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KEY ISSUES IN GLOBAL TECHNOLOGICAL INNOVATION PROJECTS

QUESTÕES FUNDAMENTAIS NA INOVAÇÃO TECNOLÓGICA DE PROJETOS GLOBAIS

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RESUMO

Este artigo procurou identificar as questões estratégicas que estiveram presentes nos projetos globais conduzidos por empresas multinacionais brasileiras e quais critérios de desempenho esses projetos atenderam. Nós investigamos 36 projetos globais de inovação tecnológica de empresas multinacionais brasileiras por meio de uma *web-survey*. Os resultados mostram que essas empresas foram além do tradicional triângulo de ferro para avaliar seus esforços tecnológicos e consideraram dimensões adicionais de desempenho como a satisfação do cliente, os resultados do negócio e a preparação para o futuro. Os resultados também demonstram elevado grau de presença para questões que emergiram da indústria, moderado grau de presença para questões que emergiram do projeto e das atividades de P&D e baixo grau de presença para questões que emergiram da matriz, das subsidiárias e do ambiente externo. Pesquisa adicional é necessária para se identificar se e como essas questões influenciaram o desempenho dos projetos globais de inovação tecnológica estudados.

Palavras-chave: Projetos Globais; Questões Estratégicas; Desempenho do Projeto.

KEY ISSUES IN GLOBAL TECHNOLOGICAL INNOVATION PROJECTS

ABSTRACT

This article aimed to identify those issues that were present in global technological innovation projects carried out by Brazilian multinational companies and which performance criterions these undertakings met. We investigated 36 global technological innovation projects from Brazilian multinational enterprises through a web-survey. Findings show that these companies went beyond the traditional iron triangle to evaluate their technological efforts and considered additional performance dimensions such as customer satisfaction, business results, and preparation for the future. Results also show high degree of presence for issues emerging from the industry, moderate degree of presence for issues emerging from both the project and R&D activities, and low degree of presence for issues emerging from the headquarters, the subsidiaries, and the external environment. Further research is needed to find out if and how these issues influenced the performance of the global technological innovation projects studied.

Keywords: Global Projects; Strategic Issues; Project Performance.

1 INTRODUCTION

The internationalization of R&D is said to be an important step for a company to be globally competitive. Much has been studied on how companies go global and how R&D supports this process. This theme has been extensively explored from the perspective of multinational companies from developed countries although only a small number of studies addressed this subject from the perspective of multinational companies from emerging economies. Moreover, the internationalization of R&D has been widely investigated at an economical, industrial, and firm level but not at the project level, especially with regard to technological innovation projects.

As companies increase the exposure to international markets by performing a variety of activities overseas, their projects also cross borders (PMI, 2000). Even though becoming global is not a necessary condition to be successful (Porter, 1980), global operations may benefit companies in several ways. On the other hand, the internationalization of R&D itself does not assure the organization's skills to innovate (Von Zedtwitz & Gassmann, 2002) neither the quality of innovative outputs (Singh, 2008).

Taking into account that technological innovation efforts are conducted through projects and global projects are much more complex than those carried out domestically, standard project management practices do not seem to be sufficiently good to efficiently manage them. Besides this limitation, it is of great importance to emphasize the action of strategic issues, which according to Cleland (1999) involve those internal and external conditions that exert pressure on the project. Considering that global technological innovation projects are assumed to be one of the means by which multinational companies achieve global competitiveness and share knowledge and learning, it seems to us that there is an open question regarding how they manage these projects. Therefore, this work aims to analyze the internationalization of R&D at the project level by identifying those issues that are present in global technological innovation projects and those project performance dimensions that these projects are likely to meet.

2 THEORY REVIEW

2.1 THE GLOBALIZATION OF R&D

The intensification of globalization has motivated market dispersion, and as a result of that, companies have spread their assets over several locations (Bardhan, 2006), however the globalization of R&D is not fully accepted in multinational companies yet (De Meyer & Mizushima, 1989; Von Zedtwitz & Gassmann, 2002). The notion of globalization of innovation has emerged between the increasing integration of economic activities and the greater relevance of knowledge to economic processes (Archibugi & Iammarino, 2002).

The need for organizing the multinational corporation to face the challenges of the global competitive environment has been increasingly calling for the scholars and practitioners' attention. Although there is no consensus concerning the best form to organize, relevant proposals include the multifocal multinational corporation (Prahalad & Doz, 1987), the transnational corporation (Bartlett & Ghoshal, 1989), the born global firm (Knight & Cavusgil, 1996), the differentiated network (Nohria & Ghoshal, 1997), and the metanational corporation (Doz, Santos, & Williamson, 2001).

As the coordination of R&D activities strongly affects the global strategic positioning of the multinational corporation (Zou & Ozsomer, 1999), the importance of the management of innovation augments as the organization faces the challenge of establishing a global strategic positioning that allows meeting both local and global demands. Hence, R&D challenges mainly encompass the evaluation of new knowledge, the motivation of laboratories and functional areas to mutually collaborate, the management of complexity in global projects, and the optimization of ways to innovate (Goldbrunner, Doz, Wilson, & Veldhoen, 2006). Additionally, the majority of challenges related to the globalization of R&D involve how the organization defines structures, processes, and mechanisms that facilitate decisions concerning new knowledge, new technologies, and new products (Von Zedtwitz, Gassmann, & Boutellier, 2004).

