

**GLOBAL PERFORMANCE EVALUATION: EFFECTS OF CHARACTERISTICS ON  
BUSINESS INCUBATORS OUTCOMES**

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# GLOBAL PERFORMANCE EVALUATION: EFFECTS OF CHARACTERISTICS ON BUSINESS INCUBATORS OUTCOMES

**ABSTRACT:** This research aims to evaluate the effects of the characteristics on the global performance of business incubators. A conceptual framework is drawn up based on the literature and confirmed with specialists. The model was tested on incubators in three countries: Brazil, Chile, Israel, Italy and USA. Mailed structured questionnaires were employed for the collected 115 expert (Survey). The data were extracted using an assessment matrix (a survey). To reduce subjectivity in the results achieved the following methods were used complementarily and in combination: Law of Categorical Judgments psychometric scaling method (Thurstone 1927), multicriteria analysis, and neurofuzzy technology. Business incubators contribute to the international economy and play a vital role not only in the economic recovery but also in smart growth and economic development. These findings will assist incubator managers, policy makers and government parties in successful implementation of incubator policies

**KEYWORDS** Characteristics; Business incubators, Outcomes, Brazil, Chile, Israel, Italy, and USA

## 1. INTRODUCTION

Business incubators have traditionally been recognized as new organizational forms for promoting entrepreneurship and stimulating new business formation (AMAZCUA 2010; CHAN AND LAU, 2005; ÖZDEMİR AND SEHITOGLU, 2013; LINDHOLM-DAHLSTRAND AND KLOFSTEN, 2002; LYONS AND LI, 2003; ALLAHAR AND BRATHWAITE, 2016; AL-MUBARAKI , MUHAMMAD , AND BUSLER, 2015; MONSSON AND JØRGENSEN, 2016). Business incubators (BI) date back to the 1950s (MIAN ET AL., 2016). After the first organization was established, the number and types of BIs increased rapidly (BRUNEEL ET.AL., 2012; CAMPBELL AND ALLEN, 1987; CORNELIUS AND BHABRA-REMEDIOS, 2003). By 2012, the number of incubators reached seven thousand globally, according to Knopp (2012). It can be said that this rapid increase is because economies are nurtured by the growth of incubation programs and because BIs are stimulated by industry needs (ABETTI, 2004; TORUN ET.AL., 2018). The roles of the incubators for the community as follows: to foster job creation (Knopp, 2012; Wynczyk and Raine, 2005), to develop new ventures (Allen and Rahman, 1985; Amezcua, 2010b; Scillitoe and Chakrabarti, 2010), to support the entrepreneurial community (Bruneel et al., 2012) and to promote economic development (CSES, 2002; LALKAKA AND ABETTI, 1999; OECD, 1997; PHAN ET AL., 2005; SCHWARTZ AND GOTHNER, 2009; S, EHITO\_GLU AND ÖZDEMİR, 2013). Hence, one can state that the main rationale of business incubation appears to be contribution to economic development either regionally or nationally (MIAN, 1996; TORUN ET.AL., 2018).

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). Systematic evaluations are needed to understand whether business incubation is an effective and efficient tools. Considering the great credence for—and the large amounts of money invested in—incubators by governments, universities, research institutions, municipal agencies and other interested parties, the question of what return society gets on these investments has been raised. Consequently, and in line with a general demand for more rigorous evaluations (OECD, 2006). The evaluation of incubator performance has attracted some attention (AERNOUDT, 2004; ALLEN AND MCCLUSKEY, 1990; BHABRA-REMEDIOS AND CORNELIUS, 2003; CHAN AND LAU, 2005; GRIMALDI AND GRANDI, 2005; HACKETT AND DILTS, 2004A; LINDELOF AND LOFSTEN, 2004; MIAN, 1996, 1997; NOLAN, 2003; OECD, 1997; PENA, 2004; PHAN ET AL., 2005; BERGEK AND NORRMAN, 2008). The effectiveness of incubators is difficult to assess due to multiple, and often moving, targets. In fact, many researches have been conducted to assess their performance or impact.

As studies have been inconclusive, we argue that performance differs according to the characteristics of incubator. In summary, the literature gap we address is the study of how different types of incubator perform based on whether the characteristics meet the objectives for which they were set up. In this study we will try to find out some more appropriate characteristics of as to understand better how incubator program can be assessed better. With a special focus in Brazil, Chile, Israeli, Italy, and USA. This research aims to evaluate the effects of the characteristics on the global performance of business incubators. Furthermore, this research examines how the characteristics affect the outcomes (Business Performance). Hence, it tackles the following research issues: (a) a profile of the characteristics of the business incubators in Brazil, Chile, Israel, Italy, and USA; (b) a description of performance practices by business incubators; and (c) an exploratory link between characteristics and performance of business incubators. Thus, systematic evaluations are needed to understand whether business incubation is an effective and efficient policy tools in those countries (OZDEMIR AND SEHITOGLU, 2013). Here incubator is conceptualized as a facilitation method for business. In fact, this is an important addition to the literature on this issue. Within this context, this paper is structured according to the following sections: background theoretical, methodology, results and underlying analyses, the paper concludes with the final considerations.

