

Opening the black box of design: the importance of innovation processes within clothing sector.¹

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Introduction

During the last decades a plentiful growth in the literature –mostly from the evolutionist and neoshumpeterian traditions- aimed toward the inquiry of the analytical dimensions that influence and condition technological construction, innovation process and technical progress, has taken place. With the intention of opening the black box of technology, Nathan Rosenberg (1982) –following Schumpeter’s (1912, 1942) and Penrose’s (1959) theoretical line, and advancing the direction opened by Nelson and Winter (1982)- has started a long tradition on theoretical discussions that conceive technology as a dimension much more complex than mere accumulation of machines and physical assets, or than an added variable in a production function that links output with work and capital stocks. Along this tradition, important debates about (i) integration or transformation of tacit and codified knowledge, (ii) systemic character of innovation processes and (iii) the importance of national, sectorial and local dimensions were generated in order to understand the structure and dynamics of innovation.

The increasing consent about conceptualization and measurement of technological development and innovation processes led to the standardization of involved dimensions on manuals that greatly guided the development of case studies and technological surveys (Frascati Manual, OCDE, 1982; Oslo Manual, OCDE, 1997.) In addition, the need for adapting the idea of innovation to the specificities of developing countries also led to subsequent advances as was described by the Bogotá Manual (2001.) The existence of differences among these conceptualizations and the emergence of other positions focused on the linkage between competencies and technology gave place to several new studies and to the development of many different instruments of data recovery.

In spite of the fact that the concept of design as an innovative activity was present within these frameworks, the opening of the black box of technology was only partial as it did not include a deeper analysis of determinant dimensions of design, an activity which is in the process of self-explaining and making itself an issue, specially in their inclusion as an innovative activity (Galán 2008). On the contrary, in most technological surveys the efforts on design are inquired without a previous conceptualization on the variables that determine it and the diversity of forms of its manifestation². In the same

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² Strictly speaking, most technological surveys not only give very low relevance to the design section, but are also limited to simple questions which don’t depict the degree of complexity of this activity.

way, traditional Pavitt (1984) taxonomy suggested that innovation within the clothing sector was dominated by suppliers (of machinery, fabrics, etc.), which was functional for the framework of a (fordist) paradigm in which product differentiation was secondary. However, in the last decades the emergence in productive systems of a model based on flexibility has given to design a key role on innovation process. In this sense, product conception is no longer just linked with its own material characteristics. On the contrary, design has begun to be conceived in a more complex way, with such aspects as supply, production, communication and commercialization, which are now integrated in a global strategy (Becerra y Cervini, 2005). As a consequence, innovation in the textile-clothing sector nowadays includes as much of old Pavitt's aspects, still valid, as new dimensions (i.e.: communication and commercialization.)

Regarding the possibilities of development for peripheral countries, productive stages in which Pavitt centered innovation process, present highly elevated barriers to entry (fundamentally on machine production and raw textile material innovation), while new dimensions as conception, communication and distribution, (much closer to design), require higher intangible capital which depend on high qualification of human resources and on the integration of tacit and codified knowledge. Although regarding specialized providers within this sector (machinery and textile) there are minor barriers to entry, the development of intangible capital –related to the increasing role of design- raises the barriers to entry on the market range in which competition based on price is lower. This opens the possibility for the development of innovative firms in developing countries, which are implementing a design process more complex and in an integral way, taking over quasi-rents on this market segment. However, design activities can't be perceived as a result of purely individual efforts. On the contrary, they constitute a complex system that has emergent properties that advance beyond individual behavior and are the result of a set of factors associated with efforts on design training of human resources, development of specialized technical services and business development, among other factors.

The relevance of this in terms of clearly tacking what is understood by design, especially in developing countries, derives from the need of creating a more complex specialization profile, which becomes specially evident from the recent world crisis and the fall in prices of commodities. In that sense, design could be considered a tool that allows beginning a process of product differentiation and developing specific and idiosyncratic skills and competences. The apprehension of design as a technological activity that transversally cuts through the set of existing productive activities is a key factor on the process of increasing the complexity of the specialization profile, and also on the possibilities of taking over quasi-rents in segmented markets, both at national and at global levels. Likewise, design could help to create a sustainable strategy within the manufacturing sector in developing countries, particularly on mature or traditional activities that characterize their specialization profile.

This paper progresses, fundamentally from a methodological approach, on the analysis of stated topics using as a case study the segment of brand companies within the clothing sector in Argentina. In spite of traditional indicators which reveal that it is a sector with scarce innovative activities, in the last years –specially from the 2002 devaluation- it becomes evident that there is an increasing demand for external designers. Therefore, it has been identified as one of the most dynamic sectors in the

country by Prodiseno INTI and CMD.³ Partly, this higher demand is explained by the fact that the Fashion Design Degree has had one of the highest growing rates of enrollment in the last ten years.⁴ However, despite this increased priority on design activities in the clothing industry, the existing evidence (exports profile, importance of non-registered employment, weakness of productive chains, issues on the social and institutional mesh (Kosacoff *et al*, 2004) allow us to hypothesize that the greater part of firms within this sector haven't yet occupied the place that clothing firms have in developed countries, where productive specialization is centered on sectorial chains with dynamic competitive advantages and based upon differentiated products with high design content.⁵

The positioning of these activities as a tool for competitive improvement has been widely used by institutions of discipline promotion - as Design Council (UK), Design Centrum (Czech Rep), Design Forum (Finland), Barcelona Centre Disenny (Spain), Sociedad Estatal para el Desarrollo del Diseño y la Innovación (DDI, Spain), Danish Design Centre (Denmark)-, but also by state technological agencies –TEKES (Finland), DTI (UK)- and international professional institutions –ICSID, ICOGRADA, ADI-. Likewise, the relationship between design activities and the competitive ability of the firm has been approached also by a number of studies in developed economies; in some cases by quantitative and in others by qualitative studies.

Following the previous indications, the questions that organize this paper are the following: (i) Which are the necessary dimensions to grasp the development level of design activity within a specific industry such as clothing?; (ii) which are the key elements of those dimensions in order to determine the complexity of design in the firms of this sector?; (iii) what is the link between design complexity and technological and organizational competences of the firms?; (iv) what is the relation between design complexity and the firm's performance in the market, in terms of productivity, sales, profitability, and exports?; (v) is it possible to grasp the determinant dimensions of design complexity by doing surveys of the firms?; (vi) To what extent does a greater use of design on clothing manufacture have a positive effect on quasi-rents generation and distribution within the whole and (vii) could those dimensions be generalized to the study of design relevance in other productive sectors?

In order to tackle some of these questions, we developed a methodology oriented towards: (i) identifying the levels and dimensions which would be taken into account the approach design matter, understood as a disembodied innovative activity which creates knowledge, and (iii) identifying the variables and indicators that allow to qualify and measure these dimensions, and therefore the complexity level of design activities performed by the firms. In that way, and as the result of multiple interviews with

³ This demonstrates, by example, from the estimations made by Prodiseno and INTI the employment searches for design professionals made by firms, and the increases of on-line job bank of CMD.

⁴ Fashion and/or Textile Design Courses are offered by 11% of higher education institutions of the country; metropolitan areas being third place in the ranking. In turn, Architecture and Design Courses (within which is included Fashion and Textile Design) are in third place according to the number of new students, following traditional courses such as "Economy and Administration" and "Law", first and second respectively.

⁵ On the other hand, and in what is an encouraging sign, some recent studies about the dynamics of entrepreneurship highlights the great importance assigned to design by the entrepreneurs of the fashion sector (Kantis y Drucaroff, 2008).

sectorial specialists and design experts, a survey was developed which included a set of dimensions necessary to grasp the complexity level of this activity.⁶ This survey was applied to 41 brand-firms of clothing sectors located in Buenos Aires, Great Buenos Aires, Mar del Plata, Pergamino and Córdoba..

