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Borderless Innovation: Innovation Capability Assessment on Business Incubators Performance using Resources, Leadership and Capability: An Investigation in Business Incubators from Chile, Italy and Israel

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Abstract

This study aims to assess the innovation capabilities on the business incubators performance using resources, leadership and capability in three countries: Chile, Israel and Italy. 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 business incubators. 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; Business incubators.

1. 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; Teece, 1986). Thus, business incubators make use of their capabilities to appropriate the value generated from their knowledge and innovations. Business incubators have traditionally been recognized as new organizational forms for promoting entrepreneurship and stimulating new business formation (Amazcua 2010; Chan and Lau, 2005; Özdemir and Sehitoglu, 2013; Lindholm-Dahlstrand and Klofsten, 2002; Lyons and Li, 2003; Allahar and Brathwaite, 2016; Al-Mubaraki, Muhammad , &Busler, 2015; Monsson and Jørgensen, 2016). Similarly, business incubation programs, activities, and events have routinely been perceived as being beneficial to entrepreneurs, start-ups, and small business. The most incubators take on ventures in early phases, whose ideas are immature, i.e. have not yet been fully developed into business ideas (Klofsten, 2005), and help develop them into viable companies.

Incubator is an organization that speeds-up and systematizes the enterprise creation and start-up process, providing them with a large choice of integrated services i.e. physical space (offices, meeting rooms, labs etc), business support services and integration and networking possibilities (European Commission Enterprise Directorate General, Benchmarking of Business Incubators, Centre for strategy and evaluation services, February 2002). An incubator is justified based on superior innovation performance (Barbero et.al., 2012). The effectiveness of incubators is difficult to assess due to multiple, and often moving, targets. In this sense, deciding on an ideal balance regarding innovation activities and innovation performance is a complicated issue, there are barriers to be challenged and substantially reconfigured in order to obtain an optimal and combined convergence of the various activities in confluence with the incubators' desired and acceptable performance. Innovation activities are admittedly complex and risky.

It is difficult to accurately assess (Afuah, 1998; García-Muin and Pez Navas-lo, 2007; Bellman and Zadeh; 1970) the innovation capacity and also discern the incubators' range of acceptable performance. It is feasible to decide on a parameter, since it allows incubators to offer the best combination of innovation activity strategies in agreement with their expected business results. To be a successful business on the market it is necessary to know the key success factors that affect the achievement of innovation performance. Every business reaches other level of innovation performance (Lendel and Varmus, 2014). Furthermore, promoting a incubators'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 capacity on the innovation performance of business incubators under resources, leadership and capability in three countries: Chile, Israel and Italy.

- Innovation performance is a measurement of the performance of an adopted new approach or a new measuring criterion to measure organizational performance (Hung-Wen and Ching-Fang, 2010).
- Innovation performance is defined as the propensity of a firm to actively support new ideas, novelty, experimentation, and creative solution (Wang and Ahmed, 2004).
- Innovation performance is defined by the annual growth rates of innovation input and output, knowledge stock, and research productivity (Gantumur and Stephan, 2007).

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.

2. Theoretical Background: Issues of Innovation

The business incubators 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 incubators can sustain a competitive advantage. Managers have only a vague sense of their incubator'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.

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 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 Cloodt, 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.

3. Methodology

3.1. 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 business incubators from Chile, Israel and Italy. 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 survey applied in business incubators from Chile, Israel and Italy. 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. The research had specialists' intervention, with knowledge and experience in the innovation management field, selected by the technical and scientific criteria.

