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Planning for the Unknown: Case Studies of Design-Driven Industrial Conversion in the Automotive Sector as a Way to Overcome Crises and Uncertainties

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Abstract: This paper explores the role of a design-led orientation strategy for automotive firms. Specifically, the study examines the industrial conversion strategies of companies that have found new markets thanks to the discipline of design. Indeed, the central thesis of this paper is to investigate how design can boost entrepreneurship, managerial procedures, and be a source of competitive advantage. Commonly, industrial conversion has been studied by many researchers belonging to the area of management. However, studies on the role of industrial designers in corporate strategies represent a growing domain in design. The research is based on three case studies of Italian companies that have produced components for the automotive sector for years and following a moment of instability, used their expertise to move into different markets. The paper shows a tool developed by Harvard University to display new opportunities based on existing capabilities. The analyzed visionary companies broke away from one production sector and ventured into new ones where design was a strategic lever. As the case studies show, industrial reconversion brings companies "back to life" and makes them flexible and resilient to sudden changes, thanks to switching products and markets based on existing capacities. What emerges is that industrial conversion is a winning strategy in cases of corporate crisis where sunk costs are to be exploited to explore new opportunities. Starting from this, we can assume and replicate comparable strategies in companies currently experiencing difficulties due to the changing technological paradigms in the automotive sector.

Keywords: *Industrial Conversion, Industrial Design, Automotive Sector, Corporate Strategy, Design Culture*

Introduction and Research Context

Recent years have seen renewed interest in the role of the discipline of design in disruptive business strategies. It has previously been observed that "business model design has emerged as a new domain in design" (Simonse 2014, 67) and how design can boost entrepreneurship, managerial procedures (Borja De Mozota 2003), and be a source of competitive advantage by including designers to the firm's competitive strategy (Olson, Slater, and Cooper 2010). A growing body of literature recognizes that the discipline of design could be an essential key to expanding the horizon of innovation (Dorst 2015) in companies due to its capacity to "radically change the emotional and symbolic content of products through a deep understanding of broader changes in society, culture, and technology" (Verganti 2008, 1).

The existing body of research on business strategies suggests several interesting, innovative business visions where the discipline of design can make essential contributions to business model innovation through innovative materials, new technologies, and advanced production processes (Bryant, Straker, and Wrigley 2020). In this respect, industrial designers

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behave like explorers who search for new meanings by envisioning new project areas, modern production processes, and unexplored markets (Lerma et al. 2018). To better understand this role, Zurlo holds the view that when a new technological frame is combined with the new market exploration, "designers are essentially given free rein to tap the companies' exploration desire" (Zurlo and Cautela 2014, 26).

However, we believe that the role of designers throughout business model innovation needs to be further investigated and find a broader perspective. Further steps are needed to look at the design culture as an added value (Borja De Mozota 2002) for manufacturing companies that have not yet exploited it as a potential competitive advantage. The contribution of designers can be particularly positive in manufacturing companies where there is a defined competence in semifinished products, components, and finished products. Moreover, companies in which designers can work most effectively are those that produce products with a medium architecture complexity, intended as a product structure not composed of numerous interdependent subsets, because of the expertise of industrial designers, who have different skills from industrial design engineers (Kim and Lee 2014; Pei, Campbell, and Evans 2011; Miller and Elgaard 1999).

This investigation takes the form of an analysis of three case studies of Italian companies in the automotive sector that have implemented industrial conversion strategies. The companies changed from a B2B to a B2C market, first selling components for the automotive sector and then finished products where design is one of the dominant added values. In particular, the case study companies are from Piedmont, the cradle of the induced production of the FIAT car company, now called Stellantis. As the case studies will highlight, the companies were able to enter completely different markets even though all three started from the automotive sector dealing with market uncertainties.

Industrial conversion is a business strategy adopted by companies under challenging conditions to increase their revenue by changing their top product. For this research, the necessary conditions are a shift in the value chain (e.g., verticalization, change from semifinished products to products) and a change in the reference sector. To better explain the changes brought about by industrial conversion, the authors systematized the company's product portfolio using the Product Space Analysis (Hidalgo and Hausmann 2009). It allows better understanding of the current state of the art and the new product opportunities that companies can seize.