Our main hypothesis is that the level of complexity of design activities influences a firm's performance. This hypothesis is grounded by the fact that different design management models are adopted and integrated to the rest of the firm's activities in very diverse ways. In advancing this concept, it is a key factor to evaluate the complexity level that acquires this activity, considering that this is not independent from the type of markets in which the firms compete, understanding that design is central to reach differentiation rates of product –of symbolic and cultural characteristics- which manifests as appropriation possibilities for market quasi-rents.

Additionally, another hypothesis is that the importance of design management within companies is strongly associated with the level of technological and organizational competences reached by firms through their evolutionary paths⁷. In this sense, it is considered that only those activities which achieve greater knowledge appropriation within the firm are the ones that allow sustained added value generation and, therefore, allow the improvement of dynamic competitive advantages.

This paper, which has a methodological character, is structured as follows: the first section introduces some stylized characteristics of clothing sector in Argentina, and locates the brand producers in this context; the second section discusses the key role of design on innovation processes; the third section identifies a group of determinant dimensions for design complexity level within the firms; the fourth section demonstrates some of the main empirical results: the application of these dimensions to a panel of clothing firms, which aspires to develop a strategy based on product differentiation starting on branding its products, and with diverse design intensities; the fifth section revises the theoretical typology of firms in light of the results; finally, the sixth section presents the main conclusions.

1. Clothing sector in Argentina: the poor role of design.

The clothing sector in Argentina is fundamentally built on small and medium national companies, labour-intensive (144.529 employees), with a high level of informality (72%) and female employment (76%). These companies target their production mainly to the local market (export rate is only 7%) while imports represent only a tenth of consumption (CEP 2007, EPH, 2007). It is a sector with a deficit in terms of its physical linkages⁸ and in its social and institutional network, which impacts negatively on firm evolution (Kosacoff *et al*, 2004).

The recent sector history can be characterized by a strong contraction suffered in the late 90s (clothing production was reduced by 46% during the 1998-2002 period),

⁶ The form used is available –only in spanish- on www.continentedigital.net (see “Documentos de trabajo”)

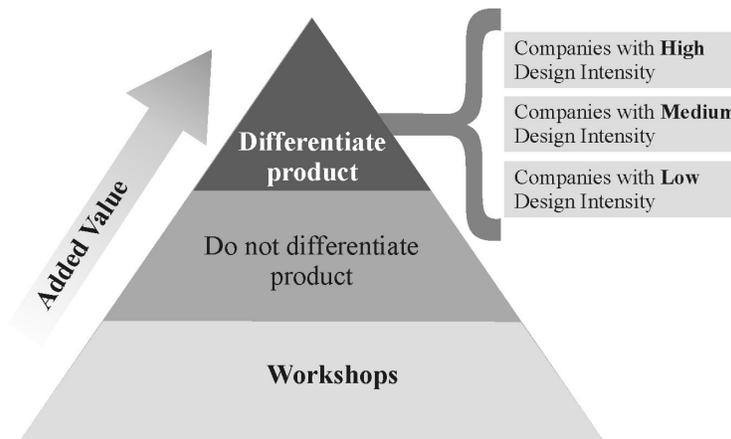
⁷ This hypothesis is also implicit on the work developed by INTI Prodiseno Team (Ariza y Ramírez, 2008).

⁸ This problem could be easily appreciated by the absence of capital goods' local production, as well as by the limitations of the textile sector on supplying quality and high-design raw materials, which also limit clothing industry possibilities.

followed by a peak after the 2002 devaluation, which was manifested on the duplication of production in the last 5 years. During this peak, the industry has grown by the stimulus of internal demand recomposition, fall of costs and raise of idle capacity, although since 2006 the productive capacity has reached near 80%, boosting an investment process targeted to increasing the production, improving products and processes quality and diversifying productive mix (CEP, 2007).

As a consequence of the strong crisis suffered by the sector during the period of convertibility, the industry adopted defensive strategies which included both productive profile modification actions –targeted at less tradable products- and sector informalization –with the intention of wage costs reduction.. As a result of these types of strategies, and in tune with the issues that this industry presents at an international level, the sector is characterized by a high degree of informality and an important participation of a female work force, which includes mainly seamstresses (Gallart, 2006).

From the clothing sector’s internal organization perspective, it is possible to categorize two types of firms: (i) those that differentiate products⁹, and (ii) those that do not differentiate products¹⁰. Both tend to outsource their production on the same workshops, which concentrate most of the sector’s informality, as they do not. Likewise, and as we progress in this paper, it is possible to identify three types of companies within the ones that do differentiate products (see graphic 1)



Graphic 1. Conceptual model¹¹ of clothing sector in Argentina

In general, both types of companies –product differentiating and non-differentiating- tend to outsource dressmaking on workshops that, in most cases, do not fulfill minimum labor and health regulations. This is why most of the workers in this sector endure a

⁹ By product differentiation we are referring to the business strategy centered on the identification and search for a group of consumers, and the suitability of products to these demands. Linked to this strategy is the idea that product differentiation could be followed by quasi-rents emergence within the firms.

¹⁰ The Center for Production Studies (Centro de Estudios para la Producción, CEP) has made a similar distinction: “...it is possible to distinguish two types of companies: those which center their strategy on brand, and those which center their strategy through low cost/price of garments” (CEP, 2007)

¹¹ The transition from a purely conceptual model to a quantitative one presents serious problems given the lack of statistics useful for the particular aims. As can be observed ahead in this work, present research makes some progress on the estimation of the degree of design intensity within a set of firms that differentiate products.

poor employment situation (Gallart, 2006). This predominant informality allows leading companies to considerably reduce the risk in an eventual crisis, by using an occupational structure of high flexibility, increasing or decreasing the number of workers involved according to the economic cycle with low costs both in terms of hiring and lay-offs.. This strategy allows for cost reduction of work, decreasing the risk of eventual labor trials, as the company is not the direct employer of informal workers.

Within this context, companies that do differentiate products tend to focus on activities that generate higher added value (in terms of design, marketing, logistics) and allow certain control over the rest of the productive stages (pattern making, cutting). Therefore, companies often integrate cutting and pattern marking (tised), because this way they can have better control over workshops, optimize supplies and reach a higher control over final product quality.

Presently, firms that do not differentiate products tend to focus on logistics and on the stages that allow for control over workshops. These types of companies tend to copy the patterns and to sell their production on non-branded branches and fairs, where competence is fundamentally centered on price-quality relation, with the first variable prevailing . Within this group, barriers to entry are considerably low, which gives place to a strong competence that drives costs down and forces producers to reduce costs, including wages to a minimum. Because of these factors, this group does not reach technological quasi-rents and, neither, is it increasingly threatened by imports from countries with lower wage costs.

Within the first group, in which is the survey and methodological proposal are centered, it is possible to differentiate three cases: (i) companies with high design intensity, (ii) companies with medium design intensity and (iii) companies with low design intensity¹².

In *high design intensity companies*, this activity constitutes the driving force for the rest of the elements of the system, such as retail, internal organization and search, processing and integration of information and both codified and tacit knowledge. In these cases, the different dimensions that determine company differentiation on the market are aligned through an integral design strategy. This alignment brings the companies closer to a strategic design management model, associated nowadays with the highest levels of design performance within the firms. Thereby, communication, commercialization, product and production dimensions constitute a coherent and systemic unit that allows reaching a differentiation degree in several levels which elevate themselves. These companies conceive design as the fundamental base for the development of all their activities and as the main source of the quasi-rents that they obtain. In these cases, the creation of competitive advantages is derived from a highly differentiated product generation, with an important brand positioning. By the aforementioned considerations, within these types of companies the design activities are translated in a model of strategic management that some authors name “strategic

¹² A similar approach is being developed by Prodiseno INTI's Team, on the elaboration of a certification system of Good Practices on Design (Ariza y Ramirez, 2008). Their classification, called “design maturity level”, goes from a zero degree (‘absolute ignorance’) to a sixth degree (‘design philosophy’). In as far as a lower degree in design maturity corresponds to non-differentiating product companies, higher degrees would correspond to companies with high, medium and low design intensity, in decreasing order, and presents several convergences with the classification developed in this work.

design” (Manzini 1999, Becerra y Cervini, 2005, INDEX 2005, Galán, 2008). When the design takes place strategically, it incorporates to the analysis not only the attributes of the company, but also the dynamics of the scenario, of the competition and of the market (Galán 2008).

