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■ risk decision ■ risk management

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GUIDELINES FOR THE DEPLOYMENT OF CRITERIA FOR SELECTION OF STRATEGIC PROJECTS IN DESIGN

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✉ ABSTRACT

Strategic projects are selected by executives based on pre-established criteria. These criteria must be deployed for product development so that they can be present as attributes in the development process. In an industrial context, this study identifies criteria that are relevant to executives and meet their expectations about convergence with the strategic vision of their organization, and it sheds light on how these criteria are unfolded to achieve the development of products. A literature review produced a theoretical background about the definition of project selection criteria, and interviews were conducted with executives from different companies for practical reference regarding how the selection process actually happens in organizations. Finally, study groups were formed to discuss the means by which the criteria migrate from managers' expectations to actual products in the development process. As a result, a set of guidelines was compiled so that companies can deploy their criteria to select strategic projects in project attributes and operational actions throughout the product development process.

1. Introduction

The process of project selection is referenced as one of the most important problems in the context of decision-making for many companies (Yu et al., 2012), and identifying the best design so that companies can gain maximum benefit and achieve their goals is described as the central problem for researchers in the field (Wang et al., 2009). By properly selecting strategic projects, companies show their ability to correctly allocate their scarce resources to achieve their most important goals (Zhang et al., 2008).

The selection of strategic projects in design is a process that is based on managers' perception and understanding of the importance of design as a factor that contributes to the successful implementation of

corporate strategies (Marion & Meyer, 2011). It is also aimed at assessing the adequacy of projects in meeting the strategic objectives of an organization as far as growth and wealth creation are concerned (Asrilhant et al., 2007).

To select, among available projects, those that can offer a better return to companies, managers should evaluate them on the basis of a set of criteria that can provide a clear understanding of the surrounding environment, both internally and externally, and reflect the critical success factors of the organization (Gray & Larson, 2007). The strategic character of these criteria requires that they be deployed and incorporated by projects to obtain the results expected by an organization.

In a certain way, the definition of criteria expresses managers' expectations to meet the strategic goals of their company and outlines how they intend to meet such objectives. Thus, the identification of the criteria is as important as their dissemination and assimilation by project development teams so that the proposals of projects and the expectations of management are aligned.

For such an understanding to take place, the criteria need to be correctly interpreted and subsequently translated into attributes of the design environment—the characteristics of the project itself (*project attributes*) and issues related to the process (*operational actions*). There is a gap in the literature regarding the translation of the criteria into project attributes and operational actions and their application in the relevant operating environment.

Therefore, this study was motivated by the identification of criteria for the selection of strategic projects in design, addressed by Benedetto et al. (2015), the deployment of these project attributes and operational actions, and the set of guidelines to foster this process.

2. Background Research

Selection of Strategic Projects

An important process in management is the selection of projects (Puthamont & Charoenngam, 2007) that should serve as means for the establishment of corporate strategies and ensure organizational sustainability. Zhang et al. (2008) identified this process as the “selection of strategic projects” and classified it as a company's commitment to select and prioritize projects aligned with its strategic goals and with customer needs.

The process of project selection is referenced as one of the most important problems in the context of decision-making for many companies (Yu et al., 2012) and also a very complex one (Mohanty, 1992; Puthamont & Charoenngam, 2007). Identifying the best project or portfolio to gain the maximum benefit and properly meet companies' expected goals is characterized as a central problem for researchers (Wang et al., 2009). The selection of strategic projects requires organizations to skillfully and wisely allocate their scarce resources to achieve their most important goals (Weiyong et al., 2008). The selection of projects is a problem related to

strategic decision-making, and it is characterized by multiple purposes that are very often conflicting and immeasurable (Liesiö et al., 2007).

The methods of project selection are present in the routine of corporations/institutions, be they formal or ad hoc. However, the effectiveness of these methods is the current concern of managers and researchers. With regard to selection criteria, Daniel et al. (2003) consider that there should be a set of criteria that can meet stakeholders' expectations. In their research studies, authors such as Jiang and Klein (1999), Meade and Presley (2002), and Grundy (1998) consider the use of criteria for the selection of strategic projects as paramount, and they observe that they vary depending on organizational strategic stance. Therefore, they seek to identify criteria that permeate the whole organization and are sufficient to allow the transposition of strategies into projects.

Selection of Strategic Projects in Design

The selection of strategic projects in design is a process that is based on managers' perception and understanding of the importance of design as a factor that contributes to the successful implementation of corporate strategies (Marion & Meyer, 2011). In addition, projects should be able to meet the strategic objectives of an organization with regard to growth and wealth creation (Asrilhant et al., 2007). This scenario defines a highly complex environment (Wang et al., 2009) because it takes into consideration the strategic goals of an organization. This environment becomes more complex in

the absence of a method of selection; under this condition, organizations start to operate in an abstract context based solely on their managers' understanding.

As a decision-making process (Yu et al., 2012), the selection of strategic projects in design must involve several levels of decision-making within the organization. According to Kumar (2012, p. 130), such an environment is characterized by a dense network of interconnecting parties. In this context, selection criteria are important for directing corporate strategies towards the overall performance of the organization through strategic projects, specifically in the context of design.

According to Gray and Larson (2007), there are many criteria for the selection of projects, and criteria in the field of design are classified as non-financial criteria. Because design in business has been regarded as an agent for increasing potential innovation (Bruce & Bessant, 2002, p. 33) and the decision process in design is based on "ill-defined" or "wicked" problems (Rittel & Webber, 1973; Yang, 2010), this set of criteria needs to exist in order to address these characteristics and support the decision-making process properly.

Selection criteria for strategic projects

To face the increasing demand for innovation and achieve better results, companies have been relying on projects to add economic value and create competitive advantage (Dutra et al., 2014). Therefore, to ensure maximum return with projects, there has to be a selection process with consistent criteria, and it should be related to the business strategy of organizations (Archer & Ghasemzadeh, 1999; Ghasemzadeh & Archer, 2000).

Regardless of the focus, the criteria used for selection are directly related to the needs and the culture of organizations, and they are classified according to the importance given by their executives (Rengarajan & Jagannathan, 1997). The research studies of Dutra et al. (2014), Messerle et al. (2013), Wang et al. (2009) and Puthamont et al. (2007) exemplify the use of several methods in different aspects of a business and different criteria for project selection.

3. Research Method

Description of the research study

A literature review provided a large quantity of material on the selection of strategic projects. For example, articles tabulated by Dutra et al. (2014), Cheng and Li (2005), Puthamont and Charoengam (2007), among others, focus on the selection and prioritization of projects in the most varied forms and contents. However, one question remains unanswered: how these criteria are understood and addressed by those who, although not involved with managers (*who select and approve projects*), are expected to materialize the ideas and projects that are later submitted to managers' judging criteria, i.e., product development designers and engineers.

This question was central to the present study because it showed that it would be necessary to discern the path between those who select and those who generate projects so that a project submitted for approval can be composed of attributes that can later lead to its approval.

