



MODEL FOR CHARACTERIZING THE INNOVATION PROCESS IN DESIGN

MODELO PARA A CARACTERIZAÇÃO DO PROCESSO DE INOVAÇÃO EM DESIGN

MODELO PARA CARACTERIZAR EL PROCESO DE INNOVACIÓN EN DISEÑO

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Cite as – American Psychological Association (APA)

Bernardo, A. A. C., & Medeiros, W. G. (2021, Jan./Apr.). Model for characterizing the innovation process in design. *International Journal of Innovation - IJI*, São Paulo, 9(1), 158-179.
<https://doi.org/10.5585/iji.v9i1.15891>.

Abstract

Objective of the study: The value of design needs to be constantly reaffirmed due to its nature with eminently qualitative elements – unlike innovation, which has a quantitative origin. This article aims to explore the relationship between design and innovation and their common points.

Methodology/approach: The study has a qualitative character, with an exploratory and descriptive investigation, based on a surveying of the main terms and concepts about design an innovation, both printed and digital publications.

Originality/Relevance: From the main points of conceptual convergence, the text proposes an approximation between innovation and design based on a model consisting of the following criteria: application context; structure and organization of the company to generate innovation; dimensions that drive innovation; degree of novelty; and results generated.

Main results: With the proposed model for the characterization of the design innovation process, the research concluded that, although historically they appeared at different times, design and innovation are complementary disciplines with contiguous objectives.

Theoretical/methodological contributions: This work not only contributes to the discussion about a closer approximation between the two areas, indicating mutual benefits, but it also demonstrates that the proposed model can favor the understanding of the value of design.

Social/management contributions: The model described in this article can help innovation agents, companies and all stakeholders who aimed to restructure existing products or design new products based on innovation criteria.

Keywords: Innovation. Design. Process. Classification.

Resumo

Objetivo do estudo: O valor do design necessita ser constantemente reafirmado devido à sua natureza com elementos eminentemente qualitativos - ao contrário da inovação, que tem origem quantitativa. Este artigo tem como objetivo explorar a relação entre design e inovação e seus pontos comuns.

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Metodologia / abordagem: O estudo tem caráter qualitativo, com uma investigação exploratória e descritiva, a partir do levantamento dos principais termos e conceitos sobre design e inovação, tanto em publicações impressas como digitais.

Originalidade / Relevância: A partir dos principais pontos de convergência conceitual, o texto propõe uma aproximação entre inovação e design com base em um modelo constituído dos seguintes critérios: contexto de aplicação; estrutura e organização da empresa para gerar inovação; dimensões que impulsionam a inovação; grau de novidade; e resultados gerados.

Principais resultados: Com o modelo proposto para a caracterização do processo de inovação em design, a pesquisa concluiu que, embora historicamente tenham surgido em momentos distintos, design e inovação são disciplinas complementares com objetivos contíguos.

Contribuições teórico-metodológicas: Este trabalho não apenas contribui para a discussão sobre uma maior aproximação entre as duas áreas, indicando benefícios mútuos, mas também demonstra que o modelo proposto pode favorecer a compreensão do valor do design.

Contribuições sociais / gestão: O modelo descrito neste artigo pode ajudar os agentes de inovação, empresas e todos os stakeholders que visam reestruturar produtos existentes ou projetar novos produtos com base em critérios de inovação.

Palavras-chave: Inovação. Design. Processo. Classificação.

Resumen

Objetivo do estudo: El valor del diseño debe reafirmarse constantemente por su naturaleza con elementos eminentemente cualitativos, a diferencia de la innovación, que tiene un origen cuantitativo. Este artículo tiene como objetivo explorar la relación entre diseño e innovación y sus puntos en común.

Metodologia / abordagem: El estudio posee mención cualitativa, con una investigación exploratoria y descriptiva, fundamentado en el levantamiento bibliográfico con respecto a los principales términos y conceptos sobre diseño e innovación, tanto en publicaciones impresas como digitales.

Originalidade / Relevância: A partir de los principales puntos de convergencia conceptual, el texto propone un acercamiento entre innovación y diseño basado en un modelo constituido de los siguientes criterios: contexto de aplicación; estructura y ordenamiento de la empresa para generar innovación; dimensiones que impulsan la innovación; nivel de novedad; resultados generados.

Principais resultados: Con el modelo propuesto para la caracterización del proceso de innovación del diseño, la investigación concluyó que, apesar de que históricamente hayan surgido en momentos distintos, el diseño y la innovación son asignaturas complementarias con objetivos contiguos.

Contribuições teórico-metodológicas: Este artículo no solamente contribuye para la discusión sobre un mayor acercamiento entre las dos áreas, haciendo indicación de beneficios mutuos, sino que además demuestra que el modelo propuesto puede ser favorable a la comprensión con respecto al valor del diseño.

Contribuições sociais / gestão: El modelo descrito en este artículo puede ayudar a los agentes de innovación, empresas y todos los grupos de interés que pretenden reestructurar productos existentes o diseñar nuevos productos en base a criterios de innovación.

Palabras-clave: Innovación. Diseño. Proceso. Clasificación.

Introduction

This article explores the approximation between design and innovation, which originate in different periods and contexts, though they are areas considered to be connected. It is possible to speculate that the propelling elements for the emergence of the two disciplines were, on the one hand, the recognition of the need to solve everyday practical problems; and on the other

hand, the creative and transformative nature of humanity, fueled by the availability of new technologies and new materials.

With the advent of the Industrial Revolution in England, around 1750 (Cardoso, 2016; Forty, 2007), industrial design emerged and, consequently the designer to meet the new demand for the creation and production of utility objects.

