

RESEARCH ON THE ROLE OF THE INCUBATION POLICY IN HELPING THE GROWTH OF NEW TECHNOLOGY BASED-FIRM

1. Introduction

The importance of new technology-based firms to the economy is now widely recognised not only by the western industrialised world, but also by many countries at large, from Asia to Africa. According to Storey (1984), new technology-based firms make significant economic growth in the creation of new jobs. Another important contribution of new technology-based firms is their catalyzing role to technology and knowledge accumulation process of innovation system.

However in reality, among the success stories of the emerging of new technology-based firms, many have failed and collapsed in the early years of their establishment. The firms found a difficulty to develop their innovation capacity. The dilemma that always appears is the choice between to keep innovating (exploring a new market) and exploiting the existing market.

As the contribution of new technology-based firms on the economic and innovation growth is of high importance, the policy to foster new technology-based firms receives a serious attention from policy makers. One of the policy tools considered most effective is technology incubator. Technology incubators provide new firms with physical facilities and variety of business services to help them increase their survival rate in the early stages of development. In general technology incubators are ones that focus on new companies with advanced technologies. Because of the nature of technology incubators is closely related with high technology development, universities or research centers act as the main actors behind their development. It is how new technology-based firms gain their name as academic spin offs.

Despite the fact that the concept of technology incubators has been known since the 1980s, we have little information on the effectiveness of the incubators support in helping new technology-based firms overcome their obstacles and improve their capacity to innovate. Nor is it clear about how new technology-based firms make use of the support. This paper is intended to explore the role of TBIs in helping the new technology based firm and find an appropriate management and strategy of TBIs in supporting the new technology-based firms innovation capacity. In the next section, we will discuss about the concept of the incubation process followed with the explanation about the reasons why this topic are important to be discussed as a research topic.

2. The incubation process

There are many different ways to explain the development process of firms especially in the high-tech sectors. Most researchers use a stage model by which the growth of firms is explicated stage by stage. After passing through a stage, firms will face the next stage and so on until they are able to be self-

dependent and stable. Various stage models have been developed by researchers. Generally there are minimally three stages and maximally eleven stages (Schere. Et al., 1988, Hisrich, R.D., 1988. Koschatzky, 1997, Vohora et al. 2002, Hannon, P.D., 2003). They all have similar stages. Figure 1 presents one of the stage model that explains the development steps of new firms in five phases, namely: (1) Potential idea for new product or service, (2) decision to proceed, (3) resources gathering (financial, people, information, etc), (4) launching of new firms / start-ups, (5) firms development.

