Implementation issues of a design management indicator system
A case study of four product development companies

Paula Görgen Radici Fraga and Maurício Moreira e Silva Bernardes
Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil, and
Darli Rodrigues Vieira and Milena Chang Chain
Universite du Quebec à Trois-Rivieres, Trois-Rivières, Canada

Abstract

Purpose – The purpose of this paper is to present and discuss the process and results achieved from the implementation of a design management indicator system in four product development companies.
Design/methodology/approach – To this end, instruments and techniques for implementing and collecting composite data were adopted.
Findings – The implementation made it possible to test the system metrics, and the analysis of the results enabled the identification of factors that hinder a successful implementation.
Originality/value – Design is being recognized as providing significant economic, social, and environmental benefits, and as it becomes a part of the management process, it can have an impact on business performance. Therefore, information sharing through indicator systems that consider factors that generate reliable and quantifiable information has become fundamental.

Keywords Design, Key indicators, Management, Implementation

Paper type Research paper

Introduction

Many researchers who promote and study design have developed research that shows design’s impact on companies and the economy and its role as a value adder (Chiva and Alegre, 2009; D’Ippolito, 2014; Gemser and Leenders, 2001; Moultrie and Livesey, 2014; Mozota, 2003). According to Mozota (2003), design must be recognized as a creative and managerial process to be integrated into a company, modifying its traditional structure through the updating of management processes. In this manner, design can become part of the management process, providing benefits that impact business performance and help the company guarantee its long-term market position (Best et al., 2010).

A change in management reinforces the collaboration and flexibility needed for organizational consolidation (Sanchez, 2006). One foundational requirement for this change to successfully occur is a well-structured decision-making process (Chiu, 2002). For this process, it is important to formulate and implement a measurement and control system that generates reliable and quantifiable information. This system becomes the key to business performance measurement, and the factors that drive its success are known as performance indicators (Velimirović et al., 2011).

Within this approach of measurement and control and aiming to broaden the study of design as a tool that can help improve the performance of companies’ business, a project was developed in Brazil to conceive an indicator system to assist design management. This paper presents and discusses issues related to the process of implementing this

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system in four medium to large product development companies. Its intention is to contribute to the process of implementing indicator systems suitable for design management in these companies.

**Performance measurement**

Performance measures are an organization’s vital signs, highlighting its strengths and weaknesses and enabling the comparison of results, the identification of effective mechanisms for decision making, and improvement in performance (Davis and Albright, 2004; Delorme and Châtelain, 2011). Therefore, the development of such measures must link strategies, resources, and processes (Hronec, 1993). This link forms a crucial relationship between strategy and day-to-day operations and becomes the basis of the company’s competitive advantage (Vieites and Calvo, 2011). In other words, it allows the quantification of an action’s efficiency and effectiveness (Valmohammadi and Servati, 2011).

As a foundation, the performance measurement process has metrics that characterize and evaluate business performance, providing indications of the extent to which the company is driving itself toward reaching its goals (Taylor and Kristensen, 2013; Velimirović et al., 2011). These metrics are called performance indicators (Eckerson, 2011). They show what is important to the company, comparing goals over time and playing a key role in the business perspective (Melnyk et al., 2014) by focusing on operational, tactical, and strategic aspects (Eckerson, 2011; Parmenter, 2010). This monitoring helps create a culture of performance improvement and promote organizational learning, communication, and strategic alignment, ensuring that the organization’s key players work to achieve the same objectives (Micheli and Mari, 2014; Barbuio, 2007).

Performance indicators uniquely determine what an organization must do to increase its performance (Shabaninejad et al., 2014). Therefore, their selection should be made such that they serve to encourage improvements within the company (Jovanović et al., 2012). The results provided by the indicators should be part of the information system at all levels of the organization (Kaplan and Norton, 1996). They should involve all stakeholders, promoting their greater ownership of the indicators and ensuring everybody’s effective participation (Schirnding, 2002).

**Indicator system for design management**

The indicator system studied was conceived in the Innovation, Competitiveness, and Design Project (Bernardes et al., 2015) and is based on three master’s theses (Dziobczenski, 2012; Fraga, 2016; Plentz, 2014). Its structure includes 26 indicators divided into five analytical categories (Table I), which aim to evaluate the following issues:

1. **Consumer response**: the extent to which the company delivers what consumers expect (Hill and Jones, 1998).
2. **Efficiency**: how efficient the company is (Hill and Jones, 1998).
3. **Innovation**: the company’s innovative capacity (Hill and Jones, 1998).
4. **Quality**: how competitively the company is performing, based on the quality of its products and processes (Hill and Jones, 1998).
5. **Outcome**: the company’s financial results (Kaplan and Norton, 1996).

To construct the system (Plentz, 2014), 33 employees from the product development, marketing, engineering, sales, strategic planning, financial, and information technology sectors of five product development companies were invited to select 20 indicators – out of 72 available – and distribute them into five categories. The objective was to select four indicators per category (“required”). However, in some categories, there was no consensus
<table>
<thead>
<tr>
<th>Category/indicator</th>
<th>Formula for calculation</th>
<th>Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Consumer response</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Estimated market share | \[
\frac{\text{estimated total sales volume of the market}}{\text{estimated company sales volume of the market}} \times 100\] | Optional |
| Complaints about new products | \[
\frac{\text{number of products sold that received complaints}}{\text{total number of new products sold}} \times 100\] | Optional |
| Variation in the number of views of the site | \[
\frac{\text{number of views of the site in the current period}}{\text{number of views of the site in the previous period}} \times 100\] | Optional |
| Repeat purchase rate | \[
\frac{\text{number of customers who bought more than once}}{\text{total number of customers in the period}} \times 100\] | Optional |
| **Ratio of new customers** |                         |           |
| **Revenue obtained from the sale of new products** |                         |           |
| **Efficiency** |                         |           |
| New product designs executed within the period stipulated | \[
\frac{\text{number of projects executed within the period stipulated}}{\text{total number of projects in the period}} \times 100\] | Obligatory |
| Orders delivered within the period stipulated | \[
\frac{\text{number of orders delivered within the period stipulated}}{\text{total number of orders sold}} \times 100\] | Obligatory |
| Waste of materials | \[
\frac{\text{cost of the wasted material}}{\text{total cost of the raw material}} \times 100\] | Obligatory |
| Projects that complied with the budget | \[
\frac{\text{total number of projects within the budget}}{\text{total number of projects in the period}} \times 100\] | Optional |
| Finalized product designs | \[
\frac{\text{total number of product projects in the period}}{\text{number of product projects finalized}} \times 100\] | Optional |
| Productivity | \[
\frac{\text{production achieved}}{\text{production capacity installed}} \times 100\] | Optional |