Description of the Research Environment

The present research relied on the participation of five Brazilian companies headquartered in the southern region of the country, where design is an element present of the product development process. They are large and medium-sized companies, and to retain confidentiality, they will be referred to by the letters A, B, C, D and E. Their basic characteristics are shown in Table 1.

Identification of Criteria

Interviews were used for the identification of criteria. This data collection technique ascribes great importance to informants' verbal description about what they know (Gil, 2008). The interviews were not standardized or structured, i.e., they were conducted without a strict script. Thus, the researcher was able to widely explore the issues, with the freedom to develop the interview in any direction.

The interview approach used open questions, following a previously defined plan with a strong exploratory nature. Thus, the interviews did not have a rigorous structure, following the pattern reported by Gil (2008b).

The search for understanding the criteria for the selection of strategic projects in design took place by interviewing senior company executives (*C-level executives*). Seven executives of five companies participated in the process. They belonged to the group of strategic management; thus, they had the power of decision and participated in the selection process of strategic projects in design in their companies.

First, the researcher presented the scope of the study, clarified its purpose and stressed the importance of focusing on the selection of strategic projects in design. In the second part, interviews followed an open format and were aligned with the following question: What must be considered when selecting strategic projects in design?

The criteria mentioned by each executive in his/her answers were selected and associated with the justifications given in the interviews. After that, the criteria were compared by subject and relevance across companies to create common identifications and thus to allow a comparison. The analysis and classification were important to gather the information and tables that will be presented in the section containing the evaluation of the results.

Deployment of the Criteria

The criteria were deployed using the study group technique, i.e., a meeting of professionals who discuss a theme related to their lines of business (Prodanov & Freitas, 2013). The QFD - Quality function deployment method was selected as a tool to deploy the criteria into operational actions or project attributes because it is a series of management and control matrices aimed at ensuring that customer requirements are firmly present during all stages of project development (Hurst, 1999). The QFD method offers a structured procedure so that its steps are performed, generating a well-defined, logical sequence of implementation for the deployment process. QFD was the tool for conducting the procedures, and Figure 1 shows the deployment process implemented by means of QFD.

Figure 1 shows that the criteria for selection of strategic projects in design are assumed as being the "voice of customers" in the development process, and this assumption creates an environment conducive to the implementation of the QFD method. After the deployment was applied, the matrix "voice of design" was generated. It was composed of project attributes and operational actions in the development process.

To start the deployment process, an initial meeting, attended by all the experts, was held with the objective of creating an environment of recognition among the members of the group and providing an individual, common understanding about the criteria. Tables 2 and 3 show the structures of the groups. To ensure the confidentiality of information, the individuals are identified by their initials. In this stage of the process, three companies participated in the dynamics.

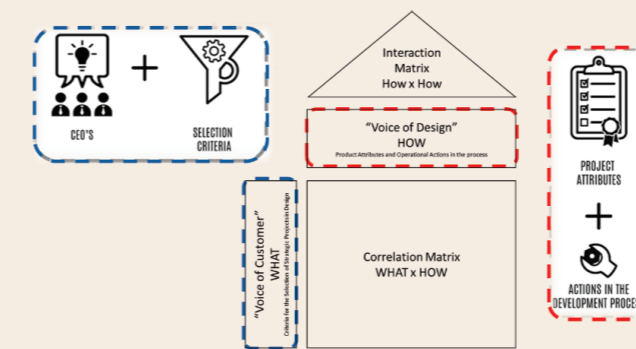


FIGURE 1. QFD and the Process of Criteria Deployment

TABLE 2. Participants in Study Group 1

Participant	Company	Line of Business
P11	A	Product Engineering
P12	B	Research and Development
P13	C	Marketing
P14	C	Design
P15	C	Product Development
P16	B	Trade Marketing
P17	B	Product Development

	Company A	Company B	Company C	Company D	Company E
No. of employees	650	700	500	600	5,000
Branch of Activity	Hand Tools	Household Cleaning products	Houseware	Games and Toys	Footwear

TABLE 1. Description of companies participating in this research study

It should be noted that the labels A, B and C assigned to the companies are not related to the labels of those companies that participated in the previous step of the research.

Although the positions inside the companies had different names, all participants were directly linked to the product development process. Taking into account the protocol of the first meeting, an explanation of the meanings of the selection criteria was offered to ensure that there was no distortion in the meaning of the concepts because this understanding should reflect the expectations of the executives. The expectations of the criteria were explained and discussed one by one based on the explanations transcribed from the interviews.

The first sessions of both groups began with the contextualization of the theme and the revision of the theory and application of QFD to level the knowledge of the participants and to set the purpose. All participants were acquainted with the method, but not all of them had previously worked with it.

Figure 2 was used to establish the foundations for the deployment process. It initiated the approach through the understanding that with strategic planning as a reference, companies—including their presidents, directors and senior executives— seek to identify which strategic projects in design will be executed. Furthermore, on the basis of strategic planning, product development groups pursue ways to meet the strategic demand and thus gain competitive advantage for their business. Among various mechanisms, Figure 2 discusses the tools and methods, e.g., the ones introduced by Vijay Kumar (2012), constituting a structured approach to guide the process of innovation in organizations.

By fostering the process of innovation with the adopted method, new ideas and therefore new projects are proposed. The purpose, in the context of the research, is

that these projects are created while taking into account project attributes and operational actions in the development process, and they should reflect the criteria to be used by executives in project selection at a later time.

If projects have the attributes “desired” by executives, there is greater chance they will be selected. Hypothetically, if a proposal for product design under analysis includes project attributes and operational actions in the process and reflects all the criteria used for the selection of strategic projects in design, the project will always be highly considered; as a result, it will be selected, regardless of the level of importance given to one particular criterion or another.

Furthermore, hypothetically, the greater the amount of projects that go through the project funnel with high adherence to the selection criteria of strategic projects, the greater the amount of products released by a company that will meet strategic goals. This ensures greater agility in the process of product release and entry into the market.

When the work of the study group effectively began, the first step of the process included the deployment of the “voice of customers” (criteria of executives) into the “voice of design/engineering” (product attributes and operational actions). In this step, again, each criterion was submitted and evaluated one by one, on the basis of the transcripts of managers’ interpretations about what they knew about the item.

