

A STUDY OF PERFORMANCE INDICATORS OF TECHNOLOGY BUSINESS INCUBATORS (TBIs) IN INDIA

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ABSTRACT

A business incubator is characterized as a point of contact between the market and the entrepreneurs' proposed business concepts. It includes provision of differential facilities like infrastructure, mentorship, capital and expertise so that there is effective utilization of creativity and ability. This research work assess the performance of technological business incubators (TBIs) based on no. of patent granted, support services offered by TBI, services offered in TBI, selection criteria for incubatee, exit criteria for incubatee, academia linkage, corporate linkage, nature of functioning as a performance indicator. Partial least squares structural equation modelling (PLS-SEM) was employed for testing the significance of hypotheses. Findings show that no. of patent granted, selection criteria for incubatee, corporate linkage, and nature of functioning of TBI have a significant influence on TBI success.

1. INTRODUCTION

The main aim of technological incubators is to foster creativity by providing social support with complementary skills and tools. "The technology incubator is an institution in which expertise is turned into new products and services (Yee, 2009)," according to Yee (2009). Such incubators can deliver good projects thanks to a mix of information sharing and incubator management. Company incubator roles have a positive and significant effect on the economy of country (Cheng and Schaeffer, 2011). However, they discovered several issues with the approved exam standard. Global business trends represent that small businesses make up almost half of a country's overall economy (both developed and developing).

Keywords: *Technology incubator; business incubator; patent granted, support services, services offered, selection criteria, exit criteria, academia linkage, corporate linkage, nature of functioning.*

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Throughout this environment, start-ups, business incubators, and technology business incubators (TBI) all contribute considerably to the country's economy, as does the knowledge and innovation-based economy. Different forms of incubators were studied (Peters et al., 2004). A company's knowledge base is a critical component of its success and ability to compete with other businesses (Gupta and Govindarajan, 2000). Among the most challenging tasks is developing projects that use incubators' products or integrating incubators into new projects. Needed several sources to ensure the feasibility of new projects (Brush and Greene, 1996). Efficiency, project viability, and experience are all critical considerations.

Technology and creativity are an essential for success (Rooney et al., 2012). The capacity of organizations to innovate is critical to their ability to improve the business economy. The absence of this means they cannot complete and limit their businesses' growth and their potential to increase their income (Taylore et al., 1993). Innovation can help improve efficiency, competencies and generate revenue (Carlson and Wilmot, 2006).

Incubators have also grown in scale and variety all over the world. It has a long history of contributing to economic promotion and career production. The need to assess the efficiency of these incubators and examine the reasons that enhance organizational performance or failure have increased proportionally over time, as has the desire to recognize the impact that these incubators have had on the companies they host but to be able to reproduce them. Unfortunately, some countries' successful models unfortunately, methodological, theoretical, and analytical limitations also hindered the assessment of incubator results (Yu & Nijkamp, 2009), subsequently, it is exceedingly difficult to draw concrete conclusions from current incubator research. Furthermore, it seems that the incubator's output is measured in a variety of ways. Geographical, industry, and a variety of other aspects all play a role in its success. A consensus about how to measure incubator performance is still to be found, also there is a lack of a consistent description of performance indicators of TBIs. Many performance indicators are witnessed in literature on business incubation but no. of patent granted to incubates and nature of functioning as a performance indicator is silent in published literature.

Therefore, this research examines the performance of TBIs by considering no. of patent granted, support services offered by TBI, services offered in TBI, selection criteria for incubate, exit criteria for incubatee, academia linkage, corporate linkage, nature of functioning as a performance indicator.

Hence, the scope of this study can be defined as under; examining the performance indicators and how they affect the success of TBIs, examining how TBI success affects the Social and Economic perspective to answer the persistent question.

2. STUDY BACKGROUND AND CONCEPTUAL FRAMEWORK

This study assessed the performance indicators affecting the success of TBI and influence of TBI success on social and economic perspective.