2.2 GLOBAL TECHNOLOGICAL INNOVATION PROJECTS

Innovation projects are the means by which the company manages its efforts with regard to new technology and product development and advances in the existing ones to serve the markets it is in. These efforts aim to improve the organization's operations to strengthen its competitiveness

and normally include product and process innovation. Although, following the Oslo Manual (OECD & EUROSTAT, 2005), marketing and organizational innovations can also be considered as innovation categories.

R&D projects differ from other projects the organization conducts especially due to the uncertainty related to scope, time, cost, and quality, among other dimensions featuring projects. Then, the perception of the benefits associated with the employment of project management techniques increases as the uncertainty decreases (Lambert, 1993). However, R&D project managers are required to make decisions without sufficient information (Hosley, 1993). Therefore, the employment of traditional project management techniques to technological projects may be harmful because these practices are not appropriate to them since they are high-risk undertakings, full of unknowns and technical uncertainties (Cooper, 2006). In spite of that, there is certain neglect on how to manage and structure global R&D projects (Chiesa, 2000).

Global project and international project terms appear interchangeably in the project management literature. Cleland (2006) suggested that global projects are those whose stakeholders are geographically dispersed in several countries. For Kerzner (2001), global projects are those that cross borders. Cleland and Ireland (2002) added that in global projects team members work for several organizations in a number of countries and there are challenges concerning costumes, cultures, and practices that emerge due to border crossing. Lientz and Rea (2003) argued that international projects are those that involve many locations, entities, organizations, and business units. Therefore, there is no precise frontier between the concepts of global and international projects. More important than that is how they are characterized and how this brings complexity and makes their management more difficult. Among a variety of global projects features, we emphasize the exposure to different kinds of risks, cultural differences among team members and partner organizations, increasing use of virtual and geographically dispersed teams, influence of stakeholders situated all over the world, and difficulties in sharing knowledge and training people.

2.3 PROJECT PERFORMANCE

Project performance criterions are the means by which companies measure and assess project outcomes. Initial works on project performance essentially considered schedule, cost, and technical performance (Pinto & Slevin, 1988; Cleland & Ireland, 2002), the so called iron triangle. Later, the customer satisfaction (Pinto & Slevin, 1988; Darnell, 1997) and stakeholder (Westerveld,

2003) dimensions were added to the list. By studying 200 cases of new product development in 125 organizations, Cooper and Kleinschmidt (1987) identified 10 success measures that they classified into financial performance, window of opportunity, and impact on market dimensions.

Pinto and Mantel (1990) investigated 97 projects considered as failures and found out that success or failure measures should consider the implementation process, the project perceived value by the organization, and the customer satisfaction regarding the main deliverable. For Freeman and Beale (1992), the most adopted success criterions are technical performance, efficiency in project execution, managerial and organizational implications, personal growth, project conclusion, technical innovativeness and business performance, and manufacturing feasibility.

Baccarini (1999) employed the Logical Framework Method to discuss project success and pointed out four levels of project objectives: goal, purpose, outcome, and insight. Andersen, Birchall, Jessen and Money (2006) argued that project success consists of a broader view encompassing both project management success and project's product success. Shenhar and Dvir (2007) proposed a set of dimensions that seems to include the most relevant aspects previously mentioned, that they labeled project efficiency, impact on customer, impact on team, business results, and preparation for the future.

2.4 STRATEGIC ISSUES IN GLOBAL TECHNOLOGICAL PROJECTS

Strategic issues differ from critical success factors since the latter refer to those aspects to be considered in order to increase the probability of project success and the former relate to those conditions that emerge during the project life cycle and may influence project performance. Strategic issues are regarded as the most important part in international projects and when they emerge their shape and nature are not sufficiently clear (Lientz & Rea, 2003). Then, the sooner strategic issues are identified, the sooner the project team will make decisions regarding how to deal with them (Cleland & Ireland, 2002). Due to the complexities and dynamics that characterize the project, we highlight the strong potential for the emergence of discontinuities, which require the organization to develop the right competences to resolve them in a professional way (Gareis, 2006).

According to Lientz and Rea (2003), international projects are subject to the influence of four types of issues; to be precise, project issues, business issues, management issues, and external issues. When related to innovation activities, these projects are likely to involve other parties and become much more complex due to the high level of uncertainty. As they are of great importance to

support the organization in pursuing competitive advantages and strengthening its competitiveness, other sources of strategic issues may call for our attention. Hence, by analyzing the literature on project management and innovation management, we propose that global technological innovation projects in multinational companies from emerging countries may be subject to the influence of issues emerging from the (i) project, (ii) R&D activities, (iii) headquarters, (iv) subsidiaries, (v) industry, and (vi) external environment.

3 METHODS

3.1 STUDY NATURE AND METHOD

To explain the study characteristics we opted for the perspectives suggested by Emory (1980) and Cooper and Schindler (2003). With regard to its nature, this is a descriptive study, mainly because it seeks to identify the issues that were present in global technological innovation projects and the project performance dimensions companies used to measure them. In relation to its scope, this study is quantitative since it focuses on reach and not on deepness. Therefore, we aim at discovering the degree to which issues were present in the projects under analysis. As a field research, we investigated real projects conducted by Brazilian multinational companies in the business environment they compete. Hence, the present work is characterized as ex post facto since we did not control the variables and projects were subject to a variety of issues. Considering that data were collected just once, this study is cross-sectional, what means that we identified those issues present in projects in a given time and not over a period of time.