This paper is organized as follows: the first section defines the phenomenon of industrial conversion and the Product Space tool used to read the company's portfolio and the opportunities exploited by the company. The second section describes the selection criteria for case studies. The third section describes three case study companies: FABBRICA TORINO, Caino Design, and Tre Spade. The fourth and fifth sections describe the results obtained, conclusions, and limitations of the research.

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In order to focus on the cited goals, this initial study sought to answer the following specific research questions (Blessing and Chakrabarti 2009):

1. How can companies benefit from the expertise of designers to become resilient to changes and crises?
2. How industrial designers help generating new concepts exploiting the company's competencies?

The aim of this work is to develop fresh insight into the field of design research in connection with business management. Indeed, the discipline of design lends itself well to interaction with other disciplines, as "the nature of design as an integrative discipline place it at the intersection of several large fields" (Friedman 2003, 508). The authors suppose that this relationship can find unexplored meanings of needs, and related products (Lüthge 2020).

Theoretical Background

Adding Value to Organizations through Design

Determining the impacts of the discipline of design in the corporate decisions has been important for the current role of design in business education and research.

> No longer the cherry on the cake for high-end goods and luxury brands, over the past decade it has gained relevance for the way organizations are structured, how they operate and how they think. An increasing number are starting to use design strategically – to differentiate themselves from the competition, to launch new brands and strengthen existing ones, and to inform strategic choices. There is already considerable evidence for design acting as a mechanism for business growth and innovation. (Micheli 2014, 5)

Companies can have different degrees of design orientation, which will be better defined later; it can be null, where the company produces not user-oriented products (components, semifinished products, etc.); overt, where products are designed for the end user and the design activity is effective; or potential, where the design may be lacking, but there is room for intervention (Germak 2001; Cantó, Frasquet, and Gil-Saura 2019). The described case studies succeed in reaching the level of overt design, becoming design-driven organizations that have "both deep and wide design capabilities enabling human-centered innovation comprehensively on all levels" (Björklund et al. 2020, 20) giving design a role as a differentiator.

Determining the financial impacts of design in the company would require further investigation with a different method; therefore, this study provides impacts as qualitative advantages regarding corporate image, new product portfolio, and customer relationship. Through the case studies, the authors want to answer the research questions and support the assumption that design is an innovation engine capable of opening new market spaces, attracting new and different customers, and conferring brand recognition.

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Industrial Conversion as Ambidextrous Strategy

Industrial conversion is a strategic process that companies under challenging conditions can implement to update and expand the product portfolio, using the plant, machinery, and competencies already owned. Indeed, the company can exploit and enhance these sunk costs to minimize the production structure's conversion costs. This process may result from internal corporate strategies or external causes, such as technological development, exceptional states of necessity (war or calamity), changes in demand, and market crisis (Naujoks 2010). The external causes are manifold and influenced by political, cultural, social, and economic factors.

This symmetry toward the exploitation of the company's intrinsic capacities and the exploration of new productions is balanced by the so-called ambidextrous strategies, first defined by Duncan (1976; Tushman and O'Reilly 1996), which aim at modeling a flexible company, ready to change toward new opportunities (exploration capacity), able to exploit the resources it already possesses (exploitation capacity). Ambidextrous strategies increase revenues and spread the business risk by changing and updating the product portfolio. Industrial conversion turns out to be particularly profitable when exploiting existing capabilities to explore new markets as ambidextrous strategies do. When implemented, industrial conversion as an ambidextrous strategy must satisfy stakeholders' interests and needs, purposes that designers know how to achieve. Through industrial conversion, companies plan which products to launch, improve, or eliminate based on the product's life cycle stage and market trends.