The dynamics were conducted as brainstorming sessions, where the researcher was a facilitator but did not join the discussions. During the deployment process, each specialist suggested one product attribute or one operational action to be considered in the process in order to reflect the selection criterion being discussed in the development process. After two or three rounds of suggestions, each criterion was discussed and either validated

Participant	Company	Line of Business
P21	A	Product Development
P22	A	Research and Development
P23	B	Product Engineering
P24	A	Trade Marketing
P25	A	Marketing
P26	B	Product Engineering

TABLE 3. Participants in Study Group 2

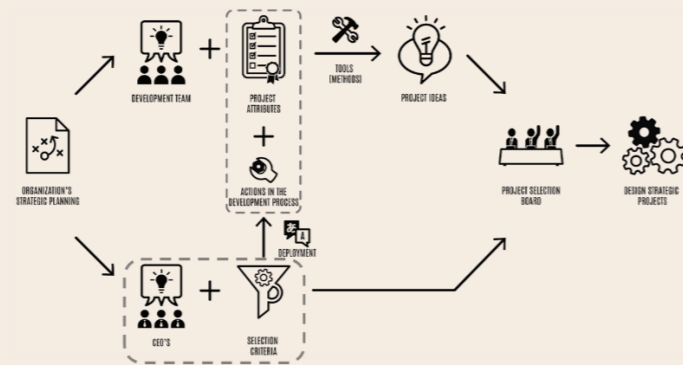


FIGURE 2. Research Context

or rejected, or possibly combined with others. At the end of the discussions, the suggested items were included in the QFD matrix.

This analysis was limited to evaluating the factors related to a single criterion at a time. The transversal evaluation across criteria was performed later, identified as “relational analysis”, which compared all items in the “voice of customers” with all the items in the “voice of design”. Figure 3 shows the sequence used for the deployment.

In Step 2, an analysis was performed on the relationships among the criteria, project attributes and operational actions. This evaluation was performed on the basis of $n \times m$, in which all items (m) of attributes or operational actions (voice of design) were compared with all (n) selection criteria for strategic projects (voice of customers), and relationships were evaluated as strong (v) or weak (x), when they existed. The condition of a medium-intensity relationship was not considered because it involves very subjective evaluation levels. In the absence of a relationship between the items, nothing was marked.

During the dynamics with specialists, all discussions were guided by the clarification of points of view on the basis of the statements made by the managers. This step resulted in the generation of the relational matrix between “WHAT”, defined by the executives, and “HOW”, suggested by design/engineering.

Step 3 was focused on the evaluation of interactions between the items that represented the “voice of design/

engineering” while considering the condition of being a positive or negative relationship and assigning the “+” and “-” signs, respectively. In product design using QFD, the remarks made in the interrelationship analysis were based on what happens to the technical characteristics when an improvement is applied to one of them individually.

In the case of characteristics with a positive relationship (+), an improvement made to one characteristic is similarly reflected as an improvement to another. In contrast, when the characteristics have a negative relationship (-), an improvement made to one characteristic reflects deterioration in another (Zhang et al., 2014). The evaluation was performed on the basis of $n \times n$, wherein all ‘n’ items of “voice of design” were compared with one another.

Subsequent levels of QFD seek to unfold the understanding of design/engineering into quality information and production, respectively, to which this research does not seek adhesion. Furthermore, these processes (quality and production) are not covered in the scope of the present study and therefore will not be addressed. Figure 4 shows the configuration used for QFD.

As this process was developed, considering two study groups, two lists of attributes and operational actions were produced, which would hinder the convergence process in the analysis of the results. Therefore, these two lists were grouped, resulting in the project result set (PRS) through the intersection of the two sets of results of the groups, as shown in Figure 5.

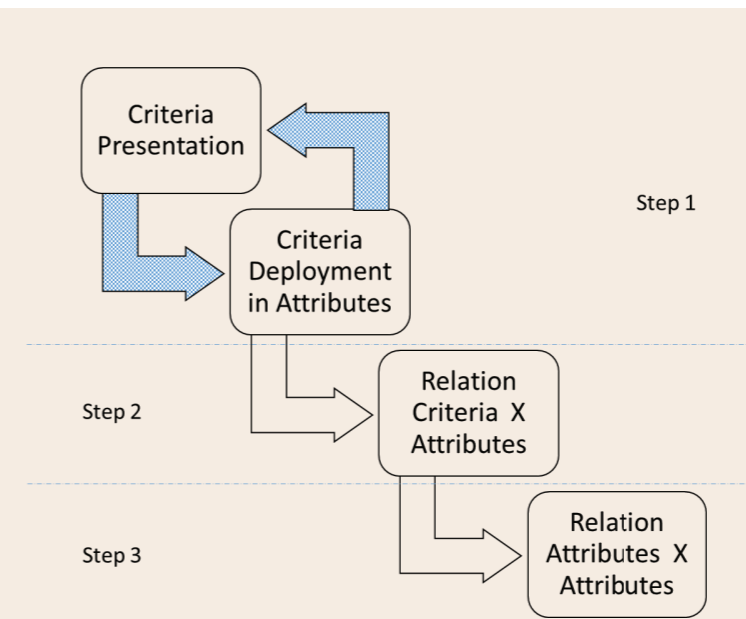


FIGURE 3. Deployment Process

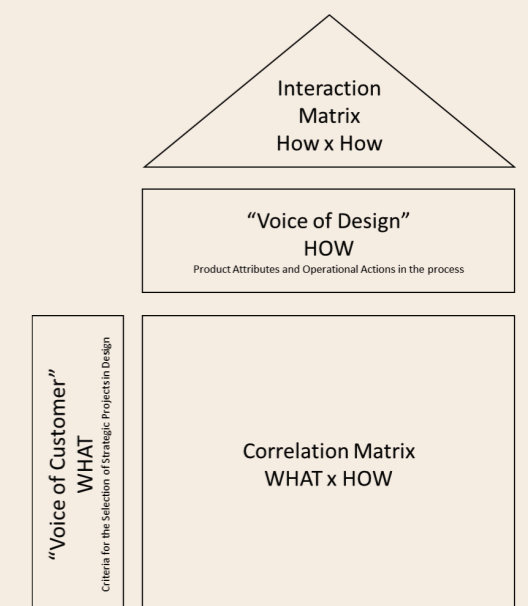


FIGURE 4. QFD for Unfolding the Criteria - House of Quality

This grouping generated a list of attributes and operational actions that were common to the two groups of study. The result of this stage of the process will be presented in the section that addresses the evaluation of the results.

4. Results

Compilation of data from interviews

Seven executives representing the companies were interviewed. All participating companies are product developers. They operate in the market for consumer goods, in the segments of hand tools, household cleaning products, games and toys, footwear, and houseware. These companies are among the largest in their segments, and they have cutting-edge manufacturing technology and highly qualified professionals. The companies have an international scope.

Benedetto et al. (2015) focus on detailing the data collection process through interviews. Figure 6 shows the set of 22 criteria identified as important for the selection of strategic projects in design.

Result of the Study Groups – Deployment

The result of the criteria deployment into project attributes and operational actions in the product development process was a list of items compiled with the items that appeared both in Group 1 and in Group 2. Appendix A shows the results of the first stage of the deployment process.

As suggested by the groups at the end of Stage 1 - Deployment, after all items of the “voice of design” were identified, a complementary activity was performed to

reassess the identifications of the criteria. This reidentification aimed to add more meaning to each identification of the criteria cited by the executives because the experts considered that the identifications occasionally did not correspond to what they had mentioned. After the explanations provided by the executives were taken into account (see Benedetto et al., 2015), new identifications were suggested. For this purpose, the contents of the interview transcripts were used.