3.2 SAMPLE AND DATA COLLECTION

Through a detailed examination of rankings and lists of Brazilian enterprises, we selected those organizations with international revenues and assets abroad, ending up with a list of 103 companies. Then, we invited R&D managers and/or directors of those organizations to participate in a web survey and gave them a 90-day period to respond to the questionnaire. We received responses from 36 companies from multiple industries regarding their technological undertakings, representing a 35% response rate. The unit of analysis was the global technological innovation

project, mainly involving those companies' technological efforts, and the sample profile included projects aimed to develop new products (44%), develop new technologies (14%), improve existing products (11%), adapt existing products to serve foreign markets (8%), improve existing technologies (6%), and other projects related to production chain arrangement, emerging technology validation and production capacity expansion (17%).

Following and adapting the OECD Science, Technology and Industry Scoreboard (OECD, 2005) taxonomy we classified the executing organizations into 2 categories, namely higher (53%) and lower (47%) technological intensity. The higher technological intensity group comprised companies from the industrial automation, road implements, electro electronics, automotive, chemical and petrochemical, machinery and equipment, pharmaceutical and cosmetics and aeronautics industries. The lower technological intensity group consisted of companies from the construction, mining, furniture, retail, metallic packing, pulp and paper, food and beverages, rubber products, financial services and steel industries.

3.3 MEASURES AND FIELD PROCEDURES

3.3.1 DEPENDENT VARIABLE

Project performance is a widely discussed subject in the project management literature, and as a result, many criterions are used to measure that. We adopted the dimensions suggested by Shenrar and Dvir (2007), which are (i) project efficiency, (ii) impact on customer, (iii) impact on team, (iv) business results, and (v) preparation for the future. We presented questions to respondents and asked them to indicate to what extent the selected project met each criterion. To do so, we used a 7-point likert scale in which the score 1 meant low extent and 7 meant high extent.

3.3.2 INDEPENDENT VARIABLE

The independent variables were defined as issues in global technological innovation projects. We based these variables upon Lientz and Rea's (2003) work, which suggested that issues in international projects may be categorized into four groups: (i) project issues, (ii) business issues, (iii) management issues, and (iv) external issues. As our research specifically addresses technological innovation projects, we adapted and upgraded Lientz and Rea's typology and created

our own set of variables to study this kind of project. Therefore, we classified issues in global technological innovation projects into six groups: (i) project issues, (ii) R&D issues, (iii) headquarters issues, (iv) subsidiary issues, (v) industry issues, and (vi) external issues.

For each of the six groups we presented a block containing 9 questions representing issues with potential to surface in global technological undertakings. These issues were identified through a carefully analysis of the literature on project management and globalization of R&D. Then, we asked respondents to indicate to what extent the listed issues were present in global technological innovation projects. To do so, we used a 7-point likert scale in which the score 1 meant low degree of presence and 7 meant high degree of presence.

3.4 MAIN LIMITATIONS

In spite of our best efforts when designing and carrying out this research, we acknowledge that there are some limitations with respect to the unit of analysis, the sample representativeness, and the data collection and analysis processes. Even though we explained to respondents that the unit of analysis was the global technological innovation project and what it was, they may have had a different understanding on this kind of project.

We carefully prepared the questionnaire and sent it to target people, although the responses we received may not exactly reflect their opinion due to a variety of factors such as the type of question (multiple choice with space to add comments), scale (7-point likert) and vehicle (web survey) used and who actually gave the answers, just to name a few. Regarding the process of analysis, limitations may come from the application of statistical techniques due to data characteristics and researcher's biases in the interpretation of results.

4 DATA ANALYSIS

We carried out a descriptive analysis in order to describe and organize data collected. By adopting a 7-point likert scale, we emphasized that an ordinal level of measurement characterized the variables observed. We assumed that discrete observed data came from a subjacent continuous distribution, which has been labeled by Muthén (1983, 1984) and Flora and Curran (2004) as a latent response distribution. Following Flora and Curran (2004: 467), "the relationship between a

latent response distribution, y*, and an observed ordinal distribution, y, is formalized as y = c if $\tau_c<y^*<\tau_{c-1}$ with thresholds τ as parameters defining the categories c = 0, 1, 2, … C – 1, where $\tau_0 = -\infty$ e $\tau_c = \infty$." Therefore, they argued that when a latent response variable y* goes beyond a threshold τ, the observed ordinal value for y will change.

As a result of the previous discussion, the quantile estimation using sample quantiles did not seem to be appropriate. To get the most out of the quantile estimation we calculated the pseudo-quantiles through R's monash pack, which is based upon the Schmeiser and Deutsch's (1977) work and considers the cell midpoints for grouped data to estimate quantiles. This is how we obtained the median values and interquartile intervals – si (difference between the third and first quartile) showed in the following tables.