On the other hand, in the *medium design intensity companies*, this activity –despite its importance for the development of its capacity to compete in the market and to obtain quasi-rents-, does not occupy a central place in its strategy. Within this group, companies oriented by a commercial logic (defined with an interest in the inclusion of certain segments of the market or channels) coexist with companies oriented by a communicational logic (centered mainly in the diffusion of a language associated with the brand). In these cases, the main competitive advantages are related to the possibility of incremental innovations generation, which update and adapt the product to the target market.

Finally, *low design intensity companies* differentiate products through strategies that relegate the design to a very secondary role, which is pronounced in the use of other dimensions to differentiate their products such as in volume and publicity. Unlike the group of companies with high intensity of design, the relationships between these dimensions are not systemic. These types of companies do not reach technological quasi-rents; on the contrary, they center their business on high production and commercialization volumes, keeping the brand as a differentiation factor and having the price factor be of very considerable importance, within the competition with other companies that also differentiate products.

In opposition to these three groups, the companies that do not differentiate products are highly dependent on the sector’s regulatory frame, as they cannot compete in terms of costs with imports of other developing countries (Dicken, 2003; Nordas, 2004). In this respect, the end of the OMC’s Textiles and Clothes Agreement in 2005 has meant a big step in the world-wide liberalization of the sector and constitutes a threat for the productive segments based on a scheme of competition by low wages, low product differentiation and therefore limited or null design. Under this scheme, the companies that differentiate products and compete on the basis of design, logistics and marketing, are the only ones that could open a footpath of sustainable growth for the medium and long term future, also compatible with a process of structural change towards activities with greater added value, higher employment quality and better wage levels.

2. Design as key for innovation

Most of the technological surveys that are carried out, as much in Latin America as in the developed countries, consider design activity as a disembodied innovation effort. Also, the questions usually proposed to identify design activities are limited in the evaluation of their existence and the company’s investment on them, without considering the important divergences on the conceptions of “design” by companies. In addition, in some cases, it is questioned whether design is important for the company, slanting the answers towards an opinion or perception of the utility or function of the design, and without contrasting it with the real practices of firms.

Regarding the importance of design for innovation, the OECD (1982) defines that design is the very core of innovation, in as much as it constitutes the moment at which a

new object is imagined, designed and constructed as a prototype. This importance of design in innovation is reflected in the literature and on the thematic Manuals (Oslo¹³; Bogotá¹⁴). Nevertheless, beyond this recognition, the space assigned to design activities and their role in development of new products and processes on innovation surveys is of low relevance. Technological surveys normally consult only if the company has developed design activities -with the issues mentioned before- and the amount assigned to them, but do not ask about the processes involved, or on the linkages on which these activities are based or on the ones that were created by it. In light of this, advances registered in the last decades to increase the understanding about the way in which the companies approach their R+D activities and their equipment incorporation have been scarcely accompanied in the field of design. Somehow, it is still necessary to characterize design intervention in terms of economic dynamics, and even to establish its results so that they can be measured in terms of impact.

As mentioned above, the relation between the design activities and the competitive capacities of the companies also has been tackled by several studies in developed economies, in some cases in quantitative form –Design Council, 2004 y 2006; Power, 2004; Korea-KIPO, 2003- and in others in a qualitative way -Maldonado, 1993; Dormer, 1993; Chiapponi, 1999; Design Council, 2002; Gemser y Leenders, 2001; Verganti, 2003; Bettiol y Micelli, 2006, among others-. These studies demonstrate the causal relation between the implementation of design activities and the economics of different industrial sectors (furniture, clothing, bazaar, toys, household-electric, etc.), as well as in the positioning of their products in global markets. In synthesis, these works emphasize that [a] the effective management of design is a key factor in competitiveness (Ughanwa, 1988); [b] successful companies view design as an investment (Roy,1990); [c] the integration of industrial design in new product development has a significant influence on the company's performance, particularly when the investment in design is new in the industry (Gemster y Leenders, 2001); [d] the main barrier for the increase of design activities within the company is the perception of these activities as being of low relevance (Design Council, 2002); [e] different levels of design implementation exist: operative, functional and strategic (Mozota, 2002); [f] it is not enough to know if the company used design, but how it was used: company without design, with design as aesthetic styling, with design as process, and with design as innovation (Teknikforetagen and SVID, 2004); [g] it appears as fundamentally necessary the integration between users and producers through design management (Verganti, 2003).

As will be discussed in this section, identification of design intensity within companies requires both a conceptual discussion -on the levels that sustain this activity- and a methodological discussion -on the method, design can be evaluated with specific inquiries-.

Among the multiple dimensions that involve a work oriented towards opening the “black box of design”, the discussion on what is understood by “design” constitutes a central point. In the first place, the discussion is necessary because the word “design” involves a set of dissimilar disciplines with their own specificities: architecture,

¹³ Oslo Manual. Medición de las Actividades Científicas y Tecnológicas. Directrices propuestas para recabar e interpretar datos de la innovación tecnológica (OCDE, 1997)

¹⁴ Bogotá Manual. Normalización de Indicadores de Innovación Tecnológica en América Latina y el Caribe (RICYT, 2001)

graphical design, industrial design, interior design, clothing design, textile design, etc., which constitute different professions. Nevertheless, they have numerous convergences.. The main common factor between these dissimilar practices is its *project-driven* characteristic, that is to say, the capacity to project solutions towards the future, from an analytical-creative process. Walsh (1995) defines this characteristic as the “creative visualisation of concepts, plans and ideas; and the representation of those ideas (as sketches, blueprints, models or prototypes) so as to provide the instructions for making something that did not exist before, or not in quite that form”. Secondly, the versatility of the term “design” is reflected in the multiplicity of meanings that companies attribute to this word (Walsh, 1995), which sets serious difficulties for its use on surveys that are limited to asking if the company creates design, or if it considers that this strategy is important. In this sense, the general public, and a significant sector of national businessmen, still links design solely with the aesthetic dimension of products. In reality, design involves an extensive set of dimensions that exceed the purely decorative aspect: ergonomics, interface between technology and user (which determines availability of technology for consumers), functionality and efficiency of material use, are also central aspects in design practice.

Different theoretical meanings of the term *design* appear with a significant level of divergence and the discussion on its definitions and its scope has still not arrived at a general consensus. There are cases in which the activities are developed within the framework of high professionalism, but it is also frequent that these activities are developed using informal methods -mainly in small firms. From the design theory it is possible to find diverse approaches that range from Maldonado’s position (1993) - “it is a project-driven activity that consists in determining the formal priorities of industrially produced objects”- to the more open conception of Shingley and Mishke (1989) - “design is to formulate a plan to satisfy a human necessity ”-. From a different point of view, design can be understood as a set of instructions and routines -in the sense of Nelson and Winter (1982)- based on both codified as well as tacit knowledge that turn resources and supplies into products and services, which consumers use and value (Baldwin and Clark 2005). A more moderate definition is promoted by the ICSID (International Council of Societies of Industrial Design): “Design is a creative activity whose aim is to establish the multi-faceted qualities of objects, processes, services and their systems in whole life cycles”. For ICSID, design activities involve products, services and systems conceived through tools, organizations and logic introduced by industrialization, and not only when they are produced by serial processes. They require active participation of a broad range of professionals, who contribute in the production and services, graphics, interiors and architecture. From these basic definitions it is possible to detach the innovative root of the activity, since design implies the search for product change and the ability to differentiate. For these reasons, it can be said that design has very similar characteristics to innovation: it does not arise from an individual inventiveness, it is part of a collective process and must have results that apply to the market.

