Strategic Capacity of Brazilian Technological Parks

Alandey Severo Leite da Silva and Sergio Henrique Arruda Cavalcante Forte
University of Fortaleza, Av. Washington Soares, 1321, Edson Queiroz,
CEP. 60811905, Fortaleza, CE, Brazil

Abstract: This study aims to investigate the Brazilian Technological Parks (TP) strategic capacity evaluation structure. For this, a framework that represents Brazilian TP strategic capacity was elaborated and finally a Strategic Capacity Evaluation Methodology (SCEM) for Brazilian TP was structured from a four dimensions (Governance, Scenarios, Infrastructure and Strategic Performance) set, indicators and propositions, based on MACBETH, a prescriptive and constructivist multi-criteria analysis approach. After MACBETH analysis, it was observed that the highest values generated by SCEM for Brazilian TP were recorded, in general, for entities already nationally known by its adherents positions to the factors and criteria proposed in this model. It is recmmended for future studies expanding the SCEM application to TP from other continents in order to know the profile of these entities, their practices and contributions to Brazilian TP.

Key words: Strategic capacity, multicriteria model of decision support, technological parks, Brazil, evaluation

INTRODUCTION

The 2012 report of the Organisation for Economic Co-Operation and Development (OECD) points out that the United States (US), the world's largest economy, accounting for 23% of global economic activities will decrease to 18% in 2030. The Euro Zone will decrease from 17-12%. China which currently produces around 17% of global economic activity, will move to 28% in 2030, making it the world's largest economy. The Chinese growth and other emerging countries will be driven by a more skilled and productive work.

Traditional organizations and their models are als changing, companies integrate and mischaracterizes, forming networks, chains, conglomerates and strategic alliances, the so-called post-Fordist organizations adapted to the knowledge era, the unpredictability conditions introduced by the fast economic and technology transformation, like the Technological Parks (TP) (Lindelof and Lofsten, 2002).

Brazil had 94 Technological Parks (TP) initiatives spread across all its regions but a survey from 80 TP respondents data showed that 30% of TP were in the design phase, 35% in the implementation phase and 35% in operation. In terms of regions, the data indicate a significant amount of parks in the South (34) and Southeast (33) regions. Northeast (6), North (4) and Midwest (3) regions have a substantially smaller number

of organizations (Ministerida Ciencia, Tecnologi e Inovaca (MCTI) and Centro de Apoi a Desenvolviment Tecnologic da Universidade de Brasilia.

In the world, especially in developing countries, TP are inefficient, unproductive and are only panacea and unrealistic dream (Pose and Hardy, 2014). Others observers not only consider the financial return and see the TP as a innovative companies concentration and individuals who have return to provide improvement in the development of the regions where they live.

The basic assumptions based on the large number of searches (Albahari *et al.*, 2013; Chan and Lau, 2005; Gainoa and Pamplona, 2014; Lee and Yang, 2000; Lindelof and Lofsten, 2002; Phan *et al.*, 2005; Quintas *et al.*, 1992; Yang *et al.*, 2009; Zhou *et al.*, 2011) involving TP support the research relevance whose overall objective is to develop a methodology for evaluating the strategic capacity for Brazilian TP. The research issue founded on that basis was: how to evaluate the strategic capacity of Brazilian TP?

The choice of Brazil is given in accordance with Peng *et al.* (2008) which stresses the need for more studies in Latin American countries regarding the influence of institutions in the field of strategy, since most studies on emerging economies made by the researcher is inserted in the Asian or East European context (Peng *et al.*, 2008, 2009). To answer the proposed research question and achieve the goal, it elaborated a

---

Corresponding Author: Alandey Severo Leite da Silva, University of Fortaleza, Av. Washington Soares, 1321, Edson Queiroz, CEP. 60811905, Fortaleza, CE, Brazil

framework composed of the dimensions: corporate governance, scenarios, infrastructure and strategic performance, derived from other studies conducted (Oliveira and Forte, 2015) secondary data survey through bibliographic research in books, printed and electronic scientific material from various bases of national and international data-SI Web of Science; Scopus; Pro Quest; CAPES; Academic Search Premier-ASP (EBSCO), Science Direct (Elsevier), Springer Link (MetaPress) interviews and questionnaires application with institutions expertise's and managers.

The SCEM weight for Brazilian TP was made by value judgments assigned by managers. To transform the qualitative value judgments in quantitative the work adopted the MACBETH multi-criteria method.

Propositions and theoretical approach: Conceptualizing TP are organizations managed by specialized professionals whose goal is to increase the wealth and well-being of their communities,stimulate the growth of technology-based companies through incubation and spin-offs (new technology-based companies) and provide other value-added services coupled with a physical space and high-quality support services (Associaca Nacional de Entidades Promotoras de Empreendimentos Inovadores. Regarding financing 70% of TP in the world receive some form of government subsidy (National Business Incubation Association. In Brazil, this percentage is close to 90%. In Latin America-excluding Brazil-s far, the involvement of the public sector with TP has been relatively scarce. The result is inefficient TP territorially, unable to promote technological development and knowledge, limited in size due to the low initial levels of investment and little interest from the private sector.

Harrison and Miller (1997) relate strategic capacity only to the acquisition of competitive advantage and strategic planning appropriateness for the company's goals. Harrison and Miller (1999) point out that the strategic capacity is the company's condition to overcome all these challenges through its strategy effective dissemination. For some the strategic capacity is usually tied to some more specific factors such as the relationship with stake holders (Collis and Rukstad, 2008); learning and organizational knowledge (Wang *et al.*, 2012); the strategy solidity through planning and efficient execution (Ismail *et al.*, 2011; Teece *et al.*, 1997) among others. An improved and systemic study of the TP strategic capacity through the dimensions of corporate governance, scenarios, infrastructure, strategic performance is required by the challenges highlighted by the necessary harmony between its various actors (stake holders and share holders) and also by surveys indicate inefficiency and an "absence of an evaluation

performance indicator or methodology" appropriate to management and evaluation of these institutions (Link and Siegel, 2003; Phan *et al*., 2005; Vedovello, 1997; Yim *et al.*, 2011).

