

# **Influence of the Innovation Capabilities on the Innovation Performance: An Investigation in Brazilian Subsidiary of Multinational Company of the Automotive Industry**

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**ABSTRACT:** This study aims to assess the influence of innovation capabilities on the innovation performance in Brazilian subsidiary of multinational company of the automotive industry. This research was elaborated in light of theoretical excerpts, with foundation in the model presented by Müller et al. (2005), which considers the following metrics: resources, enablement and leadership. Following it, in order to demonstrate the feasibility and plausibility of the model, a multiple case study was conducted in Brazilian subsidiaries of multinational companies of the automotive industry. The research had specialists' intervention, with knowledge and experience in the innovation management field, selected by the technical and scientific criteria. The data were extracted by a judging matrix with a scale type, in which the specialists gave their opinions, establishing priorities to the variables (resources, enablement and leadership), by level of importance. In order to reduce the subjectivity in the results reached, it was used statistical techniques of Multivariate Analysis and Multi-Criteria Analysis, with the support of the *Electre III*, *Compromise Programming e Promethee II* methods. The results were satisfactory, validating the modeling approach.

**KEYWORDS:** Innovation capabilities; Innovation Performance, Assessment; Subsidiaries of Multinational Companies.

## **I. INTRODUCTION**

Recently, relevant changes have made organizational boundaries more fluid and dynamic in response to the rapid pace of knowledge diffusion (Abrahamson, 1991; Griliches, 1990; Teece, 1986), and innovation and international competition (Chesbrough and Rosenbloom, 2002; Christensen, 2003; Damanpour, 1996). This helps to reassess how to succeed using innovation (Teece et. al., 1997; Tidd et.al., 1997; Teece, 1986; Martin, Horne, Schultz, 1999; Wheelwright and Clark, 1992). Thus, innovative companies make use of their capabilities to appropriate the economic value generated from their knowledge and innovations (Griliches, 1990; Teece, 1986). Therefore, the supply of innovative products is presented as a quality standard in the race for pressing demands. It is believed that companies that can offer their products to customers more efficiently and faster will probably be in a better position to create a sustainable competitive advantage (Prahalad and Hamel, 1990; Amit and Schoemaker, 1993; Nonaka and Takeuchi, 1995; Calanton et. al., 1995) due to knowledge and innovation (Teece et. al., 1997; Nelson and Winter, 1982; Nonaka

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and Takeuchi, 1995; Leonard-Barton, 1995; Grant, 1996a; 1996b; Johannessen, Olaisen, Olsen, 1999). In this dichotomy, technical efficiency is a parameter of the developing capacity of innovative products, which translates into one of the most remarkable logical arguments to potentialize and encourage competitive advantage (Wheelwright and Clark, 1992; Brown and Eisenhardt, 1995). One of the main challenges is to develop products in high complexity environments. Solutions to these challenges have been offered by the companies' equally innovative technical capabilities, greater efficiency, productivity and high quality (Wheelwright and Clark, 1992). Deciding on an ideal balance regarding innovation activities is a complicated issue (Chen and Yuan, 2007), there are barriers to be challenged and substantially reconfigured (Assink, 2006) in order to obtain an optimal and combined convergence of the various activities in confluence with the firms' desired and acceptable performance. Innovation activities are admittedly complex and risky. Thus, it is difficult to accurately assess (Afuah, 1998; García-Muñiz and Pez Navas-Lo, 2007; Bellman and Zadeh; 1970) the innovation capacity and also discern the firms' range of acceptable performance. It is feasible to decide on a parameter, since it allows firms to offer the best combination of innovation activity strategies in agreement with their expected business results. Furthermore, promoting a firm's innovation capacity should feature the confluence of technical capacities, in order to balance the objective and subjective attributes that result from the decision-making process. There is a gap in the literature concerning the procedures/practices/mechanisms of performance assessment of the innovation management. Within this spectrum, **This study aims to assess the Influence of Innovation capabilities on the innovation performance in Brazilian subsidiaries of multinational companies of the automotive industry.** This research was elaborated in light of theoretical excerpts, with foundation in the model presented by Müller et al. (2005), which considers the following metrics: resources, enablement and leadership. Thus, this paper is structured in the following sections: Theoretical Background: Issues of Innovation; Methodology; Conceptual Model Verification and Underlying Analyses; Discussion and Implications for Management Practice; and Conclusions and Limitations.

## II. THEORETICAL BACKGROUND: ISSUES OF INNOVATION

In today's global and dynamic competitive environment, product innovation is becoming more and more relevant, mainly as a result of three major trends: intense international competition, fragmented and demanding markets, and diverse and rapidly changing technologies (Wheelwright and Clark, 1992). Firms that offer products that are adapted to the needs and wants of target customers and that market them faster and more efficiently than their competitors are in a better position to create a sustainable competitive advantage (Prahalad and Hamel, 1990; Amit and Schoemaker, 1993; Nonaka and Takeuchi, 1995; Calantone et al., 1995; Alegre, 2006). Thus, the companies must exploit their innovative capabilities to develop new businesses if they are to successfully confront the disruptive effects of emerging technologies, empowered customers, new market entrants, shorter product life cycles, geopolitical instability, and market globalization. Indeed, the development of innovative capabilities is the only means by which companies can sustain a competitive advantage.