Changes in the method of production, organization, and transportation and distribution systems have established the possibility of mass production of low-cost products, allowing for an increase in the supply of consumer goods. The Industrial Revolution contributed to the consolidation of a society of material goods acquisition and, from the beginning, industrial design was subjugated to the culture of consumption, since it was conceived as the art of shaping products for mass production, and is an essential component for global economic competitiveness (Margolin, 2014).

From the twentieth century on, technological applications were directed toward domestic life, with an emphasis on the generation of wealth by means of the massification of products for everyday life (Walker, 2014; Cardoso, 2016; Burdek, 2008). Also at this time, the term innovation gained greater recognition with the publication of the works of the Austrian economist Joseph Schumpeter.

When elaborating the theory of capitalist economic development, Schumpeter (1988) argued that an innovation, in the economic sense, is only complete when there is a commercial transaction involving an invention and the consequent generation of wealth.

In the economic view, innovation is the idea in practice, enhanced by globalization as a strategy of commercial exploitation by companies to generate profits and differentiation of the market, as well as meet the demands of new products (Santos, Fazon & Meroe, 2011). It is, above all, a social process of propulsion and diffusion of ideas, seeking to extract commercial value at the same time in which it generates changes (Pinheiro & Merino, 2015). Innovation intervenes in society with the aim of changing a supposed social inertia, causing a rupture in the current context, usually associated with a tangible commercial value.

The meeting between design and innovation was established based on the expansion of marketing opportunities and the growth of productivity, increasingly intensified by digital technology. The competitiveness scenario generates demand for innovation, expressed through improvements of a product in order to distinguish it from others, raising interest in the consumer (Heskett, 2001). Factors such as business globalization, communication networks, increasingly complex consumer requirements, and technological developments result in a highly competitive

commercial environment, leading companies to invest in innovation (Pozatti, Bernardes & Linden, 2016). As a consequence, it is possible to observe a significant increase in the offer of products that claim greater efficiency, differentiation, and lower cost, reducing or eliminating products that do not adapt to these new demands. There was a shortening in the life cycle of products (Tidd, 2005) with the rapid replacement of supposedly better versions in a short period of time. Competitiveness between companies is the tipping point that makes new products be marketed as quickly as possible.

At first, although the areas of design and innovation can be interpreted as overlapping, according to Cruickshank (2010), their specificities cause limitations of dialogue, especially because design has always involved – even more so in contemporary times – non-quantifiable aspects, such as aesthetics and symbolic and affective dimensions. Apparently, this is because innovation originates in the economy, which is based on the quantitative metrification of results in the generation of profits, while the product of design is based not only on the objectivity of a need, but also on the subjectivity of affection.

This specificity is highlighted when innovation management is shared with other sectors, such as engineering and marketing. In comparison with these areas, it is noted that there is a certain limitation of design in demonstrating its potential in quantitative results, considering that in most cases the financial perspective is that the product is only considered innovation when it generates profit (Rampino, 2011). The successful exploitation of ideas, which is reflected in purchases, is a determining factor for innovation (Cruickshank, 2010; Lambert & Flood, 2017).

There are numerous triggers for innovation, from social-cultural changes, the stimulus of arts and crafts, the new needs of the market, to the heterogeneity of the leaders who propose it (Cautela, Deserti, Rizzo & Zurlo, 2014). Therefore, it is a complex system that requires connection with other disciplines to understand its particularities. On the other hand, design is an open and continuously evolving territory that, in recent years, has expanded its scope and implemented complementary approaches to innovation. The interdisciplinarity incorporated into design research is capable of creating spaces for intermediation, establishing new concepts and generating innovation (Muratovski, 2015). Thus, identifying the common points between the two areas may contribute to the understanding of the process of innovation in design with positive consequences for both.

Methodology

Scientific research is defined as a systematic and planned investigation procedure. Therefore, this article had as its object of study the relationship between design and innovation, with a methodological approach of a basic nature and qualitative character (Gil, 2008; Freitas & Prodanov, 2013). With an exploratory and descriptive investigation, whose objective was to identify points of convergence between the two disciplines (Freitas & Prodanov, 2013), literature review was of great relevance, since it contributed decisively to the foundations of the resulting model.

The study of design and innovation theories involved surveying both printed and digital publications. For that, the following keywords were defined with possible combinations and their equivalents in English: "innovation", "design" and "classification". The use of isolated words was avoided because they returned results outside the scope of the study. However, from the reading material, new research was carried out in order to investigate specific terms, such as "*open innovation*" and "*design-driven innovation*".

The searches were carried out on different databases: virtual libraries of national and international magazines and journals; Google Scholar and academic portals. The relevance of publications was established by reading the titles and abstracts, followed by reading and writing the bibliographic material.

The bibliography was grouped into two axes of theoretical discussion: 1) origin and definition of the term innovation, comprehensively; 2) survey of authors who theorize innovation with an edge in design. In conclusion, as a result, the characterization of design innovation was illustrated and described.

Concepts and definitions of innovation

The numerous works of Joseph Schumpeter, known as the father of innovation, influenced the theories of economics and the origin of the concept of innovation. His main argument is that economic development is driven by innovation through a dynamic process in which new technologies replace old ones, in a process he calls "creative destruction", when radical innovations generate more intense ruptures and incremental innovations provoke small continuous changes (FINEP, 2005; Tidd, 2005).

Hence, it is possible to evaluate innovation according to the degree of originality, that is, what is new in a product or service, which is sometimes presented at lower levels, described as incremental, marginal or evolutionary (Cruickshank, 2010), through small improvements.

On the other hand, innovation, which can be identified as radical, disruptive or architectural (Cruickshank, 2010), can occur via radical changes, which totally transform the way we think of and use things, thus changing the basis of society (Tidd, 2005).

