

REVIEW

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# Business incubation process and firm performance: an empirical review

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## Abstract

Industrialization is central if any economy is to be successful and the policy attempts at industrialization involve creating systems and institutional arrangements that can help accelerate the process of industrialization. Business incubation is also a system and an institutional arrangement to help nations industrialize by developing the SME sector. This paper hopes to understand how the business incubation process influences firm performance. The methodology adopted is a comprehensive and extensive review of literature on the incubation phenomenon. The review found that firm performance is greatly enhanced when a firm avail itself to an incubation program. Revenue growth, employment or job creation, venture funding, networking and alliance building are the performance indices most impacted by the business incubation process. The paper recommends that prospective candidates for incubation should develop their market, management and financial plans to increase their chance of being selected as tenants. Also, firms are encouraged to access the value-addition services of incubation as this greatly increases their chances of firm survival, revenue growth, employment and job creation, financial resources and networking and alliance building. Furthermore, tenants should not overstay their tenancy in an incubation program as doing so reduces their chances of survival upon graduation.

**Keywords:** Business incubation, Business incubation process, Business incubator and firm performance

## Introduction

New venture creation and indeed established ventures operate with the intent of being successful but failure is ever present due to the environment ventures operate in. Evolutionary theorists argue “that the forces of selection that eliminate uncompetitive firms are a necessary phenomena that contributes to the maintenance of healthy populations of organizations” (Aldrich, 1999). However, the forces of selection alone cannot be allowed to determine the number of organizations operating in an economy. This has therefore, given rise to attempts at reducing the likelihood of venture failures requiring not only the development of a favorable business environment and climate, but also establishing strong institutions that will assist businesses reduce the likelihood of failure. To help venture survival, governments have developed a unique institutional arrangement called business incubation designed to help business survive and grow in the contemporary competitive environment (European Commission, 2002).

The success story of the business incubation process on firm performance has been established. Incubators as cost-effective instrument of entrepreneurial promotion (EC, 2002) have impacted positively on firm survival, turnover, employment and job creation (Weinberg et al. 1991; Mian & Suny, 1996; Headd, 2003; Al-Mubarak & Busler, 2011; Voisey et al. 2013; Sehitoglu & Ozdemir, 2013) with the success of the incubation program dependent on its practices (Lewis et al. 2011). However, studies conducted by Schwartz (2012) and Amezcua (2010) have reported that incubation has not contributed significantly to the survival, employment and sales growth of incubated firms notwithstanding the time spent in the program. The conflict arising from these findings form the basis for this empirical review.

A review of empirical works focusing on the impact of business incubation process on firm performance is the focus of this paper. The goal is to establish the efficacy of this question: how does the business incubation process influence firm performance? What specific business performance indices are most influenced by the incubation process? Indeed, is entrepreneurial venture creation and promotion facilitated by the incubation framework? These are the questions that this review hopes to answer. This will contribute to our understanding of the incubation phenomenon and its likely impact on firm performance. The benefits of this review would benefit university and research scholars, business incubator managers, policy makers and government and indeed businesses among others on the importance of incubation in contributing to firm performance. Generally, the results and recommendations would contribute towards our understanding of the business incubation process and how it impacts firm performance.

To achieve this objective, the paper is divided into three major parts. Part one focus on the literature review covering the concepts of business incubation, business incubators, business incubation process and firm performance. Part two focuses on the methodology of the study with part three focusing on the empirical review of the related works based on the objectives of the study. Lastly, the paper provides the conclusion and recommendation.

### **Literature review**

Literature review would attempt an understanding of the basic concepts underlying the business incubation phenomenon. This section therefore, attempts to elucidate on the concepts of business incubation, business incubators, business incubation process and firm performance. The objective is to highlight and illuminate the concepts relevant to our understanding of the incubation phenomenon. The review gives us the opportunity to understand what the incubation phenomenon is, who or what an incubator is and most importantly, what the incubation process is.

The Campbell et al. (1985), Smilor (1987) and Hackett and Dilts (2004a) models of the incubation process provide a comprehensive perspective of what the incubation process is. The Campbell, Kendrick and Samuelson model is the first attempt at modeling the incubation process with Smilor extending the model by incorporating a network dimension to the model. Hackett and Dilts model gains input from the real options theory in explaining the incubation phenomenon. However, the success of any incubation program is dependent on the practices adopted by such an incubation program. Incubators size, age and local environment have an

influence on its success. However, incubator's best practice is perhaps the most important determinant of its success. Such understanding and exposition therefore, informs the decision to include same in this section.