Managers have only a vague sense of their company's overall innovativeness; they have little or no means to assess the effectiveness and efficacy of a particular innovation program. They need tools with which to diagnose impediments (Muller, Va'likangas, and Merlyn, 2005). Within this context, special attention needs to be paid to the measurement of innovation capacity performance. Burgelman et al. (2004) defines technological innovation capacity as a comprehensive set of characteristics of an organization that facilitates and supports its technological innovation strategies. Technological innovation capacity is a kind of special assets or resources that include technology, product, assets, or knowledge, experience, and organization (Guan and Ma, 2003). Lall (1992) defines technological innovation capacity as the skills and knowledge needed to effectively absorb, master, and improve existing technologies, and to create new ones. Evangelista et al. (1997) regards R&D activities as a central component of the technological innovation activities of firms and as the most important intangible innovation expenditure. Not only does successful technological innovation depend on technological capability, but it also requires other innovation capabilities in the area of manufacturing, marketing, organization, strategy planning, learning, and resources allocation (Yam et al., 2004; Romijn and Albaladejo, 2002). According to Adler and Shenbar (1990), four types of technological innovation capacities are identified, including (Lau, Richard, Yam, and Tang, 2010):

*The capacity of satisfying market requirement by developing new products.*

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*The capacity of manufacturing these products by using appropriate process technologies.*

*The capacity of satisfying future needs by developing and introducing new products and new process technology.*

*The capacity to respond to an unanticipated technology activity brought about by competitors and unforeseen circumstances.*

According to Peteraf (1993), a firm's heterogeneous resource portfolios (including human, capital, and technology resources) are responsible for observed variability in technological innovation capabilities its financial returns. These are a firm's specific competencies that contribute substantially to the sales growth and competitive advantage. There would have to be a causal connection between a firm's resources and performance. The innovative capabilities audit framework proposed by Burgelman et al. (1988) included five audit dimensions resource availability and allocation; capacity to understand competitor innovative strategies and industry evolution; capacity to understand technological developments; structural and cultural context; strategic management capacity. Thus, an innovation audit framework for evaluating a firm's innovation performance and competitiveness is presents following for technological innovation capabilities. The framework measured technological innovation capacities dimensions:

*Learning capability* is the capacity to identify, assimilate, and exploit new knowledge essential for a firm's competitive success.

*R&D capability* refers to a firm's ability to integrate R&D strategy, project implementation, product portfolio management, and R&D expenditure.

*Resource allocation capability* is the firm's ability to mobilize and expand its technological, human, and financial resources in the innovation process.

*Manufacturing capability* refers to the ability to transform R&D results into products, which meet market needs, in accordance with design request and can also be manufactured in batches.

*Marketing capability* indicates the capacity to publicize and sell the products on the basis of understanding consumer's current and future needs, customer's access approaches, and competitors' knowledge.

*Organizing capability* is the capacity to constitute a well-established organizational structure, cultivate organizational culture, coordinate the work of all activities towards shared objectives, and influence the speed of innovational processes through the infrastructure it creates for developmental projects.

*Strategic planning capability* is the capacity to identify internal strengths and weaknesses and external opportunities and threats, adopt different types of strategies that can adapt to environment changes for the excelling in the highly competitive environment.

A review of literature shows that the study of technological innovation performance indicators has attracted considerable attention. Traditional indicators of a firm's technological innovation activity tend to measure the financial terms of innovation, R&D expenditures (Jacobsson et al., 1996; Kleinknecht, 1987) and patent data (Patel and Pavitt, 1997, 1991; Jacobsson et al., 1996; Archibugi, 1992; Griliches, 1990). However, firms would not easily reveal any confidential financial information and different firms adopt varied accounting conventions in their inventory valuation, depreciation, and salaries computation. Besides, patent data are only a reflection of invention rather than innovation (Flor and Oltra, 2004). Muller, Va'likangas, and Merlyn (2005) presents a framework of metrics to assess a company's innovation:

*Resource view.* Companies must balance optimization (tactical investment in the existing business) and innovation (strategic investment in new businesses). The resource view addresses the allocation of resources to alter this balance. The resource inputs are capital, labor, and time. Output is the return on investment in strategic innovation.

*Capability view.* The capability view assesses the extent to which the company's competencies, culture, and conditions support the conversion of innovation resources (see resource view) into opportunities for business renewal. The inputs of this capability view are the preconditions for innovation, i.e. the extent to which a company's skills, tools, culture, and values are adapted to innovation. For example, does the company consider past demonstrations of innovativeness

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when selecting new recruits? Outputs include the development of new skills and knowledge domains that spawn innovation as well as the number of strategic options (i.e. opportunities to significantly advance an existing business or invest in a new business).

*Leadership view.* The leadership view assesses the degree to which a company’s leadership supports innovation. As such, it evaluates leaders’ involvement in innovation activities, the establishment of formal processes to promote innovation, and dissemination of innovation goals. Innovation processes are an additional element of the framework. They comprise organizational structures such as incubators, innovation markets, venture funds, and innovation incentives.

Innovation performance is the combination of overall organizational achievements as a result of renewal and improvement efforts done considering various aspects of firm innovativeness, i.e. processes, products, organizational structure, etc. Therefore innovative performance is a composite construct (Hagedoorn and Cloudt, 2003) based on various performance indicators pertaining, for instance, to the new patents, new product announcements, new projects, new processes, and new organizational arrangements. Technology innovation capability is a complex, elusive, and uncertainty concept that is difficult to determine. Measuring technological innovation capacities requires simultaneous consideration of multiple quantitative and qualitative criteria (Wang and Cheng, 2008). The next section presents the methodology.