With regard to the aims of this work two fundamental meanings are highlighted: (i) design as *result* -products and/or services commercialized in the market; and (ii) design as *process* -a series of activities that begin with an analysis and a problem definition process, to end with a device development that satisfies the problem that instigated it. These two dimensions, far from being understood as two independent conceptions, must be considered as strongly interrelated and mutually determined, since it is impossible to

obtain results without processes, and is illogical to think of design as a process whose result is not relevant. In this manner, design as result is conceived as a special kind of intangible asset. Nevertheless, using the definition of design as process, it would be advisable to understand this type of activity as a *competence*, more than as an asset, since it would imply that this competence must be generated, stimulated and maintained along, and furthermore cannot be bought packed in the market.

On the other hand, if we part from the conception of “design” as a process that the organization develops, it is possible to state that it becomes independent from the notion of the activity as something strictly professional, that is to say, depersonalized of the knowledge “carrier” that makes possible that this process takes place. Therefore, the mere hiring of a designer does not solve the issue of incorporate design culture into the company. This manifests in the fact that it is possible to find companies, small in general, that still carry out design activities without hiring designers, independently of its level of formality.

Understanding design as a process is indeed what allows observing, characterizing and evaluating it on their intervention in companies’ performance. From that viewpoint, the concept about opening the “black box” has meaning only if it is possible to divorce the conception of “design” from the perception of the organization, and from the incorporation of specialized professionals of different design disciplines. In other words, the conception of design as a process (and not as an art, for example) constitutes the ontological condition for “opening the black box”, without which would be illogical to identify the steps, actions and stages that constitute the heart of this activity and which are effectively plausible to be observed and measured through a survey as the one used in the present study.

Regarding the location of the design within the value-chain of industry, different perspectives exist that imply, also, radically different forms of conceiving the discipline. The classic approach positions design as an encapsulated instance and separated from other sub-processes, such as production and marketing. Within the framework, from this linear conception, design receives inputs -of market research or technological innovations, for example, and it gives output to other areas of the company –in the form of blueprints, scale models or manuals, without internal interchanges becoming evident. Nevertheless, for some authors (Walsh *et al.*, 1985; Galbraith, 1982; Sharifi and Pawar, 1996; Becerra and Cervini, 2005) there exists a symbiotic interconnection that accounts for the role of design in a process of dimensions, such as marketing capacities, communication and production alignment. From this conception, design process requires the establishment of a joint with other areas of the company such as engineering, production, finances, marketing, R&D, among others. The consideration of the great diversity of variables that these aspects imply, articulates the absorption and connectivity capacities of the company, in the new products development process. Therefore, design is important both for the strategies centered in the product differentiation (collaborating with R&D department in the creation of new products, for example) as in the reduction of costs (where the linkage with production is fundamental, for example for scrap minimization). Therefore, design can be characterized as an important discipline as much for innovative activities as for non-innovative ones, which opens the doors for the discipline to the set of mature industries that tend to predominate in the emergent countries.

From a similar standpoint, the designer is defined as a gatekeeper, that acquires and integrates the necessary knowledge about what customers demands, what can be produced more efficiently and what fits best with other products of the company (Walsh and Roy (1985). From this perspective the designer also acts as a focus of integration between human resources belonging to different departments of the organization

This analytical perspective has strong connections with the evolutionist perspective, in which design can be understood as a process of integration of tacit and codified knowledge, by means through which it is possible to increase both absorption capacities as well as linkages of agents (Erbes, Robert and Yoguel, 2008)¹⁵. In the same way that design can be established on the basis of the “gatekeeper” concept, it can also work as a focus within the company which captures, filters, generates and lets in information and knowledge, as it distributes them internally. Consequently, design can be conceived as an interpretation and translation process, as its objective is to coordinate the different aspects of the product so it fulfills the requirements of the client, but also responds to the necessities of the company and consumer. In turn, it needs to handle information of diverse origins and to be related to the different internal and external areas of the company. That is to say, design can work in many cases as a selection and absorption mechanism for external information, as it is permanently pending about the surrounding changes and how those can affect the company’s product profile or its innovation activities.

Therefore, design, used in a strategic way, constitutes a technological activity that allows to incorporation of different forms of knowledge into products and processes, becoming one of the most used processes in adding value, generating dynamic competitive advantages and technological quasi-rents in the global industrial practices (Walsh, 1995; Walsh, Roy and Bruce, 1988; Roy, Walsh and Salaman, 1986; Becerra and Cervini, 2005). When products reach an important degree of complexity (in terms of codified and tacit knowledge incorporated, design, weight of R&D, development of a high level chain of suppliers, etc.) the probability of producing differentiated products increases, raising the barriers to entry and therefore the possibilities of attaining technological quasi-rents in the global and national market. In this sense, design could be considered a mechanism that would allow making a system more complex, through the contribution of intrinsic characteristics such as methodological flexibility, constant search for differentiation, high connectivity needs for its operation, adaptation and operation capacity within imbalance contexts and knowledge absorption and transformation capacity, among others.

In this sense, design activities are part of the endogenous competences development of companies. On the one hand, design as a part of the endogenous competences is associated to that which Walsh *et al* raise (1985) regarding the existing interconnection in successful companies between design capacities and marketing and production capacities. On the other hand, design as a connectivity factor is analyzed by Slappendel

¹⁵ The absorption capacity is defined as “the ability to recognize, to assimilate and to apply new external information” (Cohen and Levinthal, 1989) from previous endogenous competences. In that direction, it can be assimilated to routines construction (Nelson and Winter, 1982), dynamic capacities (Teece and Tisano, 1994) and endogenous competences (Erbes and Yoguel 2007) from agents. Furthermore, the connectivity capacity is associated with the potential to establish linkages within the system and to generate interactions with other systems. The objective is to increase this knowledge base, which depends on the development of minimum thresholds of previous competitions.

(1996) who sets the existence of a statistical relation between companies' design degree and its design networks, although he does not manage to establish the direction of the causality.

From a *meso* point of view, it is possible to observe a change of direction when analyzing the characteristics that take design processes at different moments of a technological life cycle: from the first instance in which designers pursue experimentation and technological innovation, through an instance in which designers look for technical improvement, costs reduction and fabricability improvement, finally arriving at a mature phase in which the search of a multiplicity of design variations, trends and styles predominate within product range targeted to different market segments (Walsh 1995). This change of direction is closely related to the stabilization of a *dominant design*, which determines the highest peak on the curve of the technological life cycle. Most of the design activities related to mature sectors will be located, then, in the latter: the search of *non-innovative novelties* (Walsh 1995), being centered in production systems, incremental improvement, production costs reduction and appearance, and not in the radically new product generation (Utterback, 1979).

From aspects discussed previously, design is understood as a complex activity characterized by: [1] the involvement of a systematic process, made up of stages with measurable objectives, actions and specific results; [2] an implication of an integrated work between diverse areas of the company, such as marketing, production and communication, and even with external agents of the company, positioning itself as a "gatekeeper"; [3] the involvement of the systemic consideration of a multiplicity of variables such as the ergonomics, semantics, technical feasibility, etc.; [4] the operation not only of radical innovation processes, but also of frequent facilitation of incremental innovation processes, contributing to the dynamism of the mechanics of the company; [5] the formalizing, with the participation of specialized professionals, in an informal manner.