Moreover, industrial conversion makes the competition irrelevant by focusing on new markets with new products, creating and capturing new demand, as "Blue Ocean" strategies do (Agnihotri 2016). Companies operating in mature or declining sectors implement corporate-level strategies, and industrial conversion can be a chance to avoid the corporate crisis. Consequently, industrial conversion as an ambidextrous strategy aims at modeling flexible and resilient companies ready for unexpected contingencies. Indeed, as O'Reilly and Tushman (2013) assert, the proper lens to view ambidexterity is the dynamic capabilities, namely the ability to integrate, build, and reconfigure internal and external competencies to deal with rapidly changing environments (Teece, Pisano, and Shuen 1997).

In addition, the authors agree with Stoimenova and de Lille (2017) when affirming that the chance of designers managing ambidexterity is missing from the debate. Therefore, in this research, industrial conversion is a business strategy where industrial designers can provide outstanding contributions, combining their skills in exploring innovative production processes to create new products to help cope with the "lack of studies that tell practitioners how to create and manage an ambidextrous organization" (Devins and Kähr 2010, 65).

As anticipated, the case studies described here are examples of companies from the Piedmont region located in the automotive district reality of Turin that have successfully faced transformation through industrial conversion, avoiding corporate crisis, and

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guaranteeing the handing down of the productive culture, specifically the competences acquired and improved over time.

Visualize New Opportunities

This section aims to describe one relatedness measures tool of four identified to date in the literature (Whittle and Kogler 2020) useful to visualize and schematize the new opportunities that the company can seize based on its knowledge and the changes that the industrial conversion strategy brings to the product portfolio diversification. To address this challenge, the authors selected as more proper the "product space" tool, a data visualization medium of the Atlas of Economic Complexity (Hausmann et al. 2013; Hidalgo and Hausmann 2009), developed by Harvard University and launched for the first time in 2013. The Atlas allows the study of global trade flows through data about the breakdown of exports and imports by products, displaying new and feasible opportunities for diversification, and tracking these dynamics for every country for a time. The Product Space is one of these tools that help visualize complex data, showing what products a country produces and exports and connects more than 1200 products by the similarities of productive capability required to manufacture them, as shown in Figure 1. Those two aspects are worthwhile to undertake in the direction of industrial reconversion. The main production clusters are highlighted by different colors: chemicals, machinery, vehicles, minerals, textile, electronics, metals, stone, and agriculture. Although this tool was designed at the country level, we assume that the identified opportunities based on production capacity can also be applied at the company level. In fact, Hausmann et al. (2013) considers states as aggregates of firm that tend to diversify by moving toward nearby related products or requiring similar know-how to leverage existing capabilities. The Product Space makes visible the "capacity distance" between products. The analysis estimates how it is feasible to obtain the necessary know-how to make new products based on existing production capabilities. The resulting schema is a visualization of the connections between products based on the know-how they share. Visually proximity products require similar capabilities, with a greater likelihood of diversification success. Products that require entirely different capabilities are visually distant, and the diversification process could require more effort, investments, and resources. The Product Space is the chosen tool to visualize the company's product portfolio and explore possible opportunities for industrial conversion. As previously stated, although the tool has been designed on a large scale, we believe it can be very well adapted to a smaller scale, that of a company. It is crucial to consider the resources and competencies which companies must identify for new opportunities. One parameter included in the product space is the product complexity index (PCI), which ranks the diversity of the productive know-how required to manufacture a product. It will help the research to understand the degree of complexity of the production of the analyzed companies.

