KEYWORDS innovation competitiveness design benchmarking indicator

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ICD PROJECT: IN PURSUIT OF GUIDELINES TO INCREASE COMPETITIVENESS IN THE BRAZILIAN INDUSTRY THROUGH INNOVATIVE PRODUCT DESIGN MANAGEMENT

ABSTRACT

This article brings a strategy designed to set guidelines to increase competitiveness in the Brazilian industry. In order to achieve the proposed goal, this work has conducted the diagnosis of the design process in five companies that develop consumer goods. The diagnosis listed critical success factors for effective innovation management, which were essential for implementing mechanisms oriented to the development of innovative solutions for products and services. In addition, an indicator system was developed to assess the competitiveness of each company. To date, it was found that the required efforts to increase competitiveness through innovative product design management must have a well-defined strategy of integration between processes and intervening agents before the start of the project.

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INTRODUCTION

In an increasingly competitive and turbulent context, design has assumed a position of importance, since through it a company can strategically position or reposition a product or service within a determined market *(Steinbock, 2005)*. Design can be considered as inducing activity of incremental and radical innovation processes in different organizations *(Stamm, 2008)*. However, to be used in a strategic way, design should be integrated into the company's managerial processes in such a way as to effectively participate in the strategic decisions of an organization. Integration demands that a company suitably manages the design *(Borja de Mozota, 2003)*.

Due to the importance of design within the economy, diverse national and international agencies have sought to introduce it into their investment priorities. Some countries have sought to carry out diverse actions promoting design as a means for the innovation and differentiation of their services and industrial products, obtaining positive results most of the time. In this context, in research carried out through case studies of small UK product development companies *(Margaret Bruce, Rachel Cooper, & Delia Vazquez, 1999)*, it was found that there is a consensus on the benefits of design for increasing the companies' competitiveness. According to Rosane Fonseca de Freitas Martins *(2004, p. 3)*, "the UK Design Council has also carried out research studies that utilized relatively rigid comparative standards *(by range of performance measures)* among businesses with and without concentration on design. Those that presented results significantly better are the businesses with a concentration on design."

In Brazil, in recent years, incentives have been carried out through the decrease of taxes paid by the consumers of determined products, as a way to increase the consumption and productivity of some sectors of the Brazilian economy. But these measures, in addition to being seasonal, have been incipient in the status quo maintenance of an efficient design and innovation process. This can be explained due to the fact that these measures incentivized consumption and not the development of goods that radically innovate the market. These most recent, besides enabling companies to become more competitive, open space for generating value in terms of knowledge, research, and science oriented towards technological development *(Mascitelli, 1999)*.

With the intention of reverting this scenario, since the second semester of 2012, a project is being developed entitled ICD *(Innovation, Competitiveness, and Design)*, with the objective of seeking out guidelines for increasing the competitiveness of Brazilian product development companies through product design management and innovative services. With this project the intention is to capacitate, structure and provide method standards in which product development companies innovate the market. In addition to this, the project seeks to develop a benchmarking system which gives visibility to Brazilian companies and encourages them in the search for good practices of design and innovation. In this sense, the objective of this article is to present the strategy that was conceived to define guidelines that intend to increase the industrial competitiveness in Brazil.

1. Design, Success, and Competitiveness

Design creates value because it improves product image, or in other words, external appearance, and with this, the perceived quality of the product *(Borja de Mozota, 2003)*. With this view, the design is seen as a "plus", a "something more" of a product or service perceived by a specific user. In addition to this, the design increases the quality of the product in terms of performance, efficiency, functionality, and originality *(Brown, 2009)*. In other words, it provokes differentiation among products.

However, the competitive advantage doesn't come only from the differentiation of a product. The advantage is also the result of coordination