In terms of corporate governance and strategy, these issues scientifically emerged in the 1970s when Mace (1971), Norbum and Grinyer (1974), Pahl and Winkler (1974) adopted theoretical approaches as for example, the agency theory (Daily, 2003; Eisenhardt, 1989; Fama and Jensen, 1983; Hendry and Kiel, 2004) and the Resource Dependence Theory (Carpenter and Westphal, 2001; Goodstein *et al.*, 1994; Pearce and Zahra, 1991; Zahra and Pearce, 1989). Thus, the initial Proposition (P1) of this research is that.

Proposition 1 (P1): The corporate governance and strategic capacity of the organizations are important factors to be assessed. Regarding the scenarios adoption, the primary interest for their involvement in this study is the fact that they allow detailed exploration of critical uncertainties of a given system. A scenari is not a future reality but rather a mean to represent it with the aim of clarifying the present action in the light of possible and desirable future (Durance and Godet, 2010).

Taking as an example the innovative and emerging solutions produced technologically within the TP, it is possible that ownership of future scenarios these organizations can anticipate in a controlled manner to future changes, designing and developing embryonic solutions that may be even more profitable to over time. Schoemaker and Mavaddat argue that emerging technologies are considered different from other forms of investment as small innovations can produce, sometime later, major sectorials changes with social and economic impacts. The scenarios adoption is essential to strategy. In this sense, the proposition (P2)of this research is that.

Proposition 2 (P2): The scenarios and strategic capacity of the organizations are important factors to be assessed. Concerning to the adoption of the infrastructure as a construct of this study, Carvalho points out that since the Egyptian, Chinese and Indian civilizations to contemporary times, many records testify to the strategic action of infrastructure (hard and soft) in terms of: housing; locomotion; population quality of life; way of stimulating economic development; improvement factor in social development; interfederative connection instrument; interrelated with the government planning; protagonist in the fiscal adjustment policies; geopolitical influence tool by Foreign countries.

The Economist Intelligence Unit (EIU) report, an entity linked to The Economist magazine and the Hong Kong and Shanghai Banking Corporation (HSBC), pointed

the limited infrastructure as the factor that more negatively influences in the ranking organized by the institution to the countries business environment such as Brazil.

Wessner (1999) argues that it is essential the TP be provided with a capable and sufficient infrastructure to generate opportunities, promote cooperative development and promote the marketing and attracting new business. Studies points to the TP infrastructure as a resource and its lack as a barrier to be overcome (Su *et al.*, 2009; Xue, 2007). Deficiency in infrastructure, according to Chen and Yu (2008), Phan *et al.* (2005), Chan and Lau (2005) and Zhou *et al.* (2011), it is one of the major obstacle to the establishment, growth and development of the potential of TP. The infrastructure can be accepted as a positive and significant strategic resource. Therefore, the third proposition (P3)of this research is that.

Proposition 3 (P3): The infrastructure and strategic capacity of the organizations are important factors to be assessed. The organizational actions efficiency and effectiveness mark are in its strategic performance result. For that reason, the last dimension adopted as related to strategic capacity of TP in Brazil is the strategic performance. According to Albahari *et al.* (2013), the TP performance is mainly provides for:

- TP participation in the region economy
- TP impact evaluation in generating innovation
- TP impact evaluation in regional development

This and other variables were part of the framework proposed formation. In this horizon, we have the fourth proposition (P4) of this research.

Proposition 4 (P4): The strategic performance and strategic capacity of the organizations are important factors to be assessed. For Miao *et al.* (2015), the TP while complex projects and permeated by different actors, namely) stakeholders: universities, research institutes, business incubators, technology-based companies-business centers, service centers and coexistence, companies or intensive knowledge industries, public sector at all levels (federal, state and municipal), government agencies, developers and investors, business companies, banks and/or investors of venture capital and capital) shareholders: shareholders, unitholders, lenders or investors such institutions need to evolve under review.

TP strategic capacity framework: Framework is associated to the idea of a representation of something

you want to play. One way or pattern that can have reference paper and operate as a prescription for agents who make decisions about practices to be employed in the field of organizations.

Given the gap and the exposed propositions (P1-P4) after the preliminary theoretical survey, follows Fig. 1 with a preliminary and theoretical framework proposal formed of a set of four dimensions (corporate governance, scenarios, infrastructure, strategic performance) its 29 indicators that guided the following propositions that can corroborate the assessment of TP in Brazil.

Much of the TP research only address theoretical issues, context, policies, feasibility, regional development, investment and national and international relations with various stakeholders Albahari *et al.* (2013), Bowker *et al.* (2009), Chan and Lau (2005), Lee and Yang (2000), Lindelof and Lofsten (2002), Phan *et al.* (2005), Quintas *et al.* (1992), Yang *et al.* (2009), among others but studies indicators or consolidated systemic frameworks involving the strategic capacity are unknown.

Despite all plurality, complexity and difficulty of identifying the relevant factors to achieve TP organizational efficiency and effectiveness, this proposal is the hallenge to meet the level of strategic capability of the TP in Brazil through its dimensions and indicators as presented. The next section presents a set of methods and techniques to assist or support people and organizations to make decisions. These resources will be proposed as auxiliary technology to consolidate the framework of this study.

Multicriteria support for the pr posed framework consolidation: The Multicriteria Decision Support (MDS) is according to Gomes (2003), a set of methods and techniques to assist or support people and rganizations to make decisions when there is the presence of a multiplicity of criteria.

Before the application of any method of multi-criteria analysis, it is necessary establish clearly what the purpose of the analysis which means, what the decision maker aims to achieve when he wants to compare each other decision alternatives using the use of multiple criteria. Through MDS, aims to build an analytical framework of the TP strategic capacity evaluation methodology that legitimizes the subjective value judgments and present in all decision making. The makers values structure are associated with and existing criteria used in the evaluation of alternatives (Yu, 2013).