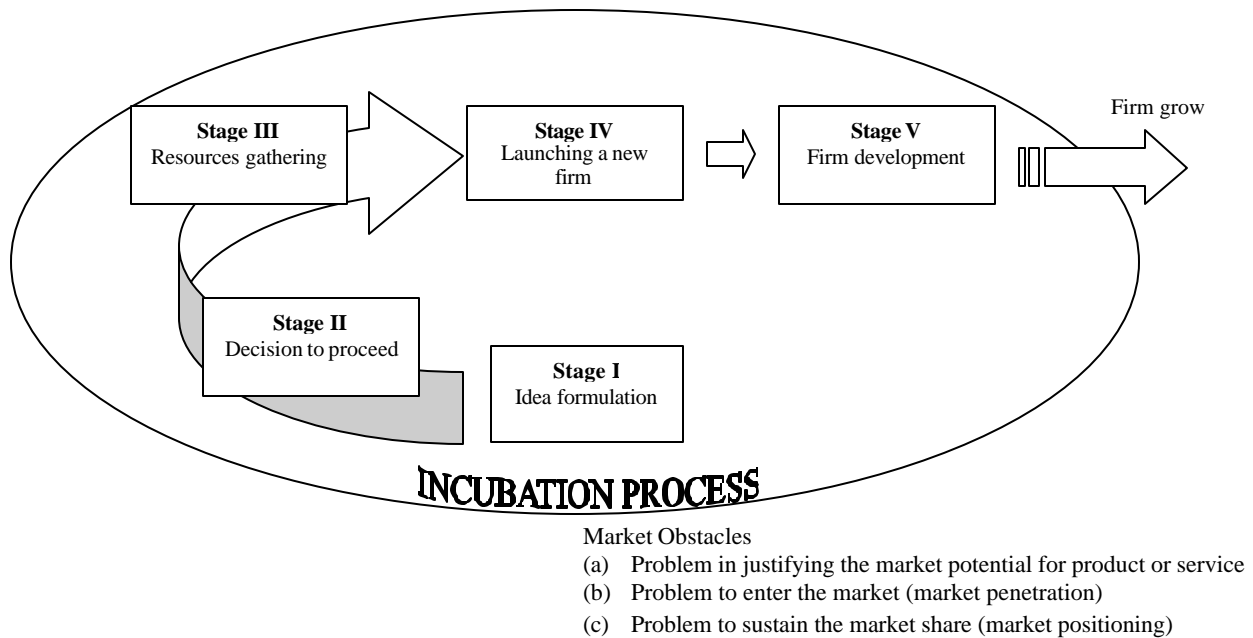


Figure 1. The Incubation Process

The figure above portrays that once the idea is formed, entrepreneurs decides to proceed and technology incubators start to play their role by helping entrepreneurs to assemble resources. As new firms grow, technology incubator can add a new support not just shared business or research facilities but also training, networking, and consultation in all areas of expertise. The supports commonly provided by technology incubators can be viewed at table 1.

Table 1. The Description of the common supports provided by Technology Incubators

Physical service	Multi-tenant facility Flexible and cheap rent space / laboratories Shared business administrative facilities
Business Assistance Service	Business plan development Entrepreneurial courses Mentoring programs General legal assistance Access to capital

However, there is no single definition of technology incubators. Differences of definition can be viewed through the objective (Clarysse et al., 2003), and the model of the incubation support. Clarysse et al. (2003), for example, proposes three incubation models in managing the spin out process. The models are comprised of low selective, supportive, and incubator model. In the low selective model, the initiative comes from public organizations and linkage with universities. The goal is to produce as many spin offs as possible. In the supportive model, it is private organizations that take the first action. The ultimate objective of this model is to create economically viable companies that stay in the region. The last model, the Incubator model, the initiative is started by center of excellent of particular technology such as biotechnology or information technology. This model also has a strong link with universities or research centers. As this model is profit seeking, it produces fewer spin offs, but is more robust in its development.

The incubation support may include a whole range of supportive measures spanning from offering basic supports, such as office and laboratories for research to providing support with added values such as business coaching, mentoring and network building. As an old model of incubation process, besides the basic supports, this model also has a centralized management structure (top down and closed). Another new development in the incubation support model is the so called 'network incubator' (van Geenhuizen, 2004). This incubator has no particular focus on supplying basic supports. Instead, their primary role is to provide a custom support such as training, coaching and network building. In providing the supports, the incubator is supported by the management structure that is more opened and self-managed.

The two examples above show us the diversity of technology incubators. In this research, we will not limit on the narrow definition of technology incubators, but rather use a general definition. Our definition of technology incubator is incubators whose primary goal is to promote the development of technology-based firms by providing a qualified environment to nurture the firm's development. They are characterized by institutionalized links to knowledge resources including universities, research centers, and national laboratories. However, the types of support from TBIs scarcely touch the innovation capacity of a new technology-based firms. The role of TBIs is limited to a mediator between firms and university or research center. This is research is conducted to find out the best strategy to enable TBIs to provide the right support for new technology-based firms, particularly in enhancing their innovation capacity.

3. A Review of Literature on Technology Business Incubators

In this section, we start with a discussion about TBIs. We illustrate theoretical concepts of TBIs grounded by others researchers. Some previous empirical studies also provide us with the information to understand the critical factors, which influence the firms' growth. Our discussion will be followed by comparing these findings with supports embedded in the existing TBIs.

To have in-depth knowledge about TBIs, we should consider the previous research of TBIs. While there has been a significant volume of research conducted on business incubators, few studies have focused on TBIs. This is among which caused by the fact that there is no single definition of incubators. In some cases the researchers are often mixed up with other definitions such as Science Park, Business Park and Technology Park. To a certain degree, they appear to offer similar supports and share the same objective with TBIs.