There is often a misunderstanding in considering radical innovations to be better than incremental ones. According to Cruickshank (2010), the incremental type of innovation has specific complexity and should not be treated as a lower stage in the innovation process. Contrary to what is divulged, radical innovation generates many uncertainties and, sometimes, inefficient results.

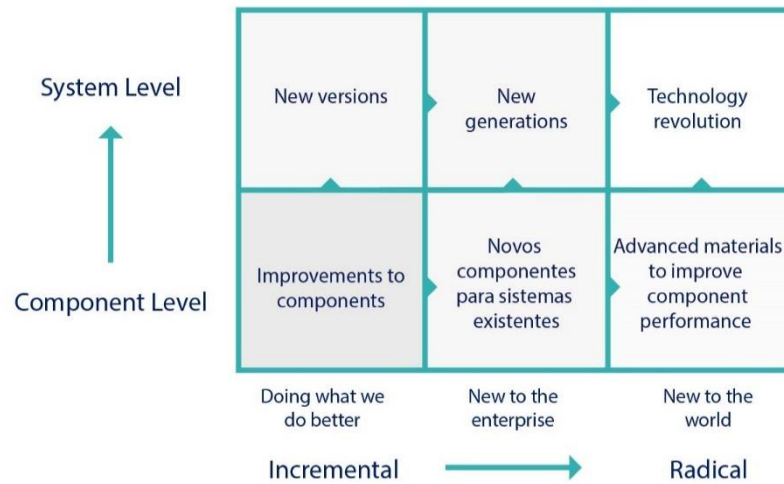
In this regard, Tidd (2005) identifies the continuous improvements of sustained incremental changes as “total quality management”, which suggests cumulative gains over time. The author also argues that the concept of innovation is strongly linked to business economic factors and the competitive potential. According to him, entrepreneurs exploit technological innovation in order to obtain a strategic advantage and use technological skills to create new offerings. Following this perspective, innovation is driven by the ability to identify connections and seize opportunities, without the imperative need to create new markets, but exploiting those already established.

In order to standardize concepts and methodologies, as well as to determine innovation indicators for industrialized countries, the Oslo Manual (FINEP, 2005) defines four types of innovations: product innovations, which is the introduction of new or significantly improved goods or services with regard to their intended characteristics or uses; process innovations, which represent changes in production and distribution methods; organizational innovations, referring to new business practices; and, finally, marketing innovations, which include market positioning, strategies and changes in design, which, according to the Oslo Manual (FINEP, 2005), refer to “the changes in the shape and appearance of the product that do not alter the functional or usage characteristics of the product” (FINEP, 2005, p. 60).

Very close to the classification of the Oslo Manual, Tidd (2005) proposes the 4 Ps of innovation: product and process innovation (as described in the Oslo Manual); and also position innovation, which refers to changes to new contexts; and, finally, paradigm, which reflects a change in the mental model of everything around.

The stages of innovation from the perspective of Tidd (2005) represent a transition from the level of component changes to the level of systems, and of incremental improvements for radical models (Figure 1).

Figure 1 – The dimensions of innovation by Tidd (2005)



Source: Adapted from Tidd (2005).

Both the Oslo Manual and Tidd's 4 Ps also place the product in the scope of services, and there is no fully defined division, since it is possible to find more than one type of innovation in the same context.

Finally, there are several mechanisms to generate innovation from the point of view of competitive strategy, such as: 1) degree of originality in a product or service, which would be the delivery of something that no one has yet presented; 2) novelty in a process, offering a new way of doing something that others cannot do, when the person in charge becomes a master at executing what others have difficulty doing; 3) intellectual property, which competitors cannot use illegally; 4) or rewriting of the rules of the market, which would be to deliver something totally new, for example, the typewriter as opposed to the computer (Tidd, 2005).

Riccini (2001) draws attention to the different existing terminologies to characterize innovation, resulting in difficulty to understand its meaning. According to the author, one of the ways to minimize this problem would be to consider its approach from a historical perspective. In this sense, Pinheiro, Merino and Gontijo (2015) state that innovation is a driving force of society, which arises from the individual capacity to combine the elements of nature to create something that can be shared by a group. The authors describe five temporal generations to define the paths of innovation.

First generation - 1930: Schumpeter proposed that technological advances are responsible for the initial impulse that modifies social inertia. This is the first economic perspective used to explain innovation, called the “technological impulse” model.

Second generation - 1950/1960: known as the “demand pressure” model, in which the driving force is social demand; at that time, incremental innovations were more effective in

meeting personal needs, for, in addition to providing mainly functional improvements, there was less risk involved in business decisions and investments.

Third generation - 1970: unlike the previous two, this generation dealt with a phenomenon with more complex layers, based on feedback. Innovation is understood here as a relative gain, provided by the interaction between market opportunities and capabilities of the companies.

Fourth generation - 1980/1990: during this period, innovation was promoted by strategic alliances and by the impact of local, national and international production networks capable of reconciling quality and agility, offering consumers high performance novelties.

Fifth generation (current stage): works with integration and innovation models as a continuous process of personalization of products or services offered by companies to consumers, who become co-authors of each invention.

The chronological path above legitimizes the term *open innovation*, coined by Chesbrough (2003) to counter the closed innovation model practiced by 20th century corporations. Closed innovation limits the innovative process to knowledge, connections, and technologies developed within organizations, without the participation of external institutions or other companies in the process (Chesbrough, 2003).

On the other hand, open innovation is an approach focused on the extension of the collaborative network, which allows the sharing of ideas and data to maximize the innovative potential (Cruickshank, 2010), decentralizing research and characterizing the end of the internal knowledge monopoly, characteristic of the closed model (Chesbrough, 2003).

Currently, the term “innovation” is an everyday expression of positive value, representing growth and prosperity, unlike the recent past when it was banned by kings and popes who considered that the idea of novelty could negatively affect people (Mortati, 2015). Due to its diffusion in the diverse creative and production sectors, the term has been recurrent in the characterization of the material culture of the 21st century.