### III. METHODOLOGY

#### *Designer of Research: Sample and Data Collection*

The research was initially conducted based on the specialized literature. To demonstrate the modeling feasibility, it used a study of case in subsidiary company in Brazil, Magneti Marelli, automotive sector. Data collection was conducted in two blocks. The first was to collect data to feed the development of the conceptual model (Innovation Capabilities and Innovation Performance), extracting construct and content data from the specialized literature. The second was to demonstrate the feasibility and plausibility of the model through a study of case in subsidiary company in Brazil. To solve the research problem and to reach the desired goals, this research was elaborated in light of theoretical excerpts, with foundation in the model presented by Müller et al. (2005), which considers the following metrics to assess the innovation capacity: resources, enablement and leadership. Following it, in order to demonstrate the feasibility and plausibility of the model, a multiple case study was conducted in Brazilian subsidiaries of multinational companies of the automotive industry. The research had specialists’ intervention, with knowledge and experience in the innovation management field, selected by the technical and scientific criteria. The data were extracted by a judging matrix with a scale type, in which the specialists gave their opinions, establishing priorities to the variables (resources, enablement and leadership), by level of importance. In order to reduce the subjectivity in the results reached, it was used statistical techniques of Multivariate Analysis and Multi-Criteria Analysis, with the support of the *Electre III, Compromise Programming e Promethee II* methods.

#### *Conceptual Model: Constructs and hypotheses*

This section examines the conceptual model (Figure 1) and presents the hypotheses to be tested throughout this work.

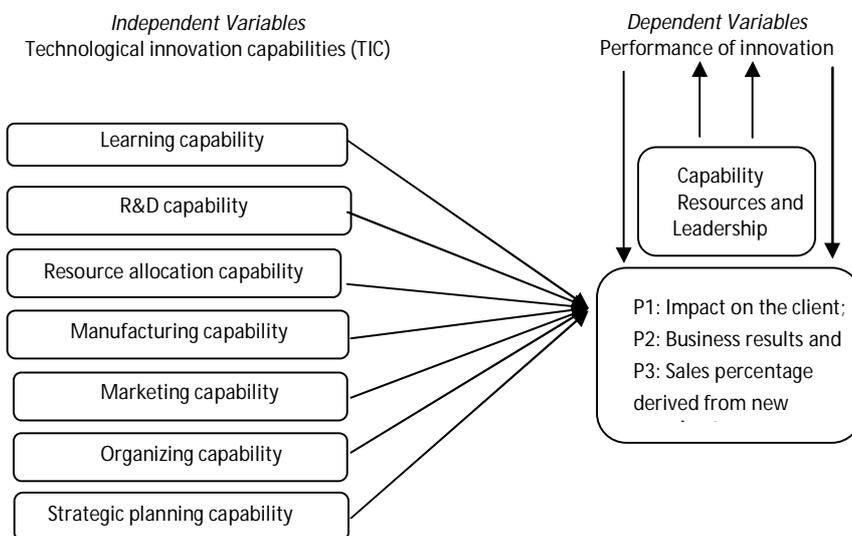


Figure 1: Framework Conceptual Model

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In recent years many studies have attempted to overcome this need to measure innovation capability (Cheng and Lin 2012; Igartua, Garrigós, and Hervás-Oliver 2010; Rodrigues, Fernandes, and Martins 2006). The evolution of innovation metrics aimed at measuring innovation related to the processes and practices involved in it instead to the dedicated resources (inputs) or new products (outputs) (Milbergs 2004; Muller, Válikangas, and Merlyn 2005). To manage the innovation capabilities the first step is to be able of measuring this characteristic, therefore, the creation of metrics or methods to measure this capacity in the companies is crucial, to determine the current condition of the company and define a strategy improvement. Many investigations seek to determine the best form of evaluation of the innovation, (Milbergs 2004; Muller, Válikangas, and Merlyn 2005) realize a literature review, analyzing the evolution of the innovation metrics and defining new metric focusing on the measurement of the innovative processes. Others authors affirm that the innovation within companies includes different areas, therefore the best way of measuring the innovation capabilities is by proposing and solving a multicriteria problem (Feeny and Rogers 2003; Rodrigues, Fernandes, and Martins 2006). Adams, Bessant, and Phelps (2006) realizes a bibliographical analysis of different propositions to measure the innovation in the enterprises and puts in evidence that at present the best way of measuring the innovation capabilities is using a multicriteria approach (Galvez et.al.,2013).

*Dependent variables:* the following dependent variables were selected for this research Performance of innovation - P1: Impact on the client; P2: Business results and; P3: Sales percentage derived from new products.

*Independent variables:* the independent variables, companies' technological innovation capacities, were based on the literature. Therefore, the following dimensions were considered as independent dimensions: Firms' Dimensions of Technological Innovation Capacities: Learning, R&D, Resource allocation, Manufacturing, Marketing, Organizing, and Strategic planning. The following hypotheses were formulated using the conceptual model: *H 1:* The Innovation capacity have positive innovation performance of innovation. *H2:* The Capability Resources and Leadership influence to a greater or lesser degree the innovation performance. The next section presents the scope of the study of case.