## **2. LITERATURE REVIEW**

Many empirical studies have been applied to assess the Business Incubators (FERNANDES, ET.AL., 2017; SHEPARD, 2013; DAHLSTRAND AND POLITIS, 2013; CAVDAR AND AYDIN, 2015). All of these researches tend to reflect different perspectives, patterns and assessment criteria in the literature which are focused on measuring performance of Business Incubators throughout the world (Phan et al. 2005). Literature suggests for business incubation success to be measured at multiple levels, more especially at the incubator related and firm level related impacts (HAMDANI, 2006). There are a variety of measures of incubation performance or outcomes such as occupancy rate, added value of incubator service, the number or proportion of firms graduated, growth of the tenant firms, jobs and wealth created (Phan et al. 2005, Chan and Lau 2005, Hackett and Dilts 2008) number of patent applications per firm (Colomba and Delmastro, 2002). Although survivability of new businesses are often used as a measure to assess the performance of Business Incubators many researchers argue that it should be accepted as a necessary but insufficient condition for success and emphasize the significance of the extent to which Business Incubators contribute to the growth of firms and creation of jobs (EUROPEAN COMMISSION 2002, AERTS ET AL. 2007).

In the literature survival measures has been widely used as indicators of incubator performance, since the (ADEGBITE 2001, ALLEN AND RAHMAN 1985, SCHWARTZ AND GOTHNER

2009). Recently, Al-Mubarak and Schrodl (2012) also studied and proposed a measurement model that concerned the international context. The four measured indicators were: (1) graduation of businesses incubated; (2) success of businesses incubated; (3) jobs created by incubation; and (4) salaries paid by incubator clients. Allen and McCluskey (1990) extract different measures from their literature review: tenant employment, incubator period, tenant success rate, local retention of graduates and added value of incubator services. They evaluate incubator size and occupancy rate, jobs created and firms graduated. Mian's research (1994, 1996, 1997) focuses on university technology business incubators in the US.

His 1994 article describes their management, policies and performance, and in 1996 he assesses them by exploring their value added contributions to technology-based start-ups. He (1997) groups incubator assessment research around four approaches in the management literature: goal approach, system resource approach, stakeholder approach, internal process approach. He introduces four dimensions in his assessment framework on the performance of university technology business incubators: programme growth and sustainability, tenant survival and growth, contributions to sponsoring university's mission and community-related impacts. Thus, there is no clear cut standard to measure incubator performance (Phan et al., 2005). One of the major problems in assessing the impact of the Business incubators is that although there is vast amount of empirical studies on the performance of business incubators, there is still lack of consensus on the measurement of the performance of Business Incubation. Thus, there is no single standard method to measure the performance which makes it complicated to measure the incubation performance and make comparisons (RATINHO AND HENRIQUES 2010, BERGEK AND NORRMAN 2008, SCHWARTZ AND GOTHNER 2009, PHAN ET AL. 2005). Second problem is that most of the researches on business incubators are conducted in developed countries (AKCOMAK AND TAYMAZ, 2007). We will present an away to understand better how incubator program can be assessed in context of the Chile, Israel and Italy based on characteristics; i.e.; this research examines how the characteristics affect the outcomes (Business Performance). Next, the characteristics related to the context of the incubators consulted by country - Israel, Chile and Italy - are presented.

*Chile:* The business incubators in Chile are supported primarily by a coalition of government and universities (CHANDRA AND MEDRANO SILVA, 2012; CHANDRA AND NARCZEWSKA, 2009; CORFO, 2015; ECHECOPAR, 2004): The Government promotes national initiative of innovation and R&D; generates jobs, incomes and taxes; promotes regional development; forms partnerships with industry and universities; creates dialogue between key stakeholder groups. The primary focus is on fostering innovative companies with high growth potential, the government also looks for economic impact in terms of job creation in economically disadvantaged regions (CHANDRA AND MEDRANO SILVA, 2012; CHANDRA AND NARCZEWSKA, 2009; CORFO, 2012; ECHECOPAR, 2004). The Universities helps commercialize academic research; utilizes faculty and students; provides experiential learning opportunities; engages with business and community; promotes networking with other universities; and promotes community engagement. Finally, the business provides access to innovative ideas and creative people; develops opportunities for acquisitions/joint ventures; and provides good marketing and community engagement (CHANDRA AND MEDRANO SILVA, 2012; CORFO, 2012; ECHECOPAR, 2004; FUNDACION CHILE, 2012). Chilean incubators seek to promote job creation, economic development, innovation, and high growth by providing a wide variety of services that are typical to most incubators: physical space and infrastructure, business consulting and training, help with funding applications (government and private), patenting assistance and IP protection, technology transfer, and networking. The main focus, however, seems to be on internal and external networking, assisting incubatees with finding funding, and providing university expertise to the start ups. All Chilean incubators provided basic administrative services (office space, infrastructure, secretarial and administrative services). However, incubators tended to emphasize high value services such as

consulting, training and networking. Consulting covers the gamut from business plan development to marketing, accounting, financial, and legal support, depending on the incubator staff's expertise. Through various partnerships, incubators also provide the technology expertise to assist the commercialization process (CHANDRA AND MEDRANO SILVA, 2012; CORFO, 2015; FUNDACION CHILE, 2012).