Traditionally, the word innovation is connected to the business world and often involves new technologies. The commercial and technological value of innovation can be perceived when we refer to products such as the *smartphone*. On the other hand, in situations of hardship and scarcity, people have to be inventive in order to create something useful with few resources, in which necessity can be the crucial stimulus for invention (Pilloton, 2009). Therefore, the term innovation, in addition to its nature often associated with technology, has gradually

expanded its concept, favoring its insertion in other contexts, such as social and sustainable innovation.

Considering Victor Papanek's questions in the 1970s (Papanek, 2005) and the various international conferences in recent decades, including the *World Commission for Environment and Development - Our Common Future* (WCED) which occurred in 1987, it is possible to verify progress in the discussions about the maintenance and the intelligent exploitation of natural resources. For example, sustainable solutions are possible through the combination of technical and socio-cultural dimensions of innovation. These dimensions, in turn, can be oriented according to the technology axis, aiming to answer questions about how better to produce products and innovate technologies in order to reduce the consumption of environmental resources. Or they may be oriented towards the culture axis, addressing proposals that discuss the meaning of the product according to its environmental and social impact (Manzini & Vezzoli, 2016).

Similar to the *open innovation* perspective, social innovation may be the result of work originating from networks of creative communities in the development of solution. In this case, innovation is based on a collaborative action, with the community itself as a transforming agent (Manzini, 2008).

However, it is important to underline that, although there is the possibility of being based on collaborative relationships outside the economic area, the approximation of innovation to the discipline of design is recent. In fact, what defines the first moments of innovation is based on the economic principle established by Schumpeter, and it is important that, although the nature of design is based on the generation of innovative solutions, this activity is not mentioned in the literature that defines the foundations of innovation. For example, the *Oslo Manual* identifies design as a subcategory of innovation in marketing, restricting it to the appearance of the product.

As a way to understand and contextualize this relationship, the following topic addresses the main theories of design, in order to establish a correlation with innovation.

Approaches between design and innovation

Creativity is a human faculty that favors attitudes that result in the exploration and conception of alternatives to products and services for the most diverse situations, without necessarily contemplating a commitment to profit in the sphere of capital production. According to Pinheiro and Merino (2015), creation, as well as invention, is established from

the motivation inherent to the subject, considering personality traits and acquired knowledge, and constitutes individual capacity to generate new ideas.

Henry Petroski (2007) argues that although only a few people have the necessary skills to invent well-defined forms, we are all capable of criticizing existing configurations. Since the human mind has the ability to question and interpret the world, everyone has the ability to observe the characteristics of objects and, even if they are not engineers, politicians, entrepreneurs, or expert designers, they can propose solutions to everyday problems and dictate changes in the world and in objects (Petroski, 2007; Norman, 2006).

In summary, Petroski (2007) proposes that the evolution of artifact shapes will always be subject to critical reactions to real or imagined deficiencies by people about those things. This would be the principle that would drive inventions, innovations and ingenuity. Considering that our evaluation of objects is not static and that it evolves over time (Cardoso, 2016), everything would be subject to changes according to alterations and stimuli that we receive and, consequently, how we look at and interpret things, such as image (Sturken & Cartwright, 2004). People in general, including those with innate or acquired skills, such as inventors, designers or engineers, have always been able to evaluate things created to make their daily lives easier – whether at home, at work, or for simple entertainment –, often identifying those who fail in completely satisfying what was expected of them (Vogel, Cagan & Boatwright, 2005). Thus, in the quest to solve deficiencies or imperfections, new artifacts were and are produced and perfected continuously (Cagan & Vogel, 2002; Krippendorff, 2006). In addition, history reports that we inherit specific objects from each culture and that different inventors in different places have looked at the same flaw, proposing different solutions to the same problem (Petroski, 2007). Therefore, regardless of the point of origin, both design and innovation use creativity as a tool to propose new solutions.

Another point to be highlighted is the widening of the focus on the role of society in promoting the dynamics of innovation, expanding its concept to other fields with several disciplines active in innovation research, including studies of management, economics, entrepreneurship, psychology, and sociology. The new approaches allow us to think about innovation developed as a social process for which multiple stories and multiple agents converge (Riccini, 2001), making it possible to study innovation in the light of design.

Among the new disciplines, broader studies are also beginning to emerge in the area of design. Business professionals, researchers, business consultants, policy makers, and innovation specialists are increasingly interested in understanding the connection between

design and innovation (Mortati, 2015), increasing research in the area, driven by the development of products that respond to demands of the digital age (Cruickshank, 2010).

In this sense, the World Design Organization – WDO presents a definition of design that narrows the relationship with the area of innovation as part of a strategic process. Therefore, in this work, we define design as a problem solving process that drives innovation, builds business success, and leads to a better quality of life through innovative products, systems, services, and experience. Design is able to connect innovation, technology, research, business, and customers to provide new competitive value and advantage in all spheres, whether economic, social, or environmental (WDO – WORLD DESIGN ORGANIZATION, 2015).

However, some scholars agree that the definition of design innovation is still a complex and unfinished task (Riccini, 2001; Cruickshank, 2010; Pinheiro et al., 2015; Mortati, 2015). This would be mainly because there are still two important open questions: whether design can measure its value, and whether it meets the problems of innovation.

To Lambert and Flood (2017), design connects creativity and innovation, in the sense of shaping ideas to become practical and attractive to users. The authors use the term “*design-intensive innovation*” to refer to the intensity of how design is applied during the innovation process.