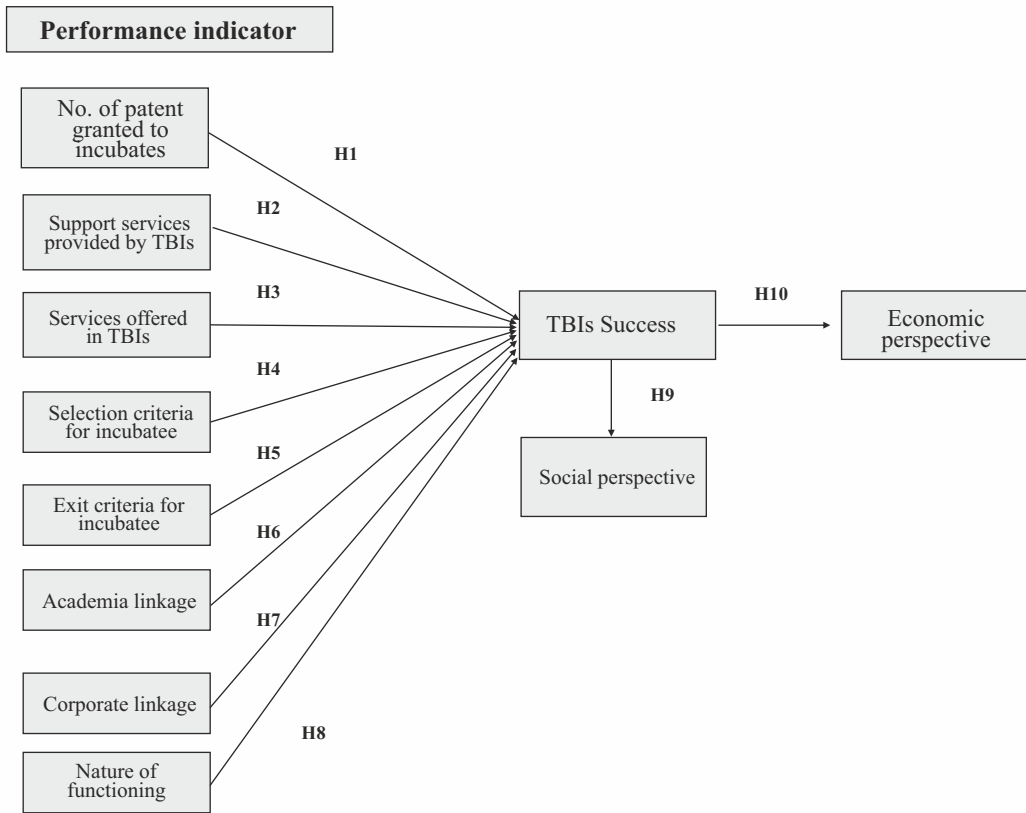


Figure 1: Proposed Research Model

Conceptual framework consists of performance indicators namely no. of patent granted, support services offered by TBI, services offered in TBI, selection criteria for incubate, exit criteria for incubatee, academia linkage, corporate linkage, nature of functioning as a performance indicators. Figure 1 shows the research model. Performance indicators which affect TBI success in the development of research model are discussed below:

Number of patent granted to incubates: Patents assist TBIs in improving their positioning, creating an innovation environment, incubating knowledge-based start-ups, generating increased income, and tracking research activity. innovators Billions of dollars are raised as a result of certain systems, which benefits everybody involved. The inventor (mostly academics), the educational system, business, and the economy as a whole are the direct beneficiaries. That number of registered patents is a good measure of a country's creativity and technological ability.

Support services provide by TBIs: TBI's support services are designed to help local companies gain access to information and expertise that they'll never be able to obtain on their own. The number of firms that graduate from such an incubator is positively influenced by the support service (Shrader and Siegel 2007). Access to financial services is amongst the most important considerations for most start-ups' survival and it is considered including some of the incubator effectiveness factors (Gozali et al. 2015).

Services offered in TBIs: Mentors or mentors are older men and women with unique backgrounds and valuable educational skills that really can impact others early through their careers and find a better role than peers or counsellors (Lichtenstein 1992).

Selection criteria for incubatee: That even a company incubator chooses the firms it wants to incubate is amongst the most crucial mechanisms also for incubator's performance, and these may differ depending upon this incubator's purpose and goals. The proposed market incubator model (Campbell, et al. 1985) indicated that one of the four fields whereby incubators / incubators generate value seems to be the collection and regulated application of business resources.