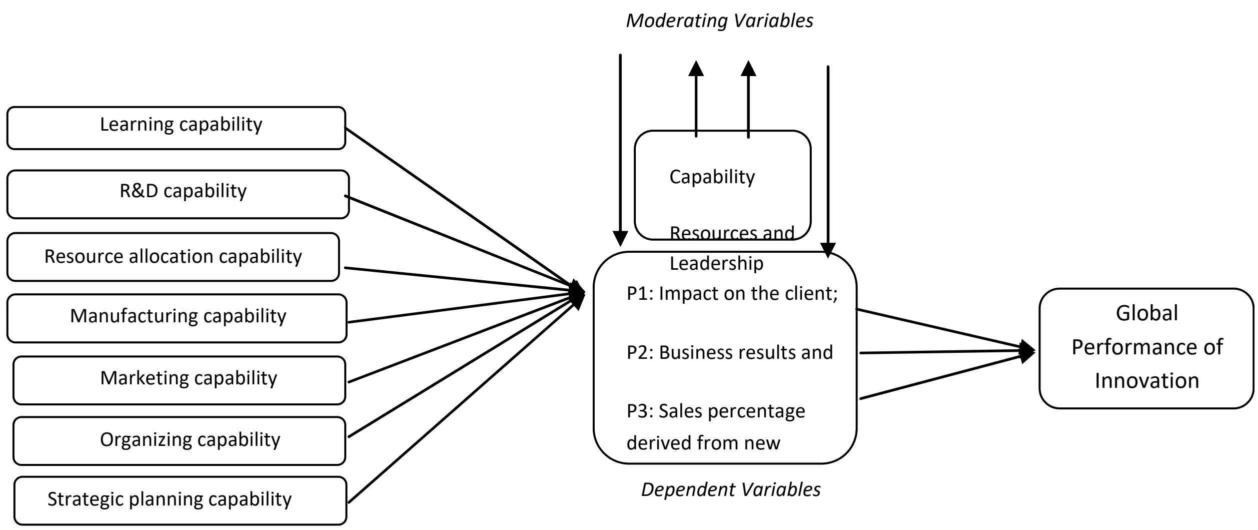
The data were extracted by a judging matrix with a scale type, in which the specialists gave their opinions, establishing priorities to the variables (resources, enablement and leadership), by level of importance. The instrument was pre-tested with business incubators managers. The pilot interviews served as a pre-test for instrument validation and changes were made to the interview instrument based on the findings and comments. The instrument was translated for Spanish, English, Italian and Hebrew. The actual survey was carried out between March and June 2014, which involved 95 specialists. The samples were selected by random sampling technique. Of the 87 specialists in our sample, 80 completed questionnaires were retuned. However, seven cases had to be excluded from further analysis due to excessive missing data. Therefore, the present sample comprised of 80 specialists in business incubators in the three countries resulting in a response rate of 82 percent. The number of respondents of this study is sufficient to carry out the analysis. The questionnaire was sent to the respondents through email. The self-administered questionnaire was chosen as the mode for data collection. Respondents were given one month to complete the questionnaire.

After one month, emails were sent to remind the respondents that the questionnaire should be sent out to the researchers. Respondents who do not yet complete the questionnaire were given another additional month to complete it. The specialists have experience in innovation, business, technology, knowledge, business incubators, project management in incubators investigated, and with the following skills: Managers of business incubators and staff, policy makers (government) and academics, Director, managers, Engineering, Senior R&D Engineer, Director Research & Innovation, Director New Technologies & Innovation, others. In Chile, the data were collected of managers of 22 business incubators and specialists. In Italy, the data were collected of managers of 39 business incubators. In Israel, the data were collected of managers of 26 business incubators and specialists. 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, and neuro-fuzzy technology. Next, these procedures are detailed.

3.2 Conceptual Model: Constructs and Hypotheses

This section examines the conceptual model (Figure 1) and presents the hypotheses to be tested throughout this work. In recent years many studies have attempted to overcome this need to measure innovation capability (Cheng and Lin 2012; Igartua, Garrigós, and Hervas-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 incubators is crucial, to determine the current condition of the incubators and define a strategy improvement.

Figure 1: Framework Conceptual Model



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.

Moderating variables: the following moderating variables were selected for this research Perturbations: Capability, Resources and Leadership. .