## *Scope of the Study of Case*

Magneti Marelli (MM) Group was founded in 1919 in Italy, with half of the capital paid up by Fiat Torino and the other half by Ercole Marelli & Co. In 1967, Fiat acquired the shares of Ercole Marelli and assumed full control of the company. The group operated in several market segments along its history, undergoing several processes of mergers and acquisitions, and then, in the late 1990s, it started focusing on the development and production of systems and components for vehicles. In October 2002, the Fiat Group decided to transform MM into a holding company, grouping together all of its auto parts units, hitherto independent. The MM group obtained €5.9 billion turnover in 2011, with 8.5% growth in comparison with the previous year, with 34,800 employees distributed in 83 production units, 12 R&D centers and 26 application centers, and with operations in 18 countries: Italy, France, Germany, Spain, Poland, Czech Republic, Russia, Slovakia, Turkey, United States, Mexico, Brazil, Argentina, China, Japan, India, Malaysia and South Africa. According to the latest annual report of Fiat (2012, p. 76; 114), the commercial profit of MM in 2011 was €181 million, almost double the €98 million in the previous year, an increase that was obtained due to the increase in the sales volume and manufacturing efficiency, which offset the pressures of the high cost of materials. The company stands in the market as "systemist" providing components and systems directly to major automakers in Europe, Asia and the Americas. Total investments accounted for 8.3% of the annual turnover of the group in 2011, with 5.4% only in R&D, with about three thousand employees involved in product innovation and process improvements in its technology centers located in four countries (Italy, France, Germany and Brazil), and in the application centers. MM Cofap Brazil has full autonomy for the R&D activities, from a technical standpoint, but the budget and the strategy must be previously approved by the parent company of the group. The shock absorbers unit has a board of engineering in Brazil, which is also responsible for R&D, and two technical centers (TCs), located in the U.S. and Italy. The strategic technology plan is common to all TCs, whose coordination is made from the Brazilian subsidiary. If there is a specific project theme, it is presented to the board of engineering, which approves, prioritizes and manages the portfolio of projects. In addition to the structure mentioned above, there is also a TC in Poland, which works as an extension of the TC in Italy, in addition to an application center (AC) adjacent to the plant in India and another under construction in China, for validation tests and application of products. The organizational structure that supports these activities

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employs approximately 200 people, of whom almost 80% are in Brazil, and the management is under the responsibility of the Brazilian director of engineering. The TCs include the following activities: new product designs, development and optimization of processes; applications of shock absorbers in new vehicles, jointly with the client-automakers; performance and durability tests on components and products; and the development of suppliers. Shortly after the acquisition of Cofap, still in 1997, an area for innovation engineering was created (located in Brazil until today), with the mission of developing new technologies not available in the company and new materials for use in shock absorbers. Over the years, the portfolio of innovations increased. Its technological innovation capacity also proved to be a notorious factor, because MM Cofap Brazil has its own structure for R&D in product, processes and application of dampers with a qualified team of engineers and technicians, in addition to proper laboratories in its TC in Mauá unit. The Brazilian board of engineering, also responsible for R&D, also coordinates the TCs in other countries. The innovation engineering area, created in the Brazilian TC in 1997, develops new technologies not available in the company and new materials for use in shock absorbers (Costa, Bruno, and Vasconcellos, 2013). The next section presents conceptual model verification and underlying analyses.

## IV. CONCEPTUAL MODEL VERIFICATION AND UNDERLYING ANALYSES

This section presents the verification procedures for the conceptual model. In this spectrum, to solve the problem and achieve the intended research goal, the next step was to prioritize the dimensions (sub-components) (Figure 2) of the technological innovation capacities in relation to the global innovation performance of subsidiary company, Magnetti Marelli, Cofap, Automotive Sector. This procedure was developed using the multi-criteria analysis.

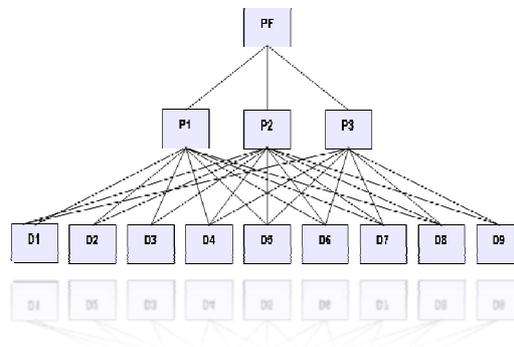


Fig. 2: Evaluation of the technological innovation capacities on the innovation performance of the Firm Magnetti Marelli – COFAP, Automotive Sector

The methods used were *Compromise Programming*, *Electre III* and *Promethee II*. The results achieved confirm *Hypothesis 1*: The Innovation capacity have positive innovation performance of innovation, and assigning values to each criterion, we arrive at a matrix of Criteria x Alternatives that together with the vector weights provides the necessary support to apply the multicriteria methods. In other words, one applies the selection and classification methodology of alternatives, using the *Compromise Programming*, *Promethee II* and *Electre III* methods. The *Compromise Programming* due to its wide diffusion and application simplicity and understanding renders it an alternative to evaluate problems as referenced in this application. The problem solution compromise is the one that comes closest to the alternative. This method was designed to identify the closest solution to an ideal one, therefore it is not feasible, using a predetermined pattern of distances. In *Promethee II* there is a function of preferences for each criterion among the alternatives which must be maximized, indicating the intensity of an alternative to the other one, with the value ranging from 0 to 1. Of the *Electre* family (*I,II,III,IV* and *V*), *Electre III* is the one considered for the cases of uncertainty and inaccuracy to evaluate the alternatives in the decision problem. All these methods enable to analyze the discrete solution alternatives, and taking into consideration subjective evaluations represented by numerical scores and weights. As these are problems involving subjective aspects, the methods that best fit the situation of this research are the methods of the family *Electre* and *Promethee*. It should be mentioned that although the *Compromise*

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Programming method is not part of this classification, it has similar characteristics, showing much simplicity in order to understand its operation, which makes it feasible for this application.