Based on the work of Lambert and Flood (2017), Table 1 summarizes the main theories about the role of design in innovation:

Table 1 – Theories of design in innovation

Theory	Description
<i>Science of the artificial</i>	Addresses design and creativity as ways to solve problems. Uses the term “limited rationality” to state that the designer does not have perfect knowledge and, therefore, the projects carried out are based on limited information. Main author mentioned: Herbert Simon.
<i>Design thinking</i>	Created as a business strategy, it proposes opening traditional design to a mental design model, believing in the universality of design. It addresses three non-linear stages (inspiration, ideation, and implementation) and puts itself in direct contact with the needs of users. Main authors mentioned: Richard Buchanan and Tim Brown.
<i>Design driven innovation</i>	Starts from the idea that people don't just buy products and services. This theory determines that design establishes its value based on the meaning. In this case, innovation focuses more on the symbolic level than on the technological innovation levels. This theoretical perspective is connected with the concept of open innovation, in which there is a network research and several stakeholders with an interest in offering users new possibilities that they were not able to perceive. Main authors mentioned: Roberto Verganti, Klaus Krippendorff and Henry Chesbrough.
<i>Concept-knowledge theory</i>	Instead of using Herbert Simon's “limited rationality”, this theory proposes “expandable rationality”: a model based on the idea that creativity starts to build the meaning of design when it interacts systemically with logical (scientific) knowledge. Main author mentioned: Armand Hatchuel.
<i>Practical design</i>	This theory is based on a critique of <i>design thinking</i> , since it assesses the risk of de-characterization of what would be the essence of design as a practical activity. It then proposes an approach centered on the project in two axes: design as practice, artifact creation, professional domain of the designer; and design in practice, a democratization of innovation in which the designer connects with other agents. Main author mentioned: Lucy Kimbell (2009).
<i>Service design and innovation</i>	Very widespread in the 90s, this approach includes design beyond physical products. Service design addresses the functionality and form of services from the user's perspective, ensuring that interfaces are useful, usable, and desirable from the customer's point of view; and effective, efficient, and distinct from the supplier's point of view. Main authors mentioned: Birgit Mager, Sabine Junginger and Daniela Sangiorgi.
<i>Social innovation</i>	This approach defines designers as social actors who collaboratively design with and for communities. In this sense, innovations can be incremental or radical, and from top to bottom, presenting something new for the social group; or from the bottom up, very close to the term <i>user innovation</i> , where change is genuinely initiated and implemented by a group, not by commercial suppliers. Main author mentioned: Ezio Manzini.

Source: Adapted from Lambert and Flood (2017).

Among the theories presented above, apparently, the theory of *design-driven innovation* is the one that comes closest to the definition of economic innovation, since it presents relationships among technology, market, and design to explain the types of innovation.

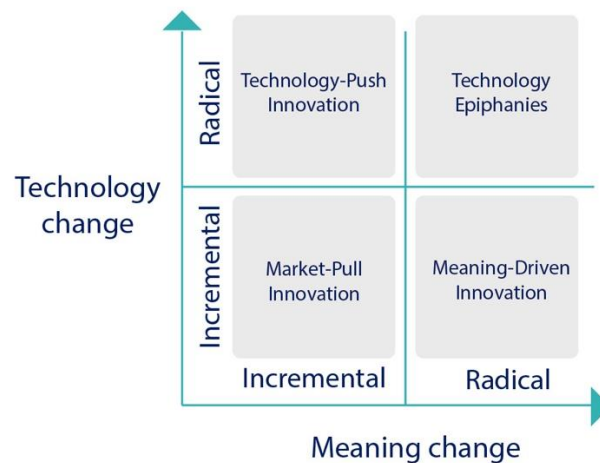
It is important to understand two key concepts in the design innovation process, which directly refer to the degree of novelty. The first concept is that of incremental innovation, which is the result of strategic research and a series of adjustments based on collaborative action among designers, companies, and users. This type of innovation meets the needs of the market, aiming to improve an existing product, or launch a new model, with the objective of reducing the company's production costs (Verganti & Norman, 2014).

On the other hand, the concept of radical innovation comes from technological advances or from deliberate change in the meaning of the product. It is important to point out that, although radical innovation has been the focus of companies' attention, it is quite rare, occurring once every five or ten years (Verganti & Norman, 2014). In radical innovation, the expected result is often not achieved in the first attempt, and for this reason, it is a sporadic event with a large time interval between one and the other. The authors also state that, in most cases, this type of innovation has a history of failures, precisely because it is an unknown context and still in development.

In order to identify radical innovation, Verganti and Norman (2014) suggest some criteria: 1) it needs to be new, that is, different from previous versions; 2) it needs to be unique, different from current versions; 3) and it needs to be adopted, that is, to influence future innovations.

Once the concepts of radical and incremental innovation are defined, it is possible to understand how the three areas – technology, market, and design – relate to the theory of design-driven innovation (Figure 2):

Figure 2 – The two dimensions and four types of innovation



Source: Adapted from Verganti and Norman (2014).

To Verganti and Norman (2014), technology, the market, and design work as drivers for innovation. In Table 2, we present the four types of possible innovation based on the theory of design-driven innovation.

Table 2 – Types of innovation in design-driven innovation

Type of innovation	Degree of novelty	Description	Example
<i>Technology push-innovation</i>	Radical	Radical innovations in technology, but without changing meanings. Are not driven by users.	Color on TV
<i>Meaning driven-innovation</i>	Radical	It begins with an understanding of the subtle dynamics of society, and generates radically new meanings, often implying a change in the socio-cultural regime.	The invention of the miniskirt in 1960
<i>Technology epiphanies</i>	Radical	Radical change of meaning due to the emergence of new technologies and existing technologies, but in new contexts, without, however, originating from the user.	Wii Console and Smartwatch
<i>Market-pull innovation</i>	Incremental	Market innovation starts from an analysis of user needs.	Updating a smartphone model

Source: Adapted from Verganti and Norman (2014).

