diversity of its direct contacts, whose number is relevant only to the extent that it increases the probability of network diversity. Several studies on networks suggest that a firm's portfolio of partners may be as influential as the dyadic characteristics of those alliances²³. A lack of redundancy in a network allows the firm to acquire new capabilities (interpreted as a proxy for innovation)²⁴. Scientists performed better maintaining contacts with colleagues that operate outside their areas of expertise²⁵. The recognition of the relationship between diversity and innovativeness has stimulated several academics and practitioners to search for factors to activate creative processes in individuals and teams²⁶. The debate about the relationship between diversity and competitive advantage is characterised by different perspectives²⁷. Diversity in terms of ethnicity, age, gender, personality and educational background promotes creativity and problem-solving capabilities²⁸. Diverse project teams should collectively manage a wider range of knowledge. Diverse teams will benefit from a variety of perspectives in a way that homogeneous teams

will not, and will thus be able to make better collective decisions and produce more creative work²⁹. In collaborating with heterogeneous partners, a firm can not only increase its recombination possibilities, but can recognize opportunities ahead of competitors. Collaboration with heterogeneous partners may lead to constructive conflict, increasing a firm's problem-solving capabilities and approaching new opportunities through new frameworks³⁰. Exposure to heterogeneous knowledge should improve managers' innovation performance; the variety of knowledge to which a manager is exposed has a positive impact on both overall managerial performance and on innovation performance³¹. In this sense, creative leaps can be interpreted as a connection between two or more disparate ideas within a unique concept³². Recent studies describe a curvilinear relationship between diversity and innovation. Diversity stimulates elaboration and enhances performance up to a point, beyond which more no longer benefits performance and might even be detrimental (i.e., an inverted, U-shaped curve)³³.

We hypothesise that the knowledge diversity in the portfolio of creative collaborators increases the innovation of design-intensive companies. In order to investigate knowledge diversity, we consider both designers' backgrounds and careers. In the first case, we analyse the country of origin and the educational background. In the second case, we point out both the variety of projects in a given industry and the number of industries in which the designer operates.

RESEARCH METHOD

This paper focuses on the Italian furniture industry for several reasons. First, furniture companies develop numerous innovations. The furniture sector is a basic industry in most industrialised countries. According to a report from the European Association of Furniture Manufacturers, it represents between 2 and 4% of the production value of the manufacturing

sector, around 2% of the GDP and 2.2% of the total workforce, in European countries. The furniture industry is one of the largest manufacturing industries in the EU-27 (total turnover of €120 billion in 2005). As a labour-intensive industry, it employs around 1.4 million people. Germany is the largest furniture producing country, representing over 27% of total EU production, followed by Italy (21.6%), France (13.5%) and the UK (10.4%). Italy is one of the leading furniture producing countries in the world. Until 2002, Italy was the top world exporter (18.6% in 1984, 17.7% in 1994 and 14.8% in 2004). Italian manufacturers exported US\$11.34 billion worth of furniture in 2004.

This paper relies on Webmobili (an Internet spin-off of Federmobili, the Italian Association of Furniture Manufacturers). The Internet database (www.webmobili.it) developed by Webmobili is particularly well-suited for our research objectives. It contains more than 19,000 products, divided into 16 sub-sectors. It is considered a good representation of the Italian furniture industry's offerings because it features data about every company using an industrial structure. All the products in the Webmobili database are actually on the market, and each listing includes the name of the product, producer, designer, production year, materials, price range and awards. According to the Webmobili experts³⁴, we have identified the furniture sub-sectors that show medium-high levels of innovation (in terms of new products launched per year): lamps (table and floor lamps), tables, chairs and sofas (sofas, seat systems and armchairs). In particular, the lighting sub-sector is considered one of most innovative and dynamic. At the time of sample selection (January 2006), the Webmobili database contained 575 lamps (table and floor lamps), 906 tables, 982 chairs and 1,571 sofas (sofas, seat systems and armchairs). For each typology, we consider products developed in the last 16 years (1990-2005) in order to identify recent phenomena among companies with at least 5 products in the database. In this way, we obtained a final sample composed of 1,792 products developed by 98 companies through 658 different collaborations.

Analysing designer portfolios

In order to discuss different collaborative strategies, we propose a model to analyse the designer portfolios (for further detail, see Method Appendix). We define the *Osmosis* dimension as the percentage of products developed by a company in collaboration with external designers. As previously mentioned, several studies argue that collaboration with external resources increases a company's exposure to socio-cultural phenomena and, consequently, its innovation. The *Balanced Breadth* measures the numerousness of collaborations with external designers and verifies whether a company prefers to develop the great part of its product portfolio in collaboration with a few designers or to exploit a broad range of creative resources equally. As previously mentioned, the socio-cultural context has a fundamental impact not only on the companies, but on the designers³⁵. Even though nationality only partially influences the socio-cultural frameworks adopted by designers, we define the *Foreign Background* dimension as the percentage of products developed in collaboration with foreign designers³⁶. After collecting additional data on the educational background of each designer, we analysed the composition of the designer portfolio of each company. We classified each designer according to the following categories of educational degree: Industrial Design (Product Design, Communication Design, Service Design), Architecture, Engineering, High School and Other. Considering designers to be brokers of languages (this interpretation is very close to the concepts of boundary-spanners or cultural intermediaries³⁷), we believe that experiences in different industries or across several categories of products can be valuable aspects of a designer's innovative capabilities. *Industry Brokering* is defined as the percentage of products developed in collaboration with "cross-industrial" designers. Finally, the *Sub-Sector Brokering* dimension represents the average number of sub-sectors in which designers who collaborate with a company operate³⁸. Table 1 synthetically reports the descriptive statistics for the six dimensions described.

Insert here Table 1

We provide a brief example in order to clarify the meaning and application of the six introduced designer portfolio dimensions. Moroso is one of the leading Italian upholstery companies. During the period 1990-2005, Moroso collaborated with 16 different designers, developing 92 new products (see Figure 1). The *Osmosis* (94.6 %) is particularly high because only 5 were internally developed by the Moroso Design Centre. Patricia Urquiola and Enrico Franzolini represent the key designers: the former developed 23 products and the latter 18, consequently the *Balanced Breadth* is low (0.166). The *Foreign Background* is particularly high (55.4 %) because more than half of the product portfolio was developed in collaboration with foreign designers. Moroso collaborated with creative resources from different educational backgrounds showing an high level of *Educational Background* (0.826): 40.2 % of the product portfolio was created with industrial designers; 39.1 % with architects; 14.2 % with designers that have a high school degree; and 6.5 % with designers that have a different educational background. Similarly to many other furniture manufacturers, more than half of the product portfolio was developed in collaboration with “cross-industrial” designers (*Industry Brokering* = 58.7 %). Finally, the *Sub-Sector Brokering* is particularly high (2.736) because designers who collaborate with Moroso operate in an average of two to three sub-sectors.