*Israel:* The Israeli innovation incubators program was adapted from the experience of other countries, mainly the US. As implemented, the program has shown a strong specificity and homogeneity, both in its content and its rules of implementation. During the last decade, the Israeli high-tech industry has rapidly expanded, with one of the highest rates of start-ups in the world. High-tech is the major driver of the Israeli economy, emphasised by a growth rate which is the highest of all Israeli industrial sectors. The Israeli market has opened up to foreign competition and international investments; A considerable wave of immigration, primarily from Russia, with many educated people in the fields of science and technology has been absorbed; Government and private support in know-how infrastructure has increased; Shrinkage of the defense industry, which had been the main driver of the Israeli high-tech industry; Education levels have continued to improve; and Changing lifestyle of the young generation and the computer era have attracted many youngsters into computer science, electronics and IT fields (DVIR AND TISHLER, 1999; LERNER AND HENDELES, 1996; LERNER AND AVRAHAMI, 1999; ISRAELI MINISTRY OF FINANCE—ECONOMIC AND RESEARCH DEPARTMENT, 2003). Israel's relative advantage resides in its high human capital, high investments in R&D and high quality of management systems, including its human resources management. Multiculturalism at the workplace has been a real challenge for managers (Jacob Weisberg, 2010). In this perspective, the collection of startups in incubators does provide unstructured collaboration of people that are in similar situations. It is this collaboration that helps form a perspective of encouragement, networking, and information collection and sharing. This incubator environment encourages these activities by creating potential for success (ZABLOCKI, 2007).

*Italy:* The Italian incubators were originated in the eighties by the initiative of the public sector in order to promote entrepreneurship and economic development, especially in economically disadvantaged areas of the country. In particular, the Society for the Entrepreneurial Promotion and Development (SPI), from the public sector, played a significant role in the creation of the first business incubators in the form of the Business Innovation Centre (BIC), oriented to the model proposed by the European Commission and mainly specialized in high-tech production areas (ASTOLFI, 2014). In the late eighties, the Science and Technology Parks also began to implement the ways of creation of incubation in order to support the development of innovative companies. At the end of the nineties, the Italian university incubators began to spread. Another type of institution consists of incubators of private nature. In beginning, the objectives of the incubators were focused on the supply of physical infrastructure and logistics for start-ups. Then the focus was addressed to intangible services with high aggregated value such as consulting, guidance, networking and guidelines for access to funding sources (AURICCHIO ET.AL., 2014; ASTOLFI, 2014). The most of the incubators are the result of public intervention, particularly by local authorities and regional development agencies and that indicates a prevalence of their non-profit character (CORSI AND DI BERARDINO, 2014). In Italy the presence of universities in incubators is significant; this leads to consider universities as a preferential tool for technology transfer from public research to the market. In fact, the universities are as local entrepreneurship catalysts, profiting from the connections established with the companies located in that territory, which stimulate the presence of corporate incubators in order to start knowledge spill-over processes involving universities, incubated start-ups and the local area (CORSI AND DI BERARDINO, 2014).

*Brazil:* Brazil: It is estimated that there are around 3,500 incubators worldwide, one-third are located in North America, about 30 percent in Europe, and the remaining 40 percent in developing countries of which most are in Brazil and China” (AKÇOMAK, 2009; WANN ET.AL., 2017). In Brazil the first incubators emerged in the 80's - the first incubator was created in 1982 in São Carlos (SP) by the High Technology Park Foundation, as presented by Lahorgue (2004). Until 1987, there were few incubators operating in Brazil according to Franco et al. 2010 (TIETZ ET.AL., 2015). In Brazil, concerning business incubators team management it is possible to register that in general the younger is the business incubators younger is the business incubators team management. Most of the business incubators offer only basic services and provide professional business services through a network of contacts. The infrastructure is considered as a relevant factor, however, infrastructure do not make the difference, it is essential the experience of management team, access to business and academic networks, to ensure success Brazil, this trend is not so clear. The success of incubators are also depending on the providing a wide variety of services tailored according to tenants requirements, concentrate more on intangible business services and use qualified managers and support staff. They are mainly focussed on infrastructure and basic services, while support for improving network and access to knowledge services are neglected (CARVALHO AND GALINA, 2015).