In our paper, we focus on TBIs as an organization form that is a vehicle for the firm development. The word of technology means that the incubators have tenant criteria, which means it is restricted to high-tech start-ups. We define TBIs as a system designed to assist high-tech start-ups in the development of new firms. By providing a variety of supports to start-ups and emerging firms, the incubators seek to combine entrepreneurial talent, technology, capital, know-how to leverage in order to accelerate the development of new firms, and of course in parallel with the benefit in the commercialization of technology to the market.

Phillips. R.G (2002) defines at least three differences between TBIs and other incubators. First, the TBIs focus on technology-based firms. Second, they differ in supports offered. TBIs offer slightly different supports such as an access to advanced technology laboratories, equipment, and other research and technical resources such as faculty, staff, students, and libraries. The third difference is that TBIs are linked to universities or research institutions, which have a concern on technology transfer or commercialization. Among these three characteristics, the second characteristic is considered to give a different added value to start-ups. For example, the access to the high technology laboratories is very valuable and difficult to offer by some institutions except university or government research centers.

Phillips argues that one factor which gives an added value to NTBFs by TBIs is a linkage to the university. Because the nature of technology, it seems logical that universities become important actors in the development of firms. Wiggins, J. and Gibson. D.V (2002) from IC2 institute (Austin Technology Incubator) argue that the added value given by traditional university or community-based incubators becomes a vital differentiator between successful and unsuccessful incubators. It shows that in 2003, there are more than 800 business incubators in U.S. Most are non-profit and technology-oriented, characterized with an association to university. On other hand, there is a sharp decline of profit business incubators (without association to university) in the U.S.A.

In addition, even the TBIs has a close link with universities or research centers, they are not the only knowledge resources for the NTBFs. NTBFs gain the knowledge also from other actors besides the university. Phillimore, J. (1999) and Rothschild. L. and Darr, A (2003) believe that the important characteristics of TBIs are their capability on the construction and maintenance of informal network of innovation. Their network is composed of start-ups within the TBIs, university and industry. They argue, with their empirical study on Australian and Israeli TBIs, and prove that the incubator serves not only as a linear bridge

connecting the academy and industry, but also as a part of a wider network of innovation.

Finally, from the policy maker point of view it is interesting to know the impact of TBIs. The problem such as other policy evaluation process, the assessment is not going to be easy. The complexity in terms of time and multiplier effect are difficult to measure. Mian (1994, 1997) is the one who offers an integrative approach for assessing the performance of TBIs. Mian offers an approach to assess the added value of the contribution of university technology business incubators (UTBIs). Yet, some empirical study such as the study on the performance of technology business incubators in Italy, Colombo, M.G. and Delmastro, M (2002), is doubtful whether TBIs have been successful in supporting the establishment and post-entry development of start-ups

With regards to the above mentioned findings, we suggest that TBIs may not just offer the infrastructure and personnel services, but rather a combination of both factors with networking and coaching that help start-ups survive in the entrepreneurial process. TBIs should play an active role in the network of NTBFs, university, industry, and government. TBIs should also expand their service by extending their support in improving innovation capacity of firms. This first concept becomes our initial model of TBIs' role (figure 2). The potential entrepreneur in high tech business will be transferred into graduate firm, if TBIs provide them with infrastructure, coaching and networking support.