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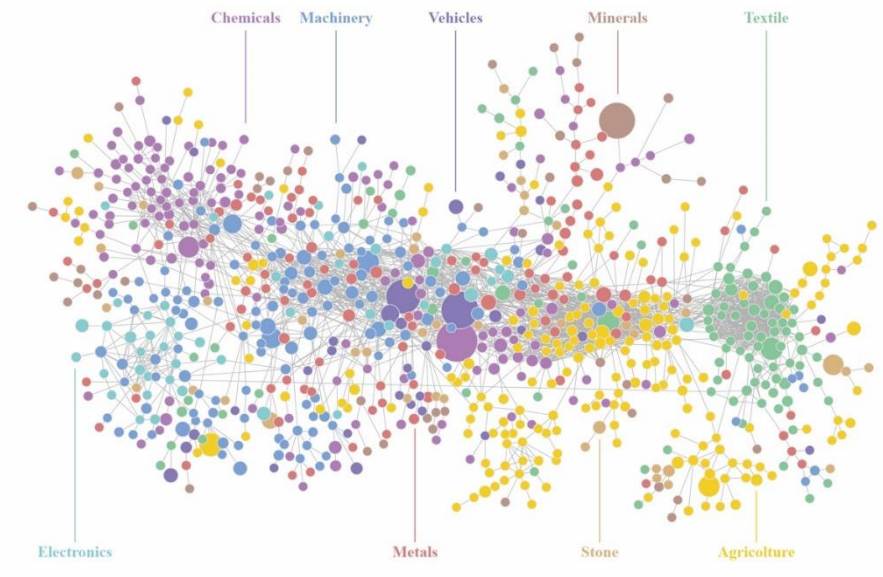


Figure 1: Product Space Tool, Italian Economic Complexity Representation
Source: The Atlas of Economic Complexity 2019[1]

Research Approach

Data Sources

The study described in this paper is a portion of Eva Vanessa Bruno's doctoral research. The research uses the collection of case studies as a research method, as a "basis for understanding a wide range of issue" (Buchanan 2001, 18), following the well-established iterative path proposed by Yin (2017), to analyze state of the art and gain insights into new design-driven business strategies. This first version of the database collects and classify sixty case studies of Italian companies that have applied design-oriented industrial conversion. The authors use Calabretta's definition of design orientation, namely when "design is a major force for innovativeness, in the sense that designers drive and support actions through-out the entire development process and across a broad scope of functional activities" (Calabretta, Montaña, and Iglesias 2008, 384). The authors consulted various sources to collect case studies, such as reports from research centers, articles from national newspapers, and research from territorial bodies. The database takes the form of a detailed and meticulous table. It collects information regarding the territory and its resources, the companies' history, size, factual and causal knowledge that allowed the diversification, and the materials and production processes used before and after the strategy.

Inclusion and Exclusion Criteria

In particular, the authors will describe a portion of the business history of three companies selected from the cited database and how they gained competitive advantages through

[1] http://www.atlas.cid.harvard.edu

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industrial conversion. Among the case studies collected, which are included in the industrial districts in Piedmont (textiles, jewelry, agri-food, mechanics, metalworking, engineering, chemicals, and plastic products), the authors will analyze in depth automotive companies. The choice fell in this area because it is a characteristic sector of the region that has recently experienced a significant crisis: the semiconductor shortage that began in 2020 and caused the delayed delivery of cars is a recent example of its fragility. In the Piedmont region, mechanics and metalworking are leading industrial segments in the automotive sector. With Fiat and its allied industries, the automotive industry has radically transformed the production culture in Turin and Piedmont, making them a flagship in Italy and worldwide, creating a solid network of suppliers and manufacturers of automotive components. Moreover, recent developments make it a good area for great experimentation in terms of shapes, materials, and processing, thanks to the electric motor, which needs not only a different product architecture but also to communicate, through shapes, colors, the new frontier of electric mobility.

The research, partially presented here, adopts criteria for selecting the firm as follows: small- and medium-sized enterprises (SMEs), following the European specifications regarding the definition of SME (European Union 2015), belonging to the manufacturing macro sector, that produce semifinished products, components, and finished products with a medium architecture complexity. The choice of SME is dictated by several factors: not only the high number of enterprises of this size but also for a common dynamic–lean structure, the capacity of filling niche opportunities and customized new products, and finally, because design can propose economic solutions that do not require great investment for great uncertainty (Gulari and Fremantle 2015). The level of manufacturing and the medium complexity of product architecture are favorable conditions for incorporating the discipline of industrial design into business strategy. In addition, companies should express a high flair for innovation through a willingness to explore new opportunity, and a broad diversification of the product portfolio.