The final result, shown in Figure 7, was defined by following the rule of adding a word to the previous identification to foster understanding, e.g., the criterion “CR11 - Brand Image”, was redefined as “CR11 - Strengthen Brand Image”.

It was observed that criterion CR17 - Design Form and Function was eliminated from the list and grouped into criterion CR4 - Design because evaluating them separately was considered inappropriate. The experts concluded that there would not be any gain with the individual assessment of these criteria, as they have a strong relationship of complementarity.

Results of Study Groups - Relationship

To perform the remaining activities of the method, the occurrences of the “voice of customers” and the “voice of design/engineering” must be compared for the evaluation of the relationship between them. In this step, all project attributes and operational actions were evaluated regarding the existence of a strong or weak relationship with all the selection criteria for strategic projects. Each group made its assessment individually, and the results were subsequently grouped.

In this step, the project attributes and operational actions identified in the previous step were organized in alphabetical order. This guideline was identified by the

researcher as a way to create a means of reassessing the process of criteria deployment. As there was a clearly identified relationship between the items of criteria and their respective items of deployment, the experts had to reassess the deployment throughout the duration of the dynamics. Because the evaluations of the relationships were performed by two different groups, they were grouped by adopting the rule shown in Table 4.

This rule sought to balance the number of possibilities among possible occurrences to avoid the tendency to direct all relationships towards a strong relationship (v). The comparison between an evaluation of a STRONG (v) relationship with an evaluation of a NON-EXISTENT (0) relationship resulted in an occurrence of a WEAK (x) relationship. Similarly, the comparison between an occurrence of an evaluation of a WEAK (x) relationship with an evaluation of a NON-EXISTENT (0) relationship resulted in an occurrence of a NON-EXISTENT (0) relationship. Figure 8 shows the results of the evaluations of relationships applied to the consolidated deployment developed by Groups 1 and 2.

The analysis of relationships showed the scope of each one of the project attributes and operational actions identified with respect to the target set of criteria for the selection of strategic projects. In addition to translating the criterion initially used for deployment, this analysis showed which other criteria may benefit from the presence of the attribute or operational action in the development process.

It could be observed that some items of the deployment process are related to other criteria. The spreadsheet in Figure 8 shows that attention can be focused on items in the deployment process that, while being present in the development process, meet a larger number of criteria.

Results of Study Groups - Interrelationship

The analysis of the interrelationship between project attributes and operational actions is represented graphically in the QFD diagram as the roof of the house of quality. In a product design project using QFD, the goal of this step is to assess the relationships among the technical characteristics that result from the deployment of the “voice of customers” and then to suggest improvements in one or more characteristics of the project, with the purpose of eliminating the negative effects that they can have on one another.

For this activity, a symmetrical matrix was created to facilitate visualization, and the evaluation was developed under the portion located below the main diagonal, as shown by Figure 9. The upper part of the main diagonal was completed with zeroes and was not used in the analysis. The dynamics followed the same path adopted for the deployment stage, seeking to compare all items with each other. The question asked in this analysis was: What happens to the attributes of the project when an improvement is applied to an attribute individually?

The answer to this question defines the relationships between the attributes. If the answer reflects an improvement in a second attribute due to an improvement applied to a first one, the interrelationship between them is positive (+). On the other hand, if applying an improvement to a given attribute deteriorates another attribute, the interrelationship between them is negative (-). Each group developed this activity considering the project attributes and operational actions derived from their previous assessments. In the end, there was a single grouping of results. The grouping of interrelationships was based on the rule shown in Table 5.



FIGURE 5. Project Result Set of the Project

Companies	Criteria																					
	CR1	CR2	CR3	CR4	CR5	CR6	CR7	CR8	CR9	CR10	CR11	CR12	CR13	CR14	CR15	CR16	CR17	CR18	CR19	CR20	CR21	CR22
A	X	X	X	X	X	X	X	X	X													
B	X		X	X	X					X	X											
C	X		X		X	X					X	X	X	X	X	X	X					
D	X	X	X	X	X						X							X				
E	X				X			X												X	X	X

FIGURE 6. Criteria vs. Companies

Companies	Criteria																					
	CR1	CR2	CR3	CR4	CR5	CR6	CR7	CR8	CR9	CR10	CR11	CR12	CR13	CR14	CR15	CR16	CR17	CR18	CR19	CR20	CR21	CR22
A	X	X	X	X	X	X	X	X	X													
B	X		X	X	X					X	X											
C	X		X		X	X				X	X	X	X	X	X	X	X					
D	X	X	X	X	X						X							X				
E	X				X			X												X	X	X

FIGURE 7. Criteria vs. Companies - Reidentification

	Group 2 Assessment			Group 1 Assessment
	Strong	Weak	NULL	
Strong	X	V	V	
Weak	0	X	V	
NULL	0	0	X	
	NULL	Weak	Strong	

Legend
V - Strong
X - Weak
0 - Null

TABLE 4. Rule for Evaluation of Relationships for the Final Set

Relationship	Voice of Design - Project Attributes and Operating Actions within PDP																					
	Capability Analysis	Capacity Analysis	Analysis of intention and action on market survey	Analysis of values of target audience vs. Product Values	Situation analysis: current, trends, desirable	Adherence to strategic objectives	Assessment of how the Project can perform as a block	Project Briefing	Business Case	Life cycle of new Project	Classify Project as per achieved strategic objective	Consultancy with experts - anthropologists, sociologists	Process Drawings	Comparative studies with equivalents - volume and price	Focus groups - comments	Identify projects with product families	Identify achieved strategic objectives	Information on potential of the Project to fight off competitors	Investment - Value	New Function	New Technology	New Market
Be an innovative Project																						
Offer Return on Investment																						
Achieve Target Cost																						
Have Design (Form and Function)																						
Strengthen Strategic Positioning																						
Offer Lock-in Strategy																						
Gain Market Share																						
Adhere to Budget																						
Implement Technology																						
Enable Production																						
Strengthen Brand Image																						
Respect Culture																						
Add Customer Value																						
Be Self-Sustaining																						
Enable Production Independence																						
Have Synergy with Portfolio																						
Add Company Value																						
Respect Investment																						
Complete Strategic Grid																						
Accomplish Strategic Objectives																						
Ensure Approval at Workflow																						

FIGURE 8. Result of Evaluations of Relationships

This rule sought to highlight the cases that are likely to have a negative effect. Thus, each interrelationship that received a negative evaluation (-) stood out among the others. Based on this rule, the matrix shown in Figure 9 was completed, in the portion below the main diagonal, with the combined contents of the assessments of the two study groups.

All interrelationships that were identified as negative (-) must be regarded as a warning for product development teams because this indicates that there is a sensitive relationship between the project attributes and the operational actions analyzed. This step of the procedure evaluated the interrelationship condition in both directions, i.e., the action of an attribute A on attribute B and vice versa. The complete QFD is shown in Appendix B.