Insert here Figure 1

Identifying innovative companies

In order to analyse the innovativeness of each company, we examined the “Compasso d’Oro Award.” This is the most prestigious honour scheme for design, products, research and merit; its international prestige is unquestioned. The Award, established in 1954, is

adjudicated by the ADI (Association for Industrial Design) “to honour the merits of those entrepreneurs, craftsmen and designers who, in their work, by applying a new and particular artistic commitment, give their products such qualities of form and presentation as to make them unitary expressions of their technical, functional and aesthetic characteristics” (from “Aims and Objectives of the Award”, 1954). The “Compasso d’Oro Award” is explicitly assigned to products that are considered particularly innovative. It includes a pre-selection process managed by the Permanent Design Observatory, where a commission of design language experts (critics, historians, journalists, designers, architects, and professors) collects information, evaluates it and selects the best products. The jury of the “Compasso d’Oro Award” is international, consisting of more than five members randomly selected from a pool of qualified researchers and experts from several market industries. The jury changes over time. We divided our sample into two groups of companies: innovators and imitators. Twenty one manufacturers (21.4%) are “Innovators” because they have received (or have been selected for) at least one “Compasso d’Oro Award”, while 77 companies (78.6%) are “Imitators”. Some innovators have received just one prize, while others have received several. For example, Artemide has received four “Compasso d’Oro Awards” and has been shortlisted three times. Kartell has won one “Compasso d’Oro Awards” and has been shortlisted five times³⁹. We believe that prizewinning products exploit the accumulated knowledge developed through the collaboration with several designers in several previous projects. For this reason, we consider the awards to be best associated with the companies rather than with specific products and, consequently, specific collaborations.

RESULTS

As mentioned previously, this article aims to analyse the relationships between the characteristics of a designer portfolio that contribute to knowledge diversity and company

innovation. We adopt the t test to compare the means for two groups of cases. More specifically, we split our sample into innovators and imitators in order to identify the distinctive characteristics of creative collaborators.

Table 2 shows that innovators are characterised by *Osmosis* to a significantly greater extent than others. Innovators tend to rely on external designers to a greater extent than their competitors. A large part of their product portfolio is developed in collaboration with external designers. In this way, they can access knowledge about different socio-cultural contexts and maintain a fresh product offering. Innovators such as B&B Italia, Cassina, Edra, Flos, Kartell and Zanotta have developed the entire product portfolio in collaboration with external designers.

Insert here Table 2

The bubble plot in Figure 2 underlines the differences between innovators and imitators. Each bubble reflects the number of awards received by each company and its *Osmosis* value. More specifically, we group the companies into five sets according to the percentage of products developed in collaboration with external designers: [0-20%]; (20-40%]; (40-60%]; (60-80%] and (80-100%]. The radius of each bubble is proportional to the number of companies, with black bubbles representing innovators and gray bubbles representing imitators. Except for Luceplan, innovators show values higher than 60.0 %. Despite the fact that several imitators also exhibited elevated values of *Osmosis*, Figure 2 demonstrates that innovators are concentrated in a small region, relative to imitators. Collaboration with external designers can be considered necessary for innovation, but at the same time it is not sufficient. In other words, Figure 2 underlines the notion that elevated values of *Osmosis* have to be connected with other characteristics of the designer portfolio.

Insert here Figure 2

Even more interesting, however, is the figure concerning *Balanced Breadth*. Innovative manufacturers interact with several creative resources, tending to exploit the contribution of each equally. The average number of external designers belonging to innovators' portfolios is impressively higher than that of the imitators' portfolios (11.9 vs 4.4). For example, innovators such as Artemide, Driade, FontanaArte, Magis and Moroso collaborate with more than 15 different freelance designers. Also, considering the ratio between the number of external designers and number of products, innovators' values are significantly higher than imitators' metrics. As mentioned in the Method Appendix, we have considered the contribution of the Gini dispersion index in the definition of *Balanced Breadth*. This is used to verify whether a company prefers to develop the majority of its product portfolio in collaboration with a few designers or to engage with a broad range of creative resources. Table 2 shows that innovators' *Balanced Breadth* is significantly higher than that of imitators (0.457 vs 0.313).

Besides *Osmosis* and *Balanced Breadth*, the relationship between knowledge diversity of creative collaborators and company innovation is analysed in terms of *Foreign Background*, *Educational Background*, *Sub-Sector Brokering* and *Industry Brokering* (see Table 2). Innovators tend to develop about half of their product portfolio in collaboration with foreign designers (45.7 %), while imitators show significantly lower values (16.0 %) for the *Foreign Background* metric. More in detail, the empirical results show a curvilinear relationship between innovation and the percentage of products developed in collaboration with foreign designers. The bubble plot for *Foreign Background* in Figure 3 shows an inverted U-shaped curve: 42.6 % of innovators belong to the central set (40-60%]. Knowledge exchange driven by creative resources from different countries allows innovators to access new semantic contexts and to consequently propose innovations in product sign and meaning. Innovators

collaborate with designers from 5.3 different nations, whereas imitators have a corresponding value of 1.0. For example, Edra collaborates with designers from several nations: Fernando Campana and Humberto Campana from Brazil, Karim Rashid from Egypt, Ross Lovegrove from Wales, Christophe Pillet from France, Maarten Van Severen from Belgium, Peter Traag from Netherlands, and Steven Blaess from Australia.

Insert here Figure 3

Furthermore, innovators who collaborate with creative resources are associated with greater heterogeneity in educational backgrounds. Figure 4 shows a bubble plot obtained by grouping companies into five sets according to *Educational Background* ([0.0-0.2]; (0.2-0.4]; (0.4-0.6]; (0.6-0.8]; (0.8-1.0]). Except in isolated cases, innovators show values higher than 0.6. Despite certain imitators showing elevated values for *Educational Background*, they are equally distributed. By contrast, innovators are concentrated on the right side of the graph. Again, collaborations with designers of different educational backgrounds can be considered a necessary but not sufficient condition of innovation.

Insert here Figure 4

Innovators' product portfolios are mainly developed in collaboration with architects (44.9 %), while imitators prefer to engage with knowledge, approaches and methods from industrial designers (52.4 %). It is also interesting to note that innovators design 5.7 % of their products in collaboration with engineers, while this is rare among imitators (see Table 3).

Insert here Table 3

Despite the fact that innovators have higher values of *Industry Brokering* when compared to imitators (61.9 % vs 51.1 %), this difference is not statistically significant. Figure 5 shows a bubble plot obtained by grouping the companies into five sets according to their *Industry Brokering* values ([0-20%]; (20-40%]; (40-60%]; (60-80%]; (80-100%]). Similarly to *Foreign Background* also *Industry Brokering* shows an inverted U-shaped: innovators are concentrated in a central set (47.6 % of innovators belongs to the (60-80%] group). Few innovative companies, such as Driade, Flos and FontanaArte, develop more than 80.0 % of their products in collaboration with designers who operate across several industries. At the same time, other innovators, such as B&B Italia, Foscarini and Luceplan, show values lower than 40.0 %. Future research could explore this further by analysing whether specific industries can significantly contribute to furniture manufacturers in terms of brokering new signs and languages.

Insert here Figure 5

Finally, while innovators collaborate with designers who tend to operate in more than two sub-sectors (2.234), imitators show significantly lower values (1.736) of *Sub-Sector Brokering*. In this way, innovative companies increase the capability to move signs and languages from one product typology to another. For example, Kartell collaborates with creative resources that tend to operate in more than three sub-sectors: Antonio Citterio, Philippe Starck and Vico Magistretti designed lamps, chairs, tables and sofas between 1990 and 2005.