Data Collection

The authors collected data and information about selected companies through desk research (websites, balance sheets, social network accounts, reports) and filed research through semi-structured interviews to validate the collected information and draw new conclusions and insights. In particular, the information aims to clarify the following topics:

- Motivations for change: What were the causes that led to implementing the industrial conversion strategies?
- Motivations to choose the new sector: Why did companies choose this new sector? Did they have the competencies required?
- New sector: Is the sector they have moved into definitive? Or do they want to be flexible?
- The economic effort: What was the level of investments? Have the production facilities (as sunk costs) been decommissioned or reconverted/remodeled/upgraded?
- Consequences: What changed with the industrial conversion?

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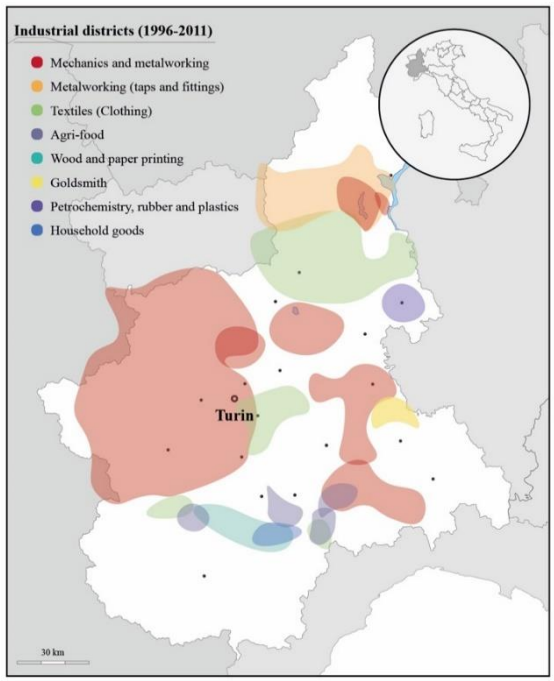


Figure 2: Industrial Districts in Piedmont Region, in the Northwest of Italy
Source: Bruno and Lerma

Case Studies: Industrial Conversion in the Automotive Sector

Automotive Sector in Piedmont: a Brief Overview

In the early 1900s, Turin became the center of Italian industry, with 40 percent of Italian companies. There are many reasons why Turin and Piedmont have been a cradle for the Italian automotive sector, reflecting the skills present in the area: the presence of coachbuilders, a workforce specialized in public works and metallurgy, the development of an entrepreneurial class interested in industry, made up of both bourgeoisie and nobility, and specialized schools. In addition, several environmental and political conditions led to the development of the automotive sector in Turin. For example, with extensive availability of cheap hydraulic energy thanks to the rivers, the municipal administration favored investing in new facilities to supply electricity, allowing companies to have cheap energy and move away from the rivers. The first car manufacturers had a craftsman's character, and the car became popular through competitions for wealthy amateurs. Especially in Europe, cars were custom-built for the customer, hence the spread of coachbuilders. The first manufacturers, who later became the first car manufacturers, specialized in woodworking machinery, metalworking, and the production of bicycles. From there, the industry began to expand more and more, creating a dense network of component manufacturers and coachbuilders (Miletto and Sasso 2017). Indeed, at the beginning of the 20th century, automotive

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production was present with more than twenty automobile companies and more than fifty companies producing auxiliary materials and accessories for automobiles.

For years now, Piedmont has shown a production slowdown and appears in a transition phase, struggling to adapt to the new global economic context and the significant changes that have managed the new drivers of competitiveness and innovation. Nevertheless, the Piedmont region continues to be the center of the Italian production of automotive components. About 33 percent of automotive components companies are based in Piedmont (Moretti and Zirpoli 2021).