Results of Study Groups – Grouping

During the group activities, the groups pondered over the numbers of generated criteria, design attributes and operational actions derived from the analysis. The group thought it would be better to group the criteria once the attributes were generated from them. The choice of grouping was easily accepted because the experts had already faced certain conditions that favor this approach over the previous dynamics.

The elevated quantity of analyses during the dynamics was due to the method used for deployment, QFD, and the necessary evaluations to go through the steps of analysis of relationships and interrelationships inherent to its application. This condition was not observed in the studied models in the scientific literature because the deployment process has not yet been addressed.

For the purpose of grouping, it was considered that the conditions of some selection criteria presented strong similarities, while others had a cause and effect relationship with each other. Another consideration was that each company had quoted individually no more than 11 selection criteria, as reported by Benedetto et al. (2015), a number that should perhaps be pursued. With the inclusion of this step (grouping) in the process, the sequence of was as shown in Figure 10.

For executing this stage, a criterion-by-criterion analysis was suggested, which generated a new list according to the elements noted above. As a result of the proposed grouping, the criteria table formerly composed of 22 items was now represented by 11 items. The items that were deleted from the relationship because they were incorporated into other ones altered the relationship table “criterion x company” due to the migration of the occurrence of those eliminated to those that remained. Figure 11 shows the list of criteria after grouping.

	Group 2 Assessment				Group 1 Assessment
+	+	-	+		
-	-	-	-		
NULL	0	-	+		

Legend (-) - Negative (+) - Positive (0) - NULL

TABLE 5. Rule for Evaluation of Interrelationships for the Final Set

Inter-relationship	Voice of Design - Project Attributes and Operating Actions within PDP																						
	Capability Analysis	Capacity Analysis	Analysis of intention and action on market survey	Analysis of values of target audience vs. Product Values	Situation analysis: current, trends, desirable	Adherence to strategic objectives	Assessment of how the Project can perform as a block	Project Briefing	Business Case	Life cycle of new Project	Classify Project as per achieved strategic objective	Consultancy with experts - anthropologists, sociologists	Process Drawings	Comparative studies with equivalents - volume and price	Focus groups - comments	Identify projects with product families	Identify achieved strategic objectives	Information on potential of the Project to fight off competitors	Investment - Value	New Function	New Technology	New Market	
CAPABILITY ANALYSIS																							
CAPACITY ANALYSIS																							
ANALYSIS OF INTENTION AND ACTION ON MARKET SURVEY																							
ANALYSIS OF VALUES OF TARGET AUDIENCE VS. PRODUCT VALUES																							
SITUATION ANALYSIS: CURRENT, TRENDS, DESIRABLE																							
ADHERENCE TO STRATEGIC OBJECTIVES																							
ASSESSMENT OF HOW THE PROJECT CAN PERFORM AS A BLOCK																							
PROJECT BRIEFING																							
BUSINESS CASE																							
LIFE CYCLE OF NEW PROJECT																							
CLASSIFY PROJECT AS PER ACHIEVED STRATEGIC OBJECTIVE																							
CONSULTANCY WITH EXPERTS - ANTHROPOLOGISTS, SOCIOLOGISTS																							
PROCESS DRAWINGS																							
COMPARATIVE STUDIES WITH EQUIVALENTS - VOLUME AND PRICE																							
FOCUS GROUPS - COMMENTS																							
IDENTIFY PROJECTS WITH PRODUCT FAMILIES																							
IDENTIFY ACHIEVED STRATEGIC OBJECTIVES																							
INFORMATION ON POTENTIAL OF PROJECT TO FIGHT OFF COMPETITORS																							
INVESTMENT - VALUE																							
NEW FUNCTION																							
NEW TECHNOLOGY																							
NEW MARKET																							
FORMAL PROJECT BUDGET																							
SURVEY MONITORING CUSTOMERS ON A DAILY BASIS																							
ANTHROPOLOGICAL SURVEY																							
SURVEY WITH RETAILERS AND CUSTOMERS																							
SURVEY WITH TARGET AUDIENCE - EXPECTATIONS																							
MARKET SURVEY - NIELSEN																							
SURVEYS AND DYNAMICS WITH USERS - COMMENTS																							
ONE-ON-ONE SURVEY WITH ANTHROPOLOGICAL QUESTIONS																							
SURVEY TO IDENTIFY NEEDS AND WISHES																							
SURVEYS IN SEVERAL REGIONS																							
PROJECT - TARGET COST																							
BUDGET ESTIMATE FOR STRATEGIC PLANNING																							
COMMUNICATION PROCESS																							
PROJECT - COST																							
PROJECT - MARGIN																							
PROJECT - PRICE																							
PROJECT - SALES VOLUME																							
PRODUCTION SIMULATION																							
LINKING PROJECT TO VERTICALIZATION PROCESS																							

FIGURE 9. Matrix for Analysis of Interrelationships Between Attributes

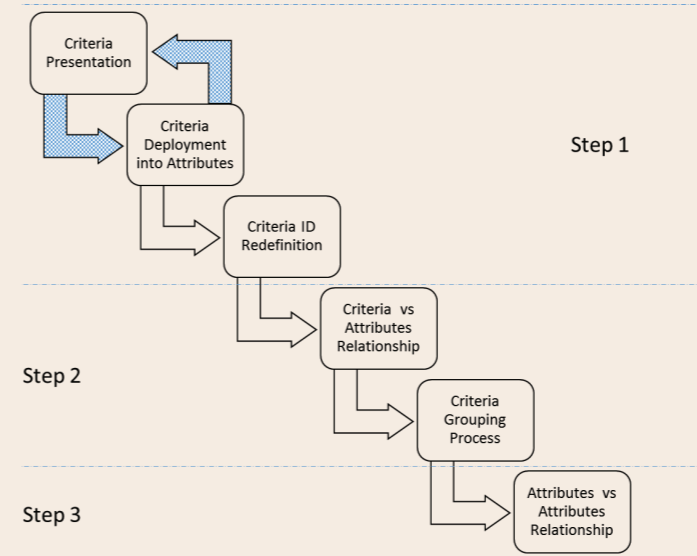


FIGURE 10. Complete Deployment Process

Companies	Criteria										
	CR1	CR2	CR3	CR4	CR5	CR6	CR7	CR8	CR9	CR10	CR11
A	X	X	X	X	X	X	X				
B	X		X	X	X			X		X	
C	X		X	X	X			X	X	X	X
D	X	X	X	X	X			X		X	
E	X	X			X		X				

CR1	Be an Innovative Project
CR2	Offer Return on Investment
CR3	Achieve Target Cost
CR4	Have Design (Form&Function)
CR5	Strengthen Strategic Positioning
CR6	Gain Market Share
CR7	Adhere to Budget
CR8	Strengthen Brand Image
CR9	Respect Culture
CR10	Add Value
CR11	Be Self-Sustaining