### **Concept of business incubation and incubators**

Business incubation is a unique institutional arrangement that is primarily concerned with developing entrepreneurial culture in a community. However, the onus remains on the entrepreneur to make the business survive, as they are prone to be affected by what Levakova (2012) calls the 'incubator syndrome'. To Brooks (1988), the whole concept of incubation is attitudinal in that incubation fosters a community attitude of encouraging and supporting emerging firms to be successful with its success dependent on three fundamental factors: "an entrepreneurial and learning environment, ready access to monitors and investors, visibility in the marketplace" (European Commission, 2002). Levakova (2012).

The concept of business incubation is founded on the premise of increasing the survival and growth of firms by developing mechanisms that will ensure the early identification of those firms that have great potentials for success but are constrained by resources. The concept ensures that firms overcome what is called the liability of newness and the liability of smallness thereby creating innovative firms that are competitive, profitable and sustainable (Salvador & Rolfo, 2011). The incubation phenomenon is therefore, considered an enabling technology "that capacitate the functionality of critical and possibly strategic technologies" (Hackett & Dilts, 2004c). Generally, the incubation concept aims at achieving some fundamental objectives which include to create new jobs and businesses, foster a climate of entrepreneurship, commercialize technology, diversify, revitalize and accelerate growth of industry and local economies, reduce company mortality rate, reduce unemployment, increase university-incubation interaction and foster technology development (Bizzotto, 2003; Mutambi et al. 2010; Al-Mubarak & Busler, 2011).

The objective of business incubation is achieved through business incubators. Incubators are major actors in the entrepreneurial ecosystem by linking talent, technology, capital and know-how (Todorovic & Moenter, 2010; Bejarano, 2012; Levakova, 2012; Al-Mubarak et al. 2013). However, definitional challenges exist on what constitute business incubators or business incubation (Bergek & Norrman, 2008). Sources of this definitional challenge arise from the confusion of virtual incubators with traditional incubators that provide in-house tenancy, the inability to properly define the incubation process or define it but fail to identify with whom the incubation process occurs and the use of the terms such as science parks, technology centers etc. interchangeably (Bergek & Norrman, 2008; Hackett and Dilts, 2004a).

The general idea of what research scholars see as business incubators is that they are institutions concerned with speeding up the growth, financial and operational stability of entrepreneurial start-ups by offering them targeted services and support (EC, 2002; Bergek & Norrman, 2008; Mendoza, 2009; Levakova, 2012; Moreira et al. 2012; Masutha & Rogerson, 2014) with a strong emphasis on knowledge agglomeration, resource sharing, innovativeness and competitiveness by creating an environment which help start-ups deal with the challenges of entrepreneurial pursuit (Phan et al. 2005; Akcomak, 2009).

Bringing a network dimension to the concept, Weinberg (1991) views incubators as inter-organizational or social partnership organizations that are concerned with addressing “socially-relevant” purposes by harnessing the strength from diverse organizations. Mian (1996) and Bollingtoft and Ulhoi (2005) championed the concept of a network incubator “based on territorial synergy, physical proximity, relational symbiosis and economies of scale” with the overall aim of leveraging entrepreneurial initiative and know-how in creating and operating successful companies. In their contribution, Bergek and Norrman (2008) observe that research scholars disagree on whether a business incubator is an organization or a general term likened to an entrepreneurial support environment. To scholars such as Brooks (1988), Weinberg et al., (1991), Lalkaka (2001), and Phan et al. (2005), incubators are registered organizations that provide affordable office space, offering targeted support services with the sole purpose of nurturing small fledgling firms into healthy businesses.

#### **Concept of business incubation process**

Business incubation program, as a tool for promoting innovation and economic development (Bergek & Norrman, 2008; Al-Mubarak & Busler, 2011), is designed to be capable of adding value to incubated companies with the intent of increasing the survival rates of such incubated companies (Bizzotto, 2003; Moreira et al. 2012). The value adding activities are generally regarded as the business incubation process with several models developed to explain the phenomenon. Bergek and Norrman (2008) cautions on the limited scope to which most of the incubation models are conceived as focusing primarily on results neglecting the interrelationship of the value added activities to other incubator activities.

Earlier researchers of the incubation phenomenon such as Campbell et al. (1985) are acknowledged as the first to develop a business incubation process model. The Campbell, Kendrick and Samuelson model has four basic ‘services’ or value addition activities, foci areas where incubators contribute to firm performance. The value addition activities starts with diagnosis of needs, which is applied to prospective incubatee’s new business proposals. When the diagnosis is successful, the successful companies selected for incubation (called incubator tenants) are monitored. The incubator tenants also enjoy additional value addition activities by way of capital investment and access to expert networks with the prospect of venture capital. The tenants then graduate from the incubation program as successful growth ventures or businesses. Hackett and Dilts (2004b), Moreira et al. (2012) in critiquing the model observes that the model is developed with the fundamental assumption that all incubated companies will survive. The Campbell model is further limited to private incubators only with it not considering the capabilities of the potential entrepreneurs, environmental barriers and a lack of a selection criterion in the selection of potential incubatees.