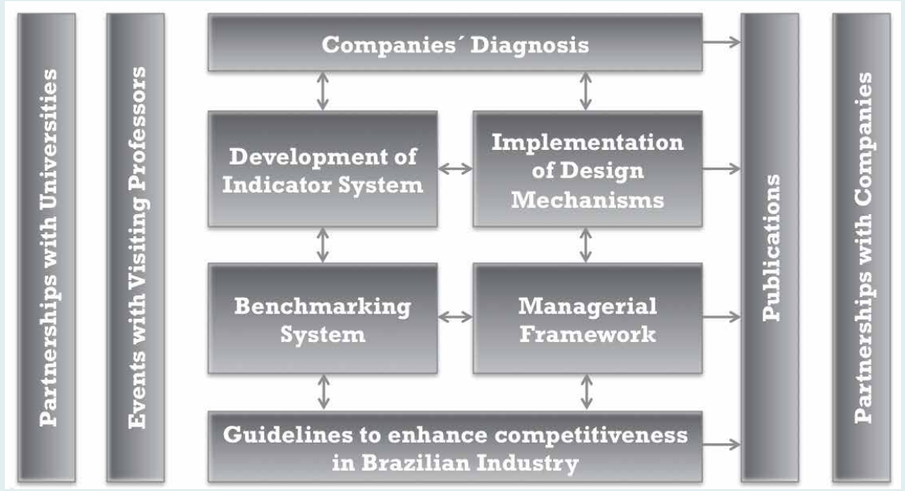

FIGURE 1. *ICD Research Design*

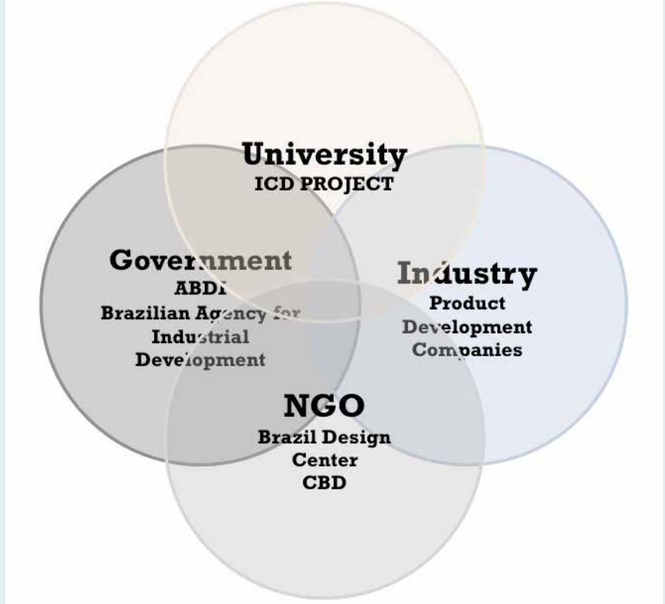

FIGURE 2. *Quad helix*

improvement among the various functions of the company *(Porter, 1998)*. This is observed in a study developed by Borja de Mozota *(2003)*, carried out with small and medium European companies. It confirmed the existence of an innovation policy within these companies as essential to their survival. This innovation policy should have clear operational goals that facilitate their integration with the other existing functions in the company.

Tatiana Schoneweg Mello *(2003)*, pg. 75, states that "the Design Management shows to have as a main function, the articulation of information via methods that facilitate the integration and the interaction of different areas, minimizing errors, risks, and uncertainties, and in this way, helping the viability and the concretization of an initial idea". Meanwhile, so that designers can be inserted into the strategic management of a company, first they must contribute to the design of the organization itself, helping its managers to identify existing gaps between

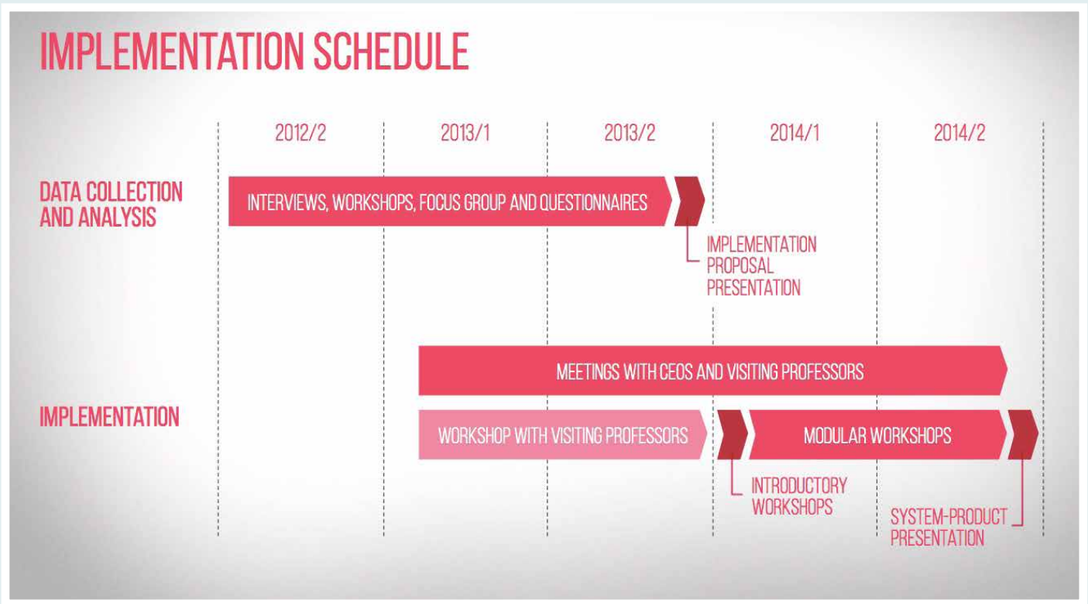

FIGURE 3. *Project development plan: collection, analysis, and implementation.*

company strategy and organizational design *(Ron Sanchez, 2006)*. One way to facilitate the insertion is to uniformize concepts practiced by both professionals: the strategic management of the company and the design management. This demonstrates the importance of the proposition of structured methods, procedures, and standards, that clarify the roles of the diverse entities involved in the product development process.

There are various research studies that corroborate with the presented context. Ahn, Zwikael, & Bednarek *(2010)* developed a multidisciplinary model to differentiate, prioritize, and select investments in technological projects within the portfolio of an organization. The results of applying the model suggested that it is possible to increase the competitiveness of technology based companies, although the study was not carried out through action research, opening up the possibility of questioning its validity. Artto, Kulvik, Poskela, & Turkulainen *(2011)* discuss the role and the importance of project management offices in the managerial integration of projects concerning innovation. This way, according to the authors, establishing the clear functions of a project office is essential to leading a well-structured innovation process. This data is also corroborated by Mir & Pinnington *(2014)*. These authors identified that the performance efficiency of the project management process is related to the success of the project itself. Gallego, Rubalcaba, & Hipp *(2013)* discuss how innovation in services supports organizational innovation, through a conceptual framework that proposes to increase the competitive advantage of companies. Wong & Chin *(2007)* propose that a company can be more competitive through a better managerial process of organizational innovation. They prove this through the presentation of a framework concerning innovation management. However, the inexistence of a structuration of design methods in the presented cases is perceived in the proposed research studies. Robin Roy & Johan Riedel *(1997)* propose that design has an important role in the innovation process of tangible products, and