FIGURE 11. Criteria x Company - Grouped

Emphasis of Selection	Relevant Aspects	References
Market	Market potential	(Rengarajan & Jagannathan, 1997), (Dutra et al., 2014), (Mohanty, 1992), (Jiang & Klein, 1999b), (Bordley, 1998), (Archer & Ghasemzadeh, 1999), (Meade & Presley, 2002), (Messerle et al., 2013)
Customer	Customer needs; visible and communicable benefits to customers	(Schenkl et al., 2013), (Jiang & Klein, 1999b), (Messerle et al., 2013)
Economic-financial Aspects	Comparing the possible profitability of the product with its cost; availability of financial resources	(Dutra et al., 2014), (Mohanty, 1992), (Schenkl et al., 2013), (Cheng & Li, 2005), (Okpala, 1991), (Puthamont & Charoenngam, 2007), (Badri et al. 2001), (Jiang & Klein, 1999b), (Bordley, 1998), (Archer & Ghasemzadeh, 1999), (Meade & Presley, 2002), (Messerle et al., 2013)
Internal and External Structures	Synergy with existing products; availability of technical resources; availability of human resources; existence of needed infrastructure	(Rengarajan & Jagannathan, 1997), (Dutra et al., 2014), (Mohanty, 1992), (Schenkl et al., 2013), (Okpala, 1991), (Puthamont & Charoenngam, 2007), (Badri et al., 2001), (Jiang & Klein, 1999b), (Bordley, 1998), (Meade & Presley, 2002), (Messerle et al., 2013)
Product/Process	Product performance and advantages; technical feasibility	(Rengarajan & Jagannathan, 1997), (Mohanty, 1992), (Wang et al., 2009), (Schenkl et al., 2013), (Okpala, 1991), (Badri et al., 2001), (Jiang & Klein, 1999b), (Bordley, 1998), (Meade & Presley, 2002), (Messerle et al., 2013)
Strategy	Adherence to strategy; adherence to trends; sustainable benefits (patents); organizational learning; entry barriers	(Rengarajan & Jagannathan, 1997), (Dutra et al., 2014), (Schenkl et al., 2013), (Cheng & Li, 2005), (Badri et al., 2001), (Jiang & Klein, 1999b), (Meade & Presley, 2002), (Messerle et al., 2013)
Policy and Legislation	Legal restrictions; existing patents; political environment	(Dutra et al., 2014), (Mohanty, 1992), (Schenkl et al., 2013), (Cheng & Li, 2005), (Okpala, 1991), (Puthamont & Charoenngam, 2007), (Jiang & Klein, 1999b), (Meade & Presley, 2002), (Messerle et al., 2013)
Suppliers	Availability of suppliers; need to develop partnerships	(Schenkl et al., 2013)
Environmental considerations	Public relations; environmental protection; geographic location; health and safety	(Cheng & Li, 2005), (Meade & Presley, 2002)
Product Description	Features that give visibility to the project and help determine its viability	(Dutra et al., 2014)
Benefits	Points out the direct benefits to the company, the benefits for society and the environment, and the intangible and extended benefits that will be achieved with the project implementation	(Dutra et al., 2014)
Competition	Assess the conditions of the competitors	(Okpala, 1991)
Core Competencies	Assess the availability of skills required for project implementation	(Messerle et al., 2013)
Risk	Project risk consideration and its relation to the benefits	(Mohanty, 1992), (Cheng & Li, 2005), (Badri et al., 2001), (Jiang & Klein, 1999b), (Archer & Ghasemzadeh, 1999)

TABLE 6. References of Important Aspects for Interviews

Criteria Relevance	Description
1	Very Low Relevance
2	Low Relevance
3	Moderate Relevance
4	High Relevance
5	Very High Relevance

TABLE 7. Graduation of Criteria Relevance

Jiang and Klein (1999), while researching the importance of project selection criteria, find that the criteria vary according to the strategic posture of the organization. Therefore, it is suggested that the criteria be reassessed with regard to the priority scale whenever there is a change in the strategic direction of the company.

For defining the prioritization criteria, executives must use a graduated scale from “1 - Very Low Relevance” to “5 - Very High Relevance”, as shown in Table 7. The relevance should be evaluated according to the criteria’s adherence to the strategic approach of the company.

The application of this priority scale is based entirely on the perception of the executives regarding the degree to be assigned and is therefore entirely subjective. This subjectivity is not a factor that introduces more or less risk into the process, as the foundation of it is the tacit knowledge of the executive, which is a prerequisite for his or her position.

The list of criteria, fully refined and understood by experts, will be translated into project attributes and operational actions in the product development process, after each criterion has been considered separately. For this activity, a study group with expert engineers and product designers is formed. It is suggested that members of the study group be from different departments related to product development, e.g., sales, marketing, engineering, and development. Thus, the dynamics also serve as an integration process and strengthens the links of the product development.

It is suggested to use quality function deployment (QFD), which is a structured method that aims at deploying the “voice of the customer” (Mehdizadeh, 2010; Carnevalli et al., 2004).

For the purpose of this guideline, QFD will be used only in its first deployment, i.e., the House of Quality, in which the “voice of the customer” will be represented by the list of grouped criteria resulting from the previous step in the process.

Based on the “voice of the customer”, experts will advance in the deployment with the “voice of design” using the brainstorming or brainwriting application methods or another method that would better fit the participants’ expertise. In this dynamic, the group runs through each criterion of the list and suggests, individually, an attribute that would reflect the criterion in the product development process.

This practice is repeated for three or four rounds. Each expert will suggest three or four attributes that must be reviewed and may be included, combined to form another one, or rejected and discarded. This way, the group goes through the entire list of criteria and formats the “voice of design”. A configuration of the QFD used for this development is presented in Figure 1.

According to Figure 1, executives, identified by CEOs, define the criteria for the selection of strategic projects in design. These populate the “WHAT” portion of the QFD. The deployment step, represented by the project attributes and actions in the development process, which is generated based on the criteria translation, make up the “voice of design”, representing the “HOW” portion of the QFD.

Based on the lists of grouped and classified criteria, experts must make two assessments: a) how the criteria can be translated and b) how to show that the project/process has the features that represent the criteria being evaluated. The answers to these questions define the list of project attributes and operational actions that reflect the criteria and include them in the development process.

In step 3 of the method, the need for an evaluation of the project environment is observed along with attributes’ identification in the search for similarities and/or redundancies. In case any are identified, the attributes should be grouped into one to simplify the steps of the deployment process. Either one or another con-

dition will be identified by the content of the information provided by experts when they explain their point of view about each of the attributes during the criteria translation.

Taking attributes lists as a reference, and based on the descriptions provided by experts, this activity examines whether the attributes are similar to each other, thereby creating redundancy. The main benefits that are obtained from processing this step are: a) defining significant IDs for attributes, b) deepening the understanding of the meaning of each attribute, and c) grouping attributes to reduce their number and simplify the following processes.