*USA:* Today, an estimated 7,000 incubators exist worldwide. Among those, approximately 1,800 are in the USA (AL-MUBARAKI AND BUSLER, 2019). Shepard (2013) studied the profile of business incubators in the USA from three periods: (1) 1959-1979; (2) 1980-1999; and (3) 2000-2012, considering the mission, plans and strategies, leadership/management, staff competence and expertise, facilities and resources and technology according each generation . In this sense, during the first generation (based on literature), the business incubator's mission was to improve economic conditions by assisting SMEs to develop viable business practices through consulting, education, and training. The second generation (based on literature) incubator's mission was to foster entrepreneurships, innovation, and to create long-term and sustainable jobs by improving incubates skills in the areas of marketing R&D, finance, human resources, physical services, and law services. Third generation incubators offer services such as assistance in the writing of business plans, development support, counseling, coaching and mentoring, training, provision of venture capital for businesses, and to provide access to networks of professional contacts. Regarding the background of clients served, findings indicate that incubator managers mainly assist incubatees who are mainly the small business owner and students (comprising two-thirds of clients served). Concerning the creation of new mindsets, the survey found that managers who responded to the survey identified new mindsets they center on as they work with clients in developing their entrepreneurial business.

The second area surveyed is on the profile of business incubators. First, on incubator mission, most managers surveyed indicated that the incubators they manage have a mission statement. Second, on services provided by incubators, surveyed managers indicated that they offer “direct services” to clients such as mentoring, training, and coaching which were deemed as being very important services to incubatees. Incubators also provide “indirect services” such as networking activities, establishing partnerships, locating resources, managing and searching for strategic relationships with external parties, identifying economic partners, facilitating meetings with potential advisors, investors, and mentors. These services were pre-requisites to success of clients served. Incubators also provide operational management such as managing facilities, the building, property, and entailed day-to-day management activities that can enhance the services provided to the incubators' clients. Third, on staffing, survey findings indicate that managers viewed their clients as highly qualified in attending to their designated tasks. Fourth, on facilities, survey findings showed that working space was important but in addition facilities such as lab space for new product development was vitally important. Here, important facilities include internet connectivity, phone system, and good office location. Fifth, on technology, findings indicate that technology played a main role of providing better and more efficient means of communication for instance, video conferencing. Whereas virtual

incubation is revolutionary by virtue of advanced communication technology (e.g. teleconferencing), actual physical setting of a business incubator is important due to the direct and indirect services that can be immediately availed and the chance of learning from the business incubator environment (SHEPARD, 2013).

These potential remarkable effects of Business Incubators on economic development generate the need for an evaluation of their performance (PHAN ET AL., 2005). Despite the fact that there is no common method for assessing incubators and there are many challenges for evaluating business incubators performance (Hackett and Dilts, 2007; Schwartz and Gothner, 2009), it is still important to estimate incubation impact for the community, incubators and incubatees (HACKETT AND DILTS, 2004). Although there are many studies about business performance evaluation, there is a gap in the literature about this object (TORUN ET.AL., 2018).

### 3. DATA AND METHODOLOGY

#### 3. Research Framework

##### 3.1 Conceptual Model: Constructs and hypotheses

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

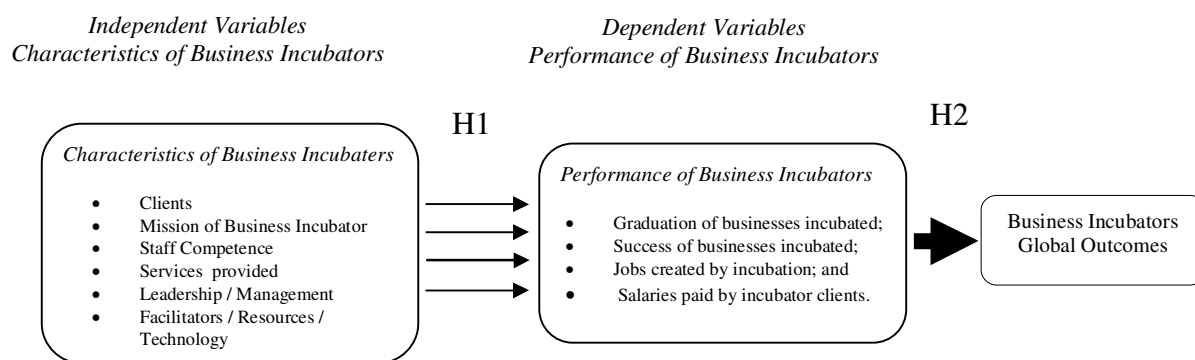


Figure 1: Conceptual model

The current study proposes a conceptual framework for a specific model designed to explain the link between characteristics and performance (Outcomes) of the business incubators. The current research lays out a conceptual framework designed to analyze the sectors different in business incubators in Brazil, Chile, Israel, Italy, and USA. This framework is then used to analyze how this variable may impact the business performance. Figure 1, which illustrates the essential constructs included in this study, will serve to guide subsequent discussions. From the conceptual model, the following independent variable, dependent variable and hypotheses were made:

*Independent Variables:* from the findings in the literature the following characteristics of business incubators were identified: Clients; Corporate mission; Plans and strategies; Leadership/management; Staff competence and expertise; Facilities/Resources and Technology.