FABBRICATORINO–Acetate Sunglasses

FABBRICATORINO was founded in the 1920s as a company producing industrial objects made of Bakelite, a thermosetting phenol-formaldehyde resin and the first plastic made from synthetic components. This material, which at the time was only recently developed, was used for car components and other industrial objects such as radios, telephones, and electrical appliances. The company was, therefore, one of many automotive suppliers in Piedmont. During the 1930s, experimentation with new materials led to the introduction of acetate that brought significant changes to the company. In fact, the company, strengthened by its knowledge in the transformation and processing of plastics, began to manufacture new products. Initially, the connection with the automotive sector remained present: the company started producing protective glasses for racing drivers. In fact, its main customer, the automobile manufacturer DIATTO, asked to produce pilot goggles, thus triggering the beginning of the conversion. Then, the first line of FABBRICATORINO glasses was born. Initially, these were very technical products, sports glasses for pilots and protective glasses for workshop use. Later, the study and production of a broader collection of sunglasses and eyeglasses for everyday use began. Nowadays, FABBRICATORINO produce glasses milled from solid sheets of acetate 100 percent made in Italy.



Figure 3: FABBRICATORINO Eyewear Made by Acetate
Source: FABBRICATORINO[2]

[2] https://www.occhialifabbricatorino.it

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STV Italia–New Decorative Panels with Caino Design

The STV Italia company has been producing screen printing frames for the automotive sector since 1967. It represents the consolidation of the experience of several screen printing loom companies. The conversion process undertaken at the end of the 1990s led to the development of electronics and the metalworking business applications, continuing to support the Piedmont automotive sector but destined to supply various industrial sectors. This transformation took place by acquiring the technologies of chemical photo-cutting, laser micro-cutting and, subsequently, electroforming. The development and acquisition of these new skills have enabled the development of new products wholly detached from the automotive sector.

As a consequence of offshoring, STV group aspired to maintain a made-in-Italy production line. Hence, in 2011 STV Italia launched the brand Caino Design to provide decorative luxury objects. Thanks to a combination of creativity, innovation and know-how acquired since 1967, Caino Design offers new innovative products for the high-end interior decoration market. The company has been able to combine the expertise in manufacturing screen printing looms, and from the 1990s, it developed engraving techniques of wafer-thin metal sheets for various industrial sectors. The new products are large steel screens finely decorated with stylish motifs. These decorative panels can be employed as space dividers, curtains, wall decorations, privacy screens, or claddings. The company's new direction has enabled the designers to explore new and unknown markets to create exclusive and unique products. Nowadays, the company manufactures highly customizable products appreciated worldwide.



Figure 4: Caino Design Metal Panels
Source: Caino Design[3]

3 https://www.cainodesign.com

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Tre Spade–High-Quality Kitchen Tools

Tre Spade was founded in 1894 as a coffee grinder company, another product of excellence of the Piedmont scenario, born together with the espresso fashion that was spreading in Italy. At the beginning of the 1900s, the first automobiles began to travel through big cities, and the company soon realized the extent of the new motorized revolution. By 1906 the company had transformed itself into one of the pioneers in the field of automobile mechanics. The company thus began to produce hot-pressed steel components for the automotive sector, establishing itself on the Piedmont automotive scene. However, alongside the automotive experiments, the company continued to innovate in kitchen tools over the years: first the meat mincers, then the tomato squeezers, followed by the sausage fillers. In 2010, moreover, the company relied on designers in laying out a strategy to relaunch brand, giving it a new international visibility. Today, the company's portfolio includes meat mincers, packaging machines, dryers, cheese graters, spice grinders, and coffee machines. After taking advantage of the good times in the automotive industry, the company returned to its original sector. Indeed, the company has taken advantage of its high expertise in hot stamping steel to completely change its market niche from automotive components to high-quality finished kitchen products.