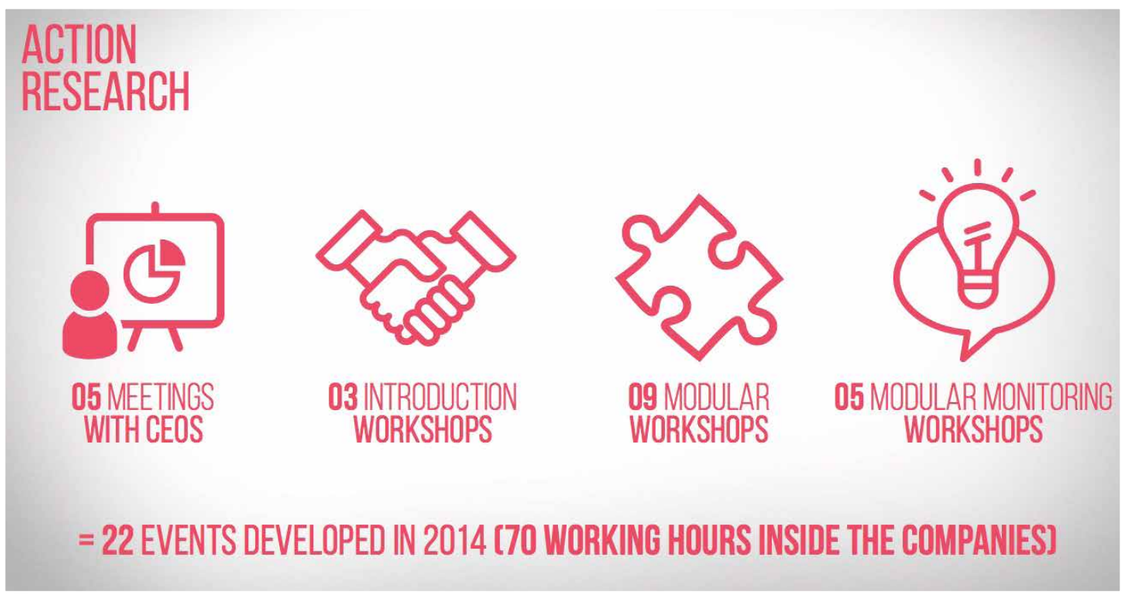

FIGURE 4. *Events developed during the action research*

this relates positively with the competitiveness of the organizations.

2. Research Methods

The project was conceived in such a way as to make possible the development of scientific works in the areas of design and innovation, in companies that develop consumer goods in Brazil. This way, it was sought to structure it with the support of four fundamental pillars *(figure 1)*: partnerships with other Brazilian Universities; partnerships with product development companies; free lectures and colloquiums of visiting professors from Foreign Universities, and publications of the project results. These four pillars were fundamental to gaining visibility for the project. This was possible with the implementation of free events with well-known professors from foreign universities, as well as through the publications based on the results of the developed research. The partnership with Brazilian Universities and product development companies improved the connections with professionals from diverse areas and academia, increasing significantly the coverage of the project.

To facilitate the communication process of the project, as well as connections among professionals and academics, it was decided to use the quadruple helix scheme, integrating the University's initiative with companies, government, and non-governmental organizations *(figure 2)*. This way, through monthly strategic meetings, the main results and work developments were discussed with representatives of each of these entities.

Action research was used as the main research strategy. To propose the guidelines for increasing Brazil's industrial competitiveness, the understanding of the context of the product development companies, defining the project to a non-probabilistic sample of consumer goods manufacturing companies, was initially decided. In this way, five companies from different performance areas were sought to work with,

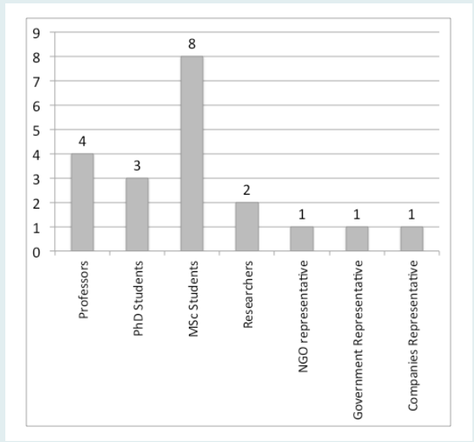

FIGURE 5. *Distribution of development team and project management*

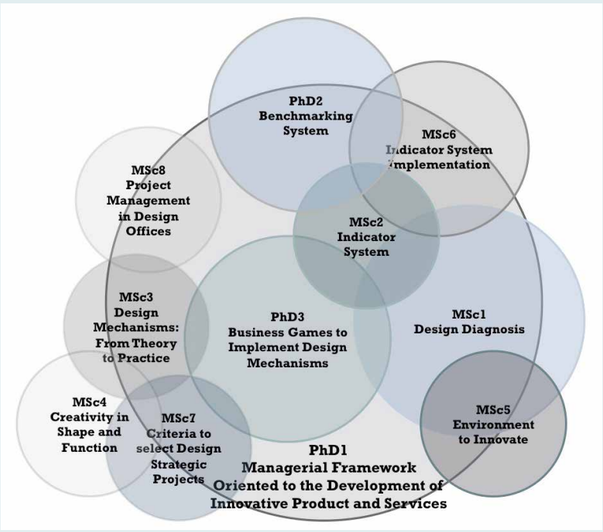

FIGURE 6. *Research paper integration*

Team Member	Research	Description	Status*	Need**
PhD1	Managerial framework	Managerial framework oriented to the development of innovative product and services	ID	BP
PhD2	Benchmark system	Computation system for the benchmarking process of product developers	ID	BP
PhD3	Business games	Development of business games to ease the implementation process of design mechanisms	ID	BP
MSc1	Design diagnosis	Design process diagnosis of studied businesses	C	BP
MSc2	Indicator system	Innovation, competition and design indicator system	C	BP
MSc3	Design mechanisms	Development of converging factors between theory and practice through the employment of design mechanisms	C	BP
MSc4	Creativity in shape and function	Correlation between creativity in shape and function of successful consumption goods in the market	C	DP
MSc5	Environment to innovate	Analysis of proper environment for innovation	TD	DP
MSc6	Indicator system implementation	Innovation, competition and design indicator system implementation in product developers	ID	BP
MSc7	Criteria do select design strategic projects	Establishing criteria for the selection of design strategic projects	ID	DP
MSc8	Project management in design offices	Analysis of project management process in design offices	TD	DP