4.1 DEPENDENT VARIABLES

Table 1 shows that all variables representing project performance dimensions had large median values. The largest median value observed was 6.42 and refers to the variable PPD3 (meeting of customer's requirements) and the smallest median score was 4.17, which relates to the variable PPD6 (synergy creation among foreign units). High frequencies were observed for moderate (scores 4 and 5) and high levels (scores 6 and 7) regarding the utilization of the criterions listed to measure the performance of projects under investigation. For the variable PPD3 (meeting of customer's requirements), we observed the frequency 47.22% with regard to the score 7 and 36.11% to the score 6.

Table 1- Frequency distribution (%) for project performance dimensions.

DEGREE OF PRESENCE	PPD1	PPD2	PPD3	PPD4	PPD5	PPD6	PPD7	PPD8	PPD9	PPD10	PPD11	PPD12
1	2.78	2.78		2.78		27.78	2.78	2.78	2.78	5.56		
2	5.56	2.78				11.11	2.78	5.56	8.33	5.56	13.89	5.56
3	8.33	2.78			5.56	5.56	5.56	8.33	2.78		8.33	11.11
4	11.11	11.11	2.78	11.11	13.89	8.33	25.00	5.56	13.89	8.33	11.11	8.33
5	27.78	30.56	13.89	25	33.33	30.56	25.00	25.00	25.00	25.00	27.78	30.56
6	27.78	22.22	36.11	33.33	36.11	11.11	25.00	33.33	33.33	36.11	25.00	27.78
7	16.67	27.78	47.22	27.78	11.11		13.89	19.44	13.89	19.44	13.89	16.67
Mean	5.06	5.42	6.28	5.67	5.33	3.58	4.97	5.22	5.06	5.28	4.83	5.14
Median	5.30	5.50	6.42	5.83	5.42	4.17	5.06	5.58	5.39	5.65	5.10	5.32
Sd	1.55	1.46	0.81	1.26	1.04	2.05	1.42	1.57	1.55	1.61	1.59	1.42
Sir	0.98	0.96	0.62	0.83	0.72	1.91	1.00	0.86	0.93	0.81	1.15	0.85

Source: Elaborated by the authors.

Concerning the score 6 (high level), the highest frequencies were associated with the variables PPD1 (completion on schedule), PPD4 (improvement of customer's performance), PPD5 (people integration within the organization), PPD7 (improvement of organization's profitability), PPD8 (increase of organization's market share), PPD9 (contribution to shareholder's value) and PPD10 (contribution to new markets creation). Moderate level (scores 4 and 5) of employment of project performance criterions was found to be highly frequent for the variables PPD1 (completion on schedule), PPD2 (completion on budget), PPD6 (synergy creation among foreign units), PPD7 (improvement of organization's profitability), PPD11 (contribution to new processes creation within the organization), and PPD12 (contribution to organization's capabilities improvement).

Results indicate that Brazilian companies under analysis were strongly committed to their customers and did their best to deliver the project on budget and schedule. Actually, they measured the performance of their projects through several criterions, transcending the traditional iron triangle and considering much more strategic dimensions. Therefore, these companies looked beyond the project environment and tried to understand how global technological innovation projects contribute to the multinational organization's growth and help preparing the organization for the future by developing new capabilities.

4.2 INDEPENDENT VARIABLES

This topic presents and discusses the results for issues emerging from the project, R&D activities, headquarters, subsidiaries, industry, and external environment. By analyzing degrees of presence and frequencies, we identified those issues that were present in global technological innovation projects undertaken by some Brazilian multinational enterprises.

4.2.1 PROJECT ISSUES

Data from Table 2 show that median values for issues emerging from the project were around 3.0. The smallest median values were found to be associated with the variables PROJISS9 (communication problems among foreign units) and PROJISS6 (incompatibility among technologies employed in the project). For these two variables, highest frequencies refer to scores 1 and 2, initially indicating low degree of presence for the global technological innovation projects studied. Since these projects were conducted by Brazilian multinational companies, whose

internationalization process differ from that of multinational companies from developed economies, low degrees of presence for the variables PROJISS9 (communication problems among foreign units) and PROJISS6 (incompatibility among technologies employed in the project) may occur due to the centralization of R&D activities in the headquarters.

Table 2 - Frequency distribution (%) for project issues.

DEGREE OF PRESENCE	PROJISS 1	PROJISS 2	PROJISS 3	PROJISS 4	PROJISS 5	PROJISS 6	PROJISS 7	PROJISS 8	PROJISS 9
1	8.33	8.33	13.89	16.67	16.67	27.78	27.78	33.33	38.89
2	27.78	25.00	30.56	22.22	36.11	41.67	16.67	16.67	22.22
3	13.89	19.44	19.44	22.22	13.89	22.22	13.89	19.44	13.89
4	8.33	27.78	13.89	25.00	13.89	5.56	16.67	11.11	8.33
5	22.22	11.11	11.11	8.33	16.67	2.78	16.67	5.56	8.33
6	16.67	8.33	5.56	5.56	2.78		5.56	13.89	8.33
7	2.78		5.56				2.78		
Mean	3.69	3.33	3.17	3.03	2.86	2.14	3.06	2.81	2.50
Median	3.50	3.36	2.79	3.00	2.42	2.03	2.90	2.50	2.00
Sd	1.77	1.41	1.70	1.42	1.46	0.99	1.77	1.77	1.66
Sir	1.58	1.07	1.22	1.09	1.18	0.68	1.55	1.38	1.18

Source: Elaborated by the authors.