Exit Criteria: The better the technological infrastructure, more the likely an incubator climate would promote the formation of technology-based businesses, their early growth, an potential to innovate, including their readiness to graduate. The basic supporting factors what ultimately assess their performance, longevity, and growth after graduation through incubators, as well as the mechanisms of survival or departure from businesses after graduation through incubators. The main objective of TBIs is to assist and support future entrepreneurs (Mas-Verdú et al., 2015). According to recent studies, incubated businesses may not get profit substantially from existing incubator relationships, and may be susceptible to failure after graduation (Lasrado and colleagues, 2016).

Nature of functioning: Accelerator and incubator programs often operate in cohorts, typically offering one or two per year, and span anywhere from a few weeks to a few months. Some expenses, like travel, may be covered by the incubator. When considering accelerator and incubator programs, it's a good idea for entrepreneurs to look at past program participants and look for companies at the same stage as their business.

Corporate linkage: Corporate linkage is regarded as the most important tools for business incubators in terms of identifying opportunities and improving entrepreneur efficacy, particularly in the face of limited resources. Company incubators and their customers benefit from social media because it shortens the path and saves time when it comes to making decisions and expediting operations. (Fernandez-Perez et al., 2013).

Academia linkage: A university based incubator (UBI) TBIs come in a variety of forms. In either regard, various typologies have also been given. Public incubators, proprietary incubators, but university incubators are the three types of incubators. That current study reflects on Barbero et al. (2012). A UBI is characterized as university-based institutions providing tangible and intangible resources to young business start-ups, per the them.

3. METHODOLOGY

The survey tool was used to gather data for this study. Based on the observation of a subset of the population, the survey instrument offers an overview of numerical or quantitative patterns in the population's views and attitudes. Babbie (2013) states that "surveys are particularly useful for describing the characteristics of a large population because they make large samples feasible". The closed question technique used in the survey queries. A minimal number of participants provides accurate responses in this technique. Rather than answering questions or sharing their views, participants were asked to pick or rate answers. Some methods are used to achieve a high survey response rate. To begin, the survey project determined that the overall time needed to complete the survey was 14 minutes. Second, follow the protocols recommended by Sekaran (2003), such as keeping the survey as brief as possible, explaining the research objectives and the relevance of the survey to the report, and including this detail mostly on the cover page.

As a result, this research utilized the data collected through the survey conducted. The survey was designed from the ground up in order to provide findings that met the study's goals. Participants was asked to complete a questionnaire based on Likert scale.

The selection of TBI from the more than 300 incubators present in India at the moment was done by selecting TBIs having more than 7 years of experience. It included TBIs that were incorporated before 2008 and facts were collected from them by using surveys and questionnaires. Final sample size for analysing the data was reduced to 57.

4. MEASUREMENT MODEL ANALYSIS

According to Chin (1998), the reliability level above 0.7 ensures that the scale is reliable which is the case for all constructs in this study (Please see table 1). In this study, reliability was assessed using two ways: Cronbach alpha and Composite or construct reliability. It was found that all the dimensions depicted the Cronbach's alpha value greater than 0.6, thereby confirming that survey instrument is reliable. Apart from Cronbach Alpha, composite reliability (CR) was also measured in this study. After establishing that the scale is unidimensional an assessment of the statistical reliability is imperative before performing any further validation analysis (Anderson and Gerbing, 1991). In this study, C.R. for all the variables considered in the research model was found to be greater than 0.70 as illustrated in table 1. Thus, the research instrument developed for studying the performance indicators for TBI success was reliable. In this study, inter-item correlation values higher than 0.30 was found except for few inter-item correlation values which are satisfactory. Item-total correlation values of the indicators in each construct were above 0.3 as shown in table 1. The findings in table 1 depict that the square roots