* C – Completed; ID – In development; TD – To be developed. ** BP – Before the start of the ICD project; DP – During the ICD project.

TABLE 1. *Description of research developed and under development*

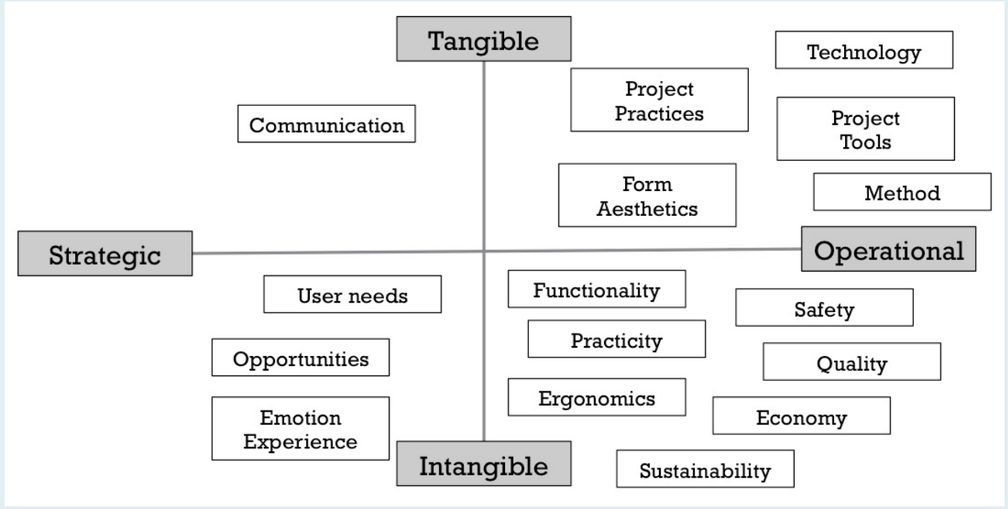

FIGURE 7. *Keywords related to design, according to the studied companies (Bruna Ruschel Moreira, 2014)*

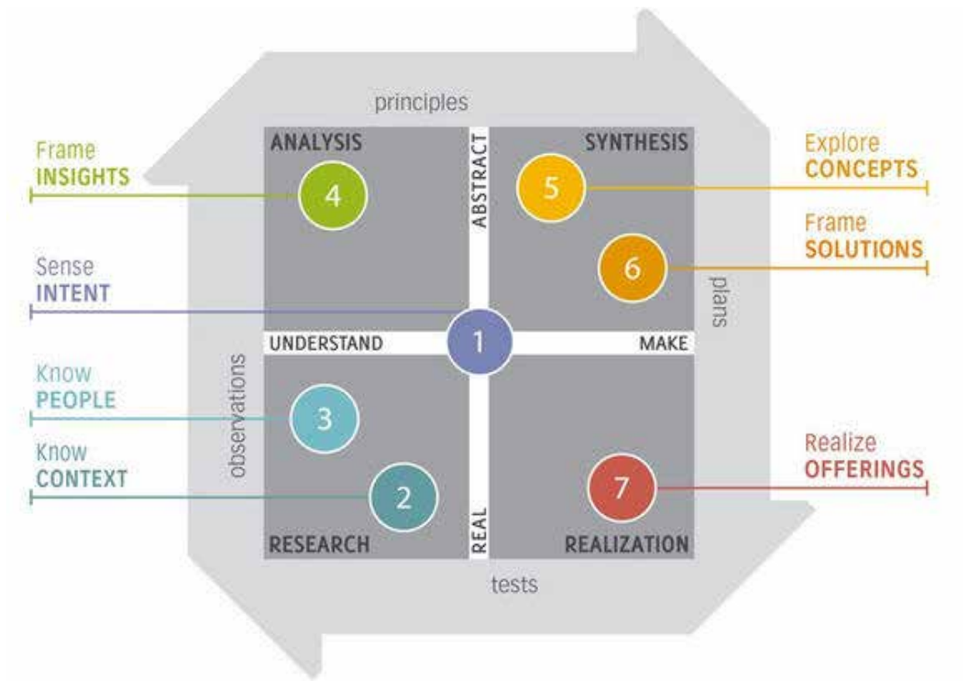

FIGURE 8. *Scheme proposed by Kumar (2012) and used to guide intervention in the design process*