Independent variables: the independent variables, companies' technological innovation capacities, were based on the literature. Therefore, the following dimensions were considered as independent dimensions: Incubators' 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 capabilities of innovation have a positive influence on innovation performance (P1: Impact on the client; P2: Business results and; P3: Sales percentage derived from new products) under perturbations (resources, leaderships and capabilities). *H2*: The optimal rate of innovation performance (Global Performance of Innovation) depends on the combination and interaction of the innovation capabilities of business incubators. The next section presents conceptual model verification and underlying analyses.

4. Conceptual Model Verification and Underlying Analyses

The results and underlying analyses are structured according to the following phases:

Phase 1: Evaluation of the technological innovation capabilities on innovation performance of the Business Incubators from Chile, Israel and Italy under perturbations.

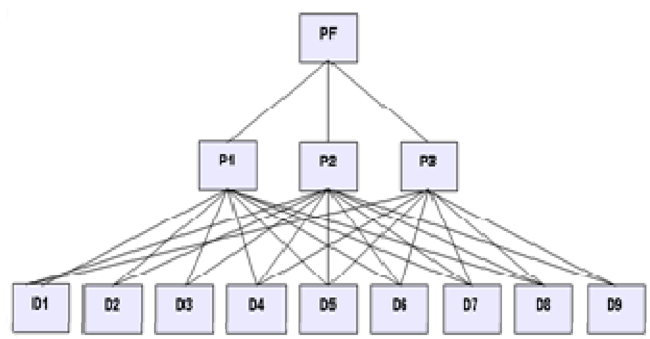
Phase 2: Effects of the perturbations (Capacity, Leardership and Research) on the innovation performance of Chile, Israel and Italy - How do the Resources, Capacity and Leadership support the innovation performance of the Business Incubators based on the proposed of Müller, Va¨likangas, and Merlyn (2005)?

Phase 3: Assessment of the effectiveness rate global performance of innovation of the business incubators in Chile, Israel and Italy. The procedures are detailed as it follows.

Phase 1: Evaluation of the technological innovation capabilities on innovation performance of the Business Incubators from Chile, Israel and Italy under perturbations.

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 capabilities in relation to the global innovation performance of the business incubators from Chile, Israel and Italy. This procedure was developed using the multi-criteria analysis.

Figure 2: Evaluation of the technological innovation capabilities on innovation performance of the Business Incubators from Chile, Israel and Italy under perturbations



The methods used were *Compromise Programming, Electre III and Promethee II*. The results achieved confirm *Hypothesis 1:* The capabilities of innovation have a positive influence on innovation performance. Innovation performance, 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 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 incubators. 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 incubators. 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 incubators that will feed the system; the criteria are in the second level, which are the innovation performance of the incubators: P1: Impact on the client; P2: Business results (success) and; P3: Sales percentage derived from innovation (new products). The dimensions of innovation capabilities 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 capabilities in relation to the performance of the incubators. Table 1 shows the results produced.

Table 1: Assessment of innovation capacity of the business incubators on innovation performance (impact on client, business results and sales percentage derived from innovation) under perturbations (capacities, leadership and resources) – Average: Chile, Israel and Italy.

Chile	**Innovation Capacity**	**Promethee II**	**Compromise Programming**	**Electre III**
	Strategic planning/ Organizing / Resource allocation	1ª	1ª	1ª
	R&D/Learning	2ª	2ª	3ª
	Marketing	3ª	3ª	2ª
	Manufacturing	4ª	4ª	2ª
Israel				
	Strategic planning/ R&D/ Organizing / Resource allocation	1ª	1ª	1ª
	Learning	2ª	2ª	3ª
	Marketing	3ª	3ª	2ª
	Manufacturing	2ª	2ª	1ª
Italy				
	Strategic planning/ Organizing / Resource allocation	1ª	1ª	1ª
	R&D/Marketing	2ª	2ª	3ª
	Learning	3ª	3ª	2ª
	Manufacturing	4ª	4ª	2ª