Within this perspective, the multicriteria methods are viable instruments to measure the innovation capacity performance of the company. The results produced by this prioritization enable managers to better focus their efforts and resources on managing the capacities that perform best, which results in achieving the goals sought by the companies. The structure of this prioritization (classification by hierarchical analysis) is proposed at three planning levels in a judgment matrix, in which at the first hierarchical structure level it defines the goal, which is to achieve the performance of the companies that will feed the system; the criteria are in the second level, which are the innovation performance of the company: P1: Impact on the client; P2: Business results and; P3: Sales percentage derived from new products. The dimensions of innovation capacities are in the third level, the alternatives, which are: Learning, R&D, Resource allocation, Manufacturing, Marketing, Organizing, and Strategic planning. The prioritization process obeys the judgment of the evaluators (experts). With the results of the judgment matrix, the methods were applied: *Promethee II*, *Electre III* and *Compromise Programming* to evaluate the innovation capacities in relation to the performance of the companies. Table 1 shows the results produced.

Tab. 1: Assessment of innovation capacity of the company

Innovation Capacity	CLASSIFICATION		
	Promethee II	Compromise Programming	Electre III
Learning, R&D, Strategic planning.	1 <sup>a</sup>	1 <sup>a</sup>	1 <sup>a</sup>
Organizing / Marketing	2 <sup>a</sup>	2 <sup>a</sup>	3 <sup>a</sup>
Resource allocation	3 <sup>a</sup>	3 <sup>a</sup>	2 <sup>a</sup>
Manufacturing	4 <sup>a</sup>	4 <sup>a</sup>	2 <sup>a</sup>

The results produced by the methods demonstrate the Learning, R&D, Strategic planning as the most significant ones to ensure the performance of the company. When comparing the results in terms of performance, the Compromise Programming and Promethee II methods did not differ in their classifications. For Electre III, the results were incompatible. And this is because the p, q and v veto thresholds, respectively, of indifference, strong preference and veto or incomparability have a discrepancy in the structure of their results (classification). Electre III presents a set of solutions with a more flexible hierarchical structure. This is due to the conception of the method, as well as the quite explicit consideration of the indifference and incomparability aspect between the alternatives. The results referenced by the Promethee II and Compromise Programming methods reflect the preference, according to the experts, for Learning, R&D, Strategic planning. The essence of the technological innovation management is the accumulation of knowledge over time.

The increase of the knowledge volume is produced by different mechanisms associated with different learning modes, such as: learning derived from R&D or Learning before doing (Pisano, 1997); Learning by doing, which arises spontaneously in the production process (Arrow, 1962a); Learning by using, which is from observing the different ways in which customers use the company's products (Rosenberg, 1982); and Learning by failing, from the analysis of bad decisions by top managers (Maidique and Zirger, 1985). But traditionally the greatest importance goes to R&D than to the other learning modes (Nieto, 2004). Based on the specialized literature (Evangelista et al., 1997) R&D has a strong impact on a company's performance. MM had no prior know how of this product or knowledge about this market, and therefore the global competence center for shock absorbers is kept in Brazil until today, concentrating most of the activities of technological innovation and R&D. It also, MM Cofap Brazil has full autonomy for the R&D activities, from a technical standpoint, but the budget and the strategy must be previously approved by the parent company of the group. R&D is a core component of the technological innovation practices of firms (Evangelista et al., 1997). In this perspective, the MM Cofap depend on the budget availability, the use of a more robust structure, with dedicated resources to ensure the compliance with the agreed deadlines and the desired quality levels, without

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compromising the regular activities of the pre-existing operations in the subsidiary, as well as the R&D and technological innovation functions.

MM Cofap works with different types of partners in their R&D projects. There are partnerships with universities, research institutions and suppliers. Additionally, the organizational learning and the dissemination of knowledge are strengths of the Brazilian subsidiary, and can be considered in the analysis as facilitating factors for its participation in the processes of technological innovation and international expansion. It is worth it to point out the creation of the knowledge management area, in the engineering division in Brazil, and the intensive use of the software platform for collaboration, which provides access to all the knowledge produced. In fact, the technological innovation capacity is a notorious factor, because MM Cofap Brazil has its own structure for R&D in product, processes and application of dampers with a qualified team of engineers and technicians, in addition to proper laboratories in its TC in Mauá unit. R&D is considered a key aspect of innovative activities. The Brazilian board of engineering, also responsible for R&D, also coordinates the TCs in other countries. The innovation engineering area, created in the Brazilian TC in 1997, develops new technologies not available in the company and new materials for use in shock absorbers [...] (Costa, Bruno, and Vasconcellos, 2013). Next, the degree of correlation between the dimensions of Capability, Resources and Leadership and innovation performance was determined using Spearman's multivariate statistical technique. The technique adapts to the case in question.

*How do the Resources, Capacity and Leadership support the innovation performance of the Magneti Marelli Company based on the proposed of Müller, Va'likangas, and Merlyn (2005)?*

This section evaluates contribution of Resources, Capacity and Leadership to support the innovation performance in the Magneti Marelli Company, i.e. how do Resources, Capacity and Leadership support the innovation performance in the Magneti Marelli Company? This procedure was developed in light of theoretical excerpts, with foundation in the model presented by Müller et al. (2005). The research had specialists' intervention. The data were extracted by a judging matrix with a scale type, in which the specialists gave their opinions, establishing priorities to the variables (resources, enablement and leadership), by level of importance.