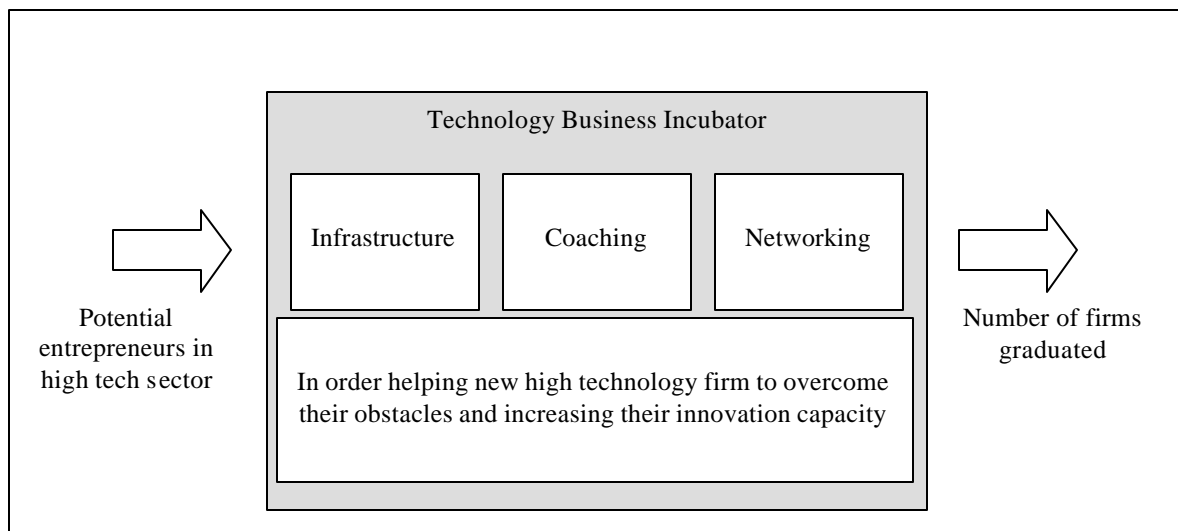


Figure 2 the first model of TBIs.

The number of start-ups graduated from incubators is often used as proxy to measure the performance of TBIs. In general, the research on performance measurement of TBIs can be categorized into three dimensions, as follows:

- Measuring the degree of innovation, in the early research, some scholars used to measure the scale of success (Maidique and Zirger, 1984, Litvak and Maule, 1980).
- Measuring their contribution to society (measured by the employment growth)

- Measuring their performance based on their objective (based on the aims of the stakeholders).

Discussing the success of TBIs becomes important for defining the role because the success of TBIs will validate the role of TBIs. The first two dimensions of success share the same idea that is the performance of TBIs can be measured in terms of the performance of NTBFs.

To be successful and grow steadily, NTBFs should recognize their needs in each phase of development. Conducting a comparison to the other sectors, such as service and manufacture, many researchers believe that NTBFs need more support in the early years of the firms development. The development process of new firms can be explained in five phases, namely: (1) Potential idea for new product or service, (2) decision to proceed, (3) gathering the resources (financial, people, information, etc), (4) launch of new firms / start-ups, (5) firms development. The need of each phase is different, and changing over time. This needs become a critical factor for the NTBFs' growth path. Since NTBFs needs change along with the phases of their development, the role of TBIs in this process should also change accordingly.

The literature on the factors that contribute to the success or failure of startups is very extensive. It includes descriptive and prescriptive writings, longitudinal or cross-sectional study, conceptual models, case study, survey, and comparative case study. While many of these research are relevant to our study, we primarily focus on the papers that address the factors contributing to the success of new high technology firms. We also adapt the criteria that were developed by Stuart. R. and Abetti, P.A. (1987) and add some new literature and trends of technology business incubators.

The success factor of NTBFs are :

- Attractive products to the market (innovative product)
- Marketing Strategy
- Organization structure
- Entrepreneurial personality and decision making
- Community support
- Selection criteria

4. Critical factors of New Technology based firms Development

To identify the population of TBIs for a review, we conduct an electronic browsing (science direct and scirus). Our objective is to conduct a census of all publications on TBIs. After identifying and retrieving all articles electronically in a scientific database, we go through the bibliographies of this article to identify other articles on TBIs. Ultimately, there are 12(??) articles included in this review. The purpose of this review is to find the critical factors of the NTBFs development and if possible to find the descriptions of the support characteristics of TBIs.

Table 2 shows the recapitulation of studies on the critical factors of the development of NTBFs.