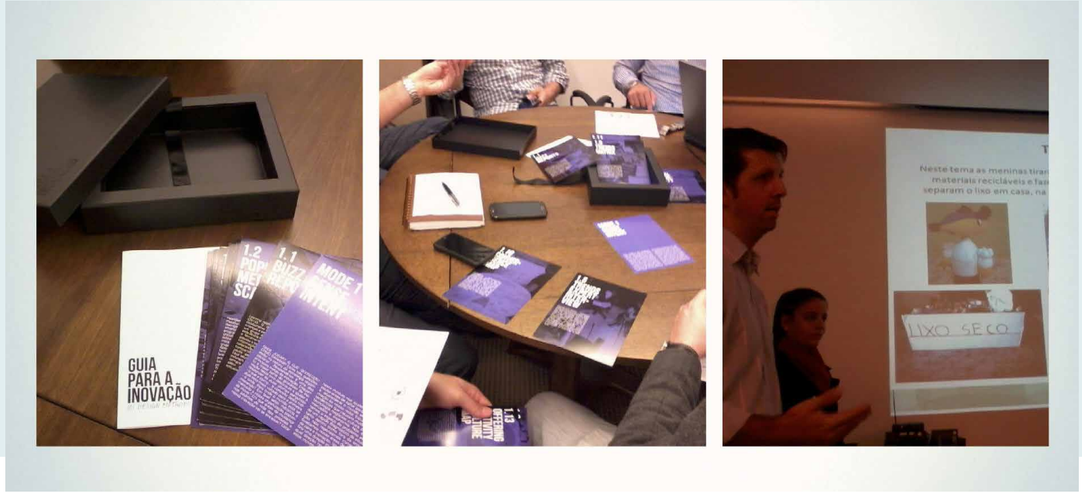

FIGURE 9. *Guide to innovation and its application*

having entered into the study for convenience and availability, since these companies had already participated in previous partnerships with the University of the authors of this article.

The studied companies operate in the following segments: footwear, cleaning tools, hand tools, plastic containers, and toys. All are large sized companies and export their products to different countries of the world, and are notably recognized in the Brazilian market for being competitive and innovative. To understand the context of these companies, case studies about the role and function of design in the product development process *(PDP)* of the studied companies were carried out. **Figure 3** shows the planning of the developed activities. In this way, the design processes of the partner companies were graphically modeled through the creation of focal groups with their teams of product development. These teams had, at minimum, a representative of the design, marketing and engineering sectors. The modeling occurred through the creation of four focal groups in the studied companies, which lasted around three hours each. Post-its and bond paper were used to carry out the modeling and indicate the form in which the PDP was developed. The modeling stage was developed between September of 2012 and April of 2013. The results of the diagnosis of the design process were presented to the partner companies in May of 2013.

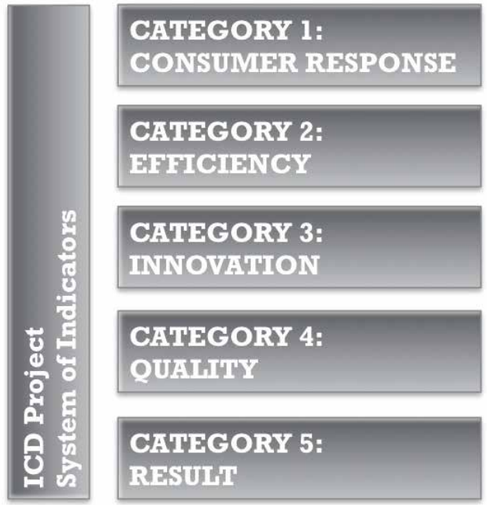

FIGURE 10. *Categories that make up the system of innovation, competitiveness and design indicators*

$$ICD\ Indicator = \sum Crc + \sum Cef + \sum Cin + \sum Cqu + \sum Cre$$

EQUATION 1. *Composite Indicator ICD*

Next, it was sought to understand how the top managers of the studied companies understood the relation between design and innovation. This second part of the diagnosis was carried out between June and November of 2013, through the realization of semi-structured interviews with the president, commercial director, and industrial director of each partner company, totaling 15 interviews, with approximately 30 hours of recordings. Through content analysis, the critical factors of success were identified, for the incorporation of design mechanisms for the companies' PDP, as well as elements that restricted the innovative potential of the participating companies. The result of this final part of the diagnosis was presented individually by each participating company between December of 2013 and January of 2014, in three-hour meetings, for the top managers of the companies.

The diagnosis listed critical success factors for the management of efficient innovation within the companies that covered the areas of strategy, communication, projects, processes, and human resources. The critical factors identified were essential to implement mechanisms concerning the development of innovative product solutions and services in the studied companies. As for mechanisms, it is an understood set of methods, techniques, and tools of design, and was defined as structured methods of design. The diagnosis enabled the development and presentation of an action plan to work with the design mechanisms to make this last process more efficient and effective.

To implement the mechanisms of the studied companies, project multifunctional operational teams were designated, formed by at least one product designer, one administrator with marketing emphasis, and one production engineer. The leader of each team was the staff member who had already coordinated the product development department of the participating companies.

The design mechanism implementation proposal was presented to the top managers *(CEO)* of the studied companies, and implemented through 09 modular workshops and 05 monitored workshops carried out at the participating companies *(figure 4)*. The five companies participated together in the workshops and their objective was the capacity and implementation of the abovementioned mechanisms in the companies. The monitored workshops had the help of professors from the area of design at the Universities. Harvard, Berkeley, Lisbon, Saragossa, and Delft. The workshops were concluded in October of 2014, and each participating company presented a solution that encompassed both a product, as well as a service connected to it. The realization of these events enabled collecting data for the construction of a managerial framework orientated towards product development and innovative services. This framework was developed between January and September of 2015.