3. An approach towards the formulation of indicators of complexity in design

The concept of *complexity* of a system alludes to self-organization and adaptation properties, derived from the absorption and connectivity capacities of the agents in conditions of imbalance, uncertainty and temporary irreversibility (Antonelli, 2008; Erbes, Robert and Yoguel, 2008). In the special case of a design process, the complexity refers to the idea of *intensity*, that is to say, it considers the integration level between this process and the activities of development of a firm's competences towards the competitive advantages and product differentiation on the market. In that sense, the complexity covers both the qualitative characteristics of the design activities' process of implementation and the quantitative dimensions of the implementation.

In an attempt to establish a methodological approach that allows one to analyze and to evaluate the incidence of design activities in companies' competitiveness, three aspects have been proposed:

- I. **Process characteristics** of design and development, understood as the way to organize the activities and the human resources of the company involved in the conception of new products and/or services;

II. **Obtained results** in terms of the dynamics of new products/services generation and the appropriation of generated value through the different mechanisms that can exceed industrial property protection;

III. **Feeding and circulation of knowledge network building**, both codified and non-codified, through the formal and informal entailment that the firms maintain with other organizations - public companies, institutions, ONGs, etc. -

From this perspective, this section considers a set of indicators to assess the degree of complexity degree of design activities, applied in this case to branded clothing companies. The considered design indicators involve (i) the absorption capacity of the companies, measured by their endogenous competences, (ii) the connectivity capacity, and (iii) the interrelation between both dimensions, that altogether allow approaching the idea of complexity (Erbes, Robert and Yoguel, 2008).

3.1 Dimensions linked to the absorption capacities: the endogenous competences

As mentioned previously, design is conceived as an activity which takes part in the endogenous competences building of a company. Although, conceptually, design cannot be detached from the rest of the dimensions that compose these competences, we have chosen to operatively isolate it with the aim of identifying its specificities with greater depth.

In order to grasp the absorption capacity and to evaluate companies' taxonomy presented in the first section, three indicators were considered, which constitute the aggregation of 20 factors (i) design of human resources (four factors), (ii) design complexity in production (six factors) and (iii) design complexity in product conception (ten factors).

(a) Design human resources and formality degree

This indicator aims to identify the importance of design activity through the quantification of human resources (internal or external to the company) devoted to that activity. Along these lines, five factors are considered (see table 1): the existence of a group that develops design activities and its formality degree (question 1); design insertion within the company (question 2); the internal, external or mixed character of design activities (question 3) and human resources incorporation related to design activities in the last 5 years (question 4). The indicator of *design human resources and formality degree of the design team* is calculated as a simple average of the mentioned questions.

It is an input indicator that combines flow and stock elements. This indicator can be understood as one of the components of companies' endogenous competences development in design area, which conditions the possibilities of linking between companies and environment to increase design competences.

Table 1 Structure of the indicator of design human resources¹⁶

Questions	Valuation
1. Existence of a group that carries out innovation activities (formal and/or informal) (318)	Both or Formal =1; Informal=0,5; None=0
2. If the group that develops innovation activities is an R+D or Design or Marketing department or another. (321)	Design Dpt. = 1 R+D Dpt. = 0.5 Other=0
3. If company develops design activities in internal, external or mixed way (11 4b)	Mixed= 1 Internal= .066 External= 0.33 None= 0
4. HHRR Incorporation related to design activities in period 2001-2006 (322)	Yes = 1 No=0

(b) Design Complexity in production

The development of design endogenous competences within a company also requires the ability of transferring conception complexity of product to the set of agents involved in production throughout the chain, and to integrate them in a systemic process. In that sense, this indicator involves the implementation of a set of activities related to the design and development process; that is to say: the existence of information exchange between pattern maker, designer and sample maker before cut (question 1), the implementation of changes into patterns and/or product/service from the dialogue with clients and suppliers (questions 2 and 3), the integration degree of the company in relation to design activities (question 4), the application of procedures degree associated to process products and/or services control, (question 5) and the information volume included on the technical sheet as a formal tool for productive process management (question 6). As in the previous case, the indicator is calculated as a simple average (minimum zero, maximum one) of the six raised questions (see picture 2).

It is worth mentioning that the fulfillment of enunciated activities is a mandatory condition of minimum efficiency in decentralized activities coordination by the companies on groups (i) and (ii) from the typology enunciated previously.

Table 2. Structure of the indicator of design complexity in production

Questions	Valuation
1. Exchange of information between pattern maker, designer and sample maker before cut (124)	Yes =1; No=0.
2. Incorporation of dialogue with clients to modify pattern and/or product/service (310g)	Yes =1; No=0; Partial=0,5
3. Incorporation of the dialogue with suppliers to modify pattern and/or product/service (310i)	Yes =1; No=0
4. Integration of activities related to design and development process (114 a-f)	(internal=1, mixed= 0.5; external=0) *q/6
5. Degree of procedures application associated with procedure quality of process, products and/or services control (309)	1/7 point by each one of the indicated alternatives
6. Technical sheet complexity in relation to design related aspects, taking the following alternatives: descriptive illustration of product,	1/8 point by each one of the

¹⁶ In all cases, the number of questions -taken into account for indicator elaboration- within the form used for field work is specified between parentheses. The form can be consulted –only in Spanish- in www.continentedigital.net, in section “Documentos de Trabajo”.

fit of clothe, measures of articles, description of fabrics, description of kits, description of packing, samples of fabric and kits combinations, description of operations (326 d-h, k-m)	noticeable alternatives
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c) Complexity of design in product conception

This indicator is considered as key to evaluating design complexity since it combines elements both from endogenous competences and linkages. In that sense, the indicator is a combination of ten factors that evaluate the degree of design complexity in the process of product conception seen as integral from (i) the perspective of external supplies, (ii) the internal design processes and (ii) product results and positioning. (see table 3)

From the **external supplies** perspective, the sources of information both for trends analysis and capture are considered (question 2; trips, visits to fairs, magazines, books, Web pages, competitors, users' following) and the sources oriented toward enriching the new products' design and development process, new processes and materials from technological institutes, universities and consultancies (question 3). From the **processes** perspective, the company's conception of design activities is considered in the first place, differentiating between those companies that copy, adapt or develop (question 1). Simultaneously, the extent to which attributes that the company considers as differentiating on its products respect to its competitors which includes functionality, form, color, texture and finishing is evaluated. (question 4). Also, process dimensions identify to what extent the design of the branches, shop windows, stands and Web pages are centralized in a same agent who gives coherence to these processes (question 5). From the perspective of **design process results and product positioning** three factors are considered. On the one hand, the cases that indicate price as a key factor of product differentiation are weighed negatively (question 9), considering that the competition centered in that variable is sustained in smaller design complexity than the corresponding one to the companies that center their strategy in design. On the other hand, the output indicator gives account of the creation of a suitable context to insert the product, considering the aspect of design communication and positioning. In that sense, advertising activities, the existence of a personal branch and the importance of positioning the brand through web and branch design are included (questions 6, 7, 8 and 10). The last indicator is calculated through a weighted average of questions, linked to the different relative importance from each one of them, and which originates from a theoretical discussion for evaluation of each factors' significance in the issues related to the conception of companies connectivity and absorption¹⁷.

Table 3. Structure of *design complexity in product conception* indicator

Questions	Valuation
1. Company's Conception of Design (open question) (104)	In-house Development=1; adaptation= 0,5, copy=0
2. Sources of information used for the analysis and capture of fashion trends, considering the following alternatives: visits to sectorial fairs and exhibitions, magazines, books, Web pages and users following (325 b, c and e)	1/3 point for each one of the selected alternatives.