(continued)
<table>
<thead>
<tr>
<th>Category/indicator</th>
<th>Formula for calculation</th>
<th>Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Innovation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal radical innovations</td>
<td>( \frac{\text{number of radical innovation projects}}{\text{total number of projects in the period}} \times 100 )</td>
<td>Obligatory</td>
</tr>
<tr>
<td>New products patented</td>
<td>( \frac{\text{number of invention patents}}{\text{total number of new products}} \times 100 )</td>
<td>Obligatory</td>
</tr>
<tr>
<td>Investment in research and development (R&amp;D)</td>
<td>( \frac{\text{investment in R&amp;D}}{\text{net revenue in the current period}} \times 100 )</td>
<td>Obligatory</td>
</tr>
<tr>
<td>Profit obtained with new products</td>
<td>( \frac{\text{net (or gross) profit obtained with new products}}{\text{total net (or gross) profit}} \times 100 )</td>
<td>Obligatory</td>
</tr>
<tr>
<td><strong>Quality</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hours of rework</td>
<td>( \frac{\text{hours of rework}}{\text{total hours worked}} \times 100 )</td>
<td>Optional</td>
</tr>
<tr>
<td>Rate of returns with return of merchandise</td>
<td>( \frac{\text{value of products returned in the period}}{\text{net revenue in the current period}} \times 100 )</td>
<td>Optional</td>
</tr>
<tr>
<td>Variation in the rate of rejection</td>
<td>( \frac{\left( \frac{\text{total number of products rejected in the previous period}}{\text{products rejected in the current period}} \right) - 1}{\text{total number of products produced in the current period}} \times 100 )</td>
<td>Optional</td>
</tr>
<tr>
<td>Compliance with the checklist</td>
<td>( \frac{\text{total number of items on the checklist}}{\text{total number of items on the checklist compiled}} \times 100 )</td>
<td>Optional</td>
</tr>
<tr>
<td>Accident frequency rate</td>
<td>( \frac{\text{total number of accidents with work accident communication (CAT)}}{\text{total man-hours worked}} \times 100 )</td>
<td>Optional</td>
</tr>
<tr>
<td>Hours training the production staff</td>
<td>( \frac{\text{total hours training production workers during the year}}{\text{total number of workers involved in production}} \times 100 )</td>
<td>Optional</td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenue variation</td>
<td>( \frac{\text{net (or gross) revenue in the current period}}{\text{net (or gross) revenue in the previous period}} \times 100 )</td>
<td>Obligatory</td>
</tr>
<tr>
<td>Return on investment (ROI)</td>
<td>( \frac{\text{net profit}}{\text{total investment}} \times 100 )</td>
<td>Obligatory</td>
</tr>
<tr>
<td>Earnings before interest, tax, depreciation, and amortization (EBITDA) margin</td>
<td>( \frac{\text{EBITDA}}{\text{net revenue in the current period}} \times 100 )</td>
<td>Obligatory</td>
</tr>
<tr>
<td>Revenue per employee</td>
<td>( \frac{\text{net (or gross) revenue in the current period}}{\text{number of employees}} \times 100 )</td>
<td>Obligatory</td>
</tr>
</tbody>
</table>
among the employees, and the decision was made to keep these indicators in the system and designate them as “optional.”

The system’s score was constructed based on 20 indicators, which can total up to 100 points (Plentz, 2014). The company selects four indicators per category; the result obtained with the formula of each indicator is transformed into a score from 0 to 5 (Table I). Finally, the sum of the results obtained in the five categories generates the Design Management Composite Indicator (DMCI), indicating the company’s degree of design management (Figure 1) (Table II).

**Implementation of an indicator system**

The process of building understanding and commitment through engagement is a key step in developing a set of performance measures; without understanding “why” it is being measured, its use will be flawed (Neely et al., 2002). In this sense, the implementation phase is structural: when it is not planned correctly, it requires greater time and effort (Neely et al., 2002), causing the focus to be lost and the process to fail.

According to Damschroder et al. (2009, p. 3), “[...] implementation is the constellation of processes intended to get an intervention into use within an organization.” It is a period of transition during which the members of the organization involved in the process become stronger, more consistent, and more committed to the change (Klein and Sorra, 1996). According to Klein and Sorra (1996), implementation is the critical gateway between the organizational decision to adopt and use an intervention in the company’s day-to-day operations.

By its very nature, implementation is a social process of using or integrating interventions, which is confused with the context (characteristics of the internal and external environment) in which it occurs (Damschroder et al., 2009; Rabin et al., 2008). Implementation is understood to be a complex task since it occurs through the transformation, behavioral change, and restructuring of organizational contexts (Fixsen et al., 2005). For this reason, when beginning an implementation process, it is necessary to answer a few critical questions about its viability. Some of these questions relate to the progress of the implementation in real time, the status and potential influence of contextual

**Figure 1. Calculation of the indicator system**

Notes: Crc, consumer response category (up to 20 points); Cef, efficiency category (up to 20 points); Cin, innovation category (up to 20 points); Cqu, quality category (up to 20 points); Cou, outcome category (up to 20 points); Iob, required indicator (up to 5 points); Iop, optional indicator (up to 5 points); DMCI, design management composite indicator (up to 100 points)
<table>
<thead>
<tr>
<th>Category/indicator</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Consumer response</strong></td>
<td></td>
</tr>
<tr>
<td>Estimated market share</td>
<td>&lt; 1% 1% ≤ x &lt; 21% 21% 41% 61% ≤ x &lt; 81% 81% &gt; 81%</td>
</tr>
<tr>
<td>Complaints about new products</td>
<td>≥ 81% 61% 41% 21% 1% ≤ x &lt; 21%</td>
</tr>
<tr>
<td>Variation in the number of views of the site</td>
<td>&lt; 1% 1% ≤ x &lt; 21% 21% 41% ≤ x &lt; 81%</td>
</tr>
<tr>
<td>Repeat purchase rate</td>
<td>&lt; 1% 1% ≤ x &lt; 21% 21% 41% ≤ x &lt; 81%</td>
</tr>
<tr>
<td>Ratio of new customers</td>
<td>&lt; 1% 1% ≤ x &lt; 21% 21% 41% ≤ x &lt; 81%</td>
</tr>
<tr>
<td>Revenue obtained from the sale of new products</td>
<td>&lt; 1% 1% ≤ x &lt; 21% 21% 41% ≤ x &lt; 81%</td>
</tr>
<tr>
<td><strong>Efficiency</strong></td>
<td></td>
</tr>
<tr>
<td>New product designs executed within the period stipulated</td>
<td>&lt; 1% 1% ≤ x &lt; 21% 21% 41% ≤ x &lt; 81%</td>
</tr>
<tr>
<td>Orders delivered within the period stipulated</td>
<td>&lt; 1% 1% ≤ x &lt; 21% 21% 41% ≤ x &lt; 81%</td>
</tr>
<tr>
<td>Waste of materials</td>
<td>≥ 81% 61% 41% 21% 1% ≤ x &lt; 21%</td>
</tr>
<tr>
<td>Projects that complied with the budget</td>
<td>&lt; 1% 1% ≤ x &lt; 21% 21% 41% ≤ x &lt; 81%</td>
</tr>
<tr>
<td>Finalized product designs</td>
<td>&lt; 1% 1% ≤ x &lt; 21% 21% 41% ≤ x &lt; 81%</td>
</tr>
<tr>
<td>Productivity</td>
<td>&lt; 1% 1% ≤ x &lt; 21% 21% 41% ≤ x &lt; 81%</td>
</tr>
<tr>
<td><strong>Innovation</strong></td>
<td></td>
</tr>
<tr>
<td>Internal radical innovations</td>
<td>&lt; 1% 1% ≤ x &lt; 2% 2% ≤ x &lt; 3% 3% ≤ x &lt; 4% 4% ≤ x &lt; 5%</td>
</tr>
<tr>
<td>New products patented</td>
<td>&lt; 1% 1% ≤ x &lt; 2% 2% ≤ x &lt; 3% 3% ≤ x &lt; 4% 4% ≤ x &lt; 5%</td>
</tr>
<tr>
<td>Investment in R&amp;D</td>
<td>&lt; 0.5% 1% ≤ x &lt; 2% 2% ≤ x &lt; 3% 3% ≤ x &lt; 4% 4% ≤ x &lt; 5%</td>
</tr>
<tr>
<td>Profit obtained with new products</td>
<td>&lt; 1% 1% ≤ x &lt; 2% 2% ≤ x &lt; 3% 3% ≤ x &lt; 4% 4% ≤ x &lt; 5%</td>
</tr>
<tr>
<td><strong>Quality</strong></td>
<td></td>
</tr>
<tr>
<td>Hours of rework</td>
<td>≥ 81% 61% 41% 21% 1% ≤ x &lt; 21%</td>
</tr>
<tr>
<td>Rate of returns with return of merchandise</td>
<td>≥ 5% 4% ≤ x &lt; 5% 3% ≤ x &lt; 4% 2% ≤ x &lt; 3% 1% ≤ x &lt; 2%</td>
</tr>
<tr>
<td>Variation in the rate of rejection</td>
<td>≥ 10% 10% 7.5% &gt; x ≥ 5% 5% &gt; x ≥ 2.5% 2.5% &gt; x ≥ 1%</td>
</tr>
</tbody>
</table>