High frequencies for moderate level of presence (scores 3 and 4) were identified for the variables PROJISS2 (cost escalation due to unplanned tasks) and PROJISS4 (difficulties in determining the status of work in different locations). As these projects are innovation efforts in which uncertainty is an important component, it is likely that some adjustments will be necessary. Moreover, when carried out all over the world, these undertakings become even more complex due to a large variety of uncertainties characterizing the global competitive arena. In the case of Brazilian multinational companies, technology and product development activities are predominantly executed domestically and the role of international units is basically adapting and manufacturing products to foreign local markets where the organization competes.

With respect to difficulties in determining the status of work in different locations, it is expected that they naturally surge due to the geographic distribution of the global project's work. This may involve people from different locations, with distinct priorities, and using not fully compatible information and communication technologies. Additionally, we have to take into account how the project's work is divided up among foreign facilities and how each party manages what it is in charge of.

The centralization of R&D activities in the headquarters may also be an explanation for the low degree of presence (score 2) identified for the variables PROJISS1 (changes in project requirements), PROJISS3 (difficulties in obtaining cooperation from functional areas), and PROJISS5 (lack of abilities to work on the project) because the main decisions and resource allocation are made by those who are responsible for the innovation efforts.

4.2.2 R&D ISSUES

Table 3 shows that the largest median values for issues emerging from innovation activities were 5.00 for the variable RDISS3 (need to simultaneously manage several technological innovation projects) and 3.00 for the variable RDISS2 (project approval without consideration of other projects and efforts).

Table 3 - Frequency distribution (%) for R&D issues.

DEGREE OF PRESENCE	RDISS 1	RDISS 2	RDISS 3	RDISS 4	RDISS 5	RDISS 6	RDISS 7	RDISS 8	RDISS 9
1	27.78	19.44	11.11	19.44	41.67	36.11	27.78	44.44	33.33
2	33.33	25.00	5.56	38.89	27.78	30.56	19.44	13.89	25.00
3	13.89	11.11	11.11	19.44	5.56	11.11	16.67	13.89	11.11
4	11.11	22.22	5.56	11.11	13.89	16.67	16.67	22.22	8.33
5	8.33	5.56	33.33	5.56	5.56	5.56	13.89	2.78	8.33
6	5.56	11.11	27.78	5.56	5.56		5.56	2.78	8.33
7	5.56		5.56						5.56
Mean	2.56	3.25	4.50	2.61	2.31	2.25	2.86	2.33	2.81
Median	2.17	3.00	5.00	2.29	1.80	1.95	2.67	1.90	2.17
Sd	1.50	1.84	1.76	1.38	1.55	1.27	1.61	1.45	1.92
Sir	1.05	1.33	1.28	0.86	1.20	1.03	1.38	1.28	1.46

Source: Elaborated by the authors.

Concerning the variable RDISS3 (need to simultaneously manage several technological innovation projects), the frequencies of 33.33% for the score 5 and 27.78% for the score 6 indicate a high degree of presence associated with the need of investigated enterprises for simultaneously managing several technological undertakings. These numbers reinforce the importance of these projects to the competitiveness of Brazilian multinational companies. More specifically, we believe that technological innovation projects are the means by which these organizations develop new technologies and products, and improve the existing ones to serve domestic and foreign markets where they compete.

With frequencies of 22.22% for the score 4, 11.11% for the score 3, 25.00% for the score 2, and 19.44% for the score 1, the variable RDISS2 (project approval without consideration of other projects and efforts) shows a moderate level of presence although with a tendency to low level, regarding the fact that some projects are approved without the careful analysis of other technological efforts. Actions like this may result from the accelerated internationalization process of Brazilian multinational companies who seek to increase their presence in foreign markets and build the required capabilities to obtain competitive advantages. As a result of that, the approval of innovation projects tends to support the internationalization process of the firm by taking advantage of emerging market opportunities.

We highlight a low degree of presence, revealed by the high frequencies for the score 1 for the variables RDISS5 (inappropriate involvement of suppliers, users, and partners), RDISS6 (need to register intellectual property in several local markets), RDISS7 (difficulties to allocate resources for innovative activities due to uncertainty), RDISS8 (lack of alignment between project strategy and business strategy) and RDISS9 (organizational restructuring in areas involved with R&D activities) and for the score 2 for the variables RDISS1 (reduction in R&D performance due to global dispersion of its efforts) and RDISS4 (undefined or ambiguous technological trajectory).

However, the low degree of presence evidenced by high frequencies for scores 1 and 2 does not mean that R&D issues are not present in global technological innovation projects but suggests that they are not sufficiently present so as to affect their performance. Possibly, these organizations acknowledge the importance of carrying out innovative activities to become more competitive and have well defined technological policies to support new technology and product development.

4.2.3 HEADQUARTERS ISSUES

Data from Table 4 show that all median values were relatively small and the largest ones were 2.00 and 1.88 for the variables HEADISS5 (centralization of R&D activities in the headquarters hinders the involvement of foreign units) and HEADISS2 (approval is centralized in the headquarters without the involvement of subsidiaries), respectively. For the variables HEADISS3 (headquarters do not give the project leader sufficient authority to resolve strategic issues when they arise) and HEADISS4 (headquarters lose interest in the project due to other commitments), the median values were 1.50. Evidences suggest that headquarters' interests prevail over those of subsidiaries what may happen because of either the former's need to strategically control technological activities or its inefficient management.