¹⁷ The formula of weighted average used is the following: Indicator = (P1 * 0.15 + P2 * 0.066 + P3 * 0.066 + P4 * 0.15 + P5 * 0.15 + P6 * 0.066 + P7 * 0.15 + P8 * 0.066 + P9 * 0.066 + P10 * 0.066)

3. Used sources of information for product, processes and/or materials development (325 g-k)	1/5 point for each one of the selected alternatives.
4. Attributes that the surveyed subject considers that differentiate his products with respect to his competitors: functionality, form, texture, finishing and color (331)	1/5 point by each one of the noticeable answers.
5. Branch and web Design, considering the following alternatives: professionals in the branch design, professionals in shop window design, development of stands for exhibitions, outsourcing of Web design, (334j-m)	¼ point by each affirmative answer;
6. Centralization of the branch, shop windows, stands and Web design (335)	Yes=1; No=0
7. Commercialization channels (existence of personal branches or franchises) (108)	personal branches or franchises=1 no= 0
8. Channels (advertising) to position its products (334a)	1/8 point by each one of the indicated alternatives
9. Attributes that surveyed subject considers that they differentiate his products respect to his competitors (PRICE) (331L)	If price is not chosen between the differentiation attributes =1
10. Attributes that surveyed subject considers that they differentiate his products respect to his competitors (MARK) (331D)	If Brand is emphasized =1

3.2 Dimensions linked to connectivity capacities: companies' linkages to increase their design endogenous competences

Companies' possibilities of developing linkages with other agents to produce more complex design activities depends on the existence of a minimum threshold of endogenous competences, that include an important level of internal connections between different areas of the company, which are necessary in order to take control of the generated externalities in the atmosphere in which they work (Erbes and Yoguel, 2007, Robert and Silva Failde, 2007). Hence, the linkage capacity of the design team is important both to establish connections with external agents (suppliers, clients, users, educative institutions or of promotion, among others), and with diverse internal operative areas (production, marketing, communication, management, etc.). In the specific case of the clothing companies that have product differentiation as strategy (group i), this minimum threshold is superior to the rest of the companies in the sector. Furthermore, in the case of companies that surpass that minimum threshold, the level reached by the linkages can contribute to improving its endogenous competences.

In order to estimate the connectivity capacity, a linkages-for-design indicator was built. This indicator is based upon seven different factors – both unilateral and bilateral (see table 4). From the perspective of the unidirectional factors, the indicator is included as much as the demand for technical assistance (question 2), the advising for the incorporation of human resources (question 4) as the technical assistance supplied to other agents (question 7). The bilateral factors give account, on the one hand, of interchanges with suppliers of different formality degrees (question 6), clients (question 5) and colleagues (question 3), and, furthermore, demonstrate new products and processes joint ventures (Roitter et al, 2007, Erbes, Tacsir and Yoguel, 2008). Also, it was considered whether companies have general linkages related to design development with an ample set of agents, including public and private actors (question

1). The indicator was calculated through a weighted average of factors described previously¹⁸.

Table 4. Structure of *linkages for design indicator*

Questions	Valuation
1. Existence of linkages with the objective on design and/or development activities (202d)	Yes=1 No=0
2. If they received technical assistance in design (204a)	Yes =1; No=0
3. If they have had informal conversations with colleagues relative to the design development (211m)	Yes =1; No=0
4. Linkages to contract to new personnel with <i>design and product development</i> oriented profile (323)	Yes =1; No=0.
5. Periodic communications with clients to detect changes in the requirements (310f)	Yes =1; No=0; Partial=0,5
6. Periodic communications with suppliers (310h)	Yes =1; No=0; Partial=0,5
7. To have offered technical assistance (207)	Yes =1; No=0

3.3 Absorption and connectivity capacities interaction Indicator

In order to be able to evaluate the importance reached in the connectivity and absorption capacities, a weighted average of the four indicators was considered (the three linked with absorption capacities and the indicator related to connectivity capacities). In the estimation of this indicator it is granted greater weight to the dimensions centered in conception and linkages (40 and 30% respectively) than to team and production dimensions (20 and 10% respectively).

This added indicator, which takes into account the set of dimensions previously analyzed, was used to evaluate the possibility of classifying the interviewed companies in the three theoretical categories: companies with high, medium and low design intensity. For such aim an absolute criterion was used, that is to say, independent from the results distribution of the sample, fixed *a priori*. It was considered that although a group criterion could be of interest on the basis of the relative and non-absolute positions of the agents, it would have the weakness of limiting obtained results to the establishment of relative positions between companies, when among the interests of the model is, in addition, the power to discern what proportion of the companies has high, medium and low levels of complexity in their design activities.

This way, on the basis of the added indicator the following criterion of classification was settled (the indicator varies between zero and one): (i) Companies with high design intensity (more than 0,66 points of the weighted average), (ii) Companies with medium design intensity (between 0,5 and 0,66 points) and (iii) Companies with low design intensity (less than 0,5 points)

3.4 Efforts in design and perception of the impact within the company

Finally, an indicator that accounts for efforts made in design activities was developed as we as another one about the perception that managers have with respect to the impact of

¹⁸ The used formula was the following one: Indicator = (P1 * 0.20 + P2 * 0.066 + P3 * 0.066 + P4 * 0.20 + P5 * 0.20 + P6* * 0.20 + P7* 0.066)

design in the performance of the company. It is important to emphasize that *it is not a design complexity indicator*, as the previous ones, but it is an indicator of the efforts made in design and of *perception* that managers have with respect to the impact of the design.

In order to calculate the indicator of design efforts (see table 5), a combination of elements was taken into account: the monetary efforts made by the company in products and channels design and development (question 1), the development of training oriented toward different design dimensions (question 3), the proportion that represents the expenses in design on total costs (question 2), the volume of personnel dedicated to developing design activities in the total number of employees of the company during 2006 (question 4) and the degree of exclusivity of the personnel dedicated to design and development activities (question 5). Using this method is the intention is to detect, from a flow perspective, the existence and reinforcement of company commitment with design activities, evaluating the answers in a dichotomizing form. The average, existence of efforts and resources oriented to products design and development and the development of commercialization channels in a period of three years is considered. Furthermore, the average efforts of training in a recurrent way in product design, product or processes technology and materials are considered. This indicator of flow suggests the intensity in the development of design of endogenous competences from the companies, with the investment and the proportion and dedication of the personnel exclusively destined for these tasks weighing in more heavily. The indicator was considered through a weighted average of the answers to the five raised questions above¹⁹.

On the other hand, the *indicator of impact perception* aims to evaluate the company's vision on the effect of design in the performance of the company. The indicator mentioned picks up the opinions of the managers with respect to the impact of design in (i) the invoicing, (ii) the change in the internal organization, (iii) the external insertion, (iv) the participation on the market, (v) the yield and (vi) the productivity, as well as the existence of significant changes in products design and development from the incorporation of specialized human resources. The indicator is derived from the proportion of positive answers in the six indicated planes.