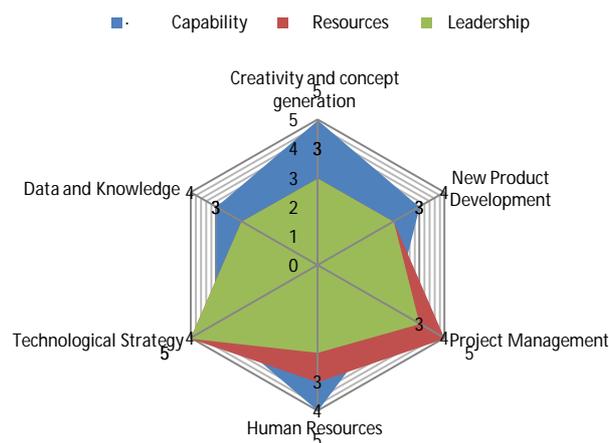


Fig. 3: Degree of contribution of the Resources, Capability and Leadership for innovation at Magneti Marelli Company

Thus, combining the dimensions, we can say with all certainty that the dimensions Capability, Resource and Leadership contribute significantly (75%) for achieving innovation performance. In fact, Capability represents 100% of contribution to human resources practice, creativity and concept generation. Resource presents maximum contribution (100%) regarding project management and technological strategies. Finally, the Leadership answers to 100% of its efforts addressed to technological strategies. In other words, Leadership and Resources contribute with maximum efficiency to the achievement of the innovation practice oriented to the technological strategies of Magneti Marelli. In

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general, at Magneti Marelli - COFAP, the dimensions are associated with resources, training, and leadership in which the Input focuses on incentives, team building, and personnel, which support the existing processes of innovation.

The *Processes* are related to the increase and the flow of innovation and to markets subject to budget constraints, and finally, Output is oriented towards reaching the goals of innovation. Regarding the assessment of Input, the company restructured the Department of Engineering and formed a new sector called Innovation Engineering. This sector represents the guiding of the innovation of the company, and it is currently comprised of a manager and four engineers. The evaluation of the divisional leaders regarding the performance of innovation is conducted by measuring the objectives established in the Strategic Plan for Technology Division. To train employees with a focus on innovation, development plans are drawn up for each employee in the area of innovation and these plans are regularly assessed regarding the reach of predetermined goals. The company adopts as a personal measurement of the employees the performance evaluation system called PLM (*Performance Leadership Management*), which provides that every employee, regardless of position, should be evaluated annually from predetermined goals for strategic innovation projects of the company.

After this evaluation, the company organizes action plans to improve employee performance. In addition, there are criteria for awards that encourage the generation of ideas or ideas that culminate into innovative products and processes by employees. Furthermore, the company Magneti Marelli has an internal program called GIS (Good Ideas and Solutions) which establishes awards to the generation of ideas in the corporate context. The proposals are evaluated by a committee that scores the return of ideas in terms of profitability, innovative content, sustainability and potential for cost reduction, especially for incremental innovations in product and process. Employees with the best scores receive a monetary incentive. The company Magneti Marelli uses the Model of Management by Processes, according to ISO TS 16949 regulation, based on the concept of innovative product development as a process that pervades the various departments of the Company. An analysis of the flowchart above allows us to establish some key "milestones" in the development of an Innovation Project at Magneti Marelli: Market Analysis, Technology Plan; technical / financial analysis of the preliminary project; Obtaining of Technology (Means); Project / Process Development; Transfer of the Project to Product Engineering (Application); Support and Project Monitoring/ Feedback, and closure / termination of the Project.

Once the Innovation Process is finished, the product becomes available to the market, leaving it to the Engineering Product Development sector its implementation in a particular customer application. The portfolio of innovation projects is generated from the strategic analysis of the company showing the importance of leadership in decision making, as proposed by Müller, Vañlikangas, and Merlyn (2005). Once the projects to be developed are selected, expense and investment budgets for each project are established, as well as the setting of the allocation of human and internal resources of the company required for the project execution. The time management of the projects is implemented through time lines. Apart from the administrative management of the projects there is the technical management, in which the project objectives are established at the beginning of it and controlled throughout its implementation. Aspects such as product performance, durability, reliability and sustainability are evaluated against established goals.

The Management System by Process established in the TS 16949 regulation establishes periodic reviews by senior management. In the case of Technology and Innovation Management Process some key indicators were established (*Key Process Index*). Among the Key Process Index used by the company, only the Lead Time Execution of the project that evaluates the time required to reach the various "stage gates" of the project constitutes an internal indicator of innovation. The innovation performance at each stage of the processes is taken into consideration by the Magneti Marelli group and outputs are proposed for each phase of the technology and innovation management process. These metrics are evaluated periodically on internal quality and system audits by independent bodies of auditing (BVQI). Two negative points assessed in the survey were the lack of internal indicators for measuring innovation in each division in comparison to the global company and the lack of assessment of factors, impeding or concurrent, which result in the loss of focus of innovative projects, or that focus on punctual improvement.

It was further observed that the company Magneti Marelli ranks as medium/low degree of importance or adherence in the company the internal corporate indicators of innovation in comparison to indicators of market performance, the

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impact of the use of internal indicators of innovation in improving the costs of products and services, the use of internal innovation indicators to assist in decision making about the sustainability policy of the company and the cost reduction in manufacturing processes. However, the reviews identified as medium / high relevance were the internal indicators associated with creative culture, such as approval of the employees regarding the evaluation of their personal metrics of innovation, the use of internal indicators of individual metrics of innovation as a motivator factor in the pursuit of improved personal skills. And finally, there is medium / high adherence of the company in the use of internal evaluation indicators with the aim of improving the company's competitiveness in the auto parts market. The assessment of Issues of innovation at Magneti Marelli in the light of the framework proposed by Muller et al. (2005) reveals that there are incentive schemes to support innovation, albeit in an incremental basis (GIS program). However, there is not a formal mapping of the "champions of innovation" in the company. An emphasis in the frequency in which strategic considerations aimed at fostering innovation the study are performed has not yet been given.