Table 4 - Frequency distribution (%) for headquarters issues.

DEGREE OF PRESENCE	HEADISS 1	HEADISS 2	HEADISS 3	HEADISS 4	HEADISS 5	HEADISS 6	HEADISS 7	HEADISS 8	HEADISS 9
1	63.89	41.67	50.00	50.00	38.89	52.78	52.78	69.44	72.22
2	25.00	22.22	16.67	30.56	22.22	27.78	13.89	5.56	5.56
3	2.78	13.89	13.89	11.11	16.67	5.56	16.67	5.56	8.33
4	5.56	11.11	8.33	5.56	11.11	5.56	5.56	8.33	2.78
5	2.78	5.56	2.78	2.78	8.33	8.33	2.78	8.33	5.56
6	5.56		8.33				5.56	2.78	2.78
7					2.78		2.78		2.78
Mean	1.58	2.33	2.22	1.81	2.39	1.89	2.19	1.89	1.83
Median	1.28	1.88	1.50	1.50	2.00	1.45	1.45	1.22	1.19
Sd	1.00	1.53	1.61	1.04	1.54	1.26	1.67	1.53	1.61
Sir	0.53	1.10	1.05	0.66	1.10	0.66	1.01	0.82	0.58

Source: Elaborated by the authors.

For the remaining variables, HEADISS1 (problems in foreign subsidiaries do not receive appropriate support in the headquarters), HEADISS6 (changes in organization's corporate strategy), HEADISS7 (conflicts with or among stakeholders impede project progress), HEADISS8 (organization is acquired, engages Joint Venture or participates in alliances) and HEADISS9 (lack of a Project Management Office hinders the management of several projects), the smallest median values were nearly 1.00. A global technological undertaking must have a proper place within the organization, with definite purposes and resources, and just not be subject to management's short-term view and lack of ability to support this kind of innovative effort. The low median values for these variables indicate that multinational companies have a clear understanding of their global technological innovation projects and do their best to improve the performance of them.

The score 1 has clearly been the most selected by respondents with regard to issues that emerged from the headquarters. The highest observed frequencies were 72.22% and 69.44% for the variables HEADISS9 (lack of a Project Management Office hinders the management of several projects) and HEADISS8 (organization is acquired, engages Joint Venture or participates in alliances), respectively. Also for score 1, the lowest frequencies were 38.89% and 41.67% for the variables HEADISS5 (centralization of R&D activities in the headquarters hinders the involvement of foreign units) and HEADISS2 (approval is centralized in the headquarters without the involvement of subsidiaries), respectively.

As all median values were less than or equal to 2.00 and all accumulated frequencies were greater than 61% (for scores 1 and 2 taken together), issues emerging from the headquarters are seem to have low degree of presence in those global technological innovation projects studied.

Once more, the centralization of R&D activities in the headquarters seem to be a plausible explanation for the low degree of presence of issues, although the largest median values for the variables HEADISS5 (centralization of R&D activities in the headquarters hinders the involvement of foreign units) and HEADISS2 (approval is centralized in the headquarters without the involvement of subsidiaries) suggest that headquarters may limit the organization's potential to innovate.

4.2.4 SUBSIDIARY ISSUES

Table 5 shows that the largest median value observed was 2.25 for the variable SUBSISS3 (need for sharing critical resources) e and the smallest was 1.25 for the variable SUBISS6 (inappropriate way to handle strategic issues that affect only the project work that is carried out in the subsidiary). All other values were less than 2.00. The score 1 was by far the most selected concerning the degree of presence along the subsidiary issues variables, with the highest frequency (66.67%) for the variable SUBSISS6 (inappropriate way to handle strategic issues that affect only the project work that is carried out in the subsidiary) and the lowest (41.67%) for the variable SUBSISS3 (need for sharing critical resources). These data suggest that even though the subsidiary only executes a small part of the project's work, resource sharing is an issue since foreign facilities are responsible for managing both local routines and project's tasks.

Taking together the scores 1 and 2, the lowest frequency observed was 52.78% for the variable SUBSISS3 (need for sharing critical resources) and the highest was 77.78% for the variable SUBSISS9 (high turnover rate of staff in subsidiaries). As the frequencies for all other subsidiary issues fall into this interval, data indicate that this kind of issue is present to a low degree in the global technological innovation projects analyzed. Even though their presence is not strong enough to hold management's attention, subsidiary issues may be seen as potential problems as multinational corporations move forward with the internationalization process.

Table 5 - Frequency distribution (%) for subsidiary issues.

DEGREE OF PRESENCE	SUBSISS 1	SUBSISS 2	SUBSISS 3	SUBSISS 4	SUBSISS 5	SUBSISS 6	SUBSISS 7	SUBSISS 8	SUBSISS 9
1	44.44	47.22	41.67	61.11	55.56	66.67	47.22	52.78	61.11
2	19.44	27.78	11.11	8.33	16.67	8.33	19.44	22.22	16.67
3	8.33	2.78	8.33	8.33	11.11	8.33	11.11	8.33	5.56
4	19.44	8.33	13.89	13.89	8.33	13.89	8.33	8.33	8.33

5	5.56	2.78	19.44	5.56	5.56	2.78	11.11	5.56	2.78
6	2.78	8.33	5.56						2.78
7		2.78		2.78	2.78		2.78	2.78	2.78
Mean	2.31	2.28	2.75	2.06	2.03	1.78	2.28	2.03	1.94
Median	1.79	1.60	2.25	1.32	1.40	1.25	1.64	1.45	1.32
Sd	1.49	1.77	1.79	1.58	1.50	1.24	1.61	1.48	1.57
Sir	1.29	0.74	1.70	1.13	0.90	0.81	1.11	0.76	0.71

Source: Elaborated by the authors.