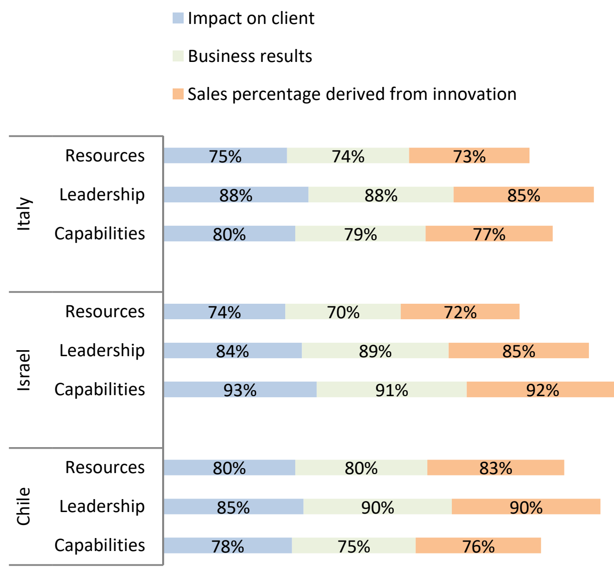
The results produced by the methods demonstrate the innovation capacities: Strategic/Planning/Organizing/R&D/Learning/Resources allocation, as the most significant ones to ensure the innovation performance of the incubators in the three countries. When comparing the results in terms of performance, the 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 Strategic planning, Organizing, Resource allocation, Learning and R&D. 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 business incubators' performance of innovation.

Thus, business incubators make use of its innovation capacity (Activities of innovation) to achieve sustainable competitive advantage and value creation. Business incubators of Chile, Israel and Italy have clearly defining the vision and mission of the business; the business's vision speaks of innovation; the business constantly looks for new ideas to improve services or processes; business constantly creates investment decisions (buying, renting equipment, etc.); business has a clearly defined innovative strategy; the business is a continuous process of learning; in the business there is a systematic approach for managing innovation. The business regularly carries out market research; the business continuously detects the needs of its customers; customer's demand for products and services are collected at each stage of the innovative process of the business, the business effectively uses its partnerships; the business regularly looks for new market opportunities. The business processes are able to efficient development of new products; the business establishes mechanisms for selection of good business ideas; the business processes are flexible enough to allow realize innovative projects. Employees in the incubators have sufficient knowledge to deal with innovation; the business structure creates suitable conditions for the development of innovation (Lendel and Varmus, 2013). Innovation performance of the business can help to business managers to effectively use the innovation potential of the business. 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.

Phase 2: Effects of the perturbations (Capacity, Leardership and Research) on the innovation performance of Chile, Israel and Italy - How do the Resources, Capacity and Leadership support the innovation performance of the Business Incubators 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 Business Incubators from Chile, Israel and Italy, i.e. how do Resources, Capacity and Leadership support the innovation performance in the Incubators? 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.

Figure 3: Degree of contribution of the Resources, Capability and Leadership for innovation at Business Incubators from Chile, Israel and Italy