Table 2 The list of previous Study of the critical factors of the development of NTBFs

	Attractiveness and innovation capacity	Marketing strategy	Organization structure	Entrepreneurial Personality & decision making	Community support	Selection criteria
Rothwell et al. (1974)	√	√	√	√		
Maidique and Zirger (1984)	√	√	√			
Cooper (1981)	√	√				
Miller (1983)		√				
Rubenstein (1976)	√	√	√	√		
Smilor, (1987)	√	√		√	√	
Campbell et al (1985)				√	√	
Merrifield (1987)			√	√	√	
Kuratko and Lafollette (1987)					√	√
Merrifield, D.B. (1987)	√	√	√	√		
Feeser, H.R., Willard. G.E. (1989)	√			√	√	
Greene, P.G., Butler, J.S., (1996)					√	
Oakey, R.P. (2003)	√	√	√			
Cumulative	8	8	6	7	6	1

From the table above, we understand that it is not easy to discover what factors are most important in determining the survival of NTBFs. The total cumulative of the factors show almost the same value, meaning that those factors are equally important to the researchers' point of view. This confirms our previous statement that the needs of NTBFs are diverse and complex. The reason is because each firm has endogenous characteristics, which are potential to generate problems. Moreover, the problems faced by NTBFs in each phase of their development are different. Sometimes they should move back and start again from the previous stage.

On a more detailed look, we find that innovation capacity; marketing strategy and entrepreneurial personality are the factors that receive relatively more attention (total cumulative 7/8). The first factor is definitely important, as TBIs' focus is start-ups of high-tech business. Their market share is likely to be determined by their level of innovation and strategy. Some firms may choose to enter the market with breakthrough technology, and others choose to be followers of some innovation.

Marketing strategy and entrepreneurial personality must have received more attention from TBIs as they are determining aspects to help the growth of NTBFs. As they have engineering/science educational background, most of the

founders of NTBFs have little knowledge about entrepreneurship whereas this factor is vital to the survival of new firms.

Logically, all the needs of NTBFs in such a way should be covered in the TBIs' support.

5. The support of Technology Business Incubators. Are they enough?

In the next step, we try to add more information about TBIs' support through review on the journal publication and website. The complete database of TBIs is detailed in the appendix. The result of the review is a set of supports provided by TBIs (tabel2). The services are labeled under the seven dimensions of the critical success factors of TBIs.

Table 3 The list of common support provided by TBIs

Critical success factors	The most common type of Support provided by TBIs to overcome this critical success factor
Products attractiveness and innovation capacity	Business consultant and coaching
Marketing strategy	Entrepreneurial course / workshop Business consultation and coaching
Organization Structure	Business consultation and coaching
Entrepreneurial personality and decision making	-
Community support	Facilities, financing, networking
Selection criteria	Business plan competition

The findings above show a doubt that all the needs of NTBFs can be covered by the supports of TBIs, especially in supporting the innovation capacity. TBIs' role is just as a provider of a qualified environment for NTBFs to growth. With such a passive role, TBIs can hopefully maximize their potency in helping high-tech start-ups. Another reason is that the needs are difficult to recognize, and consequently the solution comes late. From our observation, some TBIs have a business consultancy service. They help high-tech startups with their business planning, and strategy to overcome the barriers. The difficulty maybe lay on the knowledge of assessment of product/service development since in most of the cases, NTBFs come with breakthrough technology. In this respect, it is very difficult to predict the market's response.

The factors that are related to personal problems, such as personal innovation capability, the feelings of being lonely and tired, the lack of leadership capacity, are very difficult to overcome by helping TBIs. Starting up a high-tech firm is a life choice of the founders. The effective way to solve this problem is by conducting a good selection of potential entrepreneurs by TBIs. TBIs mostly focus on the 'emerging' technology and potential market for their products/services. Nevertheless, TBIs should also consider the personal characteristics as a critical factor in starting up a firm.

Now we revise our model of incubation process (figure 1) into an extended model of incubation process. The new model is completed with all the components needed for the incubation process.