Also there is no control on the number of monthly ideas generated in the pipeline of innovation, nor on the time required for financial viability of innovative ideas, although there is a control of timing of each innovation project from its creation to the time they are available to the market. Finally, in view of the results (output), the company controls the ratio of revenues from innovative projects in relation to the total billed. There is still control of the number of strategic projects of development in the Division, although a formal valuation of the expected revenue of innovation projects in relation to the total turnover of the company is not made. Thus, this research gives useful information to professionals that deal with innovation management and aims at increasing the efficiency in the innovation organizational/facilitator issues, overall in optimizing the resources, enablement and leadership in the environment of the study company.

## V. IMPLICATIONS FOR PRACTICE MANAGEMENT

Contextual innovation management implies that an innovation manager makes different decisions in different contexts (Ortt and van der Duin, 2008). Thus, combining the dimensions, from the interface between innovation capabilities and the innovation performance based on the dimensions Resources, Capability and Leadership, there is significant predominance of the learning capacities, R&D and planning. R&D efficiency reflects the product development process dynamics, reduces time-to-market, improves product profitability, increases productivity, as well as other benefits for Magneti Marelli. Studies on R&D efficiency have many applications as a management tool. R&D is strong performance measure, similar to ROI. It can also be used as a means of comparison (benchmark). R&D efficiency is also an aggregate measure of the overall success of a company's product in the development effort.

The presence of R&D creates an organizational setting that is favorable to questioning, promoting corporate/company flexibility, with an ability to integrate new concepts and adaptability to market changes (Freel, 2000). R&D and innovation are susceptible to sectorial influences [...] (Becheikh *et.al.*, 2006B). Product innovation is considered stronger in high-technology sectors [...] (Subrahmanya, 2005). A company's strong customer-focus can lead to an emphasis on innovation that is derived from the desire to continually adapt to customer needs (Santos-Vijande and Alvarez-Gonzalez, 2007). Rowley (2002) calls attention to the fact that client knowledge enables the companies' regrouping and creation of incremental value. However, learning is often used to describe the innovation process. It is true that companies innovate through constant learning processes that generate new technological knowledge (Nonaka and Takeuchi, 1995). Here the main features of the technological innovation process are (Teece, 1986; Nelson and Winter, 1982) continuous in nature; irreversible and affected by uncertainty. The essence of the technological innovation process is the accumulation of knowledge over time. The increase of the knowledge volume is produced through different creative mechanisms associated with different learning modes, such as: learning from R&D or "Learn before doing" (Pisano, 1997); "Learning by doing", which arises spontaneously in the production process (Arrow, 1962); "Learning by using" (Rosenberg, 1982); and "Learning by failing", from the analysis of bad decisions by top managers (Maidique and Zirger, 1985). And the capacities are generated for the companies to mobilize and expand their technology, human and financial resources in the innovation process. Resources are always a critical factor for all kinds of activities and processes. Evangelista *et al.* (1997) propose that technology resources will increase its importance as a strategic factor for the company's performance in the near future.

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## VI. CONCLUSIONS AND LIMITATIONS

This study aims to assess the Influence of Innovation capabilities on the innovation performance in Brazilian subsidiaries of multinational companies of the automotive industry. This research was elaborated in light of theoretical excerpts, with foundation in the model presented by Müller et al. (2005), which considers the following metrics: resources, enablement and leadership. The results obtained were satisfactory, validating the proposed process. In this scenario our contribution is highlighted, because it provides support to the critical priorities in order to implement this innovation project. There is a gap in the literature concerning the innovation capacity performance assessment on the innovation performance, in auto-parts industry – automotive sector. It is hoped that this study will stimulate a broad debate on the issue and it is acknowledged that more studies are needed to build more robust results in the near future.

Innovation has become the primary basis of productivity improvements, sales volume growth, and a firm's competitiveness. Increased global competition pressures are also forcing firms to continuously adopt, develop and innovate to enhance product competitiveness such as product design and quality, technological service and reliability. For these reasons, a firm must upgrade its innovation capability [...]. In fact, successful technological innovation depends on both technological capability and other critical capabilities, such as organizational, marketing, capital funds, manufacturing, strategic planning, and resource allocation (Yam et al., 2004). Such manufacturing capabilities determine a firm's ability to transform R&D into products and processes. Cooperating R&D, manufacturing, and capital capabilities provide effects of complement to accelerate successfully technological innovation activities (Wang and Cheng, 2008).

Of the findings of the state of the art and state of practice, it is reasonable to state that this research is vulnerable to criticism. In the research, cross-sectional data used in this study may not be appropriate to establish fundamental relationships between variables. Furthermore, a study was developed for Brazilian companies in a static context, which may represent a limiting factor. Therefore, it is recommended to reproduce and replicate the model in companies from other countries in order to confirm the results. Of the different dimensions, the results show a predominance of R&D efforts. However such innovation capabilities have to keep up with up-to-date changes and should be viewed as a priority of the present moment, with regards to systemic efforts guided by defining and redefining the performance of the subsidiary of the study over time. It is plausible that building capacities occur over a continuous process and converge to the desired performance, which is in constant transformation through the new demands. Therefore, the innovation policy for companies in this category should be anchored by efficient planning.