Smilor (1987) extended the Campbell model with an emphasis on the external environment (incubator affiliation and support systems) to the neglect of the internal processes occurring inside the incubator. He conceptualizes the incubator as a system that confers ‘structure’ and ‘credibility’ on incubatees while controlling a set of assistive

resources. The incubator operates a network of support 'services' or value-addition activities with affiliation to the private sector, universities, government and non-profit. The incubator has internal support 'services' or value-addition activities in four basic ways: secretarial, administrative, business expertise and facilities. Both the external and internal support systems are designed to achieve the following objectives: economic development, technology diversification, job creation, profits, viable companies and successful products.

A model of business incubation process as developed by Hackett and Dilts (2004a) is based on the concept of 'black-box'. The process is primarily concerned with what happens inside the incubator (its internal dynamism) with a link to its environment. The Hackett and Dilts model conceives business incubation as the selection of incubatees from pool munificence of prospective candidates who 'enter' into the black box of incubation. The incubatees undergo value addition activities in three ways: selection performance (which is also an aspect of selecting prospective incubatees), monitoring and business assistance intensity and resource munificence. The incubatees are then outputted from the 'black-box' of incubation as graduated companies having an outcome that is either success or failure. The Hackett and Dilts model has control variables of population size, state of the economy, incubator size, and incubator level of development. In summary, their business incubation process model comprises three fundamental activities: selecting weak but promising firms to be admitted to the incubation program, monitoring and assisting those that would be successful and lastly providing the requisite resources to help them develop and graduate from the incubation program as financially viable and freestanding firms.

To them selection performance refers to the degree to which the incubator behaves like an 'ideal type' venture capitalist when selecting emerging organizations for admission to the incubator. The selection from the pool munificence of candidate companies is done taking into consideration four characteristics: managerial characteristics, market characteristics, product characteristics and financial characteristics. It means candidate companies need to be evaluated in the light of these characteristics. Monitoring and business assistance intensity is also another value-addition activity or service offered by an incubator. As defined by Hackett and Dilts, monitoring and business assistance intensity is the degree to which the incubator observes and helps incubatees with the development of their ventures including helping them to learn from low-cost failures and containing the cost of potential failure. This is achieved through time intensity of assistance provided, comprehensiveness of the assistance provided and the quality of assistance provided. The last value addition services of the Hackett and Dilts model is what they call resource munificence which they define as the relative abundance of incubator resources, measured by the following: resource availability, resource equality and resource utilization.

Hackett and Dilts define the outcome of the incubation process as five mutually exclusive outcome states "measured in terms of incubatee growth and financial performance at the time of incubatee exit." The outcome states are: the incubatee is surviving and growing profitably, the incubatee is surviving and growing and is on a path toward profitability, the incubatee is surviving but is not growing and is not profitable or is only marginally profitable, incubatee operations were terminated while still in the

incubator but losses were minimized and incubatee operations were terminated while still in the incubator and the losses were large.

### **Concept of firm performance**

The concept of firm performance and its measurement has bases in the fields of economics, management and accounting (Tangen, 2004). The simple objective of performance measurement is to ascertain how well an organization is functioning and is being managed given a set of criteria and standards. A broader view of the concept ensures that the interest of the organization's publics is considered with effectiveness and efficiency being the two fundamental dimensions of performance (Moullin, 2003; Khan et al. 2011).

Neely, Gregory and Platts (2005) define a performance measurement system as the process of quantifying the effectiveness and efficiency of an organization. To Khan et al. (2011), performance measurement is the process of assigning "value to objects or events in such a way as to represent quantities, qualities or categories of an attribute." The quantification of the performance of organizations has been based traditionally on financial criteria with dimensions such as annual sales, annual profit, number of clients, and growth among others. However, supporters of the multiple-objective school argue that performance measurements should incorporate the different stakeholders of an organization – a systemic perspective (Malina & Selto, 2004; Wu, 2009). Kennerley and Neely (2003) therefore, submit "that financial performance measures are historical in nature, provide little indication of future performance, encourage short termism, are internal rather than externally focused with little regard for competitors and customers." Contemporary performance measurement systems have therefore, being expanded to include both financial and non-financial criteria (Laitinen & Chong, 2006) making it multidimensional in nature.

Performance measurement in incubation literature is also multidimensional. There is no acceptable performance measure in incubation literature (Phan et al. 2005) leading to incubator researchers using different performance measures. Furthermore, the definitional challenge of what incubators are has also contributed to compounding the problem of identifying a single acceptable measure of performance in incubation literature. From review of business incubation literature, the following performance indices are used: revenues, finance, venture capital funds, graduation from incubation program, firm survival, networking activity, innovative firms, organizational or firm growth, job creation, sales growth, profitability, patents registered, number of patents application, alliance, technology transfer, employment growth, technology growth or development, research and development productivity, ability to share knowledge and technology and high-tech employment.