*Dependent Variables:* The dependent variables were extracted from the specialized literature and assessed by experts for confirmation. The following independent variables were identified: Graduation of businesses incubated; Success of businesses incubated; Jobs created by incubation; and Salaries paid by incubator.

*Hypothesis 1:* The characteristics have effect to a greater or lesser degree on the Business Incubators Performance (Outcomes), in perspective Brazil, Chile, Israel, Italy, and USA.

*Hypotheses H2: The effectiveness rate global performance (ERGP) of the business incubators in Brazil, Chile, Israel, Italy, and USA depends on the combination and interaction of the characteristics on the business incubators performance (Outcomes). The sample and data collection are described below.*

### *3.2 Sample and Data Collection*

The population of this study was in business incubators in Brazil, Chile, Israel, Italy, and USA (Survey). The authors investigate the effect of the characteristics on outcomes/performance of business incubators in sectors different. The data were extracted using an assessment matrix (questionnaire scalar). The interview instrument for the semi-structured, in-depth interviews was developed after a thorough literature review. 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 Portuguese, Spanish, English, Italian and Hebrew. The questionnaire incorporated sections dealing with: general information of incubators, characteristics of incubators, measures of results, effect of characteristics on outcomes. The actual survey was carried out between March and June 2014, which involved 150 specialists. The samples were selected by random sampling technique. Of the 150 specialists in our sample, 115 completed questionnaires were returned. However, seven cases had to be excluded from further analysis due to excessive missing data. Therefore, the present sample comprised of 115 specialists in business incubators in the three countries resulting in a response rate of 77% 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 Brazil, the data were collected of managers of 33 business incubators and specialists. 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. To reduce subjectivity in the results achieved the following methods were used complementarily and in combination: Law of Categorical Judgments psychometric scaling method (Thurstone 1927), multicriteria analysis, and neuro-fuzzy technology. Next, these procedures are detailed.

## **4. CONCEPTUAL MODEL VERIFICATION: RESULTS AND UNDERLYING ANALYSES**

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

*Phase 1: Determination of the characteristics of the business incubators in the perspective of: Brazil, Chile, Israel, Italy, and USA.*

*Phase 2: Effects of the characteristics on the business incubators performance in Brazil, Chile, Israel, Italy, and USA.*

*Phase 3: Assessment of the effectiveness rate global performance (ERGP) of the business incubators in Brazil, Chile, Israel, Italy, and USA.. The procedures are detailed as it follows.*

*Phase 1: Determination of the characteristics of the business incubators in the perspective of: Brazil, Chile, Israel, Italy and USA*



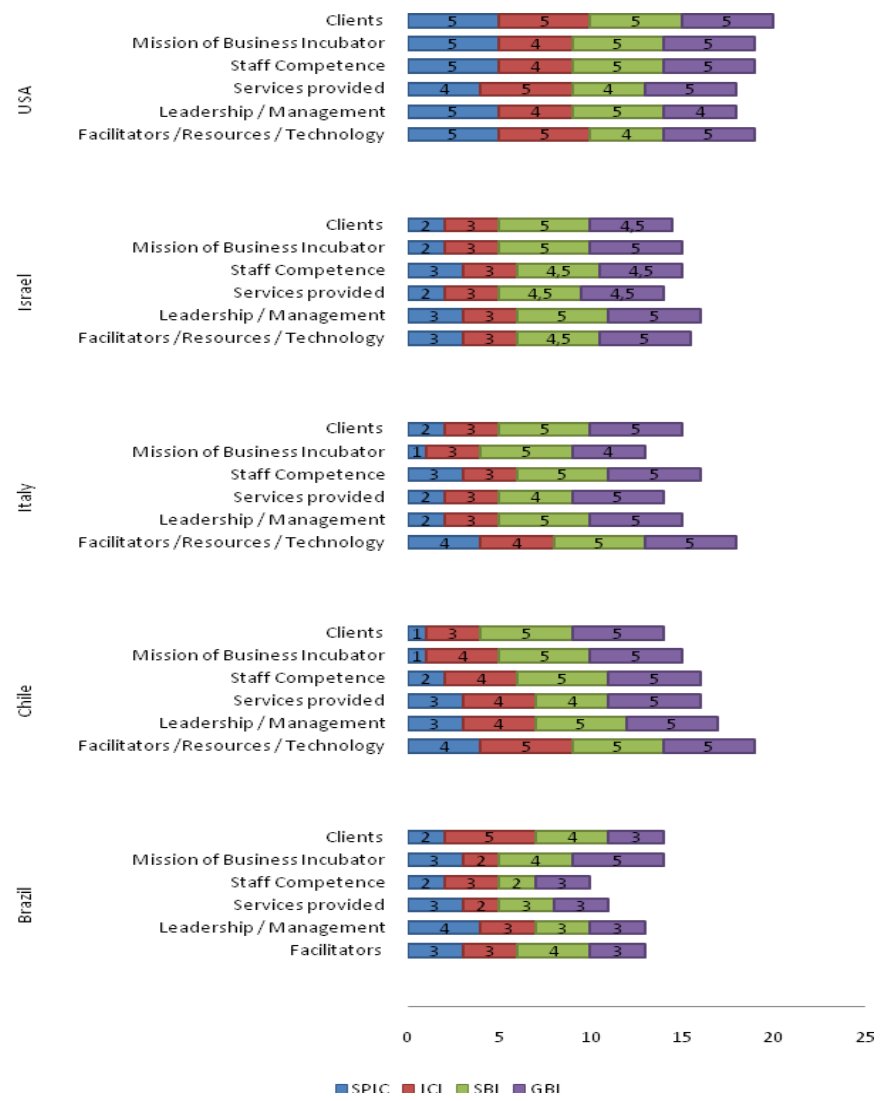
This phase has been subdivided as follows: Stage 1 - Identification of characteristics of business incubators in Brazil, Chile, Israel, Italy, and USA; Stage 2 - Business Incubators evaluation using the method of Low Categorical Judgments (LCJ) of Thurstone (1927). Thus, study was designed, based on the literature and confirmed by the assessment of experts. In this perspective, the data were first extracted from the specialized literature (400 articles). After the identifying the characteristics and for better understanding, they were regrouped by clusters.