Table 1: Validity and Reliability of construct

| | CR | AL | CL | EP | EC | NOF | SC | SO | SP | SS | TBIs | NPG |
|------|-------|--------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----|
| AL | 0.717 | 1 | | | | | | | | | | |
| CL | 0.732 | -0.093 | 1 | | | | | | | | | |
| EP | 0.764 | 0.145* | -0.166 | 1 | | | | | | | | |
| EC | 0.753 | 0.148 | -0.031 | 0.086 | 1 | | | | | | | |
| NOF | 0.719 | 0.1 | 0.335*** | 0.085 | 0.013 | 1 | | | | | | |
| SC | 0.786 | 0.12 | -0.135 | 0.122* | 0.788 | -0.228 | 1 | | | | | |
| SO | 0.727 | 0.361 | 0.093 | 0.013 | 0.221 | 0.045 | 0.133 | 1 | | | | |
| SP | 0.714 | 0.005 | 0.02 | 0.433 | -0.066 | 0.069 | -0.034 | -0.014 | 1 | | | |
| SS | 0.787 | 0.103 | 0.242*** | 0.407*** | -0.102 | -0.02 | 0.249*** | 0.579*** | 0.038 | 1 | | |
| TBIs | 0.743 | -0.054 | 0.369*** | 0.226*** | 0.276*** | 0.392*** | 0.395*** | 0.238*** | 0.234** | 0.19 | 1 | |
| NPG | 0.776 | 0.099 | 0.387*** | 0.291*** | -0.091 | -0.016 | 0.352*** | 0.624*** | 0.356*** | 0.229*** | 0.204*** | 1 |

Notes:

Significance of Correlations: † p<0.100; * p<0.050, ** p<0.010, *** p<0.001

The numeric values in bold letters indicate the square root of AVE values and imply discriminant validity CR value adequate convergence or internal consistency and strong construct reliability (Hair et al., 2006)

≥0.7 indicates

of AVEs was higher than the correlations between constructs / variables. These results confirmed discriminant validity possessed by scale. In present study the retained 39 items of the questionnaire were proved as a reliable and valid research instrument.

5. STRUCTURAL MODEL TESTING

Structural Equation Modelling (SEM) is a powerful technique to test and evaluate casual relationships between variables (measured variables and latent constructs) (Hair, 2006). After assessing the reliability and validity of the variables PLS-SEM has been employed for testing the hypothesis. In the present study the proposed research model consists of eleven constructs viz. eight exogenous latent constructs (number of patents granted (NOPG), Support services provided by TBIs (SS), Services offered in TBIs (SO), Selection criteria for incubate (SC), Exit criteria for incubate (EC), Academia linkage (AL), Corporate linkage (CL), Nature of functioning (NOF)) and three endogenous latent constructs (Social perspective (SP), Economic perspective (EP) and TBIs. For the purpose of evaluating the research model on the basis of CFA and SEM, it was decided to report the following goodness of fit indices as shown in Table 2.

Table 2: Summary of the Model Fitness

| Fit index | Observed levels | Threshold Levels | Model fit |
|-----------------------------|-----------------|---------------------|------------|
| Chi-Square 2 | 981.528 | Lower χ^2 | |
| relative to df 2:1 | Acceptable | | |
| Normed 2(2/df)(CMIN) | 1.467 | 3:1 | Acceptable |
| Goodness of Fit Index (GFI) | 0.831 | 0.80 | Acceptable |
| Adjusted Goodness of Fit | | | |
| Index (AGFI) | 0.827 | 0.80 | Acceptable |
| Root Mean Square Error of | | | |
| Approximation (RMSEA) | 0.047 | <0.06 | Acceptable |
| Standardised Root Mean | | | |
| Square Residual (SRMR) | 0.067 | <0.08 | Acceptable |
| Comparative Fit Index (CFI) | 0.901 | 0.90 | Acceptable |
| Non-Normed Fit Index | | | |
| (NNFI) | 0.845 | 0.80 | Acceptable |
| Parsimony Normed Fit Index | | | |
| (PNFI) | 0.688 | No threshold levels | Acceptable |
| Standardised Residuals | 1.153 | <2.58 | Acceptable |
| PClose | 0.214 | >0.05 | Acceptable |

Thus, the research hypotheses framed in accordance with the proposed structural model were tested. Since the model fit was acceptable in this study, parameter estimates were examined. Following hypotheses were tested in this study:

- H1: No. of patent granted has a significant influence on TBI success
- H2: Support services offered by TBI has a significant influence on TBI success
- H3: Services offered in TBI has a significant influence on TBI success
- H4: Selection criteria for incubatee has a significant influence on TBI success
- H5: Exit criteria for incubatee has a significant influence on TBI success
- H6: Academia linkage has a significant influence on TBI success
- H7: Corporate linkage has a significant influence on TBI success
- H8: Nature of functioning of TBI has a significant influence on TBI success
- H9: TBI success has a significant influence on social perspective
- H10: TBI success has a significant influence on economic perspective

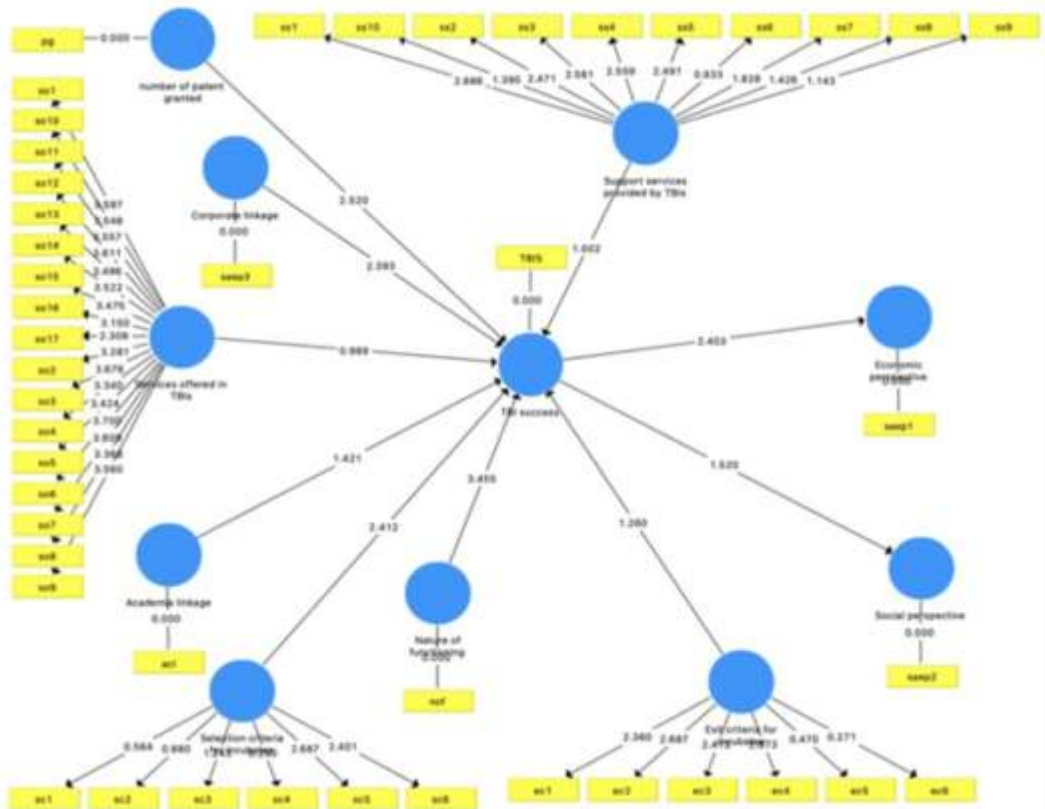


Figure 2: Standardised Path Estimates for the Model

Fig. 2 shows the standardized path estimates for the model. Based on $p < 0.01$ and $p < 0.05$, the standardized path coefficients were found to be insignificant and positive, which indicates that there existed strong evidence in rejection of the hypotheses H2, H3, H5, H6, and H10 except H1, H4, H7, H8 and H9. The significant paths included (NPG \rightarrow TBI success; $p=0.016$), (SC \rightarrow TBI success; $p=0.029$), (CL \rightarrow TBI success; $p=0.003$), (NOF \rightarrow TBI success; $p=0.001$) and (TBIs \rightarrow EP; $p=0.017$). Critical ratios lied in the range of 0.412 to 3.455. The prescribed limit of CR is 1.96 (Hair et al., 2006). In this study, only a few paths possessed a critical ratio value above the prescribed limit.