### **Summary of literature review**

Business incubation is a policy tool that facilitates entrepreneurial development by creatively initiating and implementing programs that focus on providing targeted resources and services. These services, which are designed to add value to entrepreneurial ventures, are structured to provide targeted and specific benefits for the incubated businesses. The Campbell, Kendrick and Samuelson, Smilor and Hackett

and Dilts models of value addition activities by incubators focus on providing targeted services to firms that are selected from a pool of prospective firms. Selection is an important element of the incubation process, which is an activity distinct to incubators and this activity is present in the three models discussed in this review. The Campbell, Kendrick and Samuelson and Hackett and Dilts model focus on internal network of support provided for the selected firms for incubation while the Smilor model focus more on the external network of support from government, universities, non-profit and the private sector. In all of the models, the business incubation support infrastructure is in the form of resources, expert networks, business, secretarial, and administrative support and capital investment.

Earlier research studies on the incubation phenomenon are generally classified as incubator development studies, incubation configuration studies, incubatee development studies, incubator-incubation impact studies and studies that theorize about incubators-incubation (Hackett & Dilts, 2004a). However, the focus of this review addresses the following questions: does the value addition activities by business incubators have any impact on the firm performance? In other words, does business incubation process have any influence on the performance of the incubated or graduated firms? In what specific ways does the performance of the incubatees or graduated firms impacted? What performance measure is most impacted by the business incubation process? These are the questions this review hopes to achieve.

### **Study methodology**

The methodology adopted for this review was based primarily on review of articles related to the business incubation process and firm performance. The choice of the articles reviewed and included in this paper especially under the empirical review section was dependent on whether the article is empirical in nature. Non-empirical articles were used for the literature review section while empirical articles were used for the empirical review section. The inclusion of only empirical articles in the empirical review section is to highlight the major findings reported by the studies, which will help in achieving the study's objective of assessing the influence of the business incubation process on firm performance. Furthermore, the time frame covered the period of 1999 to 2012. Only one article was selected in the period before 2000. Nine articles were selected within the period 2000 to 2009 and seven covering 2010 to 2012. Therefore, 41% of the articles selected covered 2010 – 2012 and 53% covered 2000 – 2009. The selection of the papers was therefore, reasonably spread over the period under study.

The selected articles proxied business incubation process as selection of prospective incubatees, monitoring of the firms selected for incubation, provision of business assistance, professional management services and capital/finance to the tenants, and access to incubator internal and external expert networks while firm performance is proxied by firm growth, firm survival/failure, employment/job creation, research and development productivity, research and development expenditure, revenue/sales growth, patents, venture funding and networking/alliance capability. The choice of the inclusion of the empirical studies is therefore, based on the business incubation process and firm performance indices as defined above.

An Internet search of the keywords business incubation, business incubator, technology business incubator, university incubator, network incubator, virtual incubator and firm or new venture performance provided the articles used for this review. The online database used for the Internet search included Google Scholar, EBSCO HOST, Science Direct, Springer Link, Wiley, JSTOR, Emerald, GALE, Pro-quest e-Library and ICAST Gateway. These databases produced journal articles, conference papers, working papers and academic theses, with the selection of an article dependent on the appropriateness of such a article to the objectives of this review. In other words, an article inclusion is dependent on whether it fits the overall objective of the review.

The search returned thirty-one (31) studies on the business incubation process and firm performance with only about twenty-two (22) including some aspects of the variables defined in this study that can satisfy the stated objectives. Nine (9) out of the thirty-one (31) were rejected due to the fact that their variable definition and objectives was in contrast to the objectives and variable definition of this study. Out of the twenty-two (22), five (5) had similar research design with this study but could not be accessed and hence excluded. Its exclusion has not affected the research conclusions. Therefore, a total of fourteen (14) articles were rejected with only seventeen (17) studies used. Out of the seventeen studies, thirteen (13) are journal articles, two (2) each for thesis and discussion papers. The seventeen (17) studies were included because they had similar research design and variable definition with this study and were considered relevant in achieving the stated objectives of this review.

### **Empirical review of related works**

This section summarizes empirical works carried out on the incubation phenomenon with an emphasis on empirical studies that focus on the business incubation process. About seventeen studies have been listed as assessing the impact of the business incubation process on firm performance. The stakeholder's theory explains that different stakeholders desire to achieve their objectives by identifying with a particular organization and given the numerous stakeholders that a firm deals with, such a firm is expected to at least strive to satisfy the aspirations of its stakeholders. Since the majority of incubators are publicly funded, the stakeholder's theory is relevant in justifying the diverse incubation outcomes or the firm performance measurement indices employed in incubation impact studies. A tabular presentation best captures the major highlights of the empirical studies reviewed and included in this paper. The Table 1 in Appendix below therefore, summarizes the studies reviewed. It covers the author of the study and the medium through which the research was published, the research question or objectives, methodology employed and variable definition, sample size definition and finally the major findings.