Once more, the centralization of R&D activities in the headquarters appears to be the main reason for the low degree of presence for issues emerging from the subsidiaries. Considering that technologies and products are traditionally developed in the parent company's home country, the subsidiary's role is limited to manufacturing and adaptation to foreign local markets. However, it is worth to highlight the relevance of the need for sharing critical resources, since the variable SUBSISS3 (need for sharing critical resources) was given the largest median value. As subsidiaries start playing additional roles in developing technologies and products, the need for sharing critical resources may become a significant aspect to watch out.

4.2.5 INDUSTRY ISSUES

As shown in Table 6, the largest observed median value was 4.70 for the variable INDISS7 (escalation of price competition), although large values (4.25 and 4.07) were also identified for the variables INDISS8 (competitors rapidly imitate one another) and INDISS9 (emergence of new technological standards), respectively. The smallest noticed median value was 1.79 for the variable INDISS2 (alliance formation among existing competitors).

High frequencies for the moderate level (scores 3, 4, and 5) of presence were observed for the variables INDISS5 (few companies dominate the supplier industry), INDISS6 (forward integration, with clients or backward integration, with suppliers), INDISS8 (competitors rapidly imitate one another), and INDISS9 (emergence of new technological standards). Frequencies of 30.56% and 22.22% for the score 6 were detected to variables INDISS7 (escalation of price competition) and INDISS8 (competitors rapidly imitate one another) indicating high level of presence for the projects under investigation.

Table 6 - Frequency distribution (%) for industry issues.

DEGREE OF PRESENCE	INDISS 1	INDISS 2	INDISS 3	INDISS 4	INDISS 5	INDISS 6	INDISS 7	INDISS 8	INDISS 9
1	16.67	44.44	30.56	30.56	25.00	13.89	13.89	22.22	11.11
2	30.56	19.44	11.11	16.67	16.67	19.44	13.89	5.56	13.89
3	11.11	8.33	8.33	13.89	27.78	13.89	11.11	13.89	13.89
4	13.89	8.33	16.67	8.33	13.89	19.44	8.33	11.11	19.44
5	13.89	11.11	8.33	11.11		16.67	13.89	22.22	19.44
6	11.11	8.33	16.67	13.89	11.11	13.89	30.56	22.22	16.67
7	2.78		8.33	5.56	5.56	2.78	8.33	2.78	5.56
Mean	3.22	2.47	3.44	3.17	3.03	3.58	4.19	3.83	3.94
Median	2.75	1.79	3.50	2.70	2.80	3.64	4.70	4.25	4.07
Sd	1.77	1.75	2.14	2.04	1.81	1.75	2.03	1.95	1.77
Sir	1.46	1.39	2.09	1.84	1.20	1.46	1.83	1.75	1.43

Source: Elaborated by the authors.

Although we identified high frequencies for low degree of presence with relation to alliance formation among existing competitors, changes in customers' preferences and habits, appearance of new ways to commercialize products, and entry of new competitors, multinational corporations must closely track the evolution of them because the global business environment is very competitive and dynamic. Consequently, what now seems to be irrelevant may become a serious problem in a short future.

As Brazilian multinational companies compete in both developed and emerging countries, the presence of issues regarding price competition, rapid imitation, and new technological standards is an expected result. The degree of presence may vary across industries but it is supposed to be high for all of them. Price competition is believed to be very harmful since it deteriorates profit margins and companies' reputation. Some organizations are very good at imitating their competitors and run their businesses by replicating what appears to be profitable and allows rapid growth. Others invest lots of money in high-risk innovation projects to pursue breakthroughs and as a result, dominate the marketplace for a while. Anyhow, issues emerging from the industry tend to increase the rivalry among players, which makes technological innovation projects of great importance to them.

4.2.6 EXTERNAL ISSUES

Data from Table 7 show that the largest observed median value was 3.93 for the variable EXTISS2 (economic instability) and the smallest one was 1.17 for the variables EXTISS7 (forces of nature) and EXTISS8 (demographic changes). The most selected score was 1 with the highest frequency of 75% for the variables EXTISS7 (forces of nature) and EXTISS8 (demographic changes).

Table 7 - Frequency distribution (%) for external issues.