According to Gomes the steps to the multi-criteria decision analysis, involving: identify the decision makers and their goals: individuals who make choices and take preference as a single entity, also called agent or decision
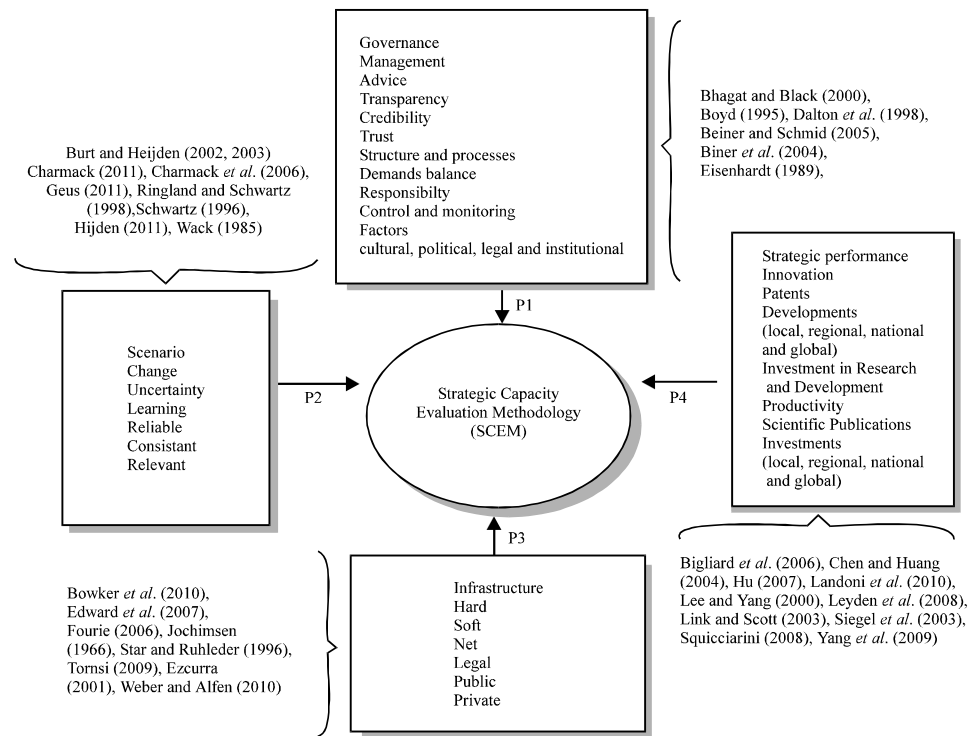
Fig. 1: TP strategic capacity evaluation methodology analysis framework; elaborated by the researcher

maker; set the alternative: global actions which means, actions that can be evaluated separately. May represent different courses of action, different assumptions about a characteristic nature, different sets of characteristics, etc., set the relevant criteria for the decision problem: the criteria are the tools that allow comparison of actions in relation to particular points of view. Bouyssou (1990) defines more precisely criterion such as a real-valued function in the set "A" of the alternatives, so that it is meaningful to compare two alternative "a" and "b" in accordance with a particular view or the qualitative or quantitative expression of a viewpoint is used in the evaluation of alternatives; evaluate alternatives against the criteria: can be divided int a phase of partial evaluation of actions (alternatives) according to each point of view (criteria) and an overall assessment phase considering the various partial assessments. To carry out the assessment is necessary to choose one of the available methods traditionally classified into methods for multi-attribute problems (deal with discrete alternatives) and multi-objective (consider a continuous space of alternatives); determine the relative importance of the criteria: structure and determine the importance attached to a policy in relation to another from the adoption of the best methods and functions; conduct the global

evaluation of each alternative: the overall value of each alternative can be interpreted as a criterion which summarizes the performances by all criteria; sensitivity analysis: examine how sensitive the chosen alternative is if the variables involved in the decision model are changed. This helps the decision maker to visualize possible paths in any unforeseen situations; recommendation: recommend courses of action to be followed; implementation: implement the courses of action.

However, according to Costa and Chagas (2004), this stage represents about 80% of the total problem. Steps 4-7 make up the evaluation phase which aims to apply multi-criteria analysis methods to support the modeling of preferences and their aggregation. The third phase, consisting of the steps 8 and 9 is the recommendation phase of courses of action to be followed. Gomes regarding step 3, warns that in a complex decision problem, the criteria may be structured as a hierarchy or tree in which the higher level criterion is decomposed into more detailed levels.

How to explain the decision maker's preference structures varies. For the construction of Brazilian TP strategic capacity evaluation methodology, it is recommended a method that can be considered as the

American multicriteria school (Pomerol and Romero, 2012), mainly because the objective is to build a unique methodology that aggregates by means of weights (also called constant scale or replacement rates), forming their dimensions. The suggested method is MACBETH (measuring attractiveness by a categorical based evaluation technique).

MACBETH: MACBETH (measuring attractiveness by a categorical based evaluation technique) is the method developed by Costa and Vansnick (1997) and presented by Bana e Costa, Bana e Costa and Chagas. MACBETH allows to aggregate the various evaluation criteria in a single criterion synthesis by assigning weights to various criteria, respecting the opinions of decision makers.

The criteria weights are awarded the pairwise comparison of the attractiveness of alternatives, namely: given two alternatives, the decision maker must say that the most attractive (should receive the highest score) and the degree of this attractiveness on a semantic scale which has correspondence with an ordinal scale (0 = indifferent, 1 = very weak attractiveness difference, 2 = weak attractiveness difference, 3 = moderate attractiveness difference, 4 = strong attractiveness difference, 5 = very strong attractiveness difference and 6 = extreme attractiveness difference).

Through, a software for the computer implementation of the method, carried out the judgments of coherence analysis and it is suggested, in case of inconsistency, how to resolve it. A rating scale is suggested for linear programming and its ranges without making the inconsistent problem (infeasible Linear Programming Problem). It is possible for the decision maker to graphically adjust the notes value assigned within the allowed ranges (sensitivity analysis). Only after this adjustment with the introduction of the experts knowledge, the cardinal scale (quantitative) values is characterized (Costa and Vansnick, 1997).