### **Summary of empirical review**

The empirical review focuses on entrepreneurial support mechanisms that are called business incubators. The common denominator for the reviewed works indicates a significant impact of the incubation phenomenon on business performance with the impact showing either a positive or negative relationship. Firm survival/failure, sales/revenue growth, employment/job creation, venture funding/capital and networking/

alliance in that order are the most used business performance measures used in business incubation research. Other measures such as technology transfer, firm patents and R & D productivity are less used as measures of firm performance. It is also worthy of note to highlight that the incubation studies attempt to prove that firms participating in incubation programs outperform those that do not assess incubation services with models developed to determine the impact on firm performance with incubation process dimensions defined as selection practices of incubators, monitoring and provision of business assistance, professional services and resources/capital to tenants and exposing tenants to the incubator's internal and external expert network resources.

The findings of this review shows that out of the seventeen (17) studies reviewed, only three (3) disputed that business incubation process does not contribute positively to improving tenants or graduated firm performance. An overwhelmingly fourteen (14) studies support the proposition lending credence to the argument that incubation creates an entrepreneurial spirit that supports businesses and promote new venture creation, impacting positively on economic growth and development. Specifically, findings from the review indicate that knowledge flows from external networks helps tenants to avoid failure and increases their access to networking resources, graduation from the incubation program and assessing funding. Also, the review shows that participating in an incubation program helps firm survival even after graduating from an incubation program with other benefits such as job creation, profitability and sales growth. Indeed, the evidence indicates strongly that participants in an incubation program outperform nonparticipants in terms of firm survival and sales growth.

In terms of business assistance and advisory, the evidence from the review shows that participants in an incubation program derive immense benefits in the areas of revenue and firm growth, patents application, obtaining finance or capital and establishing alliances. It is also important to point out that the time spent in an incubation program and indeed the age of the incubator also contributes to firm survival. A major theme in incubation literature is the screening of prospective firms and findings from the reviewed empirical studies conclusively show that incubators focus on three primary factors in carrying out screening activities: market, management team and financial factors in that order. However, focusing on only one of the factor is counterproductive implying that a business incubator needs to evaluate prospective incubatees using the factors together. In that way, the probability of survival is higher compared to when the factors are considered separately.

Contrary findings on the benefit of incubation indicate that firm survival is not improved neither is technology transfer, employment and venturing achieved when firms avail themselves to an incubation program. This evidence is not strong enough to vitiate the argument that business incubation encourages entrepreneurial spirit and significantly contribute to enhancing firm performance both within and without the incubation program. Therefore, following from the empirical review, it can be safely and convincingly submitted that business incubation process indeed contributes to improving the performance of firms right from the time they are domiciled within an incubator to when they successfully graduate from incubation as financially independent and viable entities. This is the

contribution that this review adds to the literature on business incubation process and firm performance.

### **Conclusion and recommendation**

In contemporary society today, business incubation is regarded as an important tool that has the capacity to support businesses to survive and grow. This paper has sufficiently addressed the fundamental questions raised in this review. Evidence shows that the incubation process improves firm performance. Arguing further, the review shows that the most impacted performance measures in incubation research in the order of importance is firm survival, revenue growth, employment or job creation, venture funding and networking and alliance building. Clearly, this review supports the efficacy of incubators as framework to enhance tenants or graduated firm performance, supporting the view that incubation is a tool that supports entrepreneurial promotion and new venture creation. Indeed, the evidence supports incubation as powerful instruments that must be encouraged and supported as an important component of the entrepreneurial ecosystem, as a framework for business support and the proliferation of new ventures.

To expand and promote incubation as a confirmed promoter of entrepreneurial promotion and SME proliferation, all tiers of government must be encouraged to promote the establishment of incubators and build their capacity to support emerging and new ventures. This recommendation derives from the fact that as confirmed promoters of entrepreneurship, the more capacity is built for incubators and the more support from government, the more equipped they will be able to contribute to entrepreneurship promotion. Indeed, emerging businesses with new ideas would greatly benefit if they participate in the incubation program as participation increases significantly their chances of survival, revenue growth and job creation.

Furthermore, this review encourages new and emerging businesses to avail themselves the business assistance, monitoring, expert networks, resource munificence and advisory services provided by incubators as these value addition activities have the potential of improving their ability to source for finance, improve patents application and the building of alliance. The study also recommends that incubator's capacity to leverage knowledge flows from its expert external network should be deepened so that incubatees and prospective incubatees should benefit to increase their chances of survival. Also, the study recommends that tenants should not overstay their tenancy in an incubation program as doing so reduces their chances of survival upon graduation. Finally, prospective incubatees to increase their chances of acceptance in an incubation program should creatively focus on improving their market, management and financial proposals since incubators focus on these factors in the selection of businesses to be incubated.