Range of scores of the indicator system for design management (continued)
factors, the participants’ response to the process, and the adaptations necessary to achieve change (Stetler et al., 2006). Fixsen et al. (2005, p. vi) argue that the implementation process is more successful when:

1. carefully selected professionals receive frequent training and performance appraisals; and

2. organizations provide the infrastructure necessary for appropriate training, supervision, regular processes, and evaluations of outcomes.

The effectiveness of the implementation is a homogeneous construction that describes the quality and consistency of an intervention’s application within the organization (Klein and Sorra, 1996). In this sense, different groups and relationships are crucial to the implementation: sometimes, the flow of strategy – going from management to the front line – will be the vital link; at other times, the public’s participation will be the key to success (Pawson et al., 2005). The success of an implementation thus depends on the success of the entire sequence of mechanisms through which it develops.

Some of these mechanisms include the following: the publication of performance measures on bulletin boards or in news bulletins; the existence of a forum in which performance can be discussed; and the opportunity to connect the implementation to an existing initiative (Neely et al., 2002). Bammer (2005) adds to this, stressing that collaboration is also a key point for implementation. Pawson et al. (2005, p. 32) emphasize that:

[…] implementation is not a question of everyone stopping doing A and starting to do B. It is about individuals, teams and organizations taking account of all the complex and inter-related elements of the programme theory that have been exposed by the review and applying these to their particular contexts […].

When designing implementation, it is therefore important to be mindful of how to obtain, construct, and interpret the results to reflect the perceptions of both individuals and the organization (Damschroder et al., 2009). Dealing with this complexity – the uncertainties and changes inherent to the process – involves defining the limits to the approach that will be taken, such as, for example, what and who will be included in the implementation (Bammer, 2005).

**Research method**

To achieve the study’s objective, instruments and techniques for the analysis and collection of composite data were used. This study adopted action research (Thiollent, 2011) as a
strategy, the semi-structured interview (Lodico et al., 2010) for the evaluations, and the content analysis method (Bardin, 2011) for the results. The objects of the study were four medium to large Brazilian product development companies (Table III).

This study was developed in three distinct stages (Figure 2). A detailed description of the methods applied and the results achieved are presented in the following paragraphs.

**Implementation of the indicator system for design management**

The implementation process occurred in two phases: planning and execution. In the planning phase, the instructional materials, which included both a booklet (presenting the indicators and their collection methods and characteristics) and a data collection spreadsheet, were developed. The implementation actions were sequentially planned with companies’ managers. The execution phase began with the training of the companies: in companies A, B, and C, the strategic planning analyst was trained (because the companies were a corporation, this person would be responsible for the companies’ implementation and data collection); in company D, the product development supervisor and the marketing manager were trained and then replicated the training internally. The sequence of activities developed thereafter was as follows:

1. delivery of the instructional material via physical (paper) and digital media for it to be distributed to the sectors involved in the data collection;
2. presentation of the indicator system with an explanation of the indicators, their peculiarities, and procedures for data collection;
3. indication of the deadline for delivery of the data collections, with monthly collections between April and September 2015 and digital submission on the 30th day of each month;
4. selection of the 20 indicators that would structure the system in each company;
5. delivery of the first data collection;
6. interviews for evaluating the implementation process;
7. delivery of the second data collection;

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Company A</th>
<th>Company B</th>
<th>Company C</th>
<th>Company D</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of employees</td>
<td>644</td>
<td>833</td>
<td>692</td>
<td>482</td>
</tr>
<tr>
<td>Branch of activity</td>
<td>Manual tools</td>
<td>Cleaning implements</td>
<td>Housewares</td>
<td>Games and toys</td>
</tr>
<tr>
<td>Portfolio of products</td>
<td>Paint brushes, paint rollers, spatulas, adhesive tape, sandpaper, etc.</td>
<td>Brooms, mops, dustpans, brushes, buckets, sponges, cloths, gloves, etc.</td>
<td>Pots, wastebaskets, organizing boxes, plant vases, etc.</td>
<td>Educational toys, games, school supplies, tricycles, etc.</td>
</tr>
</tbody>
</table>

*Source:* Elaborated by the author, based on the data supplied by the companies

**Table III.** Characterization of the companies studied

**Figure 2.** Research stages
meeting for adjustments in the implementation process (when necessary); and

convening a workshop to identify possible decisions to be made in relation to the

products, based on the results of the indicator system for design management.

The problems in the implementation process in companies A, B, and C emerged during

activity 4 (selection of 20 indicators), with employee conflicts and a lack of employee

understanding about the system’s content and the need to introduce it into the company. To

solve these problems, it was stipulated that the three companies’ financial data

(13 indicators) would be collected by the strategic planning analyst and the other data

(7 indicators) would be each company’s responsibility.

The delivery of the first collection was delayed by four months, indicating the need for a

meeting to discuss implementation problems. The analyst and the corporate manager of

strategy planning and management participated in the meeting and explained the
difficulties that they encountered in collecting and delivering the data. During the meeting, it

was decided to decompose the indicators to identify and generate solutions to the difficulties

that were occurring (Table IV).