DISCUSSION

As previously mentioned, the development of semantic innovations is strictly influenced by the ability to access and interpret knowledge of socio-cultural phenomena that is typically dispersed and tacit. Designers, interpreted as gatekeepers of new knowledge and brokers of languages, can support companies in the identification and interpretation of product languages that can match social and cultural needs. Results summarized in Table 2 provide interesting guidelines for managers that operate in design-intensive industries showing statistically significant differences between designer portfolios developed by innovators and imitators.

Table 2 (concerning the *Osmosis* dimension) shows that innovators tend to rely on external designers. Moreover, despite the fact that some innovators' portfolios are characterised by historical relationships with specific designers (e.g., B&B Italia with Antonio Citterio, Kartell with Philippe Starck), their collaborative strategy requires a broad range of partners in order to guarantee the freshness and innovation of their products (see Table 2, concerning the *Balanced Breadth* dimension). We suggest that they rely on a sort of “parallel sourcing”, which mitigates the problems associated with periods of low creativity among certain designers. External designers are not always better than internal professionals. For example, Luceplan and Horm have been awarded the “Compasso d’Oro” for their products developed by in-house designers. At the same time, it is difficult to be innovative without developing external collaborations that continuously refresh the approaches and methods adopted in the new product development process. In other words, collaborations with external designers allow for the accumulation of knowledge that can be exploited in the development of new products both with the same collaborator and with other external collaborators, but also with in-house designers. The breadth of the designer portfolio does not compromise the company's identity, but instead allows a company to connect and compare several approaches in order to develop a unique vision. As Giorgio Busnelli, CEO of B&B Italia, commented on the role of Antonio Citterio, a historic collaborator:

“In 1994 Antonio Citterio became a reference point for B&B Italia. Before that moment we had a product catalogue with several souls. Nowadays we have a shared and defined product identity where projects of different designers can harmoniously cohabit.”⁴⁰

[Giorgio Busnelli, CEO of B&B Italia]

The knowledge diversity demonstrated by elevated values of *Foreign Background*, *Educational Background*, *Industry Brokering* and *Sub-Sector Brokering* in the innovators' designer portfolios allows companies to collect, compare and synthesize several perspectives in original products and visions. The designer portfolios of innovators are particularly international in comparison to those of imitators (see Table 2, concerning the *Foreign Background* dimension). Collaboration with foreign designers can allow innovators to capture stimuli and emerging phenomena in a socio-cultural context far from the given territorial boundaries, and can help develop innovative product signs and languages. Richard Sapper (Germany) with Artemide and Magis, Ross Lovegrove (Wales) with Edra and Luceplan, Ron Arad (Israel) with Kartell and Moroso, Patricia Urquiola (Spain) with Moroso, Philippe Starck (France) with Cassina, Driade, Flos and Kartell are just some examples of collaborations between Italian companies and foreign designers able to generate products recognised with the “Compasso d'Oro”. According to Philippe Starck,

“When a project is presented to Claudio Luti of Kartell, to Enrico Astori of Driade, to Piero Gandini of Flos, to Umberto Cassina of Cassina, ... they love the project, they love it with a passion. When a prototype is taken to Alberto Alessi, he thinks it is Christmas. It is a splendid gift. I have never heard an Italian publisher say ‘this will make a lot of money’”⁴¹

[Philippe Starck, Designer]

Table 3 underlines the fact that architects play a central role in innovators' strategy. This may be explained by their forward-looking capability. As argued by Verganti (2006), architects are trained to design in a broad sense: they design buildings considering the connection between the history of the urban context and the lifestyles emerging in the local environment, and they pay attention to the social environment in which the buildings will be situated. They tend to take a step back from clients' requests and adopt a broader perspective (it is quite difficult to find a marketing course in any Faculty of Architecture). In contrast with imitators, innovators also engage with engineers, a type of education that is not typically user-centred. The tendency to collaborate with designers from different backgrounds is demonstrated by Patrizia Moroso, Art Director of Moroso, in the following way:

*"In the design field, it's necessary to build and adopt a clear vision, it's necessary to go down a logical path ... I'm attracted by the 'border-line' school of thought. Ron Arad was mainly an artist, Iosa Ghini was more famous as a comic book illustrator than as a designer. This tendency to work at the boundaries and continuously renew is one of my prerogatives and one of the critical success factors of Moroso."*⁴²

[Patrizia Moroso, Art Director of Moroso]

Product languages may encounter barriers in moving across different socio-cultural worlds, but they can move across different industries more fluently and easily than technologies. Products that exist in the same context influence one another: from furniture to lamps, to telephones, to computers. Despite the differences between innovators and imitators, the *Industry Brokering* characteristic is not statistically significant. Innovators also exhibit a tendency to search for intriguing and divergent stimuli through collaboration with designers who operate beyond the furniture industry. One possible explanation of our results is the fact that an important criteria in identifying key interpreters is to seek out actors who can act as

brokers of languages. Despite not belonging to the furniture industry, they can provide interpretations that are relevant for people in the same walks of life. The more companies identify bridges to worlds that are relevant to users but unusual for competitors, the more they can propose novel solutions. It is likely that only designers who operate in specific industries can provide this opportunity to furniture companies. For example, consumer electronics companies (TV, stereo, hi-fi, etc.) or appliance manufacturers (white goods, kitchenware, etc.) can be more synergistic than automotive, clothing or shoe companies because they operate in the same context of use and life. The empirical results for the *Sub-Sector Brokering* characteristic demonstrate that innovators prefer to collaborate with designers who create different typologies of furniture products in order to exploit their capabilities to move signs and languages from one typology to another. Designers act similarly to technology brokers in moving languages and meanings between sub-sectors⁴³.

The analysis of 21 innovators suggests the interpretation of the six designer portfolio dimensions as two complementary subsets that promote different activities: high levels of *Osmosis* and *Balanced Breadth* give the firm exposure to new knowledge, while *Foreign Background*, *Educational Background*, *Industry Brokering* and *Sub-Sector Brokering* measure the heterogeneity of design competencies, approaches and methods that a company can exploit. Considering the six dimensions as managerial levers, the empirical results underline the fact that the strategies of collaborative innovation are based on the adoption of two complementary levers: one (belonging to the first subset) that allows the firm to access new knowledge and the other (belonging to the second subset) that allows the firm to transform new knowledge into original product signs and meanings. For example, Horm and Luceplan base their strategy of collaborative innovation on the development of broad designer portfolios that are heterogeneous in terms of educational background (focusing on *Balanced Breadth* and *Educational Background*), while other innovators collaborate intensively with external designers (*Osmosis*), intercepting heterogeneous design approaches and methods by

mixing other levers in different ways (for example Foscarini and B&B Italia strongly focus on *Sub-Sector Brokering*).

Rather than focusing on project-level collaboration with a specific designer, this paper provides an empirical analysis about the impact of the overall portfolio of collaborations that firms use in different projects in the context of innovation. In fact, the capability to build valuable creative networks over the time is a critical asset in design-intensive industries: the knowledge developed through specific collaborations can be exploited in other projects, and even in collaboration with other designers. This cumulative asset can also be used to enter new markets and improve the business model. For example, Alessi, a leading Italian kitchenware manufacturer, collaborates with more than 200 designers, an incredible network built over decades. In recent years, Alessi has started to exploit its creative asset directly by supporting other companies to scout for appropriate designers. For example the “Fresh Surfer” toilet-cleaning flushing soap produced by Henkel (the German manufacturer of laundry, cosmetics, and home care products) has been designed by Miriam Mirri, a designer who has also developed several products in collaboration with the Italian kitchenware manufacturer Alessi. The company considers it particularly appropriate to interpret the design languages of an ironic product such as the “Fresh Surfer”⁴⁴. As mentioned, company innovation is significantly affected by the diversity of its direct contacts. Thus, the number of creative collaborators is relevant to the extent that it increases the probability of network diversity. The interaction with creative resources of different backgrounds and experiences enables the acquisition of new capabilities and interpretative models. The collaboration with heterogeneous designers can increase both the capability to recombine existing design languages in original ways, but above all helps anticipate the emergence of new design languages. Discussions regarding product concepts and needs become much more articulated, moving from utilitarian features to emotional and cultural meanings. A single interpretation cannot provide a complete view of how people give meaning to a specific product.