Further research should be conducted to illuminate the blurry aspects reported by few scholars concerning firm participation in an incubation program which they claim does not contribute to firm survival. More comprehensive research studies in this dimension would be helpful. Empirical research would definitely throw more light in this direction. Furthermore, more studies in the area of technology incubators or university incubators not having a significant impact on the transfer of technology would also benefit incubation research.

## Appendix

**Table 1** A summary of the impact of the business incubation process on firm performance

Author/Journal	Research question or objective	Methodology and variables definition	Sample	Findings
Rothaermel & Thursby (2004) Research Policy	How does knowledge flows from universities to incubator firms? How do these knowledge flows affect the performance of new technology ventures?	Ordinary least squares, logistic and multinomial regressions are employed. Performance measures defined are revenue, venture capital funding, total funds raised, firm failure, graduation and remaining in the incubator. The independent variables are licensing defined as backward citations to university research, academic journal, GT research and non-GT research with firm size, industry effects, time in incubator, non-GT university link and estimation procedures as control variables.	Firm-level data on 79 incubated technology firms with the Georgia Tech's (GT) Advanced Technology Development Center covering a period of six years from 1998 – 2003.	They found that knowledge flows proxies are not significant with respect to revenues but significant with respect to funds raised, obtaining venture capital funding, probability of failure and probability of graduation. However, they also reported that the absorptive capacity of firms also have a significant impact on the success of knowledge flows, an important component in the firm's competitive advantage.
Soetanto & Jack (2013) Journal of Technology Transfer	How does business incubators accommodate the networking needs of the firms within the incubators and how does these networking activities differ among highly innovative and medium to low innovative firms?	The study uses descriptive statistics. Framework to understand incubator networks classified in two dimensions: internal and external networks and resource types defined as tangible and intangible resources which form the independent variables and networking activity of highly innovative and less innovative firms as the dependent variable.	Networks of 62 firms in Daresbury Science and Innovation Campus in UK. Data is collected from 2008 to 2009 from survey of founders or managers. Half the sample represent highly innovative firms that are technology-based with average of four employees.	Incubatees focus on intangible resources in the process of developing networks with highly innovative firms more active in the development of networks than less or moderately innovative firms. For the highly innovative firms, the networks have significant impact on firm performance while the low or moderately innovative firms, networking ability does not have a significant impact on their performance.
Aerts et al. (2007) Technovation	How does the initial screening practices of incubators affect the survival rate of incubator tenants?	The authors regress three screening factors: market, management team and financial factors on average failure rates. The screening factors for incubators define the independent variables and failure rate defines the response variable.	A web survey was administered to 654 European incubators identified through Community Research and Development Information Service Database and Internet searches with 100 responses (of which three explicitly stated they do not screen their tenants)	Incubators carry out unbalanced screening with tenant market factors being the most important criterion, followed by management team and financial factors. European business incubators focus on tenant's market and management factors while American counterparts focus more on financial factors. They concluded that for screening practices to have any impact on firm performance, a balanced set of factors should be used in incubatee screening, with tenant survival rate having a

**Table 1** A summary of the impact of the business incubation process on firm performance  
(Continued)

Schwartz (2008) Institute for Economic Research	What is the effect of incubator age and incubation period on the long-term survival of graduated firm?	Survival analysis is used to investigate how incubator age and incubation period affects the probability that a market exit occurs within six years of graduation. Three dummy variables in addition to age and time in incubation were defined as the independent variables.	Data on five German incubators collected from June 2006 – December 2007 through face-to-face interviews. Incubators have similar ages and minimum operating time. Data on 149 graduated firms from five German business incubators located in the five cities of Dresden	positive relationship with a more balanced screening practice. Also incubators that support entrepreneurial and small business development will produce higher survival rates for its tenants.  He found a statistically negative impact of incubator age at the time the firms moved into the incubator and the probability of post-graduation firm survival. Also, time span of tenants above the average shows a statistically negative relationship on post-graduation survival. The hazard function showed that one-third of the 36 failures occurred within year of graduation and the probability of failure increased again after the fourth year. Furthermore, for firms in high-tech sectors, failure rate is lower compared to firms in low-tech sectors.
Hartmann and Masten (2000) Journal of Technology Transfer	Is the growth rate of small firm manufacturers explained by the economic environment?	The focus was on technology assistance to small manufacturers, an important element in business incubation. The data analytical tool is Stepwise regression	Data on the number of small firm manufacturers and questionnaire responses from 10 US states from 1980 to 1990 was used.	There is no relationship between the growth rate of small firm manufacturers and traditional economic variables at the state level. They however, concluded that states that focus on providing technical assistance had small firm manufacturers having a significantly higher growth rates.
Lindelof & Lofsten (2004) Journal of Technology Transfer	How does the performance of new technology-based firms located in science parks compare to those located elsewhere? Does higher education-industry links encourage innovation and new product launches?	Descriptive statistics and regression analysis using paired samples	Sample was 223 firms in Sweden of which 143 were located in science park (10 science parks) and 139 were not. Initial sample of 265 on park and 300 off-park firms. Data collected for a three-year period (1996 to 1998)	On park firms have a higher rate of job creation and sales or revenue growth. No effect on profitability. Firms within science parks are more likely to have links with local universities.
Cumming & Fisher (2012) Research Policy	Does advisory services help foster entrepreneurial outcomes for businesses when they are targeted towards the subset of SMEs that are growth and innovation oriented?	Tobit and logistic regressions, controlled through the use of an instrumental variable. Entrepreneurial outcomes were measured on the dimensions of sales growth, patents, finance and alliances while advisory services forms the independent variable for the study.	A sample of 228 firms in Ontario, Canada, of which 101 used business advisory services. The data span the period of fourth quarter of 2006 to second quarter of 2009	They found a positively significant relationship between business advisory services with firms' sales growth, patents, finance and alliances. They also found that firms with patents are more likely to receive business advisory services than firms without patents.