At the end of the meeting, the first collection for the month of May was partially
delivered; it consisted only of data that are the responsibility of the analyst. The company
committed to delivering complete data by September 2015.

In an attempt to obtain the seven missing indicators and resolve each company’s doubts
about the system and data collections, a meeting with company A’s design coordinator,
company B’s manager of innovation and product development, and company C’s marketing
analyst was convened. Each company’s difficulties were individually addressed, and the
outcomes obtained are summarized in Table V.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Indicators related</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questions about values (value collected refers to the partial share of the company in the market)</td>
<td>Estimated market share</td>
<td>The use of the market value that the company makes available, whether partial or complete, was established</td>
</tr>
<tr>
<td>Difficulty in collecting the data (values are generated outside the company)</td>
<td>Estimated market share</td>
<td>It was made flexible, accepting the value in percentage informed by external audit</td>
</tr>
<tr>
<td>Questions about concepts</td>
<td>Revenue obtained from the sale of new products</td>
<td>It was established that a new product is one that contains originality in its form, function, or raw material (including improvements)</td>
</tr>
<tr>
<td></td>
<td>Internal radical innovations</td>
<td>The definition was in the booklet: “every product, process, or service that is new to the company and that leads to performance and cost improvements; that is, radical innovations ‘within’ the company”</td>
</tr>
<tr>
<td>Absence of data (companies do not control them)</td>
<td>New product designs executed within the period stipulated</td>
<td>The researcher sought the sectors of each company responsible for the existence of controls and data</td>
</tr>
<tr>
<td></td>
<td>Finalized product designs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Investment in R&amp;D</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hours of rework</td>
<td></td>
</tr>
<tr>
<td>Partial absence of data (only one company controls them)</td>
<td>Waste of materials</td>
<td></td>
</tr>
<tr>
<td>The data exist but were not collected</td>
<td>Variation in the rate of rejection</td>
<td></td>
</tr>
</tbody>
</table>

Table IV. Problems encountered during data collection – companies A, B, and C

Source: Elaborated by the author
By the end of the meeting, the questions had been answered, and commitments to collect and deliver the data had been made. The employees requested that the instructional material be sent, alleging that they had not received it. It was sent digitally. The outcomes from the data collections of companies A, B, and C for the period from April to September 2015 are compiled in Table VI. The lack of complete collections made it impossible to analyze the behavior of the indicators and the DMCI (Indicador Composto de Gestão de Design) for the companies. It was also impossible to develop the workshop to identify possible product-related decisions based on the results of the design management indicator system.

**Company D**

As in companies A, B, and C, the problems in company D’s implementation process also began during activity 4 (selection of the 20 indicators) because there were doubts about the indicators (Table VII).

Once the questions had been answered and the data collected from April to September 2015 were obtained, the indicator system was calculated. The results obtained by Company D were analyzed by compiling the values obtained in the system’s five categories (Table VIII). The sum of the scores generated the composite indicator for each period analyzed.

The behavior of the categories was plotted (Figure 3) so that the trends could be observed. The composite indicator was analyzed separately (Figure 4).

Category 1 (Consumer response) tells the company how well it is meeting customer expectations. The values of the indicators provide information about both the product delivery aspect and the relationship between the company and its public, which includes both customers (retailers) and end consumers. The variation in the category, on a scale of 0-20 points, shows that the company had an above-average result only in April. The indicators responsible for this performance were “Variation in the number of site views” and the “Ratio of new customers.” The same cannot be observed in the months of May and June, for which a drop in these indicators means that the scores in the category were the lowest in the period analyzed. From July onward, there was a small increase in the values, influenced by the increase in “Revenue obtained from the sale of new products.”
The indicators from Category 2 (Efficiency) evaluate how efficient the company is, that is, whether it is able to produce more outputs (products and/or services) with fewer inputs (resources such as materials, information, technology, and employees), thus increasing its competitiveness. The variation in this category shows that the company’s efficiency efforts were concentrated in April and May. In August and September, the “Projects that complied with the budget” indicator positively influenced this category, preventing the result from being even lower than it was earlier.

In Category 3 (Innovation), the values of the indicators provide information that makes it possible to evaluate the company’s innovative capacity, that is, to what extent its innovation process makes it more competitive in the market. This category addresses a very delicate subject – there is a certain resistance from the companies to invest in this aspect – and it...
showed a peculiarity compared to the previous two categories: the results of its indicators oscillated from one extreme to the other; that is, a score of 0 or 5 was obtained. This oscillation may represent the company’s effort (dedication), or lack thereof, in relation to the themes associated with the indicators (e.g., radical innovations and investments in R&D). The category performed highly in April, driven by the “Internal radical innovations,” “New patented products,” and “Profit obtained with new products” indicators. Average

<table>
<thead>
<tr>
<th>Category</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>August</th>
<th>September</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 1: Consumer response</td>
<td>13</td>
<td>8</td>
<td>8</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Category 2: Efficiency</td>
<td>20</td>
<td>19</td>
<td>9</td>
<td>10</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Category 3: Innovation</td>
<td>15</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Category 4: Quality</td>
<td>11</td>
<td>11</td>
<td>14</td>
<td>13</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>Category 5: Outcome</td>
<td>16</td>
<td>17</td>
<td>19</td>
<td>15</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Composite Indicator</td>
<td>75</td>
<td>60</td>
<td>55</td>
<td>52</td>
<td>50</td>
<td>44</td>
</tr>
</tbody>
</table>

Source: Elaborated by the author

Table VIII. Result for the categories of the system and the composite indicator

Design management indicator system

Figure 3. General behavior of the categories

Figure 4. Behavior of the “composite indicator for design management”
performance was observed in August, with a balance between scores of 5 for the “Investment in R&D” and “Profit obtained with new products” indicators and scores of 0 for the “Internal radical innovations” and “New patented products” indicators. In the other months, the scores were below the mean, supported by the uniformity of values for the “Profit obtained with new products” indicator.

The indicators of Category 4 (Quality) evaluated how competitive the company is based on the quality of its products and processes. This category had average performance in the period analyzed. Three of its four indicators had results with few variations. What led to the decrease in the monthly scores of the category was the “Hours training the production staff” indicator, which had much lower results than the other indicators in this category.

The constant indicators in Category 5 (Outcome) enable an evaluation of the company’s financial results arising out of its operational activities. This category had the most variations compared to the other categories in the system. The scores obtained in the analyzed period were high – above average in almost every month. However, there was a decline from July onward that was influenced by the “Revenue variation” indicator; this decline worsened in August and September with the low results of the “EBITDA margin” indicator.

The composite indicator for design management aims to show the company its current degree of design management, enabling the creation of aids to improve the results, when necessary. The data shown in Table VIII were transformed into Figure 2 so that the analysis of the composite indicator’s monthly behavior could more effectively be performed and inferences concerning the indicator could be constructed.