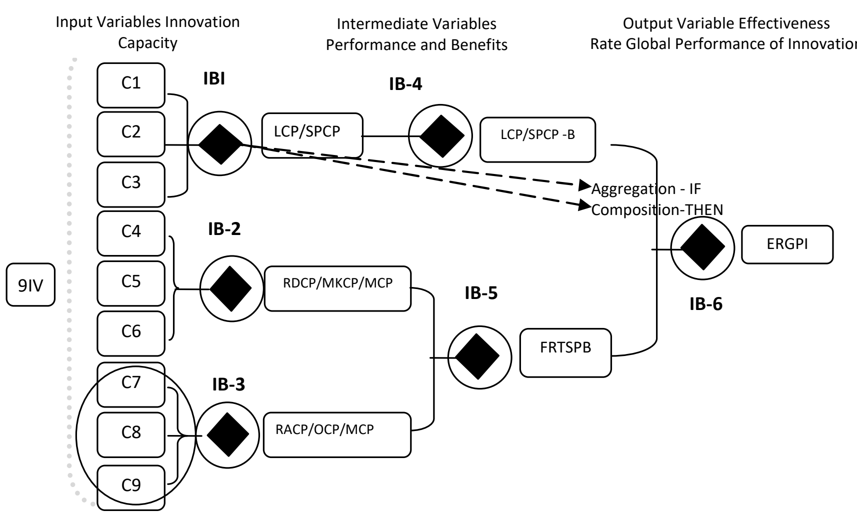
Thus, combining the dimensions, we can say with all certainty that the dimensions Capability, Resource and Leadership contribute significantly for achieving innovation performance in three countries. In fact, Capability represents 78% of contribution to impact on client to Chile, represents 93% to Israel, and represents 80% to Italy. Leadership represents 90% business results and sales percentage derived from innovation to Chile, represents 89% business results to Israel, and represents 80% impact on client to Italy. Resources represent 80% to impact on client in Chile, represents to 74% impact on client in Israel, and represents to 75% impact on client in Italy. Resource presents medium/maximum contribution (80% average). Finally, the Leadership answers to 90% of its efforts addressed to technological strategies, resources allocation and R&D, in Chile, Israel and Italy. In other words, Capabilities, Leadership and Resources contribute with maximum efficiency to the achievement of the innovation practice oriented to the technological strategies of Business Incubators in three countries. In general, at Business Incubators, 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 in business incubators 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.

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, Va ̈ likangas, 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 business incubators 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. It was further observed that the business incubators ranks as medium/low degree of importance or adherence in the incubators the internal corporate indicators of innovation in comparison to indicators of market performance, the 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 incubators and the cost reduction. 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. The assessment of Issues of innovation at Business Incubators 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. However, there is not a formal mapping of the "champions of innovation" in the Business Incubators. An emphasis in the frequency in which strategic considerations aimed at fostering innovation the study are performed has not yet been given. In view of the results (output), the business incubators 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 incubators is not made.

Phase 3: Assessment of the effectiveness rate global performance of innovation of the business incubators in Chile, Israel and Italy (ERGPI)

This phase focuses on determining effectiveness rate global performance of innovation of the business incubators in Chile, using neuro-fuzzy modeling. It is a process whose attributes usually possess high subjectivity capabilities of innovation, in which the experience of the decision maker is very significant. Thus within this spectrum there is the need for a tool that allows adding qualitative and quantitative variables that converge towards a single evaluation parameter (Oliveira and Cury, 2004; Von Altrock, 1997).

Figure 4: Assessment of the effectiveness rate global performance of innovation (ERGPI) in Chile, Israel and Italy



This model combines the Neural Networks and Logic Fuzzy technology (neurofuzzy technology). Here this model supports the management of business incubators, as it allows to evaluate the desirable rate toward the acceptable business incubators performance of innovation from interation among capabilities (activities of innovation). The model shown here uses the model of Oliveira and Cury (2004). The model consists of qualitative and quantitative variables, based on information from the experts. The neurofuzzy model is described below.

Stagy 1: Determination of Input Variables (IV) and Linguistic Terms: This section focuses on determining the qualitative input variables (IV). These variables (9) were extracted from conceptual model (Figure 1), results of effects of the capabilities of innovation on the business incubators performance of innovation. The linguistic terms assigned to each IV are: High, Medium and Low. Accordingly, Figure 4 shows the IVs in the model, which are transformed into linguistic variables with their respective Degrees of Conviction or Certainty (DoC), with the assistance of judges opining in the process. The degrees attributed by the judges are converted into linguistic expressions with their respective DoCs, based on fuzzy sets and aggregation rules and composition rules). The IV are: Learning capability, R&D capability, Resource allocation capability, Manufacturing capability, Management capacity, Marketing capability, Organizing capability, Management capacity, and Strategic planning capability.