Consequently, innovative companies in design-intensive industries have to use several different interpreters to combine insights and stimuli, and they must do this across several different categories. Several technology management studies have demonstrated that, in many cases, the novel recombination of existing knowledge can introduce innovation. This kind of approach is facilitated by actors that link different communities and people⁴⁵. In contrast with technological knowledge, languages are more dependent on culture and less on industry. Meanings are embedded into cultures because they can evolve and change within a given context and may run up against barriers to moving across different socio-cultural worlds, such as between different countries. At the same time, companies that compete globally cannot rely on local creative resources alone. The combination and hybridisation of local peculiarities with stimuli from other cultures can lead to original solutions and new vision. Razzaghi and Ramirez (2006) stress the importance of culture in product development, claiming that culturally-oriented products create stronger bonds with users.

As underlined by recent studies, the empirical results show a curvilinear relationship between innovation and knowledge diversity in specific dimensions (*Foreign Background* and *Industry Brokering*). To develop a designer portfolio composed of more than 60% foreign collaborators and of more than 80% cross-industrial designers decreases company innovation (see Figure 3 and Figure 5). The collaboration with few Italian designers specialized in the furniture industry is particularly crucial to be innovative; in other words the collaboration with only foreign designers that operate in several industries imply worst performance. One explanation may be the loss of sensibility toward the Italian furniture market, which is still a relevant part of the market of these companies. High levels of *Foreign Background* and *Industry Brokering* introduce heterogeneity able to threaten a fundamental value of design-driven companies such as product identity⁴⁶. Innovators mitigate this negative effect mixing projects developed with foreign and Italian designers, with cross-industrial and specialized creative resources. This kind of relationship is not evident for *Educational Background* and

Sub-sector Brokering, probably because these two characteristics do not imply the disadvantage previously described: they do not compromise the capability to comprehend the nuances of the Italian furniture industry.

CONCLUSIONS

The innovation of product signs and meanings requires a dispersed and tacit knowledge of socio-cultural trends and emerging societal phenomena. This knowledge should enrich collaborative efforts and rely on creative resources. Designers play an important role in helping companies to access, interpret and exploit knowledge of emerging socio-cultural models and latent market needs. We have demonstrated that innovators and their competitors build completely different designer portfolios. Consistent with the emerging approaches to innovation such as the connect-and-develop paradigm or open innovation⁴⁷, innovators in design-intensive industries collaborate with several external designers. Through collaborations with international designers in particular, they are able to access new semantic contexts and consequently enrich the knowledge concerning socio-cultural phenomena around the world. Our analysis of the educational backgrounds of creative professionals shows that innovators mix different approaches and mindsets in order to design unique and original products. Through their forward-looking capability, architects play a critical role in collaborating with innovators. Creative resources support innovative companies not only in the identification and interpretation of emerging trends, but also in the implementation of new aesthetic solutions that match the evolution of socio-cultural contexts. In this sense, innovators exploit the capability of creative resources to move product signs and languages from one sub-sector to another. In order to connect technical solutions and design languages adopted in projects about different product typologies, innovators collaborate with designers who operate across several sub-sectors. From a managerial perspective, this paper provides a

detailed description of the designer portfolios used by innovative companies. Identifying multiple interpreters with different backgrounds and from several countries is an insufficient condition for innovation. To attract this kind of creative resource, a company has to act as an interpreter, actively exchanging knowledge with design professionals. In other words, companies have to develop a reputation for being an avant-garde interpreter of social and cultural phenomena, as well as the technological capabilities that allow them to set free the designers' creativity.

*"I believe that Italy, or more specifically Northern Italy, is the centre of the design world, and above all because of the manufacturing culture; there is no other place in the world where you can find such a vast array of craftsmen and manufacturers for all intents and purposes who truly appreciate the value of design ..."*⁴⁸

[Ron Arad, Designer]

The knowledge diversity developed through the collaboration with designers of different backgrounds and experiences has to be interpreted as a cumulative asset. The identification, selection and attraction of key creative collaborators, even before competitors, requires significant investment. These activities are crucial for companies in design-intensive industries. They allow a creative asset to grow over time and this can be exploited by the company in several ways: the knowledge developed through a specific collaboration typically remains "stuck" to the company and can consequently be used in other projects. In other words, knowledge collected through the collaboration with French, cross-industrial architects can be reinterpreted and used in projects developed by in-house furniture engineers. The relationships developed with creative talents represent a distinctive asset with the opportunity to enter into a new business (the role of Alessi in the development of the "Fresh Surfer" may be a good example). The capabilities necessary to identify and select key designers require a

deep knowledge of the domain of innovation. Our research shows therefore that innovativeness does not depend on diversity brought by an individual designer, but on diversity brought by the entire portfolio of designers of a firm. In other words, the value of a single collaboration benefits from externalities generated by other collaborations. The bottom line implication is that firms should not focus only on the characteristics of single external parties when developing a collaborative innovation strategy, but, rather, manage carefully a balanced portfolio of collaborators.

However, our research does have some limitations. Even if representative of the national market, the Webmobili database does not contain all products offered by Italian furniture manufacturers. And the prestigious “Compasso d’Oro Award” represents just one prize in the design field. Specific dimensions can show reverse causality: for example innovators can have more financial resources and for this reason they can be able to collaborate with several and international designers. This paper has introduced a set of research questions that should receive further attention. It will be necessary to verify the external validity of our conclusions, as our data refer only to the Italian furniture industry. For example, although Italian furniture companies develop several products in collaboration with external designers, firms located in other countries may tend to develop products using in-house designers alone. Moreover, the central role of architects in comparison to industrial designers is probably typical of Italian companies. However, Italian innovators are successful at the international level. Consequently, the empirical evidence in this paper may offer interesting ideas for companies in other countries. Despite the fact that the contribution of designers (and of creative collaborators in general) is particularly relevant in other industries, it remains unclear whether similar results may also be evident in other domains. We would encourage further research, including the application of Social Networks Analysis (SNA) to describe the relationships between the two sets of nodes, namely companies and designers.