CATEGORY 1: CONSUMER RESPONSE
Sales of new products in relation to existing ones
Estimated market share
Percentage of products that received complaints
Variation on the number of the website views
Repurchase indicator
Indicator of new clients per year compared to the total number of clients
Percentage of net profit obtained with the sale of new products
CATEGORY 2: EFFICIENCY
Percentage of projects implemented at the estimated time
Percentage of products delivered at the estimated time
Materials waste
Percentage of projects at the estimated budget
Percentage of closed projects
Occupancy rate of production
CATEGORY 3: INNOVATION
Percentage of radical innovation projects
Percentage of new product patents
Investment in r & d over the net profit
Net profit obtained with new products over the total net profit
CATEGORY 4: QUALITY
Rework hours over hours worked
Index returns
Variation of the rejection index
Percentage of the checklist attended
Frequency rate of accidents
Hours of training in production
CATEGORY 5: RESULT
Variation of net profit
Return on investment
Profit margin
Net profit per employee

TABLE 2. *Indicators by category*

In parallel, a system of indicators was developed, which enabled investigating the competitive levels of each company in the following categories: response to the consumer, innovation, efficiency, finance, and result. For the development of the indicator system, an extensive literature review was carried out, in search of possible metrics that could be used in the proposed system. An experiment was then carried out, with the staff from the marketing, design, and engineering sectors of the five participating companies of the project, with the intention of establishing consensual indicator parameters chosen that allowed evaluating the competitive levels of these companies. The chosen indicators were validated in three focal groups with directors of the strategic, financial, and commercial areas of the studied companies. The system of indicators will be implemented in a computational system of benchmarking that will be validated with other companies in 2015. The system should provide the feeding and retro-feeding of data directly by product development companies as a form of assisting them to identify, in real-time, their competitive position in the market. In addition to this, it will be possible to register the best practices that are being employed by the participating companies, in order to facilitate the learning processes of these companies.

3. Development team and project management

Figure 5 shows the distribution of the management team and the development of the project, which is managed by a professor with PhD in Civil Engineering Project Management and Post-doctorate in Design, along with two professors with PhD in Production Engineering and a professor with PhD in Architecture.

The project development team also includes three PhD students, one with Master's degree in Civil Engineering, another with Master's degree in Design specializing in Business Games and the third with Master's degree in Strategic Design. The team also includes eight Master's students *(one business administrator, a production engineer, an electrical engineer, four product designers and a fashion designer)*. A commercial director of one of the companies involved, and a specialist in the area of industrial development of the Federal Government and the technical director of a non-governmental organization with activities focused on the dissemination of design in Brazil.

Figure 6 shows the integration strategy for studies that make up the larger project. The body of research works, which were and are being developed, was assumed to enable the construction of guidelines necessary to increase Brazil's industrial competitiveness. It starts with the view that work experience can serve as reference to companies that did not participate in the project. These companies will have free access to publications resulting from the completion of each research work. They will allow other companies in the Brazilian industry to replicate the work. In addition, the pursuit for work integration and outline gives a synergistic effect on the operational discussions of the working team.

Table 1 shows the description of each individual research project. The research works of the larger project were identified through discussions among the members of the project team. Part of these works was developed because one or another member of the work team pointed out some evidence and analysis.

4. Results and Discussions

The method called graph of initial opportunities *(Kumar, 2012)* was chosen to facilitate the analysis of the large amount of data obtained during the diagnosis of the design process. The application of this method generated two key dimensions, considered to be relevant for the

analysis. The graph was formed by two opposing axes *(**Figure 7**)*. The horizontal axis depicted the strategic and operational dimensions for interpreting the data. The vertical axis represented the dimensions of tangible and intangible elements. Thus, this diagram allowed the creation of four scenarios *(strategic tangible, strategic intangible, operational tangible and strategic tangible)*.

When analyzing **Figure 7**, each quadrant is observed to include concepts associated by the companies participating in the project with the term Design. The *(tangible and intangible)* operating axis was most commonly mentioned by the companies. This can be explained by the fact that the studied companies have related the concept of design more directly to the characteristics of products than to the elements that strategically support the efficient and effective performance of the product development process. Moreover, the least mentioned of all was the strategic axis. A fact that agrees with the idea that, for the participating companies, the concept of design is more related to operating activities than to strategic activities.

The data collected in the diagnosing phases allowed to determine critical success factors *(CSF)* for the repositioning of design activities in a strategic context *(Moreira & Bernardes, 2014)*. These factors were divided into six pillars that are characterized as deficient foci: Communication, Knowledge, Processes, Projects, Human Resources and Strategy. Every pillar relates to their respective evidences and consequences for the companies, as described below *(Moreira & Bernardes, 2014)*:

- **Communication:** associated with the need to clarify which roles are assigned to each employee, as well as the systematization, formalization and management of flows involving the product development of businesses.
  Deficiency evidences refer to difficulties in meeting deadlines; lack of awareness on inputs and outputs of the design process; slow troubleshooting and solution; and significant interference of senior managers in design operating activities.
- **Knowledge:** refers to aspects related to the theoretical deflection of employees from the department of product development with regard to their concepts of innovation, causing divergence and conflicts, as well as indifference and insecurity among the forefront staff of the design process to propose new ideas.
- **Processes:** related to the evidence that the design activities are operationally positioned in the studied companies. In this case, the design process is not explored at a strategic level in the businesses, but instead, at an operational level.
- **Projects:** since the design process is more oriented towards operational activities, projects end up missing key elements of successful solutions that are generated and released to the market. This was particularly perceived through the significant investment in incremental innovations and in new projects with no prior and clear identification of the new experiences consumers might have.
- **Human resources:** linked to the lack of career plan formalization and, above all, correlated with the lack of incentives for the development of radical innovation proposals. There were also no clear investment programs in knowledge management in the participating companies.
- **Strategy:** there was the development of products that mostly exploit the potential of equipment and machinery of the industrial park without applying structured methods to enable a clear identification of customer latent wishes.