Stage 2: Determination of the Intermediary Variables and Linguistic Terms: The qualitative input variables go through the inference fuzzy process, resulting in linguistic terms of intermediate variables (IVar). Thus, the linguistic terms assigned to IVar are: Low, Medium and High. The intermediate variables were obtained from: Learning capability performance/ Strategic planning capability performance – LCP/SPCP; R&D capability performance/ Marketing capability performance – RDCP/MKCP/MCP; Resource allocation capability performance/ Organizing capability performance/ Management capability performance – RACP/OCP/MCP. The architecture proposed is composed of eleven (6 IB) expert fuzzy system configurations, 9 IV (input variables), 5 IVar (Intermediate variables) and 1 OV (Output variables), i.e., qualitative input variables that go through the fuzzy process and through the inference block, thus producing an output variable (OV), called intermediate variable (IVar). Then, the IVars, which join the other IVar form a set of new IVars, thereby configuring a sequence until the last layer in the network. In the last layer of the network the output variable (OV) of the neuro-fuzzy is defined. This OV is then subjected to a de-fuzzification process to achieve the final result: effectiveness rate global performance of innovation (ERGPI) in Chile, Israel and Italy. The results confirm the *H2: The effectiveness rate global performance of innovation* (ERGPI) *of the business incubators in Chile, Israel and Italy depends on the combination and interaction of the innovation capacities (activities of innovation) on the business incubators performance* (IV- results of the Phase 1).

Stage 3: Determination of Output Variable – Effectiveness Rate Global Performance of innovation (ERGPI) in Chile, Israel and Italy

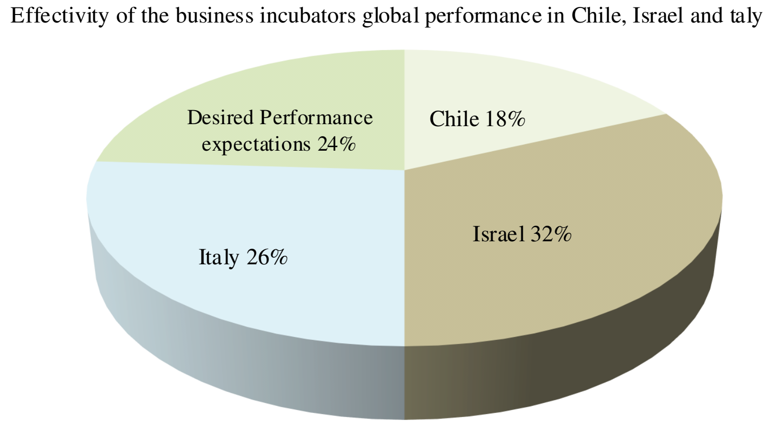
The output variable (OV) of the neurofuzzy model proposed was called effectiveness rate global performance of innovation (ERGPI) of the business incubators, resulting in the processes of:

Fuzzyfication: The fuzzification process determines the pertinence functions for each input variable.

Fuzzy Inference: The fuzzy inference rule-base consists of IF-THEN rules, which are responsible for aggregating the input variables and generating the output variables in linguistic terms, with their respective pertinence functions.

Defuzzification: For the applications involving qualitative variables, as is the case in question, a numerical value is required as a result of the system, called defuzzification. Thus, after the fuzzy inference, fuzzification is necessary, i.e., transform linguistic values into numerical values, from their pertinence functions (Von Altrock, 1997). To illustrate this, assuming that the study-object business incubator demonstrate the following performance rates for of the business incubators Chile, Israel and Italy: 0.5149; 0.8892; and 0.7328. The expected reference for performance for all incubators is 0.6827 (hypothetical) (Figure 5). It is concluded that the effectiveness rate global Outcomes of the business incubators in Chile, Israel and Italy depends of the combination and interaction of the characteristics of the business incubators (Hypothesis 2). Business incubators of Israel (89%) and Italy (73%) show efficiency in the combination of their innovation capacities. The effect of the innovation capacities on the business incubators global performance is dynamic and dependent on constraints and uncertainties that come from the environment at any given time. The environmental contingencies are crucial and essential to adapt the innovation activities.