Furthermore, with the application of QFD, considering the first deployment (*the House of Quality*), the relationship matrix denotes the force between the “voice of the customer” and the “voice of design” (*Iqbal et al., 2014*), which is exactly the purpose of this stage of the process. At this stage, we

seek to identify the existence of the relationship between the criteria and the attributes.

Experts should analyze one attribute at a time and compare it with all the criteria, also one at a time. The degree to be assigned to the relationship follows what is shown in **Table 8**, under the condition that no relationship between the items under review is established, and none is assigned.

TABLE 8. Relationship Between Criteria and Attributes

Relationship	Description
V	Strong Relationship
X	Weak Relationship

Understanding the relationship between criteria and attributes is important to assess how the criteria are represented in the development process, beyond the vision that one had when he/she proposed the attributes during deployment. With this view, it can be

understood how robust the deployment process is. Upon analyzing this process, it can be inferred that the more links exist between criteria and attributes, the denser the matrix relationship will be and the more robust the development environment with respect to meeting strategic objectives will be.

Representing the roof over the House of Quality is half an array of the interrelationships among the attributes of the project environment. **Table 9** shows the symbols that are assigned in the evaluation of the interrelationships of the attributes of the project environment.

TABLE 9. Relationships Among Attributes

Relationship	Description
+	Positive relationship
-	Negative relationship

This process step assesses the impact of an improvement in an attribute on another set of attributes. The allocation of a positive (+) interrelationship occurs when an improvement in one attribute causes an improvement in the set of attributes. On the other hand, the assignment of a negative (-) interrelationship occurs when an improvement in one attribute causes the deterioration of another one (*Zhang et al., 2014*).

The evaluation of the interrelationships among attributes aims to capture the attention of experts in order to develop adequate mechanisms to mitigate the harmful effects that improvements in one attribute can have on another. With the completion of this stage comes the conclusion of the information gathering for the deployment of criteria and the selection of strategic projects in design.

The presentation stage closes the deployment process and provides the entire product development environment guidance regarding the criteria by which projects will be evaluated. Moreover, the material available presents a list of items that translate the criteria into the development team’s understanding. This reveals the design vision of the criteria used by executives in evaluating the project development process. Based on this list of attributes and operational actions in the development environment, new projects will be developed, and the approval process will be simplified because the criteria will be reflected in both the product and the process.

Final comments on the method

The method presented was developed for implementation in environments focused on innovation, where there is the perception that design is a distinguishing element of the process and that the nurturing of creativity can improve competitiveness. This method is innovative by itself because there is no reference to another method that has focused on the deployment of the criteria for the selection of strategic projects in design. Therefore, the organization will use the method in a product development environment in a consistent, innovative process.

As the method is totally dependent on the strategic positioning of the organization, and because the criteria aim to select projects that implement strategies, it is advisable that the process be re-evaluated whenever there is a change in the company’s strategic planning. As any continuous improvement process, the method needs to enter a cyclical process of the maintenance/updating of its variables, criteria and attributes to maintain its value-adding potential for the organization. **Figure 14** summa-

rizes the steps for the method application in a product development environment.

6. Final considerations

This study began with the consideration that innovation, design and competitiveness compose the work background, providing a strategy, an agent and a goal, respectively. It was also considered that companies have a major challenge, which is to strengthen the potential of innovation increasingly within their structures by means of a culture for this discipline (*Linde & Herr, 2009*) and that this potential for innovation is directly linked to the degree of contribution of the design (*Mozota, 2003*).

In this context, where companies seek to build an environment conducive to innovation, design activities are presented as a promising approach (*Le Masson et al., 2010*), and the strengthening of these two disciplines can promote competitive advantage (*Moon et al., 2013; Carayannis & Coleman, 2005; Bruce & Bessant, 2002*). Based on these considerations, the study was oriented to develop an innovative process with design-oriented dynamics so that the results could promote an environment in which the company could expand its potential to generate results that could eventually be converted into greater potential for competitiveness.

Based on the approaches presented by Bruce and Bessant (2002) and completed by the understanding of Linde and Herr (2009) and Kumar (2012), it was assessed that the quest to achieve and sustain a strategic position establishes the need for a model that initially must be a process that further develops into a culture. Thus, this research developed the innovation at a level that the surveyed companies so far have not considered directly in internal processes. This strategy adheres to what was suggested by Moon, Miller and Kim (2013) with regard to the need to consider new internal paradigms in the pursuit of strengthening the product development process.

In addition, this study sought to approximate the design to the management environment; to do so, guidelines were identified to promote the development of the process iter-

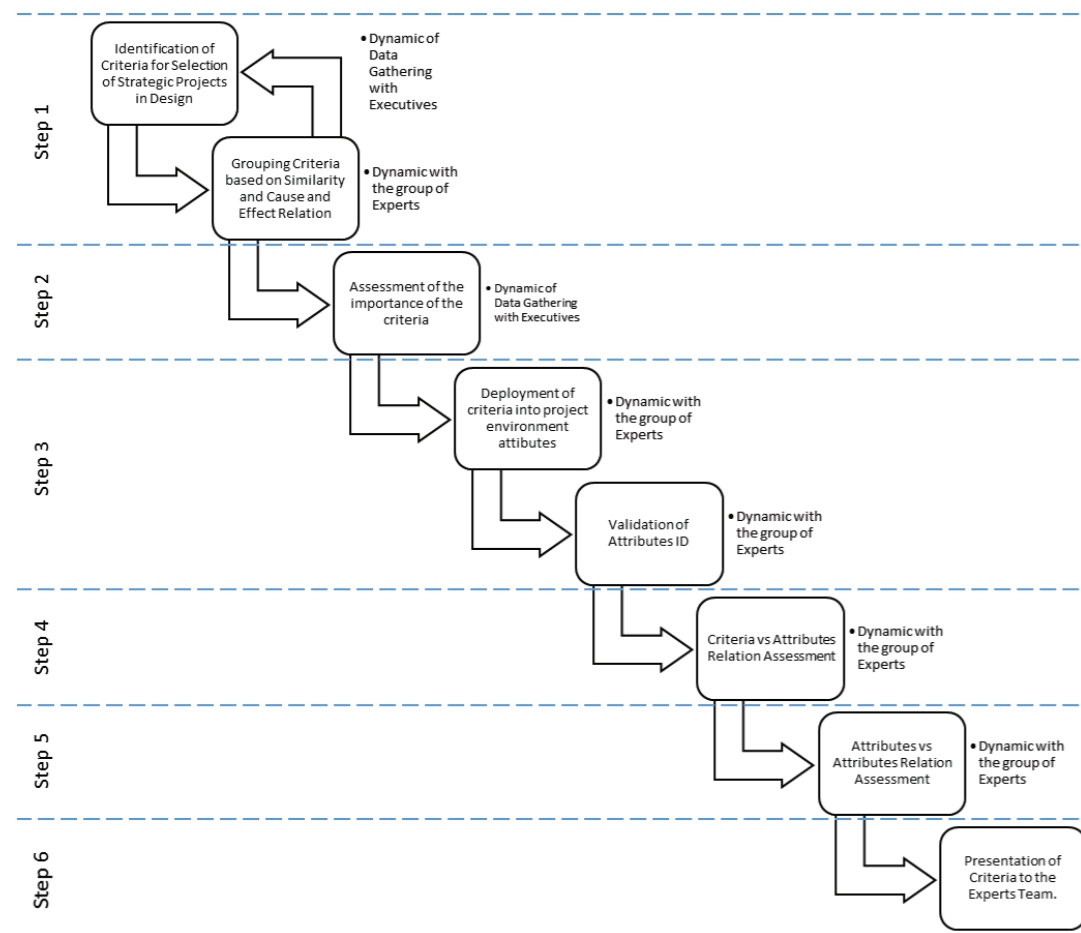


FIGURE 14. Method for Criteria Deployment

actively between these dimensions. The activities developed over the selection of strategic projects in design and were treated in the same way as they are by the scientific literature in the field; there was nothing specifically defined for business.