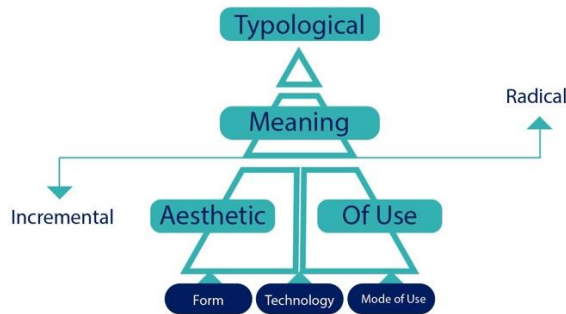
It is interesting to note that only market-driven innovation is identified as incremental innovation. One of the keys of *design-driven innovation* is the idea that the user has difficulty to predict radical innovation because of total immersion in the cultural context (Verganti, 2008). Likewise, when researchers limit themselves to studying the existing context to generate innovation, they can also only reproduce incremental adjustments already known to the user.

Fialkowki and Kistmann (2018) declare that companies have explored incremental innovation as a counterpoint to high-risk technological innovation, since it presents a scenario of uncertainty and high financial investment. Therefore, in order to reduce costs, and at the same time re-signify products, companies use existing techniques to generate profit without the total product overhaul.

Design-driven innovation would begin by observing small changes in social standards, with the aim of producing products or services from a new experience. This continuous improvement management process would occur not only through research and technological advancement, but also by market demand or by the inclusion of new meanings in the artifacts. Lastly, we must also consider that, in order to think about innovation in design, it is also important to think about the contexts of use, emphasizing the emotional, psychological, social, and symbolic value of a product (Fialkowki & Kistmann, 2018).

In parallel with design-driven innovation, Rampino (2011) proposes the design-driven innovation pyramid (Figure 3), which is structured on three axes: 1) axis of shape; 2) axis of how to use; and 3) axis of technology.

Figure 3 – The innovation pyramid



Source: Adapted from Rampino (2011).

The three axes that form the base of the pyramid move from objectivity to subjectivity, from technology to shape. The first, technology, guides the opportunities for applying new techniques. In the second, how to use occurs when the process aims to improve or generate new types of usage. Finally, the shape axis considers the product's morphological attributes in order to define a new configuration and a new aesthetic language.

Regarding the results from the pyramid, Rampino (2011) presents four types of innovation:

1. **Aesthetic/morphological innovation**, that deals with the appearance of the products, representing the visceral level from formal interpretation;
2. **Innovation of usage**, which is based on social contexts, assigning new functions to the product at the behavioral level;
3. **Meaning innovation**, which deals with the semantic dimension, and is the reflective level, capable of communicating emotional aspects by the meanings;
4. **Typological innovation**, the rarest and most disruptive of all which refers to the deviation of a product from its formal archetype.

Based on the literature presented (Pinheiro et al., 2015; Verganti& Norman, 2014; Santos, Fazion&Meroe, 2011; Rampino, 2011; Tidd, 2005), we highlight the points of convergence between design and innovation:

- They have creativity as the starting point for purposefully generating something;
- They promote economic and competitive growth in the market;
- They operate in the field of products, services, processes, and/or organizational structures;
- They share the complex process of intermediation between new technologies and the needs of users;
- They are activities with the potential of context transformation;
- They aim to achieve a degree of novelty, whether small, medium or large scale.

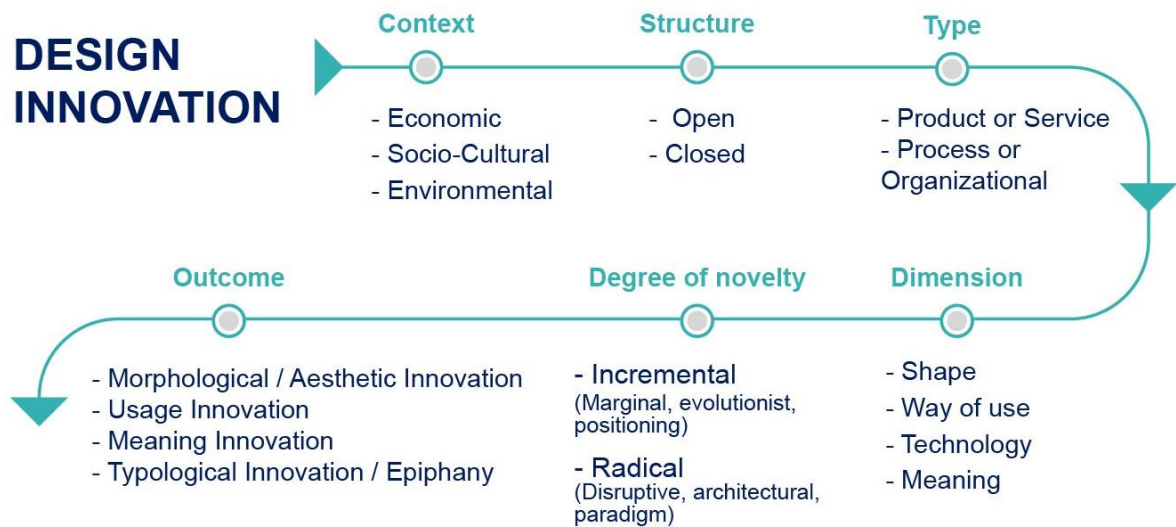
In conclusion, thinking about innovation through design can also expand the economic root of innovation, and enable solutions that reach other layers of innovation, such as those that aim at social impact, management of environmental resources, or improvement of the user experience in the emotional dimension.