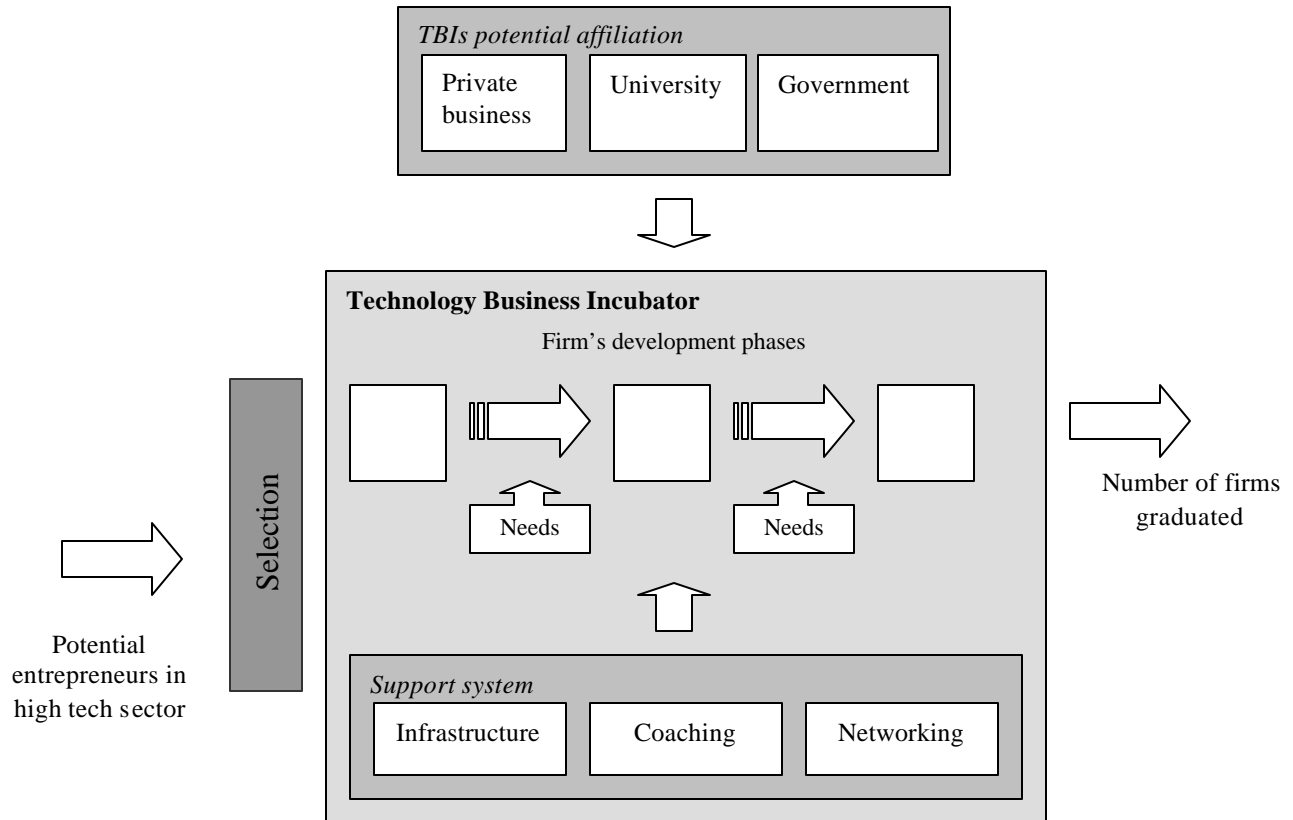


Figure 3. The extended model of TBIs

6. Discussion

One of the objectives of TBIs is to support NTBFs overcome their problem in the early years of development. As the problem is diverse and changes from time to time, TBIs have a difficulty to recognize the needs of high-tech startups. Consequently, the roles of TBIs become unclear, since they face a difficulty to apply the effective policy or support. So we try to develop a concept of support that should be provided by TBIs. The problem arise because until know there is no best practice or methods applied by TBIs in helping new technology based firms increasing their rate of survival.

In the beginning we introduce a relational model of the incubation process, showing that there are at least three fundamental support elements of TBIs: infrastructure, coaching and networking. The fact shows that the needs of NTBFs are different from those of other startups (non-technology business sector). They have to deal with technology development as their core capability. On the other hand, they lack management and entrepreneurial skills. The

combination between innovation capacity and others entrepreneurial skills are needed to ensuring the growth of NTBFs.