The composite indicator of company D had a high score in April, leveraged by the high performance in all categories, particularly in “Efficiency,” “Innovation,” and “Outcome.” From May onward, the indicator’s score began to decrease, primarily influenced by the drop in the results of the “Consumer response” and “Innovation” categories. The decrease in the scores of the “Efficiency” and “Outcome” categories in August and September meant that the values of the indicator were average and below average, respectively. Following these observations, it was concluded that the company has been reducing its degree of design management; therefore, special care is necessary with the “Consumer response,” “Efficiency,” and “Outcome” categories.

Evaluation of the implementation process
The data for evaluating the implementation process of the indicator system in the companies were collected through the semi-structured interview technique (Table AI of this paper). The objective was to collect the participants’ perceptions and evaluations – difficulties, points of improvement, and suggestions – regarding the activities and methods used in the implementation. The strategic planning analyst (companies A, B, and C) and the product development supervisor and marketing manager (company D) were interviewed. To facilitate our analysis, the issues were grouped according to the topics being addressed.

Companies A, B, and C
Regarding the implementation process, the interviewee explained that there were difficulties in the implementation and data collection, particularly in relation to the company’s unmapped processes. One Company A employee involved in the implementation had been dismissed. Regarding the sufficiency or insufficiency of the amount of time for the implementation and data collection, the interviewee said “It was sufficient. Internal issues were responsible for what did not get done.”

In the set of questions about instructional material, the interviewee indicated that the informative material (booklet) helped in the implementation process because the concepts were translated into the same language for everyone involved. However, when questioned about the digital material (table), he noted that “Because our reality is slightly more complex, the collection table becomes irrelevant.”
Regarding data collection, the interviewee stated that most of the indicators informed were extracted from the company’s own system and that it was already customary to collect them. In the question about the sectors’ contribution to data collection, the following was revealed:

We had surprises. Areas that were not even participating directly in the process – Financial Planning, for example – became a great source of help. On the other hand, areas closely linked to the project, for example, the Marketing department, began accepting indicators throughout the process, which later became very complex to measure, and in some cases, they are still not being measured.

The employee answered the last question of this set positively, asserting “I believe that everything has been very well elaborated.”

With regard to the topic about the indicator system, the first question concerned the reason for selecting the indicators, and the answer to this question was as follows:

The main reason for the selection was the relevance to the process. At first, we even thought of choosing those that were easier to measure, but as things progressed, we ended up choosing those that seemed to be most suited to the process.

The same answer was observed for three questions: “if the company would use more indicators”; “if the company considers any obligatory indicators to be irrelevant”; and “if any indicators would be added to the selected set.” The interviewee stated that it was difficult to answer the questions because the system is not solid enough to allow such evaluations. When asked about the differences between the system used by the company and the implemented system, the response was as follows:

Basically, our indicators are linked to the financial perspective of the Balanced Scorecard (BSC), that is, economic-financial indicators. Process indicators are our Achilles heel; however, we are improving them for various areas and processes in the company.

Regarding the aspect of the indicator system’s aggregating information for the company, the interviewee positively stated: “Certainly! It accelerates the creation of the indicators and the culture of indicator management for the product development area.”

Company D
Examining the interview of company D, it can be observed that in the implementation process, no difficulties were encountered in either the implementation or the data collection. The interviewees stated that the satisfactory progress of the process was the result of the strategy developed by them for the presentation of the indicator system and for the data collection. The supervisor highlighted the procedure used as follows:

[…] what I did, I distributed (the indicators) to the areas responsible for the figures of the controls, so to speak, and the staff promptly returned with the figures requested. […] some had questions, “Ah, but what is this for?”, but they were the ones who had not been participating since the beginning of the project. Yes, there was questioning, but the reason for it was then explained. Then, from there, it was straightforward.

The manager added that the fact that the company already had its indicators greatly facilitated the data collection and that in addition to explaining the reasons for the collection, special care was taken so that the employees would not consider it to be rework. Regarding those involved in the implementation, the same people remained from beginning to end, and the sales, commercial, marketing, safety, HR, production, finance, distribution, cost, and product development sectors participated. Regarding the time invested in the implementation, the interviewees stated that it was sufficient and that “[…] the first time is always slightly more complicated in relation to trying to understand (the indicators) and knowing where to get the information. After the first reading, everyone now knows.”
Concerning the questions about the instructional material, the interviewees emphasized that the informative material (booklet) was very explanatory, simple, and easy to understand. When asked about the digital material (data collection table), both stated that “[…] it was all straightforward, no mysteries.”

On the data collection theme, the supervisor explained that 18 of the 20 indicators were collected based on existing data, and only the “Orders delivered within the period stipulated” and “Productivity” indicators required more work. Regarding the contribution of the sectors involved in the implementation, there was no resistance, but there was bewilderment regarding the need for the data; the sectors wanted to know the purpose for which they would be used: “‘Ah, but where is this from?’; hence, I explained that it is a project in conjunction with the university, and so, after that, they obtained the data.”

Regarding the questions about the indicator system, the motivation for selecting the 20 indicators was the “utilization […] it was not because of the ease of access (or lack thereof) to the information but instead as a way of measuring and having a better notion in our understanding of the indicators.” When asked whether the company would use more indicators, the answer was affirmative. Regarding the irrelevance of any indicator, the manager pointed to “Estimated market share” as being a complicated indicator:

[…] because we do not have a direct competitor, and we operate in several segments. So, the market that we consider is the total market of our products. […] actually, it will not tell us very much because I will have to obtain it by category, it will be very distorted.

Regarding the addition of some indicators to the system, the manager also suggested some related to budgetary control. When questioned about the differences between the system used by the company and the implemented system, the supervisor stressed the issue of the automatic generation of data, without the need for the spreadsheet. Referring to the fact that the indicator system aggregates information for the company, the possibility of comparing the company with others and the construction of the company’s snapshot in relation to the aspects of innovation, competitiveness, and design were emphasized.

Workshop for analysis of the indicator system’s outcomes

After data collection was completed, the values of company D’s indicator system were generated, and the results and instructions for reading them were presented in the “Workshop for identifying possible product-related decisions to be made, based on the results of the design management indicator system.” The dynamic followed the cyclical experiential learning model (Braus and Monroe, 1994) in which participants engage with a topic in an interactive way; have a set amount of time to process and internalize the information received; develop correlational reasoning, extending knowledge to other situations (generalization); and apply what was learned.

During the exercise, the participants made a connection between the results obtained and the company’s day-to-day activities, generating insights about possible decisions that would contribute to improving the indicators. After understanding the purpose of each indicator, it was possible to apply the knowledge acquired through reflection and discussion concerning the behavior of the indicators and the possible reasons that they showed variations (both positive and negative). To finalize the workshop, the participants were presented with the value of the composite indicator obtained by the company and its variation in the collection period. The participants listed some factors as guiding these variations:

1. the crisis in the country, which hit the company in the middle of May 2015;
2. the time of new product launches, which would justify the positive peaks found in some indicators;
(3) seasonality, which can either positively or negatively affect production and the amount of labor employed;

(4) the critical months for sending product shipments to other regions of the country, which directly affects both production and the number of returns; and

(5) the sector’s national and international fairs, which influence sales.