FIGURES AND TABLES

Designer Portfolio Dimension	N	Min	Max	Mean	Std. Dev.
Osmosis	98	0.0 %	100.0 %	79.6 %	32.8 %
Balanced Breadth	98	0.000	1.000	0.344	0.250
Foreign Background	91	0.0 %	100.0 %	22.8 %	27.6 %
Educational Background	98	0.000	0.909	0.493	0.285
Industry Brokering	98	0.0 %	100.0 %	53.4 %	32.6 %
Sub-Sector Brokering	98	0.000	4.000	1.843	0.973

Table 1: Descriptive statistics regarding designer portfolio dimensions



Figure 1: Moroso's designer portfolio

	Innovators	Imitators	T	df
N	21	77		
Osmosis	90.5 %	76.6 %	-2.528*	69.328
Balanced Breadth	0.457	0.313	-2.973**	46.119
Foreign Background [*]	45.7 %	16.0 %	-4.847***	89.000
Educational Background	0.716	0.432	-6.059***	59.291
Industry Brokering	61.9 %	51.1 %	-1.857	59.030
Sub-Sector Brokering	2.234	1.736	-2.115*	96.000

*p<0,05; **p<0,01; ***p<0,001

[*] Including 70 imitators; 7 companies also have divisions outside of Italy

Table 2: Designer portfolios - t test: Innovators vs. Imitators

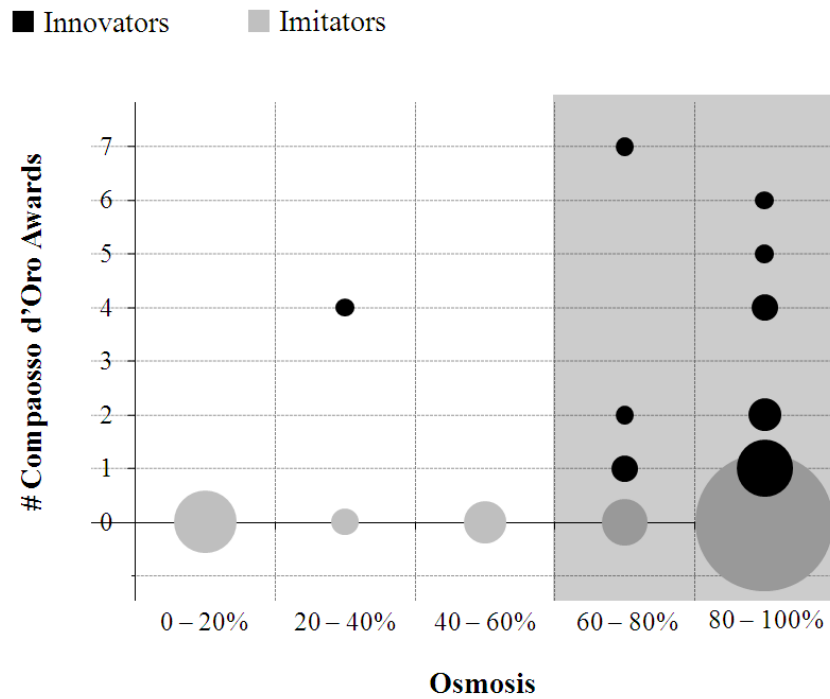


Figure 2: Osmosis – Innovators vs Imitators [radius is proportional to the number of companies]

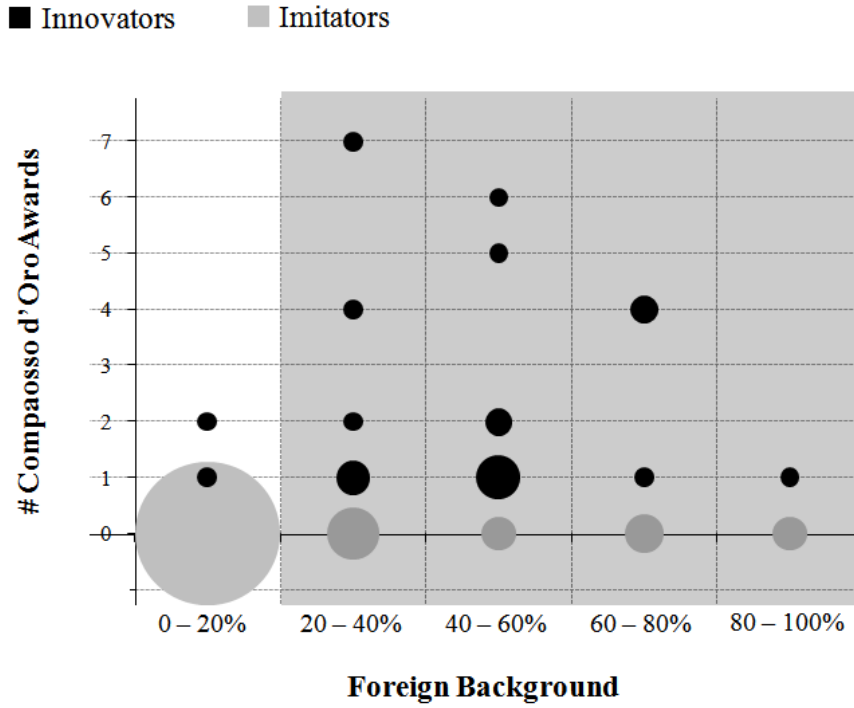


Figure 3: Foreign Background – Innovators vs Imitators [radius is proportional to the number of companies]

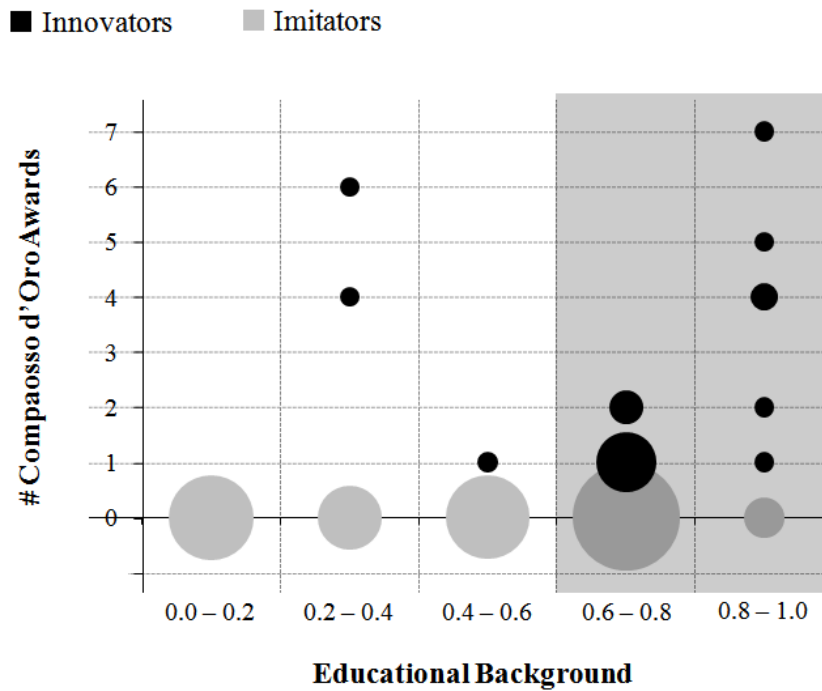


Figure 4: Educational Background – Innovators vs Imitators [radius is proportional to the number of companies]

	Innovators	Imitators	T	df
N	21	77		
% of products developed with designers who have a degree in industrial design	31.1 %	52.4 %	3.891***	63.819
% of products developed with designers who have a degree in architecture	44.9 %	32.6 %	-2.064*	43.913
% of products developed with designers who have a degree in engineering	5.7 %	0.1 %	-2.136*	20.099
% of products developed with designers who have a high school diploma	12.3 %	9.3 %	-0.742	96.000
% of products developed with designers who have some other educational background	6.0 %	5.6 %	-0.131	96.000