## REFERENCES

1. BREMSER, W.G.; BARSKY, N.P. Utilizing the Balanced Scorecard for R&D Performance Measurement. *R&D Management*, 34, 3, 229-238, 2004.
2. BROWN, M. G.; SVENSON, R. A. Measuring R&D Productivity. *Research-Technology Management*, 31, 4, 11-15, 1988.
3. CHIESA, V., COUGLAN, P. and VOSS, C. Development of a technical innovation audit. *Journal of Product Innovation Management*, 13, 2, 105-136, 1996.
4. CLARK, K. B.; FUJIMOTO, T. Lead time in automobile product development explaining the Japanese advantage. *Journal of Engineering and Technology Management*, 6, 25-58, 1989.
5. CLARK, K.B.; FUJIMOTO, T. *Product development performance: strategy, organization and management in the world auto industry*. Boston-Mass., Harvard Business School Press, 1991.
6. COLLINS, J. *Great to Good*. Harper Business, New York, 2001.
7. CORDERO, R. Managing for speed to obsolesce: a survey of techniques. *Journal of Product Innovation Management*, 8, 283-294, 1991.
8. COOPER, R. G., KLEINSCHMIDT, E. J. Major new products: what distinguishes the winners in the chemical industry. *Journal of Product Innovation Management*, 2, 90-111, 1993.
9. COOPER, R.G.; KLEINSCHMIDT, E.J. Determinants of timeliness in product development. *Journal of Product Innovation Management*, 11, 381-396, 1994.
10. CRAWFORD, M. The hidden costs of accelerated product development. *Journal of Product Innovation Management*, 9, 188-199, 1992.
11. DAVILA, T.; EPSTEIN, M. J.; SHELTON, R. *As Regras da Inovação*. Porto Alegre: Bookman, 2007.
12. FIGUEIREDO, P. N. *Gestão da Inovação: Conceitos, Métricas e Experiências de Empresas no Brasil*. Rio de Janeiro: LTC, 2009.
13. GIBSON, Rowan; SKARZYNSKI, Peter. *Inovação: Prioridade nº 1: O Caminho para Transformação nas Organizações*. Rio de Janeiro: Elsevier, 2008.
14. GODENER, A.; SÖDERQUIST, K. E. Use and impact of performance measurement results in R&D and NPD: an exploratory study. 2004.
15. GRIFFIN, A. Metrics for measuring product development cycle time. *Journal of Product Innovation Management*, 10, 112-125, 1993.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 12, December 2015

16. GRIFFIN, A.; PAGE, A. L. An interim report on measuring product development success and failure. *Journal of Product Innovation Management*, 10,4, 291-308, 1993.
17. GRIFFIN, A. The effect of project and process characteristics on product development cycle time. *Journal of Marketing Research*, 34, 24-35, 1997.
18. GUPTA, A. K.; WILEMON, D. L. Accelerating the development of technology-based new products. *California Management Review*, 32, 24 - 44, 1990.
19. HULL, F.M.; COLLINS, P.D.; LIKER, J.K. Composite forms of organization as a strategy for concurrent engineering effectiveness. *IEEE Transactions on Engineering Management*, 43, 133-142, 1996.
20. KERSSSEN-VAN DRONGELEN, I. C.; COOK, A. Design principles for the development of measurement systems for research and development processes. *R&D Management*, 27, 4, 345-357, 1997.
21. KRUBASIK, E. G. Customize your product development. *Harvard Business Review* 66, 46-52, 1988. KRUGLIANSKAS, I. Engenharia simultânea e técnicas associadas em empresas tecnicamente dinâmicas. *Revista de Administração da Universidade de São Paulo (RAUSP)*, 30, 25-38, 1995.
22. MAÑAS, A. V. *Gestão de Tecnologia e Inovação*. São Paulo: Erica, 1993.
23. MARTINS, G. A. Metodologias Convencionais e Não-Convencionais e a Pesquisa em Administração. *Cadernos de Pesquisas em Administração*, São Paulo, v. 00, n.0, 20 Sem., 1994.
24. MULLER, A., VÁLIKANGAS, L. e MERLYN, P. "Metrics for innovation: guidelines for developing a customized suite of innovation metrics". *Strategy&Leadership*, vol.33, nº1, 2005, pp.37-45, Emerald Group Publishing Ltda.
25. NEELY, A., ADAMS C., CROWE, P. "The performance prism in practice", *Measuring Business Excellence*, 5, 6-13, 2001.
26. OTTOSSON, S. Dynamic product development – DPD. *Technovation*, 24, 207-217, 2004.
27. PHAAL, R. e PROBERT, D. "Technology roadmapping: facilitating collaborative research strategy". Centre for Technology Management. Institute for Manufacturing. University of Cambridge, 2007.
28. SANCHEZ, A. M.; PEREZ, M. P. R&D project efficiency management in the Spanish industry. *International Journal of Project Management*, 20, 545-560, 2002.
29. SANDSTROM, J., TOIVANEN, J. The problem of managing product development engineers: Can the balanced scorecard be an answer? *International Journal of Production Economics*, 78, 79-90, 2002.
30. SCHUMANN, P. A.; RANSLEY, D. L.; PRESTWOOD, D. C. L. Measuring R&D Performance. *Research-Technology Management*, 38, 45-54, 1995.
31. TRIAS DE BES, F.; KOTLER, P. *A Bíblia da Inovação*. São Paulo: Leya, 2011.
32. TIDD, J., BESSANT, J.; PAVITT, K. *Gestão da Inovação*. Porto Alegre: Bookman, 2008.
33. WERNER, B. M. and SOUDER, W. E. (1997) Measuring R&D performance - State of the art. *Research*- 27.