**Table 1** A summary of the impact of the business incubation process on firm performance  
(Continued)

Scillitoe (2010) Technovation	How does direct counseling and networking interactions provided through business incubators enable new technology-based ventures?	Hierarchical multiple regression is performed using direct frequency of interactions between incubator and firm (counseling) and number of contacts (networking) with business incubation process dimension defined as business and technical assistance.	Data was collected between 2003 – 2004 through web-based surveys from 42 new technology-based firms that had contacts with an incubator: 14 firms and 6 incubators in Finland and 28 firms and 11 incubators in the US	They found that interactions with incubator management are important for understanding buyer preferences but do not enable the speed of technological learning and that business assistance in the form of venture learning about buyer preferences is best enabled through counseling while not enabled through networking interactions. For technical assistance in the form of venture learning, technological know-how skills is best enabled through networking while not enabled through direct counseling.
Lerner (2000) Journal of Private Equity	What is the impact of the Small Business Innovation Research (SBIR) program on participating firms?	Venture capital activity, measure of SBIR award status and interaction between venture activity and SBIR award status is the independent variable while employment and sales is the dependent variable. OLS regressions is used.	Sample of 1,435 firms. 541 received phase I funding, 294 received phase II funding, and 600 firms, with some overlaps, were listed in the Corporate Technology Directorate	SBIR-funded firms grow significantly faster than matched non-SBIR-funded firms in terms of employment and revenues, if they are located in areas with substantial venture capital activity. Effect more pronounced in high-technology industries. In other words, Lerner found that the interaction between venture activity and SBIR indicator is consistently significant with employment and sales growth as SBIR alone has little impact.
Hackett & Dilts (2008) Journal of Technology Transfer	What are the elements of the business incubation process and how is it measured?	Factor analysis with validity and reliability is used. Business incubation process is measured as selection performance (SP), monitoring and business assistance intensity (MBAI) and resource munificence (RM) are independent variables while incubator outcomes are five independent exclusive outcome states.	50 business incubators from an initial sample of 79. Data was collected over 5 years (1999 – 2003) using proprietary software.	The authors propose eight multidimensional scales (29 items) to use in incubator evaluation. The variables were SP, MBAI and RM as predictors with the outcome states as: the incubatee is surviving and growing profitably, incubatee is surviving and growing and on a path toward profitability, incubatee is surviving but not growing and not profitable or only marginally profitable, incubatee operations were terminated while still in the incubator but losses minimized and the incubatee operations were terminated while still in the incubator and the losses were large.
Bejarano, T. (2012) Thesis	Does incubatees that rate high on Hackett & Dilts scale have stronger outcome states compared to incubatees that rate	Descriptive statistics, correlation analysis and stepwise regression	86 incubators were selected from about 190 business incubators that were identified to be operational in Brazil within the period of	No statistically significant predictive ability of the Hackett & Dilts scales when used to predict incubatee outcomes. He concluded that in understanding the