Figure 5: Effectivity of the business incubators global performance of innovation in Chile, Israel and Italy



There is a broad spectrum of objectives that are stressed in the mission statement of business incubators in Chile, Israel and Italy, allowing multiple answers: contributing to the competitiveness of the local economy and stimulating the entrepreneurial spirit. In this view, the team's capabilities are most important to a new enterprise's success rate (Aerts, Matthyssens, and Vandenbempt, 2007). This incubator environment encourages these activities by creating potential for success.

In fact, yet innovation metrics are important for at least two reasons. First, metrics help managers make informed decisions based on objective data, which is especially valuable given the long-term nature and risk associated with certain innovation projects. Second, metrics affect behavior by helping align goals and actions with the best interests of the company.5 Among those companies that do measure their innovativeness, most use R&D and product-development metrics only, such as annual R&D budget as a percentage of annual sales, number of patents filed in the past year, percentage of sales from products introduced in the past year, and number of ideas submitted by employees. A number of academic articles address the issue of developing metrics for this kind of innovation.6 Though somewhat useful, these metrics offer a limited view of a company's innovativeness (Muller, Välikangas, and Merlyn, 2005).

6. Implications for Management Practice

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 Business Incubators 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 incubators' 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 incubators 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 business incubators’ performance in the near future.

7. Conclusions and Limitations

This study aims to assess the innovation capabilities on the innovation performance in business incubators from Chile, Israel and Italy under perturbations: capabilities, leaderships and resources. 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 business incubators. 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 an incubators’ competitiveness. Increased global competition pressures are also forcing incubators to continuously adopt, develop and innovate to enhance product competitiveness such as product design and quality, technological service and reliability. For these reasons, a incubator 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 incubators’ 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). In promoting the success of business incubators, the "leadership" has the highest priority. The incubators, with their entrepreneurial teams, support start-ups, primarily with the following guidelines: consulting, network of activities with customers and suppliers, network of activities with companies, marketing assistance, key figures recruitment, support to the administrative and legal services, among others. Government and universities act in concert to support incubation efforts in the three countries. This research presents theoretical and practices implications. The obtained findings could be of potential value to future researchers in business incubation. On the other hand, this study also contributes main managerial implications. First, it helps incubator managers' and policy makers' resource allocation decisions.

An effective management can ensure that they have resources and capabilities required to serve its start-up firms. The obtained priorities help practitioners understand the relative importance of the innovation capacities on the business incubators performance of innovation under perturbations of resources, leadership and capacities. This is helpful to establish their strategic plans. Finally, looking at the role of incubators in the entrepreneurial process, Peters et al. (2004) cite the past research of Wiggens and Gibson (2003) showing that incubators must do five things well in order to succeed (Gornall and Thomas, 2006): Establish clear metrics for success; provide entrepreneurial leadership; develop and deliver value-added services to member companies; develop a rational new-company selection process; and ensure that member companies gain access to necessary human and financial resources. Finally, there are several directions in which this research might be extended. First, replicating this research with a larger sample size including a variety of stakeholder types will be recommended. Second, characteristics others can be used in the sample to achieve superior performance. Third, the proposed approach can be adapted for others countries. Fourth, comprehensively examine more influencing characteristics to accurately assess the business incubators performance. Further studies may include factors what constrain the effects of innovation capacities on the business incubators performance, for example, the risks and uncertainties in incubation process. Fifth, though our study prioritized evidence from Chile, Israel and Italy, others international comparisons should be developed. It is also evident that the list of priorities of innovation capacities is dynamic and depend of the desired performance by incubators, always bringing new concepts and demanding new behaviors, new content and technical implementations, thus fundamentally requiring to permanently reconfigure the new characteristics for the new findings. Regarding this effort, the research on such priorities should be applied permanently and periodically.

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 business incubators from Chile, Israel and Italy in a static context, which may represent a limiting factor. Therefore, it is recommended to reproduce and replicate the model in incubators 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 incubators 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 incubators in this category should be anchored by efficient planning.

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