The MACBETH methodology consists of four mathematically Linear Programming Problems (LPPs) sequential LPP 1-Mc1 problem: performs the cardinal consistency analysis; LPP 2-Mc2 problem: responsible for building the cardinal value of scale; LPPs 3 and 4-Mc3 and Mc4 problems: reveals inconsistency sources.

Operationally, Costa and Vansnick (1997) propose the construction of value judgments arrays to facilitate the expression of absolute judgments of attractiveness difference between pairs of actions. Each x_{ij} array element toma valor k (k = 1, 2, 3, 4, 5, 6) takes the value k (k = 1, 2,

3, 4, 5, 6) if the decision maker decides that the pair's attractiveness difference (a_i, a_j) belongs to C_k category. These numbers have no mathematical meaning; only serve as semantic indicators of which attractiveness difference category was assigned to the respective pair. From the foregoing, it executes initially the MACBETH method for checking for any inconsistencies and then for determining a cardinal scale value that represents the decider value judgments (expertice). The standard scale is obtained by providing the weight values for alternative evaluation which allows the use of an aggregation model, in general, the additive.

MATERIALS AND METHODS

Given this study, object profile, this research follows a sociological conduct (Martinet *et al.*, 2012) in which social relations, power games and cultural norms are prevalent for the formation of corporate strategy understood as a learning process, an evolution pattern or path that involves modifications, synchronicity and flexibility, incorporating topics such as organizational learning and the development of core competencies.

Forte states that the statistical methods predominate in quantitative research while categorizations and more essay analyzes punctuate in qualitative research. "Anyway, as always there will be explanations of phenomena, calculations and quantitative results, the research has itself both methods". It is noted that there is no superiority of one type of research and another on the use of qualitative or quantitative techniques which depends on the researcher's ability to adapt them to your needs.

Based on these considerations, it can be said that the nature of the variables, this study is classified as a qualitative and quantitative research. The qualitative component with holistic characteristics (understand the context of interrelations), inductive (categories and dimensions emerge gradually) and naturalist (reduced intervention) (Patton, 1990) and exploratory character, aimed to identify the essential dimensions to the assessment of strategic capacity through literature, through electronic consultation in the various bases of national and international data-SI Web of Science; Scopus; ProQuest; CAPES; Academic Search Premier-ASP (EBSCO), Science Direct (Elsevier), Springer Link (MetaPress) and through interviews with decision-makers that is officers, directors, coordinators and superintendents of Brazilian TP. Complementarily, the

quantitative component of descriptive character sought to describe the phenomenon called strategic capacity, explaining it through the study of the variables, factors, criteria and their descriptors involved to thus be possible to define a Brazilian TP SCEM, considering (Costa and Vansnick, 1997) observations, through the MACBETH constructivist approach and aided by the M-MACBETH 2.4.0 Software.

Data collection used research tools such as interviews and electronic questionnaires via the internet. From 20 decision-makers TP in operation in Brazil today, were actually raised in this study and returned the questionnaires that have undergone analysis only eleven decision-makers (officers, directors, coordinators and superintendents of Brazilian TP) identified by: TP-1; TP-2; TP-3; TP-4; TP-5, TP-6, TP-7; TP-8; TP-9; TP-10 and TP-11. The whole process took place from July to November of 2015 and followed constructivist principles of decision support statements by Bana e Costa for Brazilian TP SCEM validation. In support of formatting and sharing questionnaire were used the resources of the research-based service, Survey Monkey®Surveymonkey.

The questionnaire was structured from questions with characteristics related to factors, criteria and their descriptors, according to the MACBETH method. In the questionnaire, the answers are marked observing a semantic scale of five levels (1-5) preferably from largest to smallest: "extremely", "strongly", "moderately", "weakly", "zero or does not proceed", based on MACBETH (Costa and Vansnick, 1997) and "zero or does not proceed" to the lower incidence and " extremely" to the extreme for each item. This review follows the forced and balanced Likert scales.

Attractiveness and weight scores were added, according to the experience and opinions of decision makers (representatives, principals, superintendents and engineers) of varied TP regions in Brazil. The main purpose of the answers obtained from the questionnaires is the verification and consolidation of the model and thus results analysis, comparison and ranking of the scores obtained from respondents. In addition to playing the facilitator role, the author of this study als played the role of analyst, using, for this, studies in various national and international TP, bibliographic exploration and research of renowned researcher as main instruments consultation and quote.

RESULTS AND DISCUSSION

As shown, the construction of the Brazilian TP SCEM in this study was supported by Multicriteria

Model Decision Support and was created through workshops, face and remote reunions (using Skype and Google Hangouts) and interviews applied with the "decision-makers" in this case, officers, directors, superintendents and engineers of varied TP regions in Brazil following the model of "decision conference" decision conference (Phillips and Costa, 2007). Figure 2-4 show the overall scores and the criteria, weighting and global thermometer of Brazilian TP SCEM, after the performances conversion and choice of preferences (judgments) with the value function.

The 29 main criteria knots belong to non criteria knots or governance, scenarios, infrastructure, strategic development factors and Brazilian TP SCEM (parent knot criteria) were structured with comparison basis "for qualitative performance levels" present in the questionnaire. Following, through the M-MACBETH 2.4.0 software, quantifies the qualitatively attractiveness. Each of the 29 criteria knots were subjected to eleven TP (in the role of respondent), receiving banknotes which together enabled an importance ranking between them and consequently, allowing to be flush with each other, generating the percentage of importance or degree of force between them and presented.

Figure 2 shows that for each group of attributes under each criteria, the determining factor for the order of the criteria lies in the total points awarded to each criteria. In percentage terms this score was relativized that is that criterion with the highest score received the equivalent percentage to 100% and the others had a percentage calculated in relation to the highest score. These percentages fed M-MACBETH 2.4.0 Software in order to verify the consistency of these important trials of the criteria.