Beginning in the first stage of development, in which interviews were conducted with executives, a total lack of method was noted. Even after a contextualization took place, when executives were questioned about what was considered important for selecting the strategic projects in design, they were doubtful about what the real scope of the question was. Although the companies claimed that design is an important factor and a differential, the potential of the design, or its influence factor, did not receive special attention.

In the companies studied, the recognition of the design was not shown as the force for the development to be achieved (*as postulated by Chiva and Alegre, 2007*), as important to obtain strategic success (*as discussed by McBride, 2007*), or for giving support to the change management (*as discussed by Mozota, 2003*). In this environment, design has not received the necessary attention so that the company can make use of its potential to transform aspirations into possibilities (*as quoted by Bruce and Bessant, 2002, p. 64*). These findings are based on the absence of the design being approached by the executives during the interviews.

This stage of data collection aimed at capturing the aspirations of executives with regard to the strategic projects in design to transform them into something achievable through the development of design activities. The set of criteria drawn from interviews was supported by the literature, except for the CR4 criterion - Have Design (*Form and Function*), which is design specific. However, compared with other sets also found in the literature, it was noted that there were many gaps that may indicate a flaw in the selection process. Criteria such as “Risk”, quoted by Mohanty (1992) and Cheng and Li (2005), and “Relationship Risk / Return”, quoted by Badri, Davis and Davis (2001), Jiang and Klein (1999b) Archer and Ghasemzadeh (1999), show a major analysis to be performed in all projects because the failure to consider the risk can determine the failure of the project and generate significant losses for the organization.

The absence of criteria—such as those mentioned above and many others, such as those from

interviews and those treated in the literature—is probably due to lack of a method for project selection process. The lack of interaction in the process between executives and designers is probably the cause of this gap in the set of criteria, which is worsened by the lack of interaction between these levels of the business, thus preventing the set of criteria from evolving and ensuring more robustness to the process of selecting strategic projects in design.

However, this set of criteria that emerged from the companies studied is not complete, from the point of view of the issues raised by other assemblies, e.g., those presented by Messerle, Binz and Roth (2013). However, it has fulfilled its role of selecting the strategic projects in design appropriate for achieving the strategic objectives because all companies have a good reputation in the market and have been in business for a long time. Although incomplete, compared to most sets studied in the literature, the set of criteria shows strategic direction, addressing aspects of the project, business, competition, market and consumers.

The interview process in which the design goes to the management and oxygenates the decision process for selecting strategic projects in design strengthens the differentiation factor inherent in the design and creates a communication channel that brings the two business dimensions together by a method that works very closely with the strategic issues of the organization (*Petersen et al., 2011; Fraser, 2007; Karjalainen & Salimäki, 2004*). This approach seeks to reduce the complexity of the decision-making process so that by overcoming the difficulties, it can contribute to competitive advantage, as discussed by Borja Mozota (2003). This approach overcomes barriers that impose difficulties of dynamism on the global environment of the organization (*Moon et al., 2013*).

The interview dynamics can strengthen the sense of importance of design in the decision-making process as it simultaneously strengthens the entire organization’s project selection process. With this approach, the design fulfills the generation of the function and communication of ideas for generating a new process model, which can develop into a new mental model (*Kumar, 2012; Linde & Herr, 2009; Bruce & Bessant, 2002*).

As for the criteria for the selection of strategic projects in design, it is observed that these are an individualized expression and dependent of the executive vision. Therefore, the criteria are not common to businesses and change depending on the context, the experience of the executive, and the business strategy, among many other variables.

Upon analyzing those studied models, it is observed that even in situations where the criteria are defined based on the scientific literature (*although there are no criteria that address design projects*), the interpretation of the executive is what makes the difference. This happens probably because the selection process is directly linked to the definition of projects to serve a strategic purpose, which in turn is defined by the executive and is dependent on his or her own view about the business in the market context.

The consideration that knowing the criteria for project selection is very important but insufficient for the product development process to benefit from it fosters the understanding of how the criteria affect the way projects were developed. This process was identified by the “deployment of the criteria for the selection of strategic projects in design into project attributes and operational actions.” The tool used for this step was the QFD.

The application of QFD provided reflections on how the solutions would effectively meet the need for information on the criteria during the product development process. During the application of QFD, the moments thinking about the process represented a profound reflection on how the product development takes place in the organization.

This dynamic assured the development teams part of the control over the selection process as they knew in advance the criteria and how to represent them in proposals for new developments, thus increasing the project approval possibilities in the selection process. Likewise, the dynamic promoted closer contact between the design and the management because during the iterations for grouping criteria and in the generation of the guidelines for the definition of weights, there was a collaborative process between disciplines that enlarged both functions through the exchange of experience and cooperation to improve the overall process. When establishing the guidelines, this iteration condition was further strengthened.

As a result of this research, a set of guidelines for the deployment of criteria for the selection of strategic projects in design was proposed. They were presented in a progressive linear shape but may, at any time, adopt an interactive behavior to implement a correction, an improvement or an enhancement of the intermediate results achieved in the process. The guidelines are general and have the potential to be implemented in any environment because they take into account the individualized vision of the executive and the development team, those who know the company and its market segment.

As a byproduct of this study, it can be considered that there was a great exchange of experience and information between companies and their experts and the constitution, though informal, of an environment conducive to the maintenance of this condition. This behavior favored the progress of the activities of study groups and showed that it is possible that the paths traced by the guidelines are followed within an organization because they were covered together with different companies and rendered positive results.

Finally, it is observed that the guidelines presented for the criteria development for the selection of strategic projects in design, as a result of this research, have the potential to reduce the distance among design, management and business strategy by supporting the achievement of strategic objectives through proposing more complete design projects. Ultimately, the process developed in this study bridges business strategy objectives and product development.

This approximation occurs because of the strategic side of design that, through deployment, translates the criteria for the selection of strategic projects in design into project attributes and actions in the product development process. Thus, it becomes possible to guide them in developing a new product according to the executives’ expectations.

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