DEGREE OF PRESENCE	EXTISS 1	EXTISS 2	EXTISS 3	EXTISS 4	EXTISS 5	EXTISS 6	EXTISS 7	EXTISS 8	EXTISS 9
1	52.78	25.00	55.56	36.11	44.44	44.44	75.00	75.00	58.33
2	19.44	8.33	13.89	25.00	5.56	16.67	8.33	11.11	22.22
3	11.11	8.33	11.11	8.33	8.33	13.89	2.78	5.56	5.56
4	5.56	19.44	8.33	13.89	19.44	8.33	2.78	2.78	5.56
5		2.78	2.78	8.33	19.44	2.78	5.56		5.56
6	11.11	13.89	5.56	5.56		11.11	5.56	5.56	2.78
7	22.22		2.78	2.78	2.78	2.78			
Mean	2.14	3.97	2.17	2.61	2.75	2.53	1.72	1.58	1.86
Median	1.45	3.93	1.40	2.06	2.50	1.83	1.17	1.17	1.36
Sd	1.64	2.32	1.70	1.74	1.81	1.86	1.50	1.30	1.36
Sir	0.89	2.40	1.03	1.35	1.65	1.22	0.33	0.33	0.66

Source: Elaborated by the authors.

Low median values and high frequencies for scores representing low degree of presence for issues emerging from the external environment suggest that these issues were not sufficiently present in the global technological innovation projects conducted by Brazilian multinational enterprises.

As issues are conditions of pressure that emerge throughout the project life cycle, the largest median value for the variable EXTISS2 (economic instability) suggests that, among external issues, the economic instability is the one to be considered by the organization who is responsible for the project. In global projects that are carried out in a number of locations, economic instability is not limited to the multinational company's home country but may arise in any other country where the organization has physical presence. In addition, external issues are assumed to be very complex since the organization normally does not have any control over them. It is just a matter of reducing damages.

5 CONCLUSIONS AND FINAL REMARKS

This article aimed to identify those issues that were present in global technological innovation projects carried out by Brazilian multinational companies and which performance criterions these undertakings met.

Findings show that Brazilian multinational companies went beyond the iron triangle by considering other project performance dimensions, previously unknown or neglected, when measuring the performance of their global technological innovation undertakings. Actually, these companies tried to understand how their innovation efforts contribute to organizational growth and prepare them for the future in terms of capability building, which is one of the greatest challenges multinational enterprises from emerging economies face. Additionally, they care very much about their customers' satisfaction and also pay attention to stakeholders' interests.

Exhibit 1 shows those issues that we found to be relevant when managing global technological innovation projects. We grouped them into six categories and indicated the extent to which they were present in those projects we have investigated.

Exhibit 1 – Summary of issues in global technological innovation projects.

ISSUE CATEGORY	ISSUE DESCRIPTION	DEGREE OF PRESENCE
Project	Cost escalation due to unplanned tasks.	Moderate
Project	Difficulties in determining the status of work in different locations.	Moderate
R&D	Need to simultaneously manage several technological innovation projects.	Moderate
R&D	Project approval without consideration of other projects and efforts.	Moderate
Headquarters	Centralization of R&D activities in the headquarters hinders the involvement of foreign units.	Low
Headquarters	Approval is centralized in the headquarters without the involvement of subsidiaries.	Low
Subsidiary	Need for sharing critical resources.	Low
Industry	Escalation of price competition.	High
Industry	Competitors rapidly imitate one another.	High
External	Economic instability.	Low

Source: Elaborated by the authors.

Among those issues emerging from the project itself we highlight the *cost escalation due to unplanned tasks* and *difficulties in determining the status of work in different locations*. Innovation activities are uncertain by their own nature, what makes its management not only complex but also challenging. When carried out worldwide, a variety of difficulties arise due to the dispersion of the work to be done. A moderate degree of presence indicates that these issues deserve careful and constant assessment.

Need to simultaneously manage several technological innovation projects and *project approval without consideration of other projects and efforts* are issues that emerged from R&D activities and whose moderate degree of presence suggests the need for optimizing innovative resources and efforts. A company usually does not have sufficient resources to conduct all projects it would like to. Hence, it should be savvy and skillful in selecting those projects that are really connected with its strategies and manage some of them simultaneously when necessary.

Regarding issues emerging from the headquarters we mention *centralization of R&D activities in the headquarters hinders the involvement of subsidiaries* and *approval is centralized in the headquarters without the involvement of subsidiaries* with low degree of presence. These issues seem to reflect the internationalization process of Brazilian enterprises, especially with regard to the level of autonomy they give to their foreign units. Therefore, the organization should find out the right balance between centralization and decentralization to make it support the implementation of international strategies.

Escalation of price competition and *competitors rapidly imitate one another* were those issues emerging from the industry and whose degrees of presence were high. Due to the importance of technological innovation projects to organization's competitiveness industry issues strongly call for top management's attention. There is no recipe for avoiding industry issues, although an active posture towards the management of innovation may help the organization deal with them.

Last but not least, issues emerging from the external environment should also be considered. Among those we studied, *economic instability* is the one that requires management's attention mainly due to the reduced power the organization has to deal with that. Actually, dealing with economic instability is a matter of protecting the organization against the damages this issue may cause.

In summary, Brazilian multinational companies have been very successful in pursuing foreign markets. For some of them, technological innovation projects represent the foundations of competitiveness. Therefore, it is crucial to watch for issues emerging from the projects, R&D activities, headquarters, subsidiaries, industry, and external environment. In doing so, they will be prepared to properly approach and deal with them.

Further research is needed to analyze to what extent strategic issues influence the performance of global technological innovation projects in multinational enterprises from emerging economies and which project performance dimensions are likely to be affected. Other possibility

may be the investigation of global technological undertakings in multinational corporations from developed countries for comparative purposes.

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