6. CONCLUSION

The research model proposed in this research work provides a deep understanding into the relationships between the variables. It also attempts to explain the impact of performance indicators on TBI success and impact of TBI success on social and economic perspective. As discussed earlier in this study, the proposed model was conceptualized on the basis of extant literature. All the factors possessed construct reliability and validity and thus the research instrument was considered appropriate for the study. The proposed research model possessed that the required model fit into the data and thus, the conceptual research model was considered acceptable. All the factors (performance indicators) considered in the study had standardized factor loadings, thereby establishing that the constructs are unidimensional. No. of patent granted would enhance technology incubator performance. Patents assist TBIs in improving their positioning, creating an innovation environment, incubating knowledge-based startups, generating increased income, and tracking research activity. Selection criteria for incubatee has a positive influence on TBI success. Patent grants have a huge impact on TBI success. In agreement with Khan et al. (2018), TBIs must increase their intellectual capital in order to achieve a competitive advantage. Corporate linkage has a significant influence on TBI success. This result is aligned with Binsawad (2018) which shows that sharing knowledge and corporate linking is essential for TBI success. Nature of functioning of TBI has a significant influence on TBI success. Smilor and Gill (1987) are in keeping with the conclusion. Support services offered by TBI and services offered in TBI, has insignificant influence on TBI success. The reason is that even the major objective of TBIs should be to assist elevate technological enterprises at such an “early stage to something like a level from which they can take advantage of business opportunities and enter the market without additional support. Exit criteria for incubatee has insignificant influence on TBI success. It is because they do not know whatever has occurred towards the graduating companies of TBIs from available data sources, but whether the long-term subsistence rate is different (Xiao and North, 2018). Academia linkage has insignificant influence on TBI success. This is due to fact that funds made available by the government are not adequately channeled in the way it says on the fiscal policies. TBI success has a significant influence on economic perspective. This result is in line with Ozdemir and Sehitoglu (2013) which shows that TBI success is closely related to the economic development of the country.

7. IMPLICATIONS AND RECOMMENDATIONS

The framework proposed in this study is of relevance to TBIs, because it enables them to evaluate their performance based on performance indicators. It is of major importance to understand the performance indicators in order to be a successful incubator. This study will make a sound base and support, regarding the performance indicators associated with an incubator’s success. Many studies have found strong relationship between performance indicators and TBI success.

The literature describes various performance indicators that measure TBI success. As mentioned earlier, number of patents granted, selection criteria, corporate linkage, and nature of functioning were found to directly and strongly influence TBIs success. Managers, practitioners, academicians and

incubator managers can utilize the information generated findings of this research in order to identify the performance indicators affecting TBI success. Government must advise colleges to establish incubators or entrepreneurship cells on their campus to promote grass roots innovators and facilitate their growth, sadly not many colleges in India can boast of one. Access to an innovation lab or entrepreneur cell is out of reach for many students for those pursuing technical and non-technical courses. They have yet to see the formation and expansion of university incubators of the same level in India, which is in desperate need of a vibrant start-up environment to stimulate student entrepreneurship. Proposes that the Ministry of Education or individual university administrations construct new university-based business incubators in order to boost entrepreneurial development.

8. FUTURE RESEARCH DIRECTIONS

Future research must try to do more than what this study was able to do. Our study was limited either by way the different TBI inputs were organized, despite the fact that it was based on even a primary source dataset including all TBIs in India. In order to deepen our knowledge of TBIs' significance in India's economic development, in-depth study on the performance of TBIs is required. Despite numerous efforts including government measures to promote company incubation, literature has documented the failure of so many business incubation centers throughout the world due to low service quality. As both a result, the numerous service criteria that incubation centers provide to respective clients or incubatee must still be assessed and measured.