After the diagnosis result, the planning of the implementation of design mechanisms was started. These mechanisms were implemented to enable the development of the design process in a structured manner. The pursuit for structuring it was particularly relevant, because it allowed the standardization of the method of application in all participating companies.

As described in the research method of this article, the model proposed by Kumar *(2012)* was chosen to be applied. It presents the design process in seven modes *(**Figure 8**)*: sense intent, know context, know people, frame insights, explore concepts, frame solutions, carry out offerings.

Considering that there is a great number of methods and methodologies in design *(Design Council, 2007; Burdek, 2005; Bonsiepe, 1975; IDEO, 2003; Patnaik & Becker, 2010; Baxter, 1995; Ulrich & Eppinger, 2011; Otto & Wood, 2000; Cross, 2008; Pugh, 1991)*, the proposal of Kumar *(2012)* seemed reasonable, because it is not linear, thus corresponding to the intrinsic thought of design *(Brown, 2009; Lockwood, 2010; Farrell & Hooker, 2013)*, besides presenting a set of structured tools to be used, with practical suggestions for their application.

Kumar *(2012)* was translated from English into Portuguese by the research group that made up the project management and development team. This was important in order to standardize communication, and also to reduce staff complaints about wrong translations in the companies. Thus, a box named Innovation Guide was created, and inside it the proposed mechanisms were included in the form of cards. Therefore, each mode of Kumar *(2012)* was presented in a specific workshop, in which each participating company chose a set of tools that, according to their opinion, would be more easily applicable to their reality.

After choosing the methods, each participating company had three weeks to present the results of their application *(**Figure 9**)*.

The innovation guide application results will be assessed through the application of a system of innovation, competitiveness and design indicators *(**Figure 10**)*, proposed by Natália Debeluck Plentz, Maurício Moreira and Silva Bernardes, & Paula Görgen Radici Fraga *(2015)*. The indicator system followed the categorization of Hill & Jones *(2012)*. However, indicators for each category were chosen by the product development teams of the companies studied. The selection used the list of indicators presented in Paulo Roberto Nicoletti Dziobczenski *(2012)*.

The system consists of 27 indicators, some referred to and studied in the literature review and others that were proposed in this project. There are 12 mandatory indicators and 15 optional indicators, and of these fifteen, eight should be chosen by the company that will apply the system to reach a total of 20 indicators needed for application. The system includes, thus, 20 indicators, since it has been assumed that a greater amount could hinder their implementation in the companies.

Because there were five categories, there was a need to have a composite indicator to allow the overall identification of the level of innovation, competitiveness and design of each company. Therefore, a composite indicator called ICD *(equation 1)* was proposed.

To form the composite indicator, a scoring system was assigned, which varies according to the indicator itself. The researchers preferred to have the same scoring system for most of the indicators to facilitate their use. It should be noted that, in most of them, the higher the value the better the performance. But there are cases where low scores indicate a good result on the indicator. Each indicator receives a score from zero to five according to their value. The categories consist of four indicators, and can collect up to 20 points *(four indicators that may total a maximum of five points each)*. The five categories add up to a total score of 100, which is the highest score that the company can receive in composite indicator of innovation, competitiveness and design. **Table 2** shows the indicators identified in each category.

The indicator system is adjusted through the use of focus groups conducted with three senior managers of the companies studied, along with three researchers from the same University as the authors of this article. By December 2014, five focus groups were conducted, aimed at creating small changes in classifications, method of calculation and allocation of scores for each indicator. Other two focus groups are scheduled to occur from January to February 2015, and are intended to assess issues related to the planning and implementation of the system, to make it easier.

Data needed to calculate the indicators will be collected between March and August 2015, in order to indicate the status of innovation, competitiveness and design of the studied companies; to determine whether adjustments to the indicators and their implementation are possible; and allow the analysis of the impact of the implementation on design mechanisms in the companies studied.

The ICD indicator system is the basis for programming a computer benchmarking system, whose development began in September 2014, with a view to enable the recording, analysis and view of the evolution of ICD indicators in companies that develop products. The aim is to complete programming and validation in companies from similar industries of those companies studied, by August 2015. Thus,

through the government agency that has been a partner to this project *(**Figure 2**)*, we intend to disseminate it in the Brazilian market. The system will be distributed with no charge to companies that develop consumer goods, and it is believed that in 2016, Brazil will have a reliable database regarding the competitive level, in terms of innovation and design, of these companies.

5. Final Remarks

This paper presented actions currently being developed in a large research project in Brazil, with the aim of increasing the competitiveness of the Brazilian industry.

This is pursued through design methods structuring initiatives, oriented to innovation in companies that develop products, together with standard forms of performance measurement.

Up to the present, it was found that the required efforts to increase competitiveness through innovative product design management must have an integration strategy between processes and well defined actors involved before the project starts. The communication process has shown to be essential, so that everyone involved can have a clear idea of intentions, deadlines and goals to be achieved. Process integration and communication were thus essential to facilitate the coordination of design resources geared towards the development of innovative solutions in products and services. It showed that, even in complex projects with companies from different sectors pursuing similar objectives, increased competitiveness and collaborative work has its advantages. The different views and exchange of experiences for the development of products with the help of the methods provided greater involvement and commitment of members, for the implementation of the proposed mechanisms.

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references

Ahn, M. J., Zwikael, O., & Bednarek, R. *(2010).* Technological invention to product innovation: A project management approach. International Journal of Project Management, 28*(6)*, 559–568. doi:10.1016/j.ijproman.2009.11.001

Artto, K., Kulvik, I., Poskela, J., & Turkulainen, V. *(2011).* The integrative role of the project management office in the front end of innovation. International Journal of Project Management, 29*(4)*, 408–421. doi:10.1016/j.ijproman.2011.01.008

Baxter, M. *(1995).* Product Design *(Reissue edition.)*. CRC Press.