Figure 5: Tre Spade "Toollio" Meat Grinder and Cheese Grater
Source: Tre Spade[4]

Product Space Related to the Automotive Sector

To analyze the diversification paths that the automotive sector in Italy could take, the authors use the Harvard University Product Space tool, described earlier. The tool is easy to use and

4 https://www.trespade.it/

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provides a clear and interactive reading of the idea of product correlation. Figure 6 displays a portion of Italy's exported products in 2019. The product "Cars" is the white dot in the center of the figure, which is linked to five related products: safety glass, consisting of toughened (tempered) or laminated glass; springs and leaves for springs, of iron or steel; other lifting, handling, loading, or unloading machinery (e.g., elevators, escalators, conveyors, teleferics); parts and accessories of the motor vehicles. If we went into detail to see the second level of correlation, the branches would be more and more numerous and gradually more distant apart. This means that thanks to this tool it is possible to map products, and consequently technologies, that are already connected to the automotive sector. Starting from here, designers can leverage existing technologies to orient the company to design.

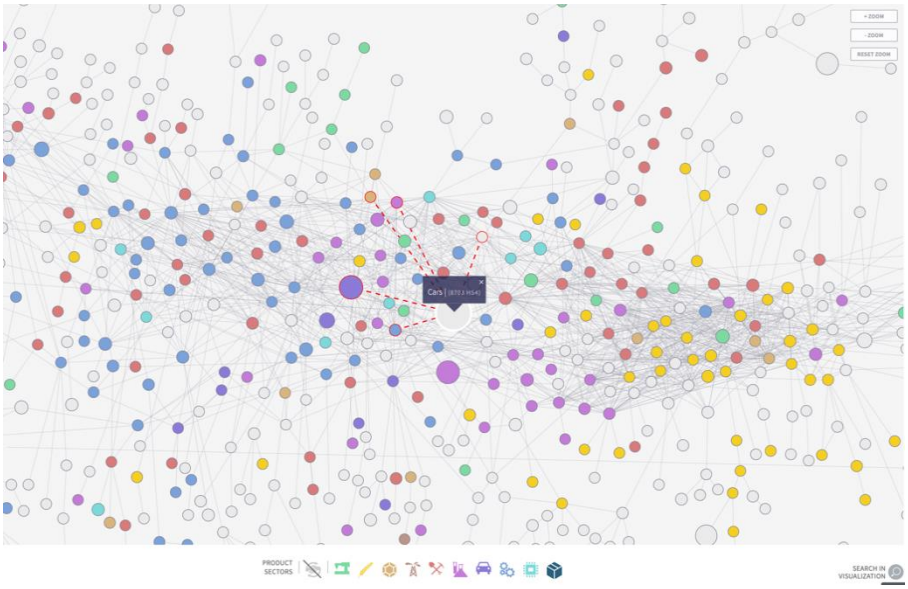


Figure 6: Product Space related to "Cars"
Source: The Atlas of Economic Complexity 2019

Findings and Discussion

A strong relationship between the design practice and corporate management has been reported in the literature and one of the aims of this study was to strengthen this link by introducing design as a corporate strategy, as a boost to entrepreneurship, managerial procedures, and a source of competitive advantage.

With respect to the first research question (How can companies benefit from the expertise of designers to become resilient to changes and crises?), it was found that the activities of designers can help the company in creating a strategy that creates a relationship between design, identity, and the company's production culture. This has positive effects such as: expressing company's values, strengthening branding, and improving distinguishing.

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The second question in this research aimed to understand how industrial designers help generating new concepts exploiting the company's competencies. Visualizing the company's portfolio and related new opportunities based on existing competencies with complex data visualization tools, such as the Product Space described in the article, helps the company on the path to diversification.

Visualization is a starting point. Cooper identified that "Design thinking applied to business strategy and business transformation involves the visualization of concepts and the actual delivery of new products and services" (2009, 48). Moreover, the characteristic creativity of industrial designers allows to generate this differentiation toward surprising directions to attract new customers.

One interesting finding is that the difficulty of uncovering a common ground between design research and day-to-day reality (Dorst 2016) can be overcome in business, where "leaders often bog down in their decision-making and overlook essential cues in their company's environment that have a direct bearing on their future success" (Zell, Glassman, and Duron 2007, 93) and academia can provide fresh insights. However, a subsequent difficulty should not be overlooked: "the presence of mental models regarding innovation processes that are different among designers and managers" (Scaletsky and Da Costa 2019, 31).