*Multivariate Analysis Grouping was adopted by Cluster for the data treatment:* The following groups of characteristics were adopted: a) Clientes; b) *Mission statement and plans and strategies*; c) *Staff Competence and Expertise*; d) *Services provided on by incubators*; e) *Leadership and Management*; f) *Facilitator, features and technology*. Once the characteristics are identified, the scaling model of categorical judgments by Thurstone, 1927 (Souza, 1988), was used as a support tool for the evaluation. The result of the preferences, then, is presented orderly importance increasing. ): first, the clients; second the leadership and management; third mission, plan and strategies; fourth, the facilitator, features and technology; fifth, the services provided on by incubators. The results show that there is a predominance in “clients, leadership and management” in all business incubators of *Brazil, Chile, Israel, Italy, and USA*. In general, based on the preferences of experts and confirmed by the LCJ method, it can be stated that business incubators (Chile, Israel and Italy) have given strong support to start-ups (high: 80-100%). Furthermore, there is also a low probability that incubators do not declare their missions, which are fundamentally based on their respective business plans (Low: 0-20%). The incubators’ work teams are highly qualified (higher: 80-100%). The LCJ method showed a strong tendency to a high degree to the advisory activities of the incubators (high: 80-100%). This opens the door to accelerate the learning process of business support or counseling. In addition, there is a strong management (80-100%) in the incubators of the three countries in direct services, such as guidance and counseling; and also in indirect services, such as participation in meetings. The LCJ method showed that incubators are suitable in what concerns the location and the services provided. There is a satisfactory and plausible relationship between the incubators and the universities and financial institutions, as well as being viable partners. Finally, the relationship between the incubators and the economic and financial performance is seen as moderate (60-80%). In addition, the success of an incubator depends on the performance of its tenants and thus an incubator benefits from limiting the tenant failure rate. The managers estimated that the majority of their time is spent in direct interactions with clients (counseling and related activities).

*Phase 2: Effects of the characteristics on the business incubators global performance in Brazil, Chile, Israel, Italy, and USA.*

This section evaluates the characteristics on the business incubators global performance in the perspective of *Brazil, Chile, Israel, Italy, and USA*. This procedure was developed using the multi-criteria analysis. The methods used were Compromise Programming, Electre III and Promethee II. The results achieved confirm Hypothesis 1: The characteristics have effect to a greater or lesser degree on the business incubators performance, in perspective *Brazil, Chile, Israel, Italy, and USA*. 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 performances of the business incubators: Graduation of businesses incubated; Success of businesses incubated; Jobs created by incubation; and Salaries paid by incubator clients. The dimensions of characteristics are in the third level, the alternatives, which are: Clients, Corporate mission, Plans and strategies; Leadership/management, Staff competence and expertise, Facilities/Resources and Technology. The prioritization process obeys the judgment of the evaluators (experts). The results can be observed (multi-criteria analysis)

in Figure 2. The results produced by the methods show the “clients”, “mission of business incubators and strategies plan” and “leadership and management” as the most significant ones to ensure the Performance of the Business Incubators (GBI) of the three countries, mainly in the perspective of the Graduation of Business Incubated (GBI) and Success of Business Incubated (SBI). “Wages paid by customers” is the feature with less impact on the performance of the incubators (40-60%) and job creation is influenced moderately (60-80%) by the characteristics of the incubators. When comparing the results in terms of performance, the Compromise Programming and Promethee II methods did not differ in their classifications. In fact, the business incubator’s mission were to improve economic conditions by assisting small medium enterprises develop viable business practices through consulting, education, training and others. In general, the mission business incubators are based on business plan. Some professional business services provided in business incubators include business plans, development support (Penã, 2004), counseling, coaching and mentoring (Chan and Lau, 2005), and training (AERTS ET AL., 2007; BARROW, 2001).