Model for characterizing innovation in design

It is possible to highlight that the problem of a concise definition for innovation, especially when aligned to the discussion on the design axis, does not result from the lack of theoretical elaborations. As stated by Pinheiro et al. (2015), the research problem focused on the study of innovation in the field of design is in the out-of-context and divergent cutouts, because several authors theorized the aspects of innovation by creating their own nomenclatures and definitions.

The relationship between design and innovation is, therefore, characterized by a multiplicity of points of view, expressed by different authors who tend to oppose each other. However, understanding that the theoretical lines on the two areas are complementary, this article does not aim to propose new terminologies to classify innovation; but aims to connect the different definitions in a model to characterize design innovation (Figure 4).

Figure 4 – Classification model of design innovation



Source: Own authorship (2019).

The model was designed based on the definitions presented by the following authors: Pinheiro et al. (2015), Verganti and Norman (2014), Manzini (2014), Rampino (2011), Cruickshank (2010) and Chesbrough (2003). The different points of view present complementary theoretical resources on innovation that favored the constitution of the classification proposal described here, starting from an analysis from the macro point of view of the performance of innovation to a micro view of the particularities of the possible results achieved.

The first stage of classification takes place within the scope of purpose and context in which the innovation will be implemented. Since the purpose of achieving greater economic potential is intrinsic to the nature of innovation, wealth generation is often the starting point. However, as discussed in this article, the scope has been expanded to think about innovation also in the context of social impact and the maintenance of natural resources. Therefore, innovations that deal directly with the relationship between the user and the market aiming to generate profit are classified as an economic context. On the other hand, the socio-cultural context refers to innovations that aim to improve quality of life and development. Generally, this type of context seeks to promote a balance between social classes and the enhancement of local resources and culture. Finally, innovations in the environmental context are those that seek to improve the use and distribution of natural resources and generally focus on new possibilities of generating renewable energy and the life cycle of the product.

It Is Important to emphasize that the model proposed here brings together different points of analysis of innovation, categorized only for didactic and interpretive purposes,

therefore, we understand innovation as a complex multifactorial network, whose points are interconnected and sometimes overlapping. This implies that innovation can permeate more than one context simultaneously. In this case, sustainable innovation would be one that manages to align the three axes: economic, social and environmental.

The second stage, called dimension, refers to the structure that deals with the development model and how the agents that project the innovation are articulated. In the closed structure, research and development happen within the company and without external participation. On the other hand, the open structure works with the decentralization of knowledge, through a collaborative network between companies, academic and research institutions and the community.

In the third stage, the typology – or area of operation – in which the innovation will be developed is analyzed. The type is directly related to what will be generated at the end of the process. Strategies can be established for the development of a new physical or digital product, or a new service; or, still, for the restructuring of a process at an organizational level, usually associated with strategy and design management.

The first three stages deal with the general aspects of innovation. The other three points below characterize the particularities.

The fourth stage refers to the design axis that is driving innovation. Thus, if the research is conducted in the dimension of shape, this implies that the point of change that is intended to be carried out corresponds to a morphological change, which, therefore, will result in morphological/aesthetic innovation at the end of the process. By analogy, it is possible to suppose: the shape dimension results in morphological innovation; the dimension of how to use generates innovation of use; the dimension of meaning establishes innovation of meaning; and the dimension of the technology can result in typological/epiphany innovation. Therefore, the result of the process corresponds directly to the dimension chosen to generate the innovation.

Lastly, the fifth stage establishes the classification as to the degree of novelty and defines the intensity of the change compared to the previous models. Innovations with minor changes, also interpreted as continuous improvement management, are described as incremental degree. On the other hand, those in which there is greater distance from what is already in practice and which are able to generate major changes are classified as radical degree.

Innovation is a dynamic process and is composed of layers. It is important to highlight that, similar to the categories of context, structure, and type, an innovation can contemplate more than one dimension of design and act on more than one result with different degrees of

novelty. For example, it is possible that when a product is analyzed, it presents innovation in the shape dimension with a high degree of novelty, at the same time that it has undergone changes in the dimensions of technology and meaning, but to a lesser extent. Consequently, there are layers of innovation at different degrees in the results.

In summary, the path proposed in this article and illustrated in Figure 4 suggests the idea that, although there is a multiplicity of concepts, when trying to bring design and innovation closer together, we must consider that what is exhibited are complementary, and not necessarily excluding, approaches. We can also conclude that, although the proposed route for the classification of innovation is linear, there are no defined limits between the stages. This means that innovation can start from more than one context, have more than one dimension, and generate more than one result.

Conclusions

Creative impulse is part of people's lives as a practice to solve everyday individual or collective problems. Creativity is, therefore, the point that connects and guides both design and innovation. Therefore, even though historically the two disciplines are recent and have different origins, the connection between them is complementary and often has analogous objectives. Both aim to discuss, create, and implement possibilities for improving people's lives under different aspects, whether economic, social, or environmental.

This article presented fundamental terms and concepts for understanding the relationship between innovation and design in order to not only highlight the divergences, but above all to demonstrate the points of convergence. Although the literature on these areas presents many concepts, which apparently are different, we conclude that these are only questions of nomenclatures and definitions that sometimes end up making the approximation between design and innovation more difficult and confusing.

However, with the innovation characterization model proposed in this research, it was possible not only to bring the two areas together, since they move separately at some points, but above all to make the qualitative value of design more tangible in the innovation process.

Finally, the contributions of the model presented are about the understanding of existing innovations, but also as a tool capable of modeling and characterizing innovations that are still in the designing stage. In the planning stage, it is possible to define the categories in which it is intended to act, and to use the model as a route to guide the research and development of innovation.