Figure 2 and 3 shows that of the 29 "criteria knots", governance (management, council, independence, transparency, credibility, trust, structure and processes, demands balance, responsibility, control and monitoring, factors (cultural, political, legal and institutional) factor knots had the highest weights. Scenari (change, uncertainty, learning, reliable, consistent and relevant) factor knots had the second best weights, followed by the infrastructure (hard, soft, net, legal, public, private) factor knots. Finally, strategic performance (innovation, patents, development (local, regional, national and global) investment in Research and Development (R&D), productivity, scientific publications, investments (local, regional, national and global) factor knots had the lower weights.

After building a MACBETH Model, we can analyze the results (scores and weights) in a table of scores and the overall scores of the options can be
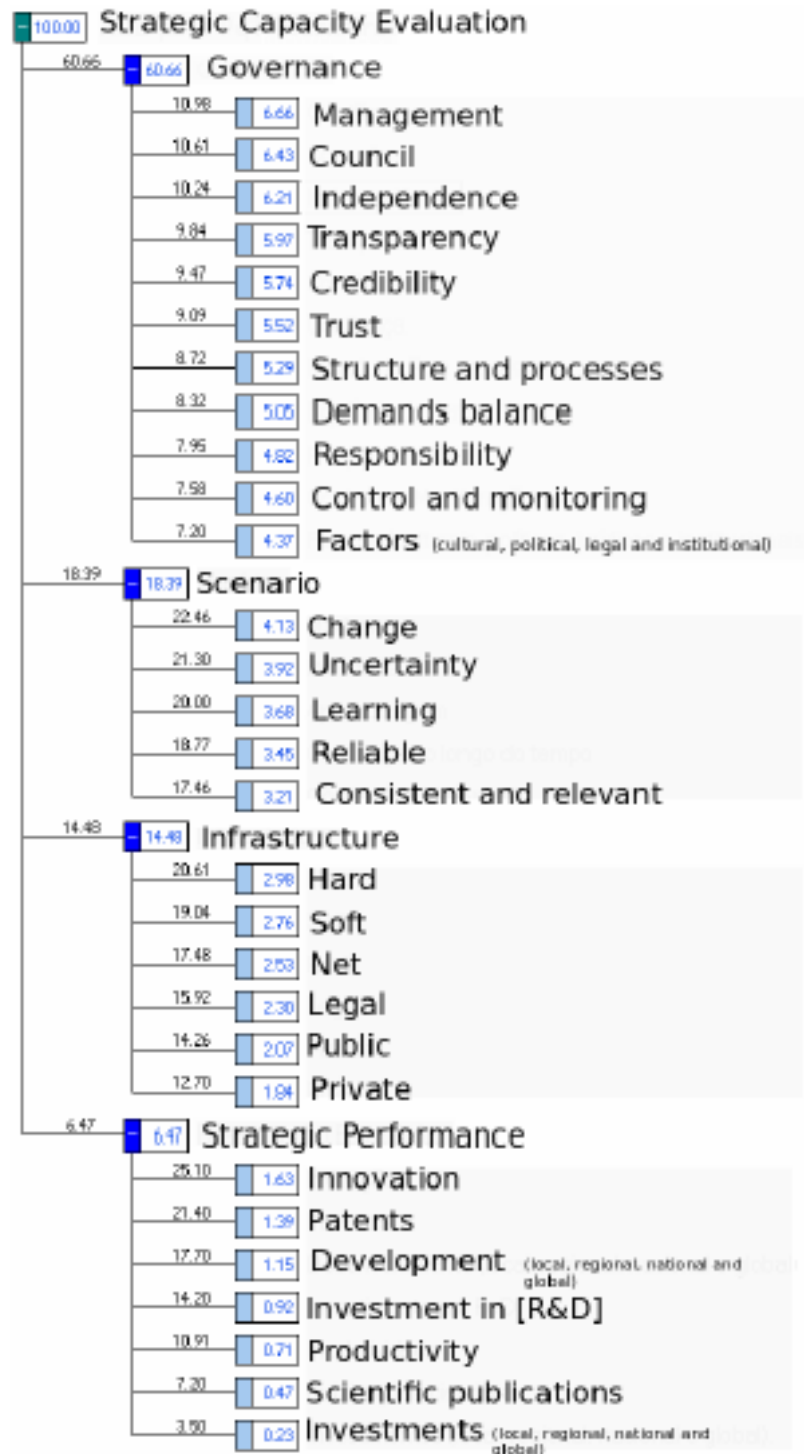
Fig. 2: Importance of the criteria by taking the highest value to 100%. Similar treatment given to the attributes of each criteria; elaborated by the researchers, using M-MACBETH 2.4.0 Software