Table 5. Structure of the indicator of design efforts and impact

EFFORTS AND INVESTMENTS IN DESIGN	1. Efforts and allocation of resources made to design and develop activities, considering the following alternatives: product design and development, and design and development of commercialization channels (301 g-h)	½ point by each one of the positive answers
	2. Recurrent training in issues related to the design and the development process, considering the following alternatives: product and/or process technology, materials, product design (504 cdj)	1/3 point by each one of the affirmative answers
	3. Proportion of the expenses in design, in relation to the total costs (337c)	0.01 by each percentage point of the final cost assigned to the item design

¹⁹ The formula that used was the following one: Indicator = (P1 * 0.225 + P2 * 0.10 + P3 * 0.225 + P4 * 0.225 + P5 * 0.225)

	4. Dedicated personnel to design activities over the total number of employees of the company during 2006 (319/402c)	Quotient of the amount of personnel dedicated to design over the occupied total personnel
	5. Exclusivity of the personnel for design and development activities (320)	0.01 by each percentage point of the exclusive dedication of the personnel assigned to the design tasks
IMPACT	Impact degree that design activities had in: invoicing; change in the internal organization; external insertion; participation in the market; yield; productivity (339)	1/6 point by each positive answer

4. Empirical evidences of the presented indicators

In this section we present the empirical evidences about the degree of design complexity of a panel -41 firms producing clothing for men, women and children-- interviewed in Buenos Aires and Great Buenos Aires, Mar del Plata, Pergamino and Cordoba. These firms have the singularity of having brands with commercial profile, by which they aim to develop a strategy of product differentiation. The used panel gives account of the segment of branded companies that seek to center their strategy of competition in the product differentiation -with greater or lesser success. For this reason, although it is not statistically representative of the totality of the Argentine clothing sector, characterized by the existence of extremely heterogeneous companies and with a high informal employment, the panel interviewed is representative of the segment of branded clothing companies.

The evidence emerged from the field work and from the estimation of discussed indicators which allowed for the identification of the diverse strategies of the branded companies group and for the differentiation within the three alternatives raised in the first section: **companies with high, medium and low design intensity**. This taxonomy can be reproduced from the added indicator which considers the four factors discussed that report on design complexity and intensity: internal team, production, conception and linkages (see table 6).

Table 6. Brand companies Typology. Main indicators of design complexity and intensity.

		Absorption Capacity			Connectivity Capacity	Level of Complexity (absorption and connectivity capacities)
Design Intensity	% of companies	Design HHRR *	Design in Production *	Design in Conception *	Linkages for design*	Weighed average**
High	18	0.80	0.87	0.75	0.83	0.80
Medium	33	0.81	0.83	0.54	0.49	0.61
Low	49	0.35	0.66	0.32	0.39	0.36
Average	--	0.59	0.76	0.47	0.50	0.52

Source: Own Elaboration

* All the indicators are expressed between zero and one, 0 being the minimum and 1 the maximum.

** The used weighting relation was: 20% for “Design HRRR”, 10% for “Design in Production”, 40% for “Design in Conception” and 30% for “Linkages for Design”.

Whereas only in a 18% of the brand companies strategies with high design intensity prevail, 33% of the panel are constituted by companies with medium design intensity and 49% of the cases can be identified as companies in which the design is not significant. As it can be observed, the group of smaller design development presents clearly unfavorable results in all of the analyzed dimensions. Nevertheless, the intermediate group only presents considerable differences with the most virtuous group in two dimensions: “Conception of the Design” and in “Linkages Degree”; whereas in the other two dimensions, “Resources” and “Production”, the differences are not significant.

Also, the indicators are consistently decreasing from first to third group reflecting strong systematicity between each other, giving consistency to this group of companies and reducing the relevance of considered weighing over groups’ integration. In the case of design conception and linkages indicators the average of each group descends significantly. However, team and production indicators both verify significant differences only between the first group with respect to the third.

At the same time, group integration maintains a strong association with two of the factors that determine it: conception and team, a weaker relation with respect to the indicators of linkages for design and complexity in production, which would constitute a mandatory condition to offer branded products and because of this is present in the three identified groups.

Likewise, the identified taxonomy of companies is closely related to the indicator of design efforts (see table 7), reflecting that while little more than half of companies with low design intensity effects reduced efforts, almost 90% of the ones with high design intensity are characterized by high efforts.

Table 7: Relation between design intensity and design efforts

	Low Design Efforts	Medium Design Efforts	High Design Efforts	Total
Companies with Low Design Intensity	32 %	37 %	31 %	100 %
Companies with Medium Design Intensity	8 %	31 %	62 %	100 %
Companies with High Design Intensity	0 %	14 %	86 %	100 %

Source: Own elaboration

Chi square test significant to 10%

Finally, the impact of design activities in the performance of the companies is strongly associated with the complexity of those activities (see table 8). This would reflect the existence of a suitable level of self-consciousness from company-managers interviewed with respect to the effect of design complexity in other planes of the company.

Table 8. Distribution of the companies of panel by strategy according to perception of design activities impact

	Low Impact	Medium Impact	High Impact	Total
Companies with Low Design Intensity	69 %	25 %	6 %	100 %
Companies with Medium Design Intensity	17 %	75 %	8 %	100 %
Companies with High Design Intensity	29 %	43 %	29 %	100 %

Source: Own elaboration
 Chi square test significant to 5%

5. Proposed group conceptualization in light of empirical evidence.

On the first part of this article we defined in theoretical terms and based on its capacities of design what, from our understanding, characterized the clothing companies. In this section, we formulated a new description and conceptualization of groups of companies which we have defined from the empirical work. Hence, we attempt through the following description to give account of *in facts* shared characteristics within the companies that we have grouped under a same label based on the proposed methodology.

High design intensity companies.

They are companies with a conception of design based on the pursuit of differentiation, both in terms of product attributes and in terms of brand. Consequently, these companies assign great relevance to communication and commercialization spheres as an adequate complement for the products that they design. In this sense, they excel at the importance assigned to publicity, brand development, own commercialization channels, as well as to the design of these branches and Web design. With respect to the attributes of the product, these companies give particular importance to the attributes identified in the theoretical framework as key differentiation elements on the market: functionality, form, texture, finishing, and color.

In order to boost the developed strategy, the companies “with high design intensity” have largely formal design teams, having incorporated great amounts of human resources in the last years. These teams use the totality of existing information sources to grasp fashion trends, including elements such as visits to sectorial fairs and exhibitions, magazines, books, Web pages and users’ following. Nevertheless, the amount of sources that they use for product development is limited, as the cooperation with universities, technological centers and suppliers is rare and hence do not fulfill the aims of product development.

With respect to the relation of the companies with their productive environment, there are many linkages in design and/or development activities, including often informal conversations with other colleagues on diverse issues that contribute to the development of their competences. Also, almost all of the companies are linked with other agents (Universities, Design Centers, etc.) in order to contact personnel related to the design field, which contrasts strongly with relative isolation predominant in other groups. Along these lines, most of this group receives technical assistance, demonstrating a certain network dynamics that exceeds the relation with the workshops.

As far as the linkage between production and design activities, these companies stand out by a high degree of application of procedures associated with the quality of products, processes and/or service controls. Also, in all of the cases there exists a fluid dialogue between the pattern maker, designer and the sample maker before cut, whose results are mostly incorporated to modify patterns. Nevertheless, this tangible aim is frequently only partially the aim of the dialogue. On the other hand, this highlights a high level of internalization of the stages of collection planning, design, pattern making, tised, prototypes manufacture and tests of use, that is to say, the central activities for the integral development of design in the clothing sector²⁰. They do not present a great difference between companies that do design in an external, or mixed in an internal way; only one company affirms to create design in a mixed team. This presents a pattern far from the initial assumptions of this work. Nevertheless, this behavior could be explained as a self-sufficiency and independence factor derived from market scales targeted by these types of companies (generally smaller), that do not require an extended work team.

Companies with medium design intensity

This intermediate group involves very different situations and a strong variance in greater part due to the considered indicators. In that sense, two sub-groups can be identified. The first subgroup are, companies that in having a qualitative conception relatively weak of design have a good performance on the market. The second subgroup, includes companies that have a qualitative conception closest to the first group but also have a more limited performance both in terms of their position on the market and in relation to the rest of the considered indicators.