After the end of the workshop, the deliberations were analyzed, and summary tables were constructed that listed each of the system’s categories, the indicators selected by the company, and the possible decisions indicated. Many decisions were generated, and to present them all would exceed the scope of this paper. Nevertheless, to illustrate the results of the workshop, the analysis of the “New product designs executed within the period stipulated” indicator from the “Efficiency” category is presented.

By analyzing this indicator, the company observed that to improve its performance, it could analyze the product development process and the sectors involved; create mechanisms for greater control of project deadlines, thus identifying bottlenecks; restructure product development to make it more efficient; ensure better decisions at the beginning of projects; identify and list the reasons for project development delays; identify and list the reasons for delays in the commercial area (regarding the projects); and eliminate small delays in each sector to avoid compromising project launch dates.

**Issues related to the implementation process**

The development of a measurement system requires design, review and acceptance, implementation, and use (Bourne *et al.*, 2000). From this list of activities, implementation is the point at which most measurement initiatives fail (Neely *et al.*, 2002). It is the phase in which systems and procedures are put into practice to collect and process the data that enable the measurements to be regularly performed (Bourne *et al.*, 2000). It represents a transitional period for all those involved and begins from the change in behavior and the restructuring of the organizational contexts (Fixsen *et al.*, 2005; Klein and Sorra, 1996).

In an implementation process, the guidelines should consider, among other things, information security, the influence of contextual factors, and the response of the participants in the process (Sans Institute, 2003; Stetler *et al.*, 2006). In this regard, analyzing the two implementations – the first in companies A, B, and C and the second in company D – it can be observed that both received the same initial assistance. However, they had completely different outcomes in the finalization stage. It was observed that the actions taken in each company determined the failure and the success, respectively, of the implementation.

Workshops are one strategy that can be used for the effective dissemination of information (Tanner and Hale, 2002). The dynamic thus allowed the company to visualize its daily processes. Moreover, individual analysis of the indicators is important to obtain ideas for actions that can improve their results, whereas more comprehensive and systemic analyses call attention to global actions in which work with one indicator triggers a series of developments in others.

Based on the results obtained in the study and in the literature on the topics addressed, it was possible to create a list of issues related to the implementation of the design management indicator system (Table IX). The objective is to create an understanding of these issues and the agents involved. The individual description of each issue does not determine its occurrence in isolation; in other words, one issue can trigger others:

1. Lack of understanding of the importance of implementing the indicator system: this factor is related to the fact that the organization does not understand the purpose and benefits of the indicator system (Marble, 2003; Mendibil and Macbryde, 2006). The organization’s members do not see improvements that can be linked to the
system’s use, and there is a strong inclination toward skepticism (Niven, 2006), i.e., toward understanding the system as a trend that the company has tried out without seriously intending to implement it (Othman et al., 2006), causing them to abandon the implementation process.

<table>
<thead>
<tr>
<th>Issue</th>
<th>Related literature</th>
<th>Evidence</th>
</tr>
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<tbody>
<tr>
<td>(1) Lack of understanding of the importance of implementing the indicator system</td>
<td>Marble (2003), Mendibil and Macbryde (2006), Niven (2006), Othman et al. (2006)</td>
<td>Employee conflicts and a lack of employee understanding of the system’s content and the need to introduce it into the company. The indicator system was not understood as a potential support for decision making related to the design management processes.</td>
</tr>
<tr>
<td>(2) Lack of commitment and involvement from senior management</td>
<td>Kaplan and Norton (2001), Bourne et al. (2002), Niven (2005), Mendibil and Macbryde (2006)</td>
<td>Managers did not guide the implementation process for the system but intervened only when problems arose.</td>
</tr>
<tr>
<td>(3) The organization is in an unstable phase</td>
<td>Marble (2003), Bourne et al. (2005), Waal and Counet (2009)</td>
<td>The company was going through a restructuring in its units. Instability and uncertainties arose in the market and the economic situation of both the company and the country.</td>
</tr>
<tr>
<td>(4) There is resistance from members of the organization</td>
<td>Nair (2004), Greiling (2010), Pereira and Melão (2012)</td>
<td>Employees did not see any increase in knowledge with the calculation of the indicators and the use of a new system, considered the data collection to be useless and a waste of time, and did not provide the requested data. Even after all of the interventions, employees did not prioritize the data collection, considering the implementation of the system to be irrelevant.</td>
</tr>
<tr>
<td>(5) The system is not used for day-to-day decision making throughout the organization</td>
<td>Lantelme and Formoso (2000), Nair (2004), Othman et al. (2006)</td>
<td>Managers did not see the system as an aid to decision making at all levels of the company instead of just at the managerial level.</td>
</tr>
<tr>
<td>(6) There are difficulties in obtaining the data to calculate the indicators</td>
<td>Lohman et al. (2004), Nair (2004)</td>
<td>Employees had no sense of responsibility for the data generated. Employees were not motivated to use the data as a source of information. Some of the data requested in the system were not controlled by the company.</td>
</tr>
<tr>
<td>(7) Insufficient training</td>
<td>Fixsen et al. (2005), Mendibil and Macbryde (2006), Niven (2006)</td>
<td>The lack of sufficient training in and a proper introduction to the system led to a lack of understanding among employees. A heavy workload existed for the employee involved in the implementation, along with communication problems between her/him and the different sectors of each company.</td>
</tr>
<tr>
<td>(8) Lack of a proper implementation team</td>
<td>Marble (2003), Niven (2006), Othman et al. (2006)</td>
<td>The implementation of the system did not occur in such a way that it became part of the employees’ day-to-day routine. It occurred in an imposed way, causing discomfort and resistance in data provision. Employees had no knowledge of the dates of data delivery, the system’s operation and purpose, or how the information generated could help with their day-to-day work.</td>
</tr>
<tr>
<td>(9) The entire organization does not use the system</td>
<td>Kaplan and Norton (2001), Franco and Bourne (2003), Nair (2004), Othman et al. (2006)</td>
<td>The implementation of the system did not occur in such a way that it became part of the employees’ day-to-day routine. It occurred in an imposed way, causing discomfort and resistance in data provision.</td>
</tr>
<tr>
<td>(10) Lack of planning and communication</td>
<td>Niven (2005), Niven (2006), Othman et al. (2006), Hwang et al. (2013), Speckbacher et al. (2003)</td>
<td>Employees had no knowledge of the dates of data delivery, the system’s operation and purpose, or how the information generated could help with their day-to-day work.</td>
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</table>

Source: Author

Table IX. Issues related to implementation.
Despite the various requests for data delivery and the researcher’s availability to clear up any doubts, it is believed that the failure to place any priority on the system or understand its importance were obstacles that strongly impacted data collection in companies A, B, and C. There were employee conflicts and a lack of employee understanding of the system’s content and the need to introduce it into the company. Simultaneously, the data collection began to be seen as “data collection for the study” and not as the foundation for developing an indicator system for the company that would enable support for decision making related to the design management processes and whose result would stimulate innovation and increase competitiveness. In company D, whose team recognized the usefulness and objectives of the indicator system, the implementation was more effective.