viewed through denominated graphics "global thermometer". The global therm meter was as shown in Fig. 4. Figure 4, it is stated that options TP 11, TP 1 and TP 2 achieved overall scores in the range of 80.0.
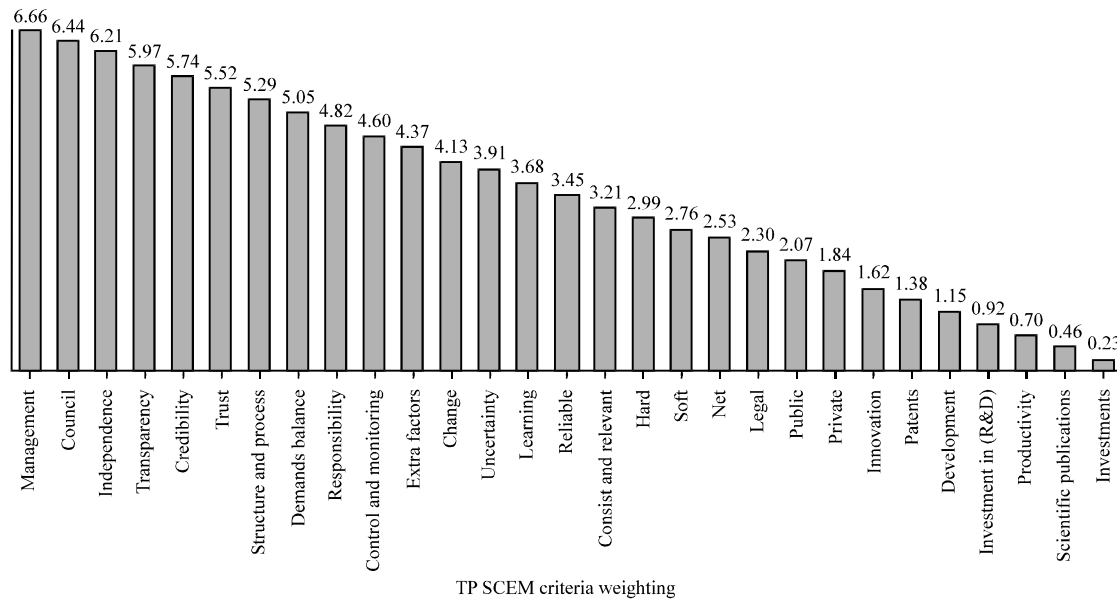
Fig. 3: Brazilian TP SCEM criteria weighting; elaborated by the researchers, using M-MACBETH 2.4.0 Software
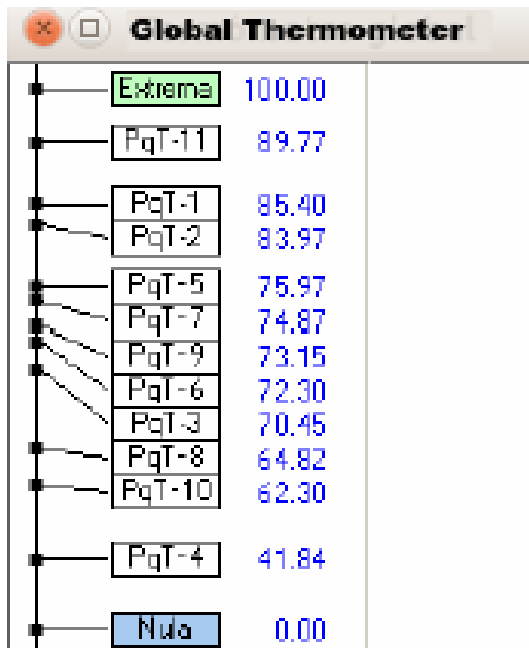

Fig. 4: Global thermometer; elaborated by the researchers, using M-MACBETH 2 .4.0 Software

CONCLUSION

The evaluation index of strategic capacity has a practical application for the Brazilians TP but can be used by other national and international organizations of the same profile in subsequent studies in view of its comprehensive character. In this sense, the TP strategic capacity framework proposed checks the significance of the following constructs or integrating factors of the strategic capability evaluation structure: governance, scenarios, infrastructure and strategic performance. Therefore interviews were conducted through questionnaires along with the decision-makers of Brazilian Technological Parks.

After the questionnaires application and the results analysis obtained through the options studied, it was evidenced by the overall score obtained by Brazilian TP considered in the study that if the TP get an average (score) >80 points, it can be considered that it presents strategic capability to be economically, socially and environmentally sustainable. In the event that the score is below this average are necessary plans for the loss-making practices can be remedied and that TP has a different strategic capacity.

The TP called "TP-11", "TP-1" and "TP-2" were highlighted in the study and are located in the South, Northeast and Southeast in geographic areas of reference in developing all aspects. It is verified that if the officers, directors, superintendents and engineers of Brazilian TP do not get a good performance on the criteria and factors considered in the model created for the study in which it was considered the characteristics and skills essential to the strategic ability of different TP for Brazil and its criteria, the projects under their responsibility are less likely to be successful and sustainable, because the

options with better grades (above 80 points performance) were precisely the TP respondents who have shown good results nationally.

The studied TP in greater depth in the research are meant for science parks and innovation, making it a limiting aspect, given that the technology parks cover other categories focused on other activities and markets, with objectives and stakeholders with opinions and goals different, namely: technopolis define as a city in which the public and private sectors interact to generate economic development through technological development); university driven research parks or university technology parks; innovation ateliers (communities, laboratories or innovation hubs); innovation networks. Despite that with minor adjustments and new research (together with the decision- makers of these categories) and application of new interviews and questionnaires, you can get new models or adjust the present study. Finally, it is recommended for future studies using the SCEM to TP from other continents in order to know the profile of these entities, their practices and contributions to Brazilian TP.

REFERENCES

Albahari, A., G. Catalano and P. Landoni, 2013. Evaluation of national science park systems: A theoretical framework and its application to the Italian and Spanish systems. Technol. Anal. Strategic Manage., 25: 599-614.

Beiner, S., W. Drobetz, F. Schmid and H. Zimmermann, 2004. Is board size an independent corporate governance mechanism?. Kyklos, 57: 327-356.

Bhagat, S. and B. Black, 2000. Board independence and long-term firm performance. MA Thesis, University of Colorado, Colorado, USA.

Bigliardi, B., A.I. Dormio, A. Nosella and G. Petroni, 2006. Assessing science parks' performances: Directions from selected Italian case studies. Technovation, 26: 489-505.

Bouyssou, D., 1990. Building Criteria: A Prerequisite for MCDA. In: Readings in Multiple Criteria Decision Aid, Carlos, A.B.E.C., (Ed). Springer, Berlin, Germany, ISBN:978-3-642-75935-2, pp: 58-80.

Bowker, G.C., K. Baker, F. Millerand and D. Ribes, 2009. Toward Information Infrastructure Studies: Ways of Knowing in a Networked Environment. In: International Handbook of Internet Research, Hunsinge, J., L. Klastrup and M. Allen (Eds.). Springer, Berlin, Germany, ISBN:978-1-4020-9789-8, pp: 97-117.

Boyd, B.K., 1995. CEO duality and firm performance: A contingency model. Strategic Manage. J., 16: 301-312.

Burt, G. and K.V.D. Heijden, 2002. Reframing industry boundaries for structural advantage: The role of scenario planning. Scenarios Bus. UK., 2002: 223-232.

Burt, G. and K.V.D. Heijden, 2003. First steps: Towards purposeful activities in scenario thinking and future studies. Futures, 35: 1011-1026.

Carpenter, M.A. and J.D. Westphal, 2001. The strategic context of external network ties: Examining the impact of director appointments on board involvement in strategic decision making. Acad. Manage. J., 44: 639-660.