*p<0,05; **p<0,01; ***p<0,001

Table 3: Educational Background - t test: Innovators vs Imitators

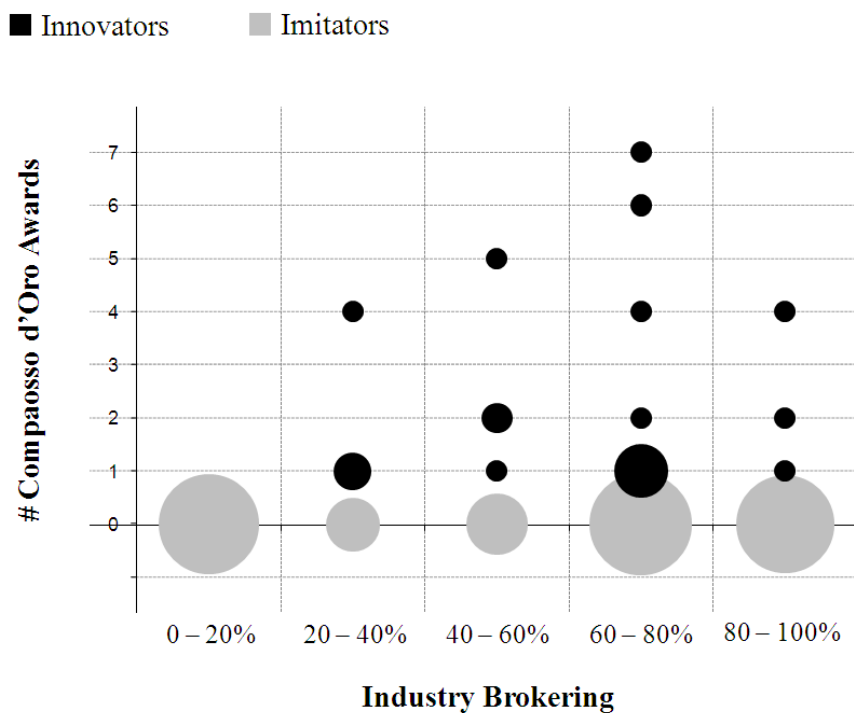


Figure 5: Industry Brokering – Innovators vs Imitators [radius is proportional to the number of companies]

METHOD APPENDIX: Analysing designer portfolios

We define “collaboration” as the relationship between a company and a designer. Each collaboration is characterised by the number of products developed by the same group of actors. Products developed by “Designer A” and products developed by “Designer A” and “Designer B” within the same company are considered to be two different collaborations. Using the Webmobili database, we were able to access a preliminary set of data regarding collaborations between each company and a group of designers. We retrieved the names of designers who have collaborated with each company, the total number of designers who have collaborated with each company, the number of products developed by each designer in collaboration with each company and the total number of products developed by each company. Through secondary resources (Internet and design libraries), we enriched the initial database by adding new information about each collaboration. We retrieved the nationality of each designer⁴⁹, the types of relationships with companies, whether “in-house designer” or “external designer”, the industries in which he or she developed products, whether “only furniture” or “multiple industries”, and the educational background.

Osmosis	
Description	Percentage of products developed by a company in collaboration with “external” designers
Note	-
Example	Alias develops products only in collaboration with external designers (<i>Osmosis</i> = 100,0 %), while 81.5 % of Berloni’s products have been designed by the in-house research centre (<i>Osmosis</i> = 18,5 %)
Balanced Breadth	
Description	<p>Multiplication of the ratio between the number of collaborations with external designers developed by each company and the number of products developed through these collaborations and the Gini dispersion index. It indicates whether a company prefers to develop the majority of its product portfolio in collaboration with a few designers or to engage with a broad range of creative resources.</p> $\text{Balanced Breadth} = \frac{k_E}{N_E} \times G = \frac{k_E}{N_E} \times \frac{k_E}{k_E - 1} \left(1 - \sum_{i=1}^{k_E} \left(\frac{n_{E,i}}{N_E} \right)^2 \right),$ <p>where k_E represents the number of collaborations with external designers developed by a company; N_E the total number of products developed with external designers, and $n_{E,i}$ represents the number of products developed through the external collaboration i</p>
Note	A first version of the <i>Breadth</i> dimension was calculated as the ratio between the number of collaborations with external designers developed by each company and the number of products developed through these collaborations. However, some companies, even those involved in many different collaborations, prefer to exploit only few of them. For this reason, we refined the first version by multiplying it by the Gini dispersion index. This verifies whether a company prefers to develop the great part of its product portfolio in collaboration with a few designers or to exploit a broad range of creative resources equally.
Example	Horm shows a particularly high value of <i>Balanced Breadth</i> (0,844) because in the period 1990-2005 they developed 8 products in collaboration with 7 different external designers (one designer developed 2 products, while the remaining 6 designers completed 1 each)

(table continues in the next page)

Foreign Background	
Description	Percentage of products developed in collaboration with foreign designers
Note	In <i>Foreign Background</i> we excluded 7 companies that also have subsidiaries outside of Italy
Example	Triade exhibits a particularly high value of <i>Foreign Background</i> (85,0 %) because in the period 1990-2005 it developed 34 products in collaboration with foreign designers (the total number of products launched in the period 1990-2005 was 40)
Educational Background	
Description	<p>The Gini dispersion index pertains to the following categories of educational degree obtained by designers who collaborate with each company: Industrial Design (Product Design, Communication Design, Service Design), Architecture, Engineering, High School and Other:</p> $\text{Educational Background} = \frac{5}{4} \times \left(1 - \sum_{j=1}^5 \left(\frac{n_j}{N} \right)^2 \right),$ <p>where n_j represents the number of products developed by a company in collaboration with designers of educational background j (j goes from 1 to 5: Industrial Design, Architecture, Engineering, High School and Other) and N the total number of products.</p>
Note	-
Example	Cassina shows the highest value for <i>Educational Background</i> (0,909): 18,2 % of the products were developed with industrial designers, 40,9 % with architects, 4,5 % with engineers, 13,6 % with collaborators that have obtained a high school diploma and 22,7% with partners that have different educational backgrounds. By contrast, many companies (e.g., Acam Biesse, Essepi, Ommag, etc.) collaborate only with industrial designers.
Industry Brokering	
Description	Percentage of products developed in collaboration with “cross-industrial” designers (designers who work beyond just the furniture industry)
Note	-
Example	95,0 % of the Varaschin’s products were developed in collaboration with designers who work beyond the furniture industry, while Marchetti Casa prefers to focus its collaborations with furniture designers: only 3,3 % of its products were developed with “cross-industrial” designers
Sub-Sector Brokering	
Description	<p>Average number of sub-sectors (Lamps, Tables, Chairs and Sofas) in which designers who collaborate with a company have experience</p> $\text{Sub - Sector Brokering} = \frac{\sum_{i=1}^{k_E} (c_{E,i} \times n_{E,i})}{N_E},$ <p>where $c_{E,i}$ represents the number of sub-sectors (Lamps, Tables, Chairs and Sofas) in which the external designer of collaboration i operates.</p>
Note	<i>Sub-Sector Brokering</i> for those companies that develop products only with internal designers is equal to 0
Example	B&B Italia exhibits a particularly high value of <i>Sub-Sector Brokering</i> (3,200) collaborating with 14 external designers: 2 of whom operate in all sub-sectors, 3 in three sub-sectors, 5 in two sub-sectors and 4 only in a single sub-sector. The top two designers developed 40 products in collaboration with B&B Italia during the period 1990-2005 (61,5 % of the entire product portfolio)