In terms of the number of used information sources, these companies have similarities with the previous group since near two thirds uses more than 70% of the proposed sources. In terms of the attributes that the company considers for product differentiation, companies within this group are different from the first one and closest to the characteristics of the less virtuous group. On the contrary, the importance assigned to publicity and the existence of personal commercialization channels (branches) is in-between the most virtuous group and the one of smaller design relevance. In this case, the aforementioned position worsens because centralization of these activities is very low. As in the previous group, the presence of personal channels is almost decisive. However, in relation to the use of advertising means, this attribute approaches the group of smaller design complexity. These elements would allow the affirmation that making the profile of this group more complex leads towards

²⁰ It is important to keep in mind that our departure point is to evaluate the internalization of design as sub-optimal; the existence of an internal team that interacts with designers outside the company is the most valued option.

commercialization rather than towards communication. As in the first group, the brand is highly relevant although, for the previously mentioned reasons, it would not seem to be developed consistently.

Hardly a quarter of these companies have linkages related to design issues. However, most of them do not receive technical assistance. Also, in the same way as in the previous group, a significant percentage of the companies have informal conversations with other colleagues in relation to design issues.

Although these are companies with informal design teams, a strong incorporation of human resources in the period 2001-2006 is noticeable. Finally, in relation to design applied to production, these companies are characterized by a relatively high degree of application of associated procedures in terms of quality and process products and/or services control, as well as by a fluid dialogue between pattern maker, designer and sample maker before cut.

Companies with low design intensity.

These companies have in general a utilitarian vision of design. There predominates a commercial and communicational logic that is significantly weaker than in the previous groups. This is reflected in a much more simplified vision of the product. In this sense, unlike the previous groups, copying appears as a central mechanism for the product development²¹. These companies have mostly neither formal nor informal design teams; the marketing department having the potential to engage in an outstanding role in this task. Also, along the same lines, these companies have also not incorporated human resources related to the design activities throughout the studied period (2001-2006). Consequently it appears as evident that most of these agents do not use information sources to grasp fashion trends, something that implies greater effort than simple copying. As a consequence, these companies' process of product differentiation is almost absent, using the brand as a more operative role in the competition process. In line with the indicated characteristics, more than half of the companies of this group do not consider the attributes identified in the theoretical framework as key elements of differentiation as being relevant.

In reference to the relation with their environment, there are companies that barely have extra-commercial relations with other agents on issues related to design. In addition, almost none of the companies of this group receive technical assistance in design nor are there informal conversations with colleagues who could potentially collaborate to increase their endogenous competences.

As far as design applied to production, these companies present a low degree of application of procedures associated with quality and process products and/or services control; in addition, there is lower integration of central activities for design process, such as planning of collection, pattern making, tised, usage test, etc. Finally, a smaller but relevant percentage shows to have no dialogue between the pattern maker, designer

²¹ Although it is certain that in the three groups efforts are made to grasp market and competitors' trends, there exists an important difference between being "aware" of the environment and "copying", understood as the straightforward assimilation of designs created by others.

and model maker before cut, which can be considered as a serious weakness in a key stage of the design and production process.

6. Design, endogenous competences and linkage degree of the companies.

The companies' capacity to compete in the market through an increasing product differentiation requires being able to integrate design efforts and capacities with development of linkage and endogenous competences. For this reason, in the present section, the existing relation between design complexity degree, the linkages and endogenous competences are streamline analyzed.

In the first place, the indicators of **endogenous competences**²² are statistically associated with the degree of design complexity (see table 9). In this sense, quality management and innovation efforts, both embodied and disembodied, are components that explain the existence of a strong correlation. Furthermore, the use of tools and systematic analysis methods, work organization and training efforts appear as independent of the design complexity reached by companies. All these elements allow for the corroboration of the initial hypothesis, according to which design complexity of a company constitutes a dimension of inseparable analysis from the rest of the planes that determine the endogenous competences of a company. Therefore, it is possible to affirm in light of the empirical evidence presented that design complexity constitutes a systemic element of the companies, in agreement with the approach used in diverse studies (Ariza and Ramirez, 2008; Becerra and Cervini, 2005; among others)

Table 9. Endogenous Competences and Design Complexity

Type of companies	Endogenous competences			
	Low	Medium	High	Total
With low design intensity	67 %	25 %	8 %	100 %
With medium design intensity	37 %	50 %	13 %	100 %
With high design intensity	0 %	50 %	50 %	100 %
Average	42 %	39 %	19 %	100 %

Source: own elaboration

Test of significant Chi-square to 5%

Secondly, as it can be observed in table 10, the empirical results give evidence to the existence of a strong interrelation between design complexity degree and the development of companies' **connectivity**. Nevertheless, even though the companies with more virtuous levels of linkages are those that have more complex levels of design, the results give evidence of a high percentage of companies with low relation with the environment, even in the case of the companies with high design intensity.

On the other hand, beyond the existence of the statistical correlation between linkages degree and design complexity, almost 60% of companies of the panel lack extra-

²² For the elaboration of endogenous competences indicators, the questions that had been used for the elaboration of design complexity indicators were excluded, with the objective of statistically comparing the two groups of indicators independently of each other. Nevertheless, many of the questions that were left aside for the elaboration of design indicators are key questions to approach the issue of a company's endogenous competences. This fact, emerging from the experience of the present attempt to develop a methodology to quantify design complexity, is itself very illustrative of the necessity to include design as part of companies endogenous competences.

commercial bonds with other agents, do not offer, nor receive technical assistance, nor maintain conversations with colleagues, which necessarily implies that a majority set of companies works as isolated compartments, and not in networks that facilitate the circulation of knowledge.

Table 10: Design Complexity and linkage degree of the companies.

Type of Companies	Connectivity of Companies			Total
	Low	Medium	High	
With low design intensity	77 %	23 %	0 %	100 %
With medium design intensity	58 %	17 %	25 %	100 %
With high design intensity	14 %	57 %	29 %	100 %
Average	58%	28%	14%	100 %

Source: own elaboration

Test of Chi-square: significant to 5%

7. Conclusions

This work constitutes a methodological effort oriented toward opening what we have named the “design black box”. In spite of the extensive recognition of this activity as a central factor for the generation of dynamic competitive advantages and for its potential to make the specialization profile more complex in developing countries, neither theoretical nor empirical studies of importance have yet been generated in the region. Toward this goal, we have made a conceptualization of design which was made operatively from the estimation of a set of indicators grouped in (i) design complexity in production, (ii) design complexity in conception, (iii) design in human resources and formality degree and (iv) design linkages.

The indicators built specifically for clothing sector were applied to a representative set of branded companies. The obtained results give evidence of considerable internal coherence among considered indicators, which have a systemic character. This empirical evidence corroborates our initial conceptualization of design as an integral innovative activity within the company.

In that frame, this work quantifies the design intensity degree among companies that differentiate products. As was expected, considering the specialization profile of this activity in Argentina, the proportion of companies with low design intensity is relatively high. In spite of this, it was possible to identify a group -near fifth of the panel- in which design has a high intensity.

An interesting result of this work is the strong association found between the complexity degree reached by design activities and the level of endogenous competences and connectivity of companies. This emphasizes the systemic character design activities acquire, both when it is considered the group of greater intensity and when it is of lesser intensity. In policy terms, this would mean that it is not possible to approach design capacities development of the companies independently of the

treatment of the rest of the dimensions that determine their techno-organizational competences and their linkages degree with the environment.

This article constitutes a methodological proposal, applied specially to a company segment of branded clothing, which would have to be continued through the accomplishment of theoretical and empirical studies on the estimation of design activity within companies. With this aim, it is necessary to move even further in the opportunity of a survey generation on design complexity that could be extrapolated to other sectors. This is particularly important considering the new scenario that has opened with the world-wide crisis, and that puts in doubt the possibilities of the emergent countries of sustaining their economic dynamics and their international specialization based only on commodities and on goods intensive in natural resources. Thus, in this new context, where the terms of commerce would seem to begin acting against the developing countries again, to place design in a productive policies agenda turns out indispensable in the advancement of the concretion of a structural change that improves life conditions of people in these countries.

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