Chan, K.F. and T. Lau, 2005. Assessing technology incubator programs in the science park: The good, the bad and the ugly. Technovation, 25: 1215-1228.

Chen, C.J. and C.C. Huang, 2004. A multiple criteria evaluation of high-tech industries for the science-based industrial park in Taiwan. Inf. Manage., 41: 839-851.

Chen, H.C. and Y.W. Yu, 2008. Using a strategic approach to analysis the location selection for high-tech firms in Taiwan. Manage. Res. News, 31: 228-244.

Chermack, T.J., 2011. Scenario Planning in Organizations: How to Create, Use and Assess Scenarios. Berrett-Koehler Publishers, USA.,.

Chermack, T.J., S.A. Lynham and L. van der Merwe, 2006. Exploring the relationship between scenario planning and perceptions of learning organization characteristics. Futures, 38: 767-777.

Collis, D.J. and M.G. Rukstad, 2008. Can you say what your strategy is?. Harv. Bus. Rev., 86: 82-90.

Costa, C.A.B.E. and J.C. Vansnick, 1997. A Theoretical Framework for Measuring Attractiveness by a Categorical Based Evaluation Technique (MACBETH). In: Multicriteria Analysis, Climaco, P.J., (Ed). Springer, Berlin, Germany, ISBN:978-3-642-60667-0, pp: 15-24.

Costa, C.A.B.E. and M.P. Chagas, 2004. A career choice problem: An example of how to use MACBETH to build a quantitative value model based on qualitative value judgments. Eur. J. Oper. Res., 153: 323-331.

Daily, C.M., D.R. Dalton and A.A. Cannella, 2003. Corporate governance: Decades of dialogue and data. Acad. Manage. Rev., 28: 371-382.

Dalton, D.R., C.M. Daily, A.E. Ellstrand and J.L. Johnson, 1998. Meta-analytic reviews of board composition, leadership structure and financial performance. Strat. Manage. J., 19: 269-290.

Durance, P. and M. Godet, 2010. Scenario building: Uses and abuses. Technol. Forecasting Social Change, 77: 1488-1492.

Eisenhardt, K.M., 1989. Agency theory: An assessment and review. Acad. Manage. Rev., 14: 57-74.

Ezcurra, J.L.V., 2001. La construccion y financiacion de las infraestructuras publicas: Viejos y nuevos planteamientos. REDETI. Revista Derecho Las Telecomunicaciones Infraestructuras, 10: 79-118.

Fama, E.F. and M.C. Jensen, 1983. Separation of ownership and control. J. Law Econ., 26: 301-325.

Fourie, J., 2006. Economic infrastructure: A review of definitions, theory and empirics. South Afr. J. Econ., 74: 530-556.

Freeman, E., 1984. Strategic Management: A Stakeholder Approach Marshfield. Pitman Publishing, Boston, MA., USA., ISBN-13: 9780273019138, Pages: 276.

Geus, A., 2011. The Living Company: Growth, Learning and Longevity in Business. Nicholas Brealey Publishing, London, England, UK.,.

Godet, M. and F. Roubelat, 2000. Scenario planning: An open future. Technol. Forecasting Social Change, 65: 1-2.

Goodstein, J., K. Gautam and W. Boeker, 1994. The effects of board size and diversity on strategic change. Strategic Manage. J., 15: 241-250.

Harrison, R. and S. Miller, 1999. The contribution of clinical directors to the strategic capability of the organization. Br. J. Manage., 10: 23-39.

Heijden, K.V.D., 2011. Scenarios: The Art of Strategic Conversation. John Wiley & Sons, Hoboken, New Jersey, USA.,.

Hendry, K. and G.C. Kiel, 2004. The role of the board in firm strategy: Integrating agency and organisational control perspectives. Corporate Governance Int. Rev., 12: 500-520.

Hu, A.G., 2007. Technology parks and regional economic growth in China. Res. Policy, 36: 76-87.

Ismail, H.S., J. Poolton and H. Sharifi, 2011. The role of agile strategic capabilities in achieving resilience in manufacturing-based small companies. Intl. J. Prod. Res., 49: 5469-5487.

Jensen, M.C. and W.H. Meckling, 1976. Theory of the firm: Managerial behavior, agency costs and ownership structure. J. Financial Econ., 3: 305-360.

Kihlgren, A., 2003. Promotion of innovation activity in Russia through the creation of science parks: The case of St. Petersburg (1992-1998). Technovation, 23: 65-76.

La Porta, R., F. Lopez-De-Silanes and A. Shleifer, 1999. Corporate ownership around the world. J. Finance, 54: 471-517.

Landoni, P., G. Scellato and G. Catalano, 2010. Science parks contribution to scientific and technological local development: The case of AREA Science Park Trieste. Intl. J. Technol. Policy Manage., 10: 36-52.

Lee, W.H. and W.T. Yang, 2000. The cradle of Taiwan high technology industry development-Hsinchu Science Park (HSP). Technovation, 20: 55-59.

Leyden, D.P., A.N. Link and D.S. Siegel, 2008. A theoretical and empirical analysis of the decision to locate on a university research park. IEEE. Trans. Eng. Manage., 55: 23-28.

Lindelof, P. and H. Lofsten, 2002. Growth, management and financing of new technology-based firms-assessing value-added contributions of firms located on and off Science Parks. Omega, 30: 143-154.

Link, A.N. and D. Siegel, 2003. Technological Change and Economic Performance. Routledge, London, UK.,.

Lofsten, H. and P. Lindelof, 2001. Science parks in Sweden-industrial renewal and development?. Res. Dev. Manage., 31: 309-322.

Lofsten, H. and P. Lindelof, 2002. Science Parks and the growth of new technology-based firms-academic-industry links, innovation and markets. Res. Policy, 31: 859-876.

Mace, M.L., 1971. Directors: Myth and Reality Boston: Division of Research Graduate School of Business Administration. Harvard University, Cambridge, Massachusetts,.

Martins, P.P.P., J.G.B. Mauricio, A.A. Fischmann, C.B. Kramer and S.R. Giovinazzo, 2012. Scenarios for the Brazilian road freight transport industry. Foresight, 14: 207-224.