Bonsiepe, G. *(1975).* Diseno industrial: Artefacto y proyecto. Madrid: A. Corazon.

Borja de Mozota, B. *(2003).* Design Management: Using Design to Build Brand Value and Corporate Innovation *(1 edition.)*. New York, NY: Allworth Press.

Brown, T. *(2009).* Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation. New York: HarperBusiness.

Bruna Ruschel Moreira. *(2014).* Framework gerencial com foco no desenvolvimento de sistemas produtos inovadores através da intervenção do design *(Projeto de Qualificação de Doutorado)*. UFRGS, Porto Alegre.

Burdek, B. E. *(2005).* Design: The History, Theory and Practice of Product Design *(1 edition.)*. Boston, MA: Birkhäuser Architecture.

Cross, N. *(2008).* Engineering Design Methods: Strategies for Product Design *(4 edition.)*. Chichester, England ; Hoboken, NJ: Wiley.

Design Council. *(2007).* Eleven lessons: managing design in eleven global companies *(p. 18)*. London.

Farrell, R., & Hooker, C. *(2013).* Design, science and wicked problems. Design Studies, 34*(6)*, 681–705. doi:10.1016/j.destud.2013.05.001

Gallego, J., Rubalcaba, L., & Hipp, C. *(2013).* Services and organisational innovation: the right mix for value creation. Management Decision, 51*(6)*, 1117–1134. doi:10.1108/MD-11-2012-0446

Hill, C. W. L., & Jones, G. R. *(2012).* Strategic Management: An Integrated Approach *(10 edition.)*. Mason, OH: Cengage Learning.

IDEO. *(2003).* IDEO Method Cards: 51 Ways to Inspire Design. London: William Stout.

Kumar, V. *(2012).* 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization *(1 edition.)*. Hoboken, N.J: Wiley.

Lockwood, T. *(2010).* Design Thinking: Integrating Innovation, Customer Experience, and Brand Value *(1 edition.)*. Allworth Press.

Margaret Bruce, Rachel Cooper, & Delia Vazquez. *(1999).* Effective design management for small business. Design Studies, 20*(3)*, 297–315.

Mascitelli, R. *(1999).* Growth Warriors *(1st edition.)*. Northridge, CA: Technology Perspectives.

Mir, F. A., & Pinnington, A. H. *(2014).* Exploring the value of project management: Linking Project Management Performance and Project Success. International Journal of Project Management, 32*(2)*, 202–217. doi:10.1016/j.ijproman.2013.05.012

Moreira, B. R., & Bernardes, M. *(2014).* Fatores críticos de sucesso para o reposicionamento estratégico da atividade do design *(pp. 2928–2939)*. Editora Edgard Blücher. doi:10.5151/designpro-ped-00297

Natália Debeluck Plentz, Maurício Moreira e Silva Bernardes, & Paula Görgen Radici Fraga. *(2015).* Sistema de indicadores de inovação, competitividade e design para empresas desenvolvedoras de produtos - Versão 01 *(01 ed.)*. Porto Alegre: Marcavisual.

Otto, K., & Wood, K. *(2000).* Product Design: Techniques in Reverse Engineering and New Product Development *(1 edition.)*. Upper Saddle River, NJ: Prentice Hall.

Patnaik, D., & Becker, R. *(2010).* Needfinding: The Why and How of Uncovering People's Needs. Design Management Journal *(Former Series)*, 10*(2)*, 37–43. doi:10.1111/j.1948-7169.1999.tb00250.x

Paulo Roberto Nicoletti Dziobczenski. *(2012).* Diretrizes para a proposição de um sistema de indicadores para a gestão de design de empresas desenvolvedoras de produtos *(Dissertação de Mestrado)*. UFRGS, Porto Alegre.

Porter, M. E. *(1998).* Competitive Advantage: Creating and Sustaining Superior Performance *(1 edition.)*. New York: Free Press.

Pugh, S. *(1991).* Total Design: Integrated Methods for Successful Product Engineering. Wokingham, England ; Reading, Mass: Addison-Wesley Pub.

Robin Roy, & Johan Riedel. *(1997).* Design and innovation in successful product competition. Technovation, 17*(10)*, 537–548.

Ron Sanchez. *(2006).* Integrating Design into Strategic Management Processes. Design Management Review, 17*(4)*, 10–17.

Rosane Fonseca de Freitas Martins. *(2004).* A gestão de design como uma estratégia organizacional – um modelo de integração do design em organizações *(Tese de Doutorado)*. UFSC, Florianópolis.

Stamm, B. von. *(2008).* Managing Innovation, Design and Creativity *(2 edition.)*. Chichester, UK ; Hoboken, NJ: Wiley.

Steinbock, D. *(2005).* Design and Mobile Innovation. Design Management Review, 16*(4)*, 55–62.

Tatiana Schoneweg Mello. *(2003).* Aspectos relativos à promoção no design no Brasil visando à área de gestão: O caso da empresa vencedora do Prêmio CNI José Mindlin 2000 *(Dissertação de Mestrado)*. UFSC, Florianópolis.

Ulrich, K., & Eppinger, S. *(2011).* Product Design and Development *(5 edition.)*. New York: McGraw-Hill/ Irwin.

Wong, S., & Chin, K. *(2007).* Organizational innovation management: An organization wide perspective. Industrial Management & Data Systems, 107*(9)*, 1290–1315. doi:10.1108/02635570710833974