- ¹ Gemser G and Leenders M. (2001). How integrating industrial design in the product development process impacts on company performance. *Journal of Product Innovation Management*, Vol. 18, Pp.28-38.
- Hertenstein JH, Platt MB, Veryzer RW. (2005).The Impact of Industrial Design Effectiveness on Corporate Financial Performance. *Journal of Product Innovation Management*, Vol. 22, Pp. 3-21.
- Veryzer RW (2005). The Roles of Marketing and Industrial Design in Discontinuous New Product Development. *Journal of Product Innovation Management*, Vol. 22, No. 1, Pp. 22–41.
- ² Bloch PH, Frederic FB and Todd JA (2003). Individual Differences in the Centrality of Visual Product Aesthetics: Concept and Measurement. *Journal of Consumer Research*, Vol. 29 (March), Pp. 551-565.
- Schmitt B and Simonson A (1997). *Marketing Aesthetics: The Strategic Management of Brands Identity and Image*. Free Press, New York.
- ³ Postrel V (2003). *The Substance of Style*. Harper Collins Publishers, New York.
- ⁴ Cillo P and Verona G (2008). Search Styles in Style Searching: Exploring Innovation Strategies in Fashion Firms. *Long Range Planning*, Vol. 41, No. 6, Pp. 650-671.
- Verganti R. (2003). Design as brokering of languages: The role of designers in the innovation strategy of Italian firms. *Design Management Journal*, (3): pp. 34–42.
- ⁵ Chesbrough HW (2003). *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Harvard Business School Press, Boston.
- Iansiti M and Levien R (2004). *The Keystone Advantage: What the New Dynamics of Business Ecosystems Mean for Strategy, Innovation and Sustainability*, Boston, MA: Harvard Business School Press.
- Rigby D and Zook C (2002). Open-Market Innovation. *Harvard Business Review*, Vol. 80, No. 10, Pp. 80–89.
- Soh PH and Roberts EB (2003). Networks of Innovators: A Longitudinal Perspective. *Research Policy*, Vol. 32, Pp. 1569–1588.
- Sorenson O and Waguespack DM (2005). Research on Social Networks and the Organization of Research and Development: An Introductory Essay. *Journal of Engineering and Technology Management*, Vol. 22, Pp. 1–7.
- Huston L and Sakkab N (2006). Connect and Develop – Inside Procter & Gamble’s New Model for Innovation. *Harvard Business Review*, March 2006.
- Pisano G and Verganti R (2008). Which Kind of Collaboration Is Right for You? *Harvard Business Review*, December 2008.
- ⁶ Lakhani KR and Panetta JA (2007). The principles of distributed innovation. *Innovations*, Summer 2007, Pp. 97-112.
- ⁷ We use the term “designer” to refer to a design team built around an individual (e.g., products designed by Philippe Starck for Kartell are developed by a design team coordinated by Philippe Starck).
- ⁸ Gierke M; Hansen JG and Turner R (2002). Wise counsel: A trinity of perspectives on the business value of design. *Design Management Journal*, Vol. 13, No. 1, Pp. 10.
- Durgee JF (2006). Freedom of superstar designers? Lessons from art history. *Design Management Review*, Vol. 17, No. 3, Pp. 29-34.
- ⁹ Ravasi D and Lojaco G (2005). Managing Design and Designers for Strategic Renewal. *Long Range Planning*. Vol. 35, Pp. 51-77.
- ¹⁰ Heimeriks KH, Klijn E and Reuer JJ (2009). Building Capabilities for Alliance Portfolios. *Long Range Planning*. Vol. 42, No. 2, Pp. 96-114.
- Holmberg SR and Cummings JL (2009). Building Successful Strategic Alliances: Strategic Process and Analytical Tool for Selecting Partner Industries and Firms. *Long Range Planning*, Vol. 42, No. 1, Pp. 164-193.
- Verganti R (2009). *Design Driven Innovation – Changing the Rules of Competition by Radically Innovating what Things Mean*. Boston, MA: Harvard Business Press.
- ¹¹ Granovetter M (1982). The strength of weak ties: a network theory revisited. In: Marsden P and Lin N (Eds.). *Social Structure and Network Analysis*. Sage, Beverly Hills, CA, Pp. 105–130.
- Nooteboom B (1999). Innovation, learning and industrial organization. *Cambridge Journal of Economics*, Vol. 23, Pp. 127–150.
- Sobrero M and Roberts EB (2002) Strategic management of supplier–manufacturer relations in new product development. *Research Policy*, Vol. 31, Pp. 159–182
- ¹² Lampel J, Scarbrough H and Macmillan S (2008). Managing through Projects in Knowledge-based Environments: Special Issue Introduction by the Guest Editors. *Long Range Planning*, Vol. 41, No.1, Pp. 7-16.
- Ordanini A, Rubera G and Sala M (2008). Integrating Functional Knowledge and Embedding Learning in New Product Launches: How Project Forms Helped EMI Music. *Long Range Planning*, Vol. 41, No.1, Pp. 17-32.
- ¹³ Krippendorff K. (1989). On the Essential Contexts of Artifacts or on the Proposition that «design is Making Sense (of Things)». *Design Issues*, Vol. 5, No. 2, Spring, 9-38. Klaus Krippendorff proposes the following definition of design: “The etymology of design goes back to the Latin de + signare and means making something, distinguishing it by a sign, giving it significance, designating its relation to other things, owners, users or goods. Based on this original meaning, one could say: design is making sense (of things).”