2. Lack of commitment and involvement from senior management: this factor refers to the level of involvement and support from managers in the implementation of the indicator system (Mendibil and Macbryde, 2006). No initiative in an organization, regardless of its potential, has any chance of succeeding without the support of senior management (Bourne et al., 2002; Niven, 2005). Senior managers are responsible not only for communicating the initiative but also for clearly presenting its importance to the organization as a whole (Kaplan and Norton, 2001; Mendibil and Macbryde, 2006).

Although the managers in companies A, B, and C had seen the system from its conception, they were not sufficiently involved in guiding its implementation process. The managers’ participation was limited to interventions only when implementation problems became so severe that the process was undermined. It was observed in company D, however, that when managers are committed and guide the process, it rolls out more effectively, allowing any negative impact from other obstacles to be overcome or at least minimized.

3. The organization is in an unstable phase: this issue refers to a moment of instability experienced by the company that can influence the implementation of measurement systems (Marble, 2003). This instability may be related to, inter alia, projects such as reorganizations, mergers, or acquisitions; factors such as market uncertainties; and the company’s economic situation (Bourne et al., 2005). In most cases, this unstable environment transfers a great deal of stress to management, distracting managers from the implementation process (Waal and Counet, 2009).

Because of the restructuring that was occurring in units of companies A, B, and C, nobody involved gave priority to the implementation and collection of data from the system. Furthermore, during the implementation period, there were major instabilities and uncertainties related to the market and the economic situation of both the company and the country. These issues, all of which arose at the same time, caused delays in deliveries, and the requests for data caused fatigue among the employees involved.

4. There is resistance from members of the organization: resistance to change – or something new – is also a challenge. The implementation of an indicator system involves changes such as an investment of time, a culture of responsibility for the data generated, and a commitment to the information provided, among others (Nair, 2004; Pereira and Melão, 2012). These changes are not always well received by the organization’s members, as the addition of a new and unknown tool raises questions about its function (i.e. whether or not it will work) and shakes up work habits that can sometimes be deeply rooted in the employees, preventing them from innovating and applying what is new (Pereira and Melão, 2012). Therefore, employee commitment can be considered an important facilitator of implementation (Greiling, 2010).
In companies A, B, and C, the collections were divided between the strategic planning analyst and the employees representing the companies, with the former responsible for the data collection of 13 indicators from each of the three companies and the latter responsible for the collection of 7 indicators from their company of origin. Since the seven indicators referred to data that had not previously been collected at the company, the employees responsible for the collection had to create a different data-entry routine. During the meeting to discuss their doubts, the employees said that they saw the system as “more work to be done”; i.e., they did not feel motivated to try out the new tool, preferring to work with the system they already used. Even after all of our explanations and demonstrations, no priority was placed on the data collection because the employees still considered the system’s implementation to be irrelevant.

(5) The system is not used for day-to-day decision making throughout the organization: the implementation of performance measurement systems requires the creation of conditions that allow them to be incorporated into decision making at different levels of the organization (Lantelme and Formoso, 2000). These conditions are related to the procedures, rules, routines, skills, and attitudes of everybody there. This implies changing how management is conducted within the organization, creating a more transparent and participatory environment (Lantelme and Formoso, 2000; Othman et al., 2006). When the information generated by the system is not used in the organization’s day-to-day management, corrective measures may not be taken in time, resulting in a failure to achieve the organization’s objectives (Nair, 2004; Othman et al., 2006). Organizations that make an indicator system part of everyone’s day-to-day functions – i.e., part of the company’s performance communication culture – are guided toward success (Nair, 2004).

The difficulties encountered in the implementation also occurred because some managers from companies A, B, and C did not understand that the indicator system should be used for decision making at all levels of the company, not just at the managerial level. Decision making occurs on a daily basis in each employee action, and an indicator system acts as a compass, guiding actions so that they are aligned with the company’s strategic objectives.

(6) There are difficulties in obtaining the data to calculate the indicators: the process of collecting and sorting data can be challenging. For the most part, organizations do not suffer from a lack of data but rather a failure to identify the correct and relevant sources of data that will help improve their performance (Nair, 2004). Generally, the employees who provide the most reliable data about a process are the ones who are directly involved in this process (Lohman et al., 2004). These employees’ cooperation thus becomes fundamental, and communicating the importance and priority of the system’s implementation can improve the data collection and delivery process (Lohman et al., 2004; Nair, 2004).

This issue is strongly linked to (4), “There is resistance from members of the organization,” as the employees of companies A, B, and C had no sense of responsibility for the data generated and did not feel motivated to use it as a source of information. The employees failed to comply with their data collection in a comprehensive manner, preventing their companies from advancing to later research stages.

(7) Insufficient training: for the implementation of an indicator system to be properly carried out, the people involved must learn about it (Niven, 2006). The essence of any initiative related to the use of an indicator system is to encourage people throughout the organization to implement it and take advantage of the information it generates.
(Fixsen et al., 2005). If these people do not have an in-depth understanding of the tool, the chances of success are reduced (Mendibil and Macbryde, 2006; Niven, 2006).

Because of the centralization of data collection in a single employee, there was insufficient training in companies A, B, and C for everyone involved. The employee who received the training did not pass the information on, resulting in a failure to understand the purpose of the system, the data that should be collected, the type of information that could be generated from these data, and how the system could help and/or interfere with the company’s day-to-day operations. Furthermore, the insecurity generated by this lack of knowledge and understanding created disbelief about the initiative.

(8) Lack of a proper implementation team: for an indicator system to be properly implemented and connect individuals, creating new behaviors, and improving communication, a team of people must be involved (Marble, 2003; Niven, 2006). In this sense, many initiatives failed only because they were led by ineffective teams or because they did not have a team assigned to the process (Niven, 2006; Othman et al., 2006).

The choices made by the managers of companies A, B, and C at the beginning of the implementation determined the path along which it developed. They were advised to create a multidisciplinary team so that through the participation of a representative from each sector of the companies, the system could be disseminated and the data collected and delivered. However, the position adopted by the managers was that there would be only one person responsible for collecting and delivering the data. Delegating the responsibility for collections to a single employee resulted in a heavy workload for them, along with communication problems between them and each company’s various sectors. This led to incomplete data delivery.

At company D, however, all the sectors were involved in the implementation process. Each sector received both the instructional material and an explanation of the reason for the data collection. The contribution of other sectors and the integration of the company culminated in a successful implementation.

(9) The entire organization does not use the system: when an indicator system is implemented arbitrarily, i.e., from top to bottom (from senior management down to employees), the result may be a lack of employee understanding and employee commitment to the initiative (Nair, 2004; Othman et al., 2006). Involving employees in the process of implementing the system can reduce resistance and increase the use of the performance measures in the company’s day-to-day activities (Kaplan and Norton, 2001; Franco and Bourne, 2003; Nair, 2004).