These findings mirror those of previous studies that have examined design management.

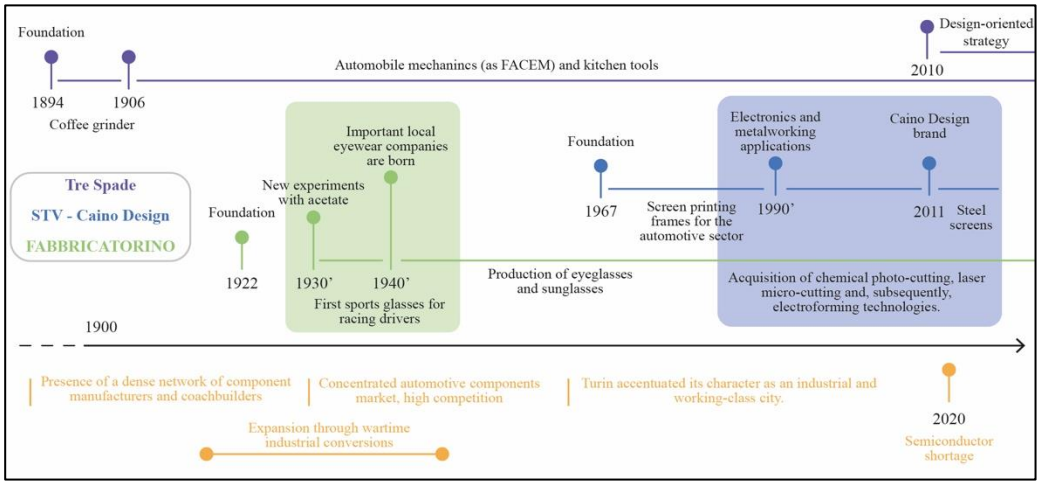


Figure 7: Timeline of Industrial Conversions in Relation to Some Highlights of the Industrial Scenario in Turin
Source: Bruno and Lerma

Conclusions, Limitations, and Implications for Research

This research aims to examine the emerging role of the discipline of design in the context of corporate business and its positive impact through the design-driven industrial conversion process; in this study, it is intended as an ambidextrous strategy capable of exploiting the

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existing capability to explore new markets. In particular, the chosen companies have leveraged their competencies acquired thanks to previous productions in the automotive sector.

The proposed schemes highlighted the primary manufacturing sector, metal and plastic components, and products in the new product portfolio, looking for connections between common manufacturing skills. This study finds that the Product Space Analysis can help industrial designers define the paths to introduce new products based on the companies' know-how and competencies, contributing to new business decisions.

Moreover, we firmly agree with Borja de Mozota (2010) when she explains that design can boost the company's ability to cope with change, namely defined design as transformer.

Even though the case studies described in this paper are part of a database of sixty case studies, the number is too small to consider theory building.

Through this alternative product-market strategy, industrial designers leverage existing company's capabilities, embrace new trends, and increase the potential for new geographic markets (Denis, Denis, and Yost 2002). In addition, industrial designers allow, starting from a company that processes materials and produces products, to include new materials in the production process or increase the number of production processes to differentiate the product portfolio.

In 2020 the COVID-19 outbreak pointed out the need to rethink new growth models. "Turbulences create turning points for extraordinary gain or pain" (Naujoks 2010, 104) and the automotive sector in Piedmont, whose main historical strength has been traditional manufacturing, needs a new development strategy that makes the most of the specializations and consolidated skills of the production sector. Moreover, the region should follow the new global growth trends such as digital, ecological, and sustainable, representing an opportunity that the region can exploit to increase.

As shown in the article at hand, the industrial conversion process is the strategy identified to explore emerging technological paradigms and take advantage of new design-driven products that highlight the design culture. Finally, industrial reconversion makes companies ready, flexible, and resilient to sudden changes, thanks to changing products and markets based on existing capacities.

Conflict of Interest

The authors declare that there is no conflict of interest.

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