Miao, J.T., P. Benneworth and N.A. Phelps, 2015. Making 21st Century Knowledge Complexes: Technopoles of the World Revisited. Routledge, Abingdon, England, UK.,.

Norburn, D. and P. Grinyer, 1974. Directors without direction. J. Gen. Manage., 1: 37-48.

Oliveira, O.V.D. and S.H.A.C. Forte, 2014. Business strategy pentagon: Five visions framework for the strategy of stock exchange listed companies. Bus. Manage. Rev., 4: 205-215.

Pahl, R.E. and J.T. Winkler, 1974. The economic elite: Theory and practice. Elites Power Br. Soc., 1974: 102-122.

Patton, M.Q., 1990. Qualitative Evaluation and Research Methods. 2nd Edn., Sage Publications Inc., Thousand Oaks, CA., USA., ISBN-13: 9780803937796, Pages: 532.

Pearce, II J.A. and S.A. Zahra, 1991. The relative power of CEOs and boards of directors: Associations with corporate performance. Strategic Manage. J., 12: 135-153.

Peng, M.W., D.Y.L. Wang and Y. Jiang, 2008. An institution-based view of international business strategy: A focus on emerging economies. J. Int. Bus. Stud., 39: 920-936.

Peng, M.W., S.L. Sun, B. Pinkham and H. Chen, 2009. The institution-based view as a third leg for a strategy tripod. Acad. Manage. Perspect., 23: 63-81.

Phan, P.H., D.S. Siegel and M. Wright, 2005. Science parks and incubators: Observations, synthesis and future research. J. Bus. Venturing, 20: 165-182.

Phillips, L.D. and C.A.B.E. Costa, 2007. Transparent prioritisation, budgeting and resource allocation with multi-criteria decision analysis and decision conferencing. Ann. Oper. Res., 154: 51-68.

Pomerol, J.C. and S.B. Romero, 2012. Multicriterion Decision in Management: Principles and Practice. Vol. 25, Springer, Berlin, Germany,.

Pose, R.A. and D. Hardy, 2014. Technology and Industrial Parks in Emerging Countries: Panacea Or Pipedream?. Springer, Berlin, Germany,.

Quintas, P., D. Wield and D. Massey, 1992. Academic-industry links and innovation: Questioning the science park model. Technovation, 12: 161-175.

Rechner, P.L. and D.R. Dalton, 1991. CEO duality and organizational performance: A longitudinal analysis. Strategic Manage. J., 12: 155-160.

Ringland, G. and P.P. Schwartz, 1998. Scenario Planning: Managing for the Future. John Wiley & Sons, Hoboken, New Jersey, USA.,.

Schwarz, P., 1996. The Art of the Long View: Planning for the Future in an Uncertain World. Currency Doubleday, New York, USA.,.

Shleifer, A. and R.W. Vishny, 1986. Large shareholders and corporate control. J. Political Econ., 94: 461-488.

Shleifer, A. and R.W. Vishny, 1997. A survey of corporate governance. J. Finance, 52: 737-783.

Siegel, D., P. Westhead and M. Wright, 2003. Science parks and the performance of new technology-based firms: A review of recent UK evidence and an agenda for future research. Small Bus. Econ., 20: 177-184.

Squicciarini, M., 2008. Science Parks? tenants versus out-of-Park firms: Who innovates more? A duration model. J. Technol. Transfer, 33: 45-71.

Star, S.L. and K. Ruhleder, 1996. Steps toward an ecology of infrastructure: Design and access for large information spaces. Inf. Syst. Res., 7: 111-134.

Su, J., J. He, E.Y. Xue, Y.D. Xiao and S.C. Li *et al.*, 2009. A Study of Knowledge-based Innovation and Technology Spin-offs in Chinese University (in Chinese). Tsinghua University Press, Beijing, China,.

Teece, D.J., G. Pisano and A. Shuen, 1997. Dynamic capabilities and strategic management. Strategic Manage. J., 18: 509-533.

Vedovello, C., 1997. Science parks and university-industry interaction: Geographical proximity between the agents as a driving force. Technovation, 17: 491-502, 530-531.

Wack, P., 1985. Scenarios: Uncharted waters ahead. Harv. Bus. Rev., 63: 72-89.

Wang, C.Y.P., B.S. Jaw and C.H.C. Tsai, 2012. Building dynamic strategic capabilities: A human capital perspective. Intl. J. Hum. Resour. Manage., 23: 1129-1157.

Weber, B. and H.W. Alfen, 2010. Infrastructure as an Asset Class: Investment Strategies. John Wiley & Sons, Hoboken, New Jersey, USA.,.

Wessner, C., 1999. Industry-Laboratory Partnerships: A Review of the Sandia Science and Technology Park Initiative. National Academies Press, Washington DC.,.

Westhead, P., 1997. R&D inputs and outputs of technology-based firms located on and off Science Parks. Res. Dev. Manage., 27: 45-62.

Yang, C.H., K. Motohashi and J.R. Chen, 2009. Are new technology-based firms located on science parks really more innovative?: Evidence from Taiwan. Res. Policy, 38: 77-85.

Yim, D.S., Y.C. Seong, W.I. Lee, S. Park and J.K. Hong, 2011. Management and governance issues in the development of Science and Technology based Innovation Cluster. Proceedings of Conference on Technology Management in the Energy Smart World (PICMET), July 31-August 4, 2011, IEEE, New York, USA., ISBN:978-1-890843-23-6, pp: 1-8.

Yu, P.L., 2013. Multiple-Criteria Decision Making: Concepts, Techniques and Extensions. Springer, Berlin, Germany,.

Zahra, S.A. and J.A. Pearce II, 1989. Boards of directors and corporate financial performance: A review and integrative model. J. Manage., 15: 291-334.

Zhou, Y., G. Xu, J. Su and T. Minshall, 2011. Barriers to entrepreneurial growth: An empirical study on university spin-offs in China. J. Sci. Technol. Policy China, 2: 277-294.