The implementation of the system in companies A, B, and C did not occur in such a way that it became part of the employees’ day-to-day routine. It occurred in an imposed and unstructured way, causing discomfort and resistance in the provision of data. As a result, there was a lack of understanding of the initiative, little acceptance of the system and low commitment to the goals of the implementation process.

(10) Lack of planning and communication: this factor refers to an issue that makes the implementation of the system more complicated, causing it to take longer and leaving people confused and unsatisfied (Niven, 2005, 2006; Othman et al., 2006). The development of an indicator system requires a precise development plan to guide the team through the process (Hwang et al., 2013; Speckbacher et al., 2003).

In companies A, B, and C, there was no planning or communication of the initiative to implement the indicator system. During the meeting to discuss their doubts, the employees
stated that they did not receive either the instructional material or the collection timeline and that there was no way to resolve any doubts about the system because they did not know with whom they should speak. These facts show that even when there was interest among employees in collaborating, a lack of organization and communication caused the implementation to fail.

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Conclusions

This paper sought to present the process and the outcomes achieved with the implementation of an indicator system for design management and the issues that arose during this implementation. The results obtained in companies A, B, and C demonstrated that design is not treated in a strategic way. It also made it possible to identify that its usefulness as an articulating and multidisciplinary activity, which integrates strategic and operational plans according to the company’s vision and mission (Stoner and Freeman, 1994), remains unknown.

We emphasize that the implementation of an indicator system does not end after the data collection. Implementation must be included in a company’s routine (Lantelme and Formoso, 2000; Nair, 2004) because it involves continual reassessments, adjustments, and improvements to continually fine-tune both the process and the system. However, if the companies do not educate themselves in relation to the development of a sense of system permanence and maintenance, the system will not work properly. Experience has shown that the implementation strategy should involve the entire organization; when an indicator system is available to the entire company, it can promote integration and lead those involved to achieve the same objective (Kaplan and Norton, 2001; Franco and Bourne, 2003; Nair, 2004; Niven, 2006; Othman et al., 2006).

The results obtained show the strong influence of the human factor in the implementation process. It is observed that the effectiveness of the latter depends on two capacities: creating new knowledge, i.e., identifying, acquiring, and processing relevant information, and transmitting that knowledge by providing fast and accurate information (Hwang et al., 2013; Speckbacher et al., 2003). It is understood that issues related to indicators, metrics, and nomenclatures, for example, are easily resolved through a detailed analysis of the problem. However, because of their importance in the implementation process, issues connected to human factors can become an insurmountable obstacle, compromising the entire process to the point of making it unfeasible (Kaur et al., 2012; Habtoor, 2016).

It is recommended that future studies create comparisons between the results of companies before and after the use of an indicator system; evaluate the role of the system to identify improvements in the processes with a view toward superior performance in the companies’ innovation, competitiveness, and design; generate a set of best practices used by companies that function as a benchmarking tool for problem solving; and develop a computational system that allows the comparison of results between companies in a benchmarking process.

References


Appendix

Paula Görgen Radici Fraga was a PhD Student at the Federal University of Rio Grande do Sul (UFRGS) (2016), Master in Design (2016), Specialization in Controlling (2009), and Graduate in Business Administration (2007) by the same institution. She performs research works in the areas of design, management, strategy, indicators, and instructional design, among others. Paula Görgen Radici Fraga is the corresponding author and can be contacted at: paula.radici@ufrgs.br

Maurício Moreira e Silva Bernardes is an Associate Professor at the Federal University of Rio Grande do Sul (UFRGS) in Brazil and the Vice Director of the product development center at the University’s School of Engineering. He holds a BA in Civil Engineering, an MSc and a PhD in Construction Management, and a post-doctorate degree in Design from the IIT Institute of Design in Chicago. Bernardes’ research areas include project and design management, design methods, and product development. He is also the Coordinator of the ICD project that aims at enhancing the competitiveness of the Brazilian industry through innovative solutions and design management.

Darli Rodrigues Vieira, PhD, Full Professor. Holds the research chair in Management of Aeronautical Projects, Management School, Université du Québec à Trois Rivières (UQTR - Trois –

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Table AI.
Interview protocol classified by topic addressed

<table>
<thead>
<tr>
<th>Topic addressed</th>
<th>Protocol issue</th>
</tr>
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<tbody>
<tr>
<td>Implementation process</td>
<td>(1) Was there any difficulty with the implementation or data collection of the indicators? What doubts and problems were encountered? How were they resolved?</td>
</tr>
<tr>
<td></td>
<td>(4) Were the same people involved in the implementation from the beginning to the end of the process? If not, why was there a change?</td>
</tr>
<tr>
<td></td>
<td>(6) With regard to the amount of time invested in the implementation and data collection, do you think that the time dedicated to implementing the system was sufficient or insufficient? Explain.</td>
</tr>
<tr>
<td></td>
<td>(15) Reflecting on the implementation and results obtained, do you have any suggestions for improving the system?</td>
</tr>
<tr>
<td>Instructional material</td>
<td>(2) Did the informative material (booklet) help in the process? How?</td>
</tr>
<tr>
<td></td>
<td>(3) Did the digital material (data collection table) help in the process? How? Do you believe it was suitable for your data collection routines and informational needs?</td>
</tr>
<tr>
<td>Data collection</td>
<td>(5) Were the data that were already available in the company collected through systems or control procedures that were already in use? Which ones?</td>
</tr>
<tr>
<td></td>
<td>(7) Did the sectors involved in the implementation and data collection make a positive contribution to the data collection (facilitated collection)? If not, what happened?</td>
</tr>
<tr>
<td></td>
<td>(8) With regard to the requested information, categories, and indicators themselves, do you believe that this presentation sequence is logical and leads to an understanding of each element of the system?</td>
</tr>
<tr>
<td>About the UFRGS ICD indicator system</td>
<td>(9) What is the reason for selecting this set of indicators?</td>
</tr>
<tr>
<td></td>
<td>(10) Would the company use more indicators if it were possible to do so? Which ones?</td>
</tr>
<tr>
<td></td>
<td>(11) Is there any required indicator that the company considers irrelevant? Why?</td>
</tr>
<tr>
<td></td>
<td>(12) Would you add any indicator to this set? Which one?</td>
</tr>
<tr>
<td></td>
<td>(13) Was the company already using an indicator system? If so, what differences between them can you observe?</td>
</tr>
<tr>
<td></td>
<td>(14) Do you believe that the ICD indicator system will add information to your company? In what way?</td>
</tr>
</tbody>
</table>

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Rivieres, Quebec, Canada) and a former Professor at the Universidade Federal do Paraná and at the Instituto Tecnológico de Aeronáutica (ITA). His current research focuses on project management, logistics chain management, strategy and management of operations, and management of MRO (maintenance, repair, and overhaul).

Milena Chang Chain is a DBA candidate and a Researcher at the Chair in Management of Aeronautical projects at the University of Quebec at Trois-Rivieres. She holds a degree in Production Engineering from the Catholic University of Paraná (PUC-PR) and a degree in Business Administration from the Federal University of Paraná (UFPR). She also holds an MBA in Logistics Management Systems from the UFPR.

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