REFERENCES

- Lee, H and B Choi (2003). Knowledge management enablers, processes, and organizational performance: An integrative view and empirical examination. *Journal of Management Information Systems*, 20(1), 179–228.
- Cheng, S and PV Schaeffer (2011). Evaluation without bias: A methodological perspective on performance measures for business incubators. *Region et Development*, 33, 211–225.
- Udell, GG (1990). *Academe and the goose that lays its golden egg*. *Business Horizons*, 33(2), 29–37.
- Smilor, RW (1987). Commercializing technology through new business incubators. *Research Management*, 30(5), 36–41.
- Peters, L, M Rice and M Sundararajan (2004). The role of incubators in the entrepreneurial process. *The Journal of Technology Transfer*, 29(1), 83–91.
- Gupta, AK and V Govindarajan (2000). Knowledge management's social dimension: Lessons from nucor steel. *MIT Sloan Management Review*, 42(1), 71.
- Brush, CG and PG Greene (1996). Resources in the new venture creation process: Strategies for acquisition. *Academy of Management*, Cincinnati, OH.
- Rooney, D, G Hearn and T Kastle (2012). Knowledge is people doing things, knowledge economies are people doing things with better outcomes for more people, In *Handbook on the Knowledge Economy*, Vol. 2 (Edward Elgar, Cheltenham and Northampton), pp. 1–14.
- Taylor, MS, GM Grossman and E Helpman (1993). Innovation and growth in the global economy. *Economica*, 60(239), 373.
- Carlson, CR and WW Wilmot (2006). *Innovation: The Five Disciplines for Creating What Customers Want*. Crown Business.

- Ascigil, SF and NR Magner (2009). Business incubators: Leveraging skill utilization through social capital. *Journal of Small Business Strategy*, 20(1), 19
- L. Gozali, M. Masrom, and T. Y. M. Z. Haron, "Critical Success Factors of Successful E-Business Incubators Framework in Indonesian Public Universities," 2015.
- G. A. Lichtenstein, "The significance of relationships in entrepreneurship: A case study of the ecology of enterprise in two business incubators," 1992.
- Campbell, C., Kendrick, R., Samuelson, D., 1985. Stalking the Latent Entrepreneur. *Economic Development Review*, Volume 3(2), pp.43–48.
- Lasrado, V., Sivo, S., Ford, C., O'Neal, T., & Garibay, I. (2016). Do graduated university incubator firms benefit from their relationship with university incubators? *The Journal of Technology Transfer*, 41(2), 205-219. [http:// dx.doi.org/10.1007/s10961-015-9412-0](http://dx.doi.org/10.1007/s10961-015-9412-0).
- Mas-Verdú, F., Ribeiro-Soriano, D., & Roig-Tierno, N. (2015). Firm survival: The role of incubators and business characteristics. *Journal of Business Research*, 68(4), 793-796. <http://dx.doi.org/10.1016/j.jbusres.2014.11.030>.
- Fernandes, C.C., Miranda Oliveira J.M, Sbragia, R., & Borini, M., (2016). Strategic assets in technology-based incubators in Brazil. *European Journal of Innovation*, 20(1), 153-170.
- Sekaran, U. (2003) *Research Methods for Business: A Skill-Building Approach*. 4th Edition, John Wiley & Sons, New York.
- Chin, Wynne & Marcoulides, G. (1998). *The Partial Least Squares Approach to Structural Equation Modeling*. *Modern Methods for Business Research*. 8.
- Hair Jr., J. F., Black., W. C., Babin., B. J., Anderson., R. E., & L. Tatham., R. (2006). *Multivariate Data Analysis*. New Jersey: Pearson International Edition.
- Ozdemir, O. C., Sehitoglu, Y. (2013). Assessing the impacts of technology business incubators: a framework for technology development centers in Turkey. *Procedia-Social and Behavioral Sciences*, 75, 282-291.
- Xiao, L., North, D. (2018). The role of Technological Business Incubators in supporting business innovation in China: a case of regional adaptability?. *Entrepreneurship & Regional Development*, 30(1-2), 29-57.
- Smilor, R.W. (1987). Managing the Incubator System: Critical Success Factors to Accelerate New Company Development. *IEEE Transactions on Engineering Management*, Volume 3, pp. 146–155.
- Binsawad, M., Sohaib, O., Hawryskiewicz, I., Aleidi, A. (2018). Individual Creativity Towards Technology Business Incubator Performance.
- Kuryan, N., Khan, M. S., & Gustafsson, V. (2018). Born globals and business incubators: a case analysis. *International Journal of Organizational Analysis*.