(SPIC) Salaries paid by incubator clients – (JCI) Jobs created by incubation – (SBI) Success Business Incubated – (GBI) Graduation Business Incubated - 1: Low importance – 5: High importance

Figure 2: Effects of the characteristics on the business incubators global performance in Brazil, Chile, Israel, Italy, and USA

There is a broad spectrum of objectives that are stressed in the mission statement of business incubators in Brazil, Chile, Israel, Italy and USA, 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. All the business incubators apply indicators (metrics) for performance evaluation to a greater or lesser degree of intensity. In the pre-incubation, the application of indicators rate for all incubators is maximum (100%). At this stage, it was considered indicators such as: total number of projects in pre-incubation, number of incubated projects resulting from the pre-incubation by the number of pre-incubated projects, Number of pre-incubated projects that went straight to the market by the number of pre-incubated projects. Number of students involved in pre-incubated projects by the number of students enrolled in entrepreneurship programs and others. *In incubation*, the incubators apply all indicators (100%). The indicators considered were the following: number of selected for incubation by the number of candidates per year. Mortality rate in the incubation process. Number of graduated companies per year. Average time of incubation. The incubator revenue profile per year. Annual growth rate of revenues of incubated companies. Number of requests for records by the number of patents per year by incubated companies. Others. Business incubators partially apply the indicators in the post-incubation phase (60-100%).

*Phase 3: Assessment of the effectiveness rate global performance (ERGP) of the business incubators in Brazil, Chile, Israel, Italy, and USA*

This phase focuses on determining effectiveness rate global performance (ERGP) of the business incubators in Chile, using neuro-fuzzy modeling (Figure 3). It is a process whose attributes usually possess high subjectivity characteristics, 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). 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 from interaction among characteristics. 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.

*Stage 3.1: Determination of Input Variables (IV) and Linguistic Terms:* This section focuses on determining the qualitative input variables (IV). These variables (16) were extracted from Phase 2, results of effects of the characteristics on the business incubators performance. The linguistic terms assigned to each IV are: High, Medium and Low. Accordingly, Figure 3 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).