**Table 1** A summary of the impact of the business incubation process on firm performance  
(Continued)

	low on the same scale?		May, 2011 to December 2011	impact of the incubation process on firm performance, using the Hackett and Dilts scale alone would not help in understanding whether an incubated firm that rates highly on the scale performs better than one that rates low on the same scale.
Khalid, Gilbert & Huq (2012) <i>Asian Journal of Social Sciences and Humanities</i>	Does selection performance, monitoring and business assistance intensity, resource munificence and professional management services significant predictors of the business incubation performance?	Statistical procedure involved two main processes, exploratory factor analysis and multinomial logistic regression. Variable defined are: selection performance, monitoring and business assistance intensity, resource munificence and professional management as independent variables while incubation outcome states defined as dependent variables.	Survey questionnaire was used to gather the necessary data from 118 incubatees from a population of 180 ICT-based companies in ICT incubators in Malaysia from the period February 2010 to May 2010.	Selection performance, monitoring and business assistance intensity and professional management were significant predictors of business incubation outcome of 'our company is making profit' and 'our company is highly profitable' while resource munificence failed to show any relationship to any of the outcome categories.
Amezcuca (2010) Thesis	Does the performance of incubated firms outperform the performance of non-incubated firms? Are certain attributes of business incubators more associated with better tenant performance?	An accelerated failure time unshared-frailty regression model using a log-logistic distribution for survival analysis with double differences model to address selection bias. Survival, employment and sales growth were the dependent variables.	Three datasets is used. A panel data set consisting of 944 business incubators in the US between 1990 and 2008 and two panel dataset of firm-level data from the National Establishment Time-Series Database	Compared to non-incubated firms, incubated firms fail 10% sooner. Incubation stems a firm's economic loss in terms of employment and sales but does not contribute to economic growth. Amezcuca found a statistically marginal difference between incubated and non-incubated firms in terms of performance. He observed that an incubator and entrepreneur's traits when related with how incubated firms perform, shows evidence of a measurable impact of the duo of incubator and entrepreneur trait on the performance of the incubated ventures.
Yang et al. (2009) <i>Research Policy</i>	Does on-park firms exhibit better innovative performance in terms of R & D and productivity than off-park firms? Does on-park firms more efficient in R & D efforts than their off-park counterparts?	Paired sample and two stage regressions to control for section effects. Dependent variable is modeled using the Cobb-Douglas Production Function against the log transformation of capital, labor, intermediate inputs and research and development expenses as independent variables.	Panel data for new technology-based firms located on and off the Hsinchu Science Industrial Park in Taiwan. A total of 247 firms, 57 of them located within the park. 1998 – 2003	They found that NTBFs domiciled at an incubation facility invest more efficiently and have the added advantage of networking advantages or clustering effect. Their major findings also reveal that the elasticity of R & D with respect to outputs of NTBFs located within HSIP is significantly higher than that of other firms not located at the HSIP. NTBF within incubation facilities exhibit better performance in terms of R & D productivity.
Schwartz (2012)	Does an incubated firm has a greater	Comparison of survival rates as well as the	371 incubated firms from 8 incubators and	They found that out of the graduated firms

**Table 1** A summary of the impact of the business incubation process on firm performance (Continued)

Journal of Technology Transfer	chance of success in the long run as a result of availing itself to an incubation program when compared to a non-incubated firm?	evolution of the risk of market exits of incubator firms (after graduation) and non-incubated firms.	a control group of 371 non-incubated start-ups from Germany.	from five incubator programs, non-showed a statistically significant survival rate when compared to non-incubated firms. For the 3 incubators, the incubated firms showed a statistically significant lower survival rates when compared to non-incubated firms. They therefore, concluded that incubation is doubtful as a policy of improving firm performance in the long run.
Phillips (2002) Technology in Society	How effective are technology business incubators as technology transfer mechanisms?	Employed descriptive methodology to assess how technology business incubators are effective in technology transfer.	Surveyed 44 business incubators (34 from technology business incubators and 10 from university business incubators). Survey was based on the US National Business Incubator Association Survey of 2001.	Technology business incubators have not been found to have a significant effect on technology transfer. Despite being formed as a medium of technology transfer, they do not have a high incidence for technology transfer. Furthermore, they found that tenants of technology incubators are larger (in terms of revenue and employment) with more costs than conventional incubators.
Wallsten (2001) Stanford Institute for Economic Policy Research	What is the impact of the US Small Business Innovation Research (SBIR) program and science parks on participating firms?	Three stage regressions to distinguish between selection and treatment effects. Independent variables are university research and development spending and general economic conditions proxied by per capita income and number of high-tech firms while dependent variables are proxied by high-tech employment, number of small firms and venture capital.	367 SBIR-funded firms, 90 rejected SBIR-applicant firms, 22 eligible firms that did not apply for the SBIR funding spanning 1983 – 1997.	Wallsten found that university research and development positively correlates with high-tech employment but is not a significant correlate with either venture capital or number of small firms. Also no statistically significant impact on participating firms performance from neither SBIR-funded nor research parks. Insignificant correlation between science parks and high-tech employment.

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**Authors' contribution**

FAA modified the topic and structure of the work while NK read through the work with some modifications and inputs to the content of the work. IAS conceived the idea of the study and carried out the research and write-up of the work. All authors read and approved the final manuscript for submission to the Journal of Global Entrepreneurship Research.

**Competing interest**

The authors declare that they have no competing interests.

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