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- Csikszentmihalyi M and Rochberg-Halton E. (1981). *The Meaning of Things: Domestic Symbols and the Self*. Cambridge: Cambridge University Press.
- Cooper R and Press M. (1995). *The design agenda*. John Wiley and Sons, Chichester UK.
- Margolin V and Buchanan R. (1995). *The Idea of Design: A Design Issues Reader*. Cambridge: MIT Press.
- Wijnberg NM (2004). Innovation and Organization: Value and Competition in Selection Systems. *Organization Studies*, Vol. 25, No. 8, Pp. 1413-1433.
- ¹⁴ Verganti (2003) defines design driven innovation as “an innovation where novelty of message and design language is significant and prevalent compared to novelty of functionality and technology”
- Verganti R. (2003). Design as brokering of languages: The role of designers in the innovation strategy of Italian firms. *Design Management Journal*, (3): pp. 34–42.
- ¹⁵ Verganti R. (2006). Innovating through design. *Harvard Business Review*, December 2006.
- ¹⁶ Bruce M and Morris B (1998). In-house, outsourced, or a mixed approach to design. In Bruce M and Jevnaker BH (1998). *Management of Design Alliances: Sustaining Competitive Advantage*. Chichester, Wiley.
- ¹⁷ Fleming L, Mingo S, and Chen D (2005). Brokerage vs. Cohesion and Collaborative Creativity: An Evolutionary Resolution. Working Paper, Harvard Business School, October.
- ¹⁸ Capaldo A. (2007). Network structure and innovation: the leveraging of a dual network as a distinctive relational capability. *Strategic Management Journal*, Vol. 28, Pp. 585-608.
- ¹⁹ Van Onck A. (2000). Semiotics in design practice. *Design plus research, Proceedings of the Politecnico di Milano Conference*, May 18-20.
- ²⁰ Lloyd P and Snelders D. (2003). What was Philippe Starck thinking of? *Design Studies*, Vol. 24, Pp. 237–253.
- ²¹ Hargadon A and Sutton RI (1997). Technology Brokering and innovation in a product development Firm. *Administrative Science Quarterly*, Vol. 42, Pp. 716-749.
- ²² Burt RS (1992). *Structural Holes: The Social Structure of Competition*. Harvard University Press: Cambridge, MA.
- ²³ Gulati R. (1998). Alliance and networks. *Strategic Management Journal*, Vol. 19, Pp. 293-317.
- ²⁴ McEvily B and Zaheer A. (1999). Bridging ties: A source of firm heterogeneity in competitive capabilities. *Strategic Management Journal*, Vol. 20, Pp. 1133-1156.
- ²⁵ Allen T. (1977). *Managing the flow of technology: Technology transfer and the dissemination of technological information within the R&D organization*. MIT Press: Cambridge, MA.
- ²⁶ West MA and Anderson NR (1996). Innovation in top management teams. *Journal of Applied Psychology*, Vol. 81, Pp. 680-693.
- ²⁷ Cox T and Blake H (1991). Managing cultural diversity: implications for organizational competitiveness. *Academy of Management Executive*, Vol. 5, No. 3, Pp. 45-57.
- Iles P and Hayers PK (1997). Managing diversity in transnational project teams. *Journal of Management Psychology*, Vol. 12, No. 2, Pp. 95-117.
- Richard OC and Shelor M (2002). Linking top management team heterogeneity to firm performance: Juxtaposing two mid-range theories. *International Journal of Human Resource Management*, Vol. 13, No. 6, Pp. 958-974.
- ²⁸ Latimer RL (1998). The case for diversity in global business and the impact of diversity on team performance. *Competitiveness review*, Vol. 8, No. 2, Pp. 3-17.
- ²⁹ Bantel K and Jackson S (1989). Top management and innovations in banking: does the composition of the team make a difference? *Strategic Management Journal*, Vol. 10, Pp. 107-124.
- Ancona DG and Caldwell DF (1992). Demography and design: Predictors of new product team performance. *Organization Science*, Vol. 3, Pp. 321-341.
- Jehn KA, Northcraft GB and Neale MA (1999). Why differences make a difference: A field study of diversity, conflict, and performance in workgroups. *Administrative Science Quarterly*, Vol. 44, Pp. 741-763.
- Pelled LH, Eisenhardt KM and Xin KR (1999). Exploring the black box: An analysis of work group diversity, conflict, and performance. *Administrative Science Quarterly*, Vol. 44, Pp. 1-28.
- ³⁰ Haunschild P and Sullivan B. (2002). Learning from complexity: Effects of prior accidents and incidents on airlines’ learning. *Administrative Science Quarterly*, Vol. 47, Pp. 609-643.
- ³¹ Rodan S and Galunic C (2004). More than network structure: how knowledge heterogeneity influences managerial performances and innovativeness. *Strategic Management Journal*, Vol. 25, Pp. 541-562.
- ³² Amabile TA (1996). *Creativity in Context* (2nd edn). Westview Press: Boulder, CO.
- Fiol MC (1995). Thought worlds colliding: the role of contradiction in corporate innovation processes. *Entrepreneurship Theory and Practice*, Vol. 19, No. 3, Pp. 71–91.
- Zaleznick A, Ed (1985). *Organizational Reality and Psychological Necessity in Creativity and Innovation*. Ballinger: Cambridge, MA.
- ³³ Van Knippenberg D, De Dreu C and Homan AC (2004). Work Group Diversity and Group Performance: an Integrative Model and Research Agenda. *Journal of Applied Psychology*, Vol. 89, No. 6, Pp. 1008-1022.
- ³⁴ Before choosing the sub-sectors (lamps, tables, chairs and sofas) we developed preliminary interviews with five industry experts: a journalist that operates in the furniture industry since 20 years writing articles on the main specialized magazines, two professors of the Industrial Design Faculty of Politecnico di Milano that

develop researches in several design-intensive industries and two architects that work in Webmobili. All of them identified the following sub-sectors: lamps, chairs and sofas. At the same time they admitted that in many situations chairs and tables can be considered as belonging to the same sub-sector. Especially lamps and chairs show the higher innovation rates in terms of new products proposed on the market each year.

³⁵ Razzaghi M and Ramirez M (2006). The influence of the designers' own culture on the design aspects of products. *Proceedings of EAD Conference*.

³⁶ In the calculation of *Foreign Background* we excluded 7 companies that have divisions also outside of Italy.

³⁷ Rieple A, Haderberg A and Gander J (2005). Hybrid Organizations as a Strategy for supporting New Product Development. *Design Management Journal*, Vol. 16, No. 1, Pp. 48-55.

Hirsch P (1972). Processing fads and fashions: an organization-set analysis of cultural industry systems. *American Journal of Sociology*, Vol. 77, Pp. 639–659.

³⁸ *Sub-Sector Brokering* for those companies that develop products only with internal designers is equal to 0.

³⁹ These data are about four sub-sectors (Lamps, Tables, Chairs, Sofas) and historical period (1990-2005) used to build the dataset.

⁴⁰ Mastropietro M and Gorla R (1999). *Un'industria per il design - La ricerca, i designers, l'immagine di B&B Italia*. Edizioni Lybra Immagine.

⁴¹ <http://www.educational.rai.it/lezionididesign/designERS/STARCKP.htm>.

⁴² Interview by Anna Lombardi published on *Chairs* (19th January 2005, http://www.moroso.it/home_moroso.php?n=404&l=it).

⁴³ Dell'Era C, Marchesi A, Verganti R and Zurlo F (2008). Language Mining: analysis of the innovation of dominant product languages in design-intensive industries. *European Journal of Innovation Management*. Vol. 11, No. 1, Pp. 25-50.

⁴⁴ Pisano G and Verganti R (2008). Which Kind of Collaboration Is Right for You? *Harvard Business Review*, December 2008.

Verganti R (2009). *Design Driven Innovation – Changing the Rules of Competition by Radically Innovating what Things Mean*. Boston, MA: Harvard Business Press.

⁴⁵ Hargadon A and Sutton RI (2000). Building an Innovation Factory. *Harvard Business Review*, May-June (2000), Pp. 157-166.

Hargadon A (2003). *How Breakthroughs happen: The Surprising Truth about How Companies Innovate*. Harvard Business School Press, Boston, MA.

Fleming L and Marx M (2006). Managing Creativity in Small Worlds. *California Management Review*. Vol. 48, No. 4, Summer (2006), Pp. 6-27.

⁴⁶ Dell'Era C and Verganti R (2007). Strategies of Innovation and Imitation of Product Languages. *Journal of Product Innovation Management*, Vol. 24, Pp. 580-599.

⁴⁷ Chesbrough HW (2003). *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Harvard Business School Press, Boston.

Huston L and Sakkab N (2006). Connect and Develop. Inside Procter & Gamble's New Model for Innovation. *Harvard Business Review*, March 2006.

⁴⁸ Interview by Giulia Crivelli published on *Il Sole 24 Ore* (05th April 2005).

⁴⁹ We retrieved the nationality of designers about 616 collaborations; in 42 cases it was impossible to retrieve these data.