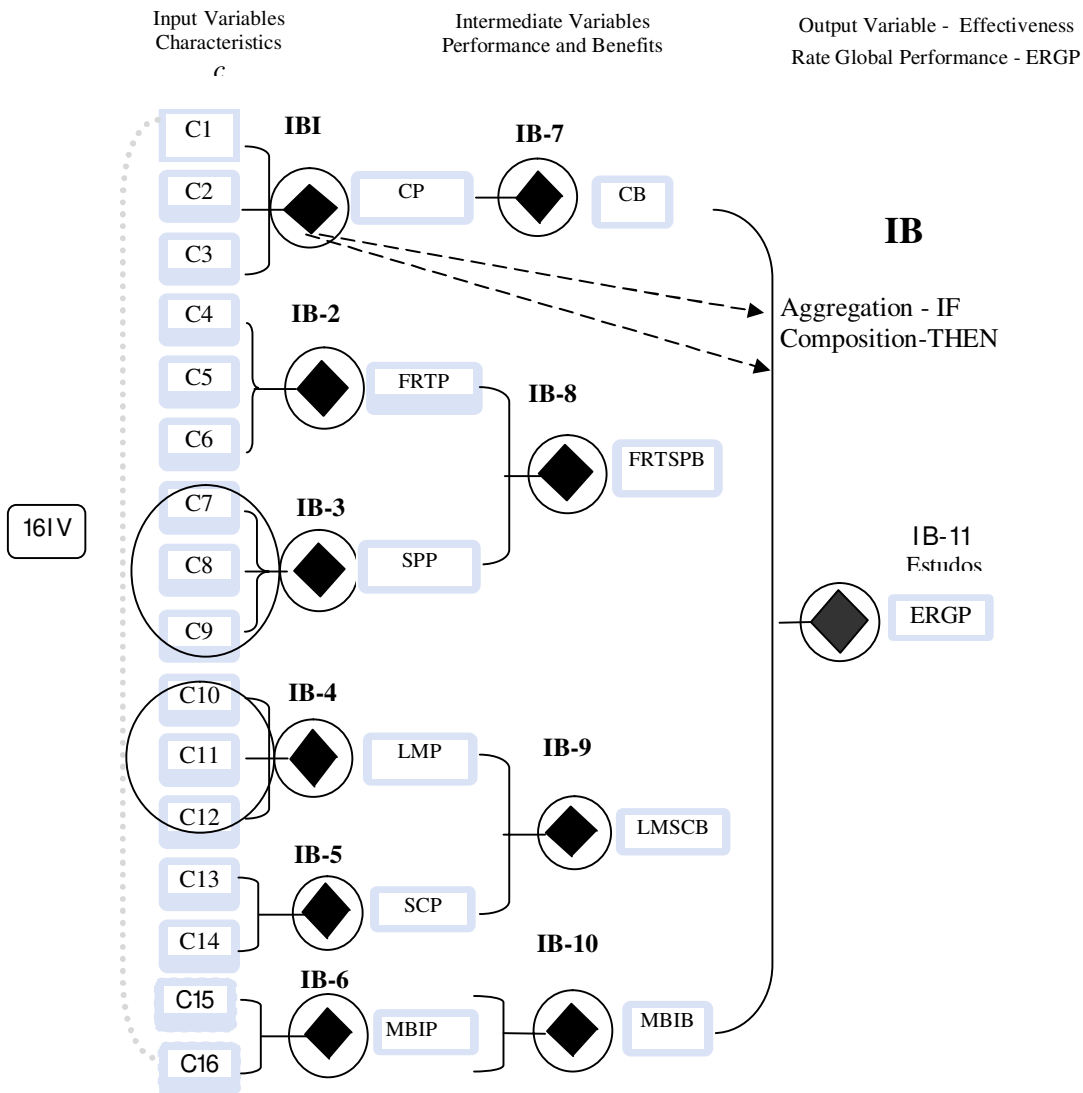


Figure 3: Assessment of the Effectiveness Rate Global Performance (ERGP) in Brazil, Chile, Israel, Italy, and USA

*Stage 3.2: 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: Clients Performance – CP; Mission of Business Incubator Performance – MBIP; Leadership / Management Performance – LMP; Staff Competence Performance – SCP; Services Provided Performance – SP; Facilitators / Resources Performance – FRP; and Technology Performance – TP. The architecture proposed is composed of eleven (11 IB) expert fuzzy system configurations, 16 IV (input variables), 10 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 (ERGP) in Chile, Israel and Italy. The results confirm the *H2: The effectiveness rate global performance (ERGP) of the business incubators in*

Brazil, Chile, Israel, Italy, and USA depends on the combination and interaction of the characteristics on the business incubators performance (IV- results of the Phase 3).

*Stage 3.3: Determination of Output Variable – Effectiveness Rate Global Performance (ERGP) in Brazil, Chile, Israel, Italy, and USA*

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

*Fuzzification:* 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 Brazil, Chile, Israel, Italy and USA: 0,4917; 0,5149; 0,8892; 0,7328 and 0,8936. The expected reference for performance for all incubators is 0.6827 (hypothetical) (Fig. 5). It is concluded that the effectiveness rate global Outcomes of the business incubators in Brazil, Chile, Israel, Italy and USA depends of the combination and interaction of the characteristics of the business incubators (Hypothesis 2). Business incubators of USA and show efficiency in the combination of their characteristics. The effect of the characteristics 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 characteristics.

**Effectivity of the business incubators global performance in Brazil, Chile, Israel, Italy and USA**

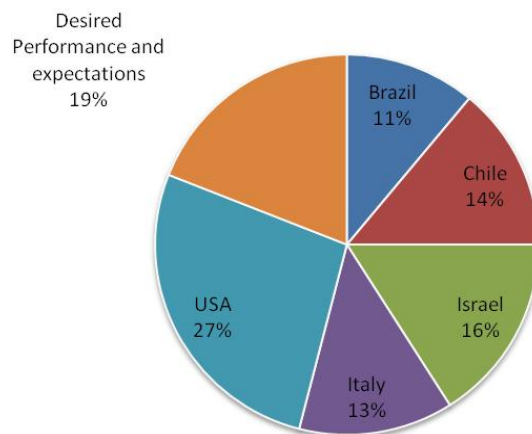


Figure 4: Effectivity of the business incubators global performance in Brazil, Chile, Israel, Italy and USA

Business incubators make use of its innovative characteristics to achieve sustainable competitive advantage and value creation. Essentially the value creation system is an analytical tool; it facilitates the identification and evaluation of strategic alternatives (WALTERS AND RAINBIRD, 2007).

## 5. CONCLUSIONS: WHAT CAN BE LEARNED?

This research aims to evaluate the effects of the characteristics on the global performance of business incubators in Brazil, Chile, Israel, Italy and USA. In this study, we attempted to take a first step in closing this gap in literature on business incubator. By identifying characteristics and their priorities on the business performance, we enable incubators to strategically manage the priority effectively and to improve the business performance. By using these priorities, managers can decide which enabling characteristics they will focus on first, next, and then last. 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 characteristics on the business incubators performance. 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 Wiggins 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 characteristics on the business incubators performance, for example, the risks and uncertainties in incubation process. Fifth, though our study prioritized evidence from Brazil, Chile, Israel, Italy and USA, others international comparisons should be developed. It is also evident that the list of priorities of characteristics 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.

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