In conclusion, in this work we seek to define innovation as a dynamic and continuous process, with several points of convergence that act simultaneously. Design innovation is a complex system and, therefore, a way of questioning an existing scenario and proposing transformations based on small incremental changes, operating in the quantitative field, or major radical changes with qualitative disruptions in the current design model, favoring the creation of products with solutions that are more connected to the contemporary user.

References

- Bürdek, B. E. (2006). *História, teoria e prática do design de produtos*. Blücher.
- Cagan, J., & Vogel, C. M. (2002). *Creating Breakthrough Products*. Prentice Hall.
- Cardoso, R. (2016). *Design para um mundo complexo*. 2. Ubu Editora.
- Cautela, C., Deserti, A., Rizzo, F., & Zurlo, F. (2014). Design and Innovation: how many ways? *Design Issues*, 30, nº 1 Winter, 3-6.
- Chesbrough, H. W. (2003). *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Harvard Business School Press.
- Chochinov, A. (2009). *A good long tradition*. Em Design Revolution: 100 products that are changing people's lives, por Emily Pilloton. Thames & Hudson, 6-9.
- Cruickshank, L. (2010). The Innovation Dimension: Designing in a Broader Context. *Design Issues*, 26, nº 2 Spring, 17-26.
- Fialkowski, V. P. & Kistmann, V. B. (2018). Gestão de Design e Inovação Incremental Guiada Pelo Significado. *Estudos em Design*, 26, nº 2, 28-53.
- Financiadora de Estudos e Projetos – FINEP (2005). *Manual de Oslo: diretrizes para coleta e interpretação de dados sobre inovação*. 3ª. Tradução: Flávia Gouveia. DCOM/FINEP.
- Forty, A. (2007). *Objetos de desejo: design e sociedade desde 1750*. CosacNaify.
- Heskett, J. (2001). *Industrial Design*. 2ª. Thames & Hudson.
- Krippendorff, K. (2006). *The semantic turn*. Boca Raton, FL.
- Lambert, R. & Flood, R. (2017). *Understanding design-intensive innovation: a literature review*. Design Consul.
- Margolin, V. (2014). *A política do artificial: ensaios e estudos sobre design*. Record.
- Manzini, E. (2008). *Design para a inovação social e sustentabilidade: comunidades criativas, organizações colaborativas e novas redes projetuais*. Cadernos do Grupo Altos Estudos.

- Manzini, E. & Vezzoli, C. (2016). *O Desenvolvimento de Produtos Sustentáveis*. Tradução: Astrid de Carvalho. 1. Ed. 4. Reimpr. Editora da Universidade de São Paulo.
- Mortati, M. (2015). A Framework for Design Innovation: Present and Future Discussions. *Design Issues*, 31, nº 4 Autumn, 4-16.
- Muratovski, G. (2016). *Research for Designers: a guide to methods and practice*. 1º. SAGE Publications Ltd.
- Norman, D. A. (2008). *Design Emocional: porque adoramos ou detestamos os objetos do dia-a-dia*. Rocco.
- Norman, D. A. (2006). *O design do dia-a-dia*. Tradução: Ana Deiró. Rocco.
- Ostrower, F. (1990). *Acasos e percepção artística*. Campus.
- Papanek, V. (2005). *Design for the Real World: Human Ecology and Social Change*. Chicago Review Press.
- Petroski, H. (2007). *Evolução das Coisas Úteis: cliques, garfos, latas, zíperes e outros objetos do nosso cotidiano*. Tradução: Carlos Irineu W. da Costa. Jorge Zahar.
- Pilloton, E. (2009). *Design Revolution: 100 products that are changing people's lives*. Thames & Hudson.
- Pinheiro, I. R. & Merino, E. A. D. (2015). Os 4 vetores da inovação: Um quadro de referência para a gestão estratégica do design. *Estudos em Design*, 23, nº 2, 75-101.
- Pinheiro, I. R., Merino, E. A. D., & Gontijo, L. A. (2015). Sobre a definição de inovação em design: o uso da análise de redes para explorar conceitos complexos. *Revista Brasileira de Design da Informação*, 12, nº 3, 357-375.
- Pozatti, M., Bernardes, M. M. S., & Linden, J. C. S. V. (2016). Avaliação de Soluções Geradas a Partir de Métodos de Design Voltados Para a Inovação. *Design & Tecnologia*, 6, nº 12, 31-43).
- Rampino, L. (2011). The Innovation Pyramid: A Categorization of the Innovation Phenomenon in the Product-design Field. *International Journal of Design*, 5, nº 1, 3-16.
- Riccini, R. (2001). Innovation as a Field of Historical Knowledge for Industrial Design. *Design Issues*, 17, nº 4, Autumn, 24-31.
- Santos, A. B. A., Fazon, C. B., & Meroe, G. P. S. (2011). Inovação: um estudo sobre a evolução do do conceito de Schumpeter. *Caderno de Administração da FEA PUC/SP*, 5, nº 1.
- Schumpeter, J. (1988). *A teoria do desenvolvimento econômico*. Nova Cultural.
- Sturken, M.; Cartwright, L. (2004). *Practices of looking*. Oxford University Press.

Tidd, J. (2005). *Integrating Technological, Market and Organizational Change*. 3^a. John Wiley & Sons Ltd.

Verganti, R. (2008). Design, meanings and radical innovation: A meta-model and a research agenda. *Journal of Product Innovation Management*, 25, n° 5, 436-456.

Verganti, R. & Norman, D. A. (2014). Incremental and Radical Innovation: Design Research vs. Technology and Meaning Change. *Design Issues*, 30, n° 1, Winter , 78-96.

Walker, S. (2014). Terra dos resíduos: sustentabilidade e design com dignidade. In *Design, Resíduo&Dignidade*. Olhares, 15-27.

World Design Organization (2018). *Definition of Industrial Design*. 03 de junho de 2018. <https://wdo.org/about/definition/>.