By considering the critical success factors and changing needs, we develop a more comprehensive model of the incubation process (figure 2). The idea is that the support provided by TBIs should be 'flexible' and 'comprehensive' because the dynamism and uncertainty of the needs of high tech startups. Having a thorough review of literature and website, however, we find out that there are no flexible and comprehensive factors in TBIs' services. Most TBIs start with the real estate facilities, and equip them with some sharing administrative machine. Entrepreneurial courses are held to fill the lack of entrepreneurial skills of NTBFs depending on the available resources of TBIs. Some supports such as financing the project, legal or business consultancy and making network are offered to help NTBFs.

The concept that we develop here, is a 'custom-made' support which is provided depending on the needs of NTBFs. This kind of support is believed to be more effective to overcome the problems faced by NTBFs, and efficient, saving the resources of TBIs. Instead of using a linear phase of incubation process, we also believe that the difference of each stage is not clear. In some cases, it needs to have a strategy evaluation or assessment. The needs such as entrepreneurial personality and lack of marketing strategy, are embedded in the whole process of incubation. With this reason we introduce a feedback concept in the incubation process. The process of incubation is not linear but cyclic. The best approach for this process is the support, which is flexible but still comprehensive to deal with the uncertainty and complexity of the high-tech startups needs (custom made support).

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This part will explain the further research that I will conduct.

1. Research objective

This research project aims to find the best strategy in helping new technology-based firm to survive in their development path.

2. Research question

In details, our research aim will be decomposed into four research questions, which are:

1. What are the types of the obstacle that influence the growth of new technology-based firms? In which stage of the firm's development do the obstacle appear? And what factors cause the obstacle?
2. Are the obstacles related with firms' innovation capacity?
3. What strategies of technology incubators are effective in supporting new technology-based firms to overcome their obstacle?
4. In applying those strategies, what management model of technology incubators is appropriate? What requirements are needed for those strategies?

3. Research design

Our overall research design will be decomposed into several phases in combination with literature research, field research, survey and gathering information from expert.

Phase 1: Preparation

To get more understanding on the content of the research project, the first task to do is reviewing a number of literatures about entrepreneurship and small business management and specifically related to technology incubators and their obstacles. Some studies of literature about the management and organization theory in relation to the resource dependence theory and network theory will be examined. A study about several social science research techniques also takes place in this phase. An emphasis will be given to the analysis methods of some case studies (meta-analysis and rough set theory). Furthermore, we will develop a definition about technology incubator and incubation process. Finally we will explore a causal relationship that underlies their obstacles.

Phase 2: Overview

At this stage we will conduct a meta-analysis study on the characteristics and performance of technology incubators. The aim of this analysis is to describe and explore the differences in the performance of technology incubators. Besides enhancing our understanding about the current model of incubation and their performance, the result of the analysis may also be used as a foundation of a case study selection. At this phase, based on the explanatory literature review, the meta-analysis result, and the study on the critical juncture of the firm's development, we will develop several hypotheses regarding the support from technology incubators and the obstacles.

Phase 3: Case Studies (international comparison)

The third phase is set up as a field research and survey. The purpose of this phase is to get reliable data to test our conceptual framework of the incubation process in many circumstances on the other side of the world. We try to study the factors that become more important to overcome the obstacles or the characteristics of the technology incubators' condition that will boost this process.

We are going to use the case study research methods. The case studies are especially appropriate to get in-depth knowledge about “why” and “how” questions. Our research technique will be a combination of in-depth interviews and surveys. Some statistical or other methods will be used to analyze the data collected through this phase.

Phase 4: Designing Rules

In this phase, we will have a revision of the conceptual framework of managing a technology incubator. We will show the findings of our result to the experts, and ask their opinion. By maximizing the knowledge from the experts, hopefully it will increase the quality of our conceptual framework of incubation process. If needed, one or two case studies can be used to test our final framework in order to have a robust model of the incubation process.

Phase 5: Conclusion

The final phase of our research project is writing a dissertation. The flow of our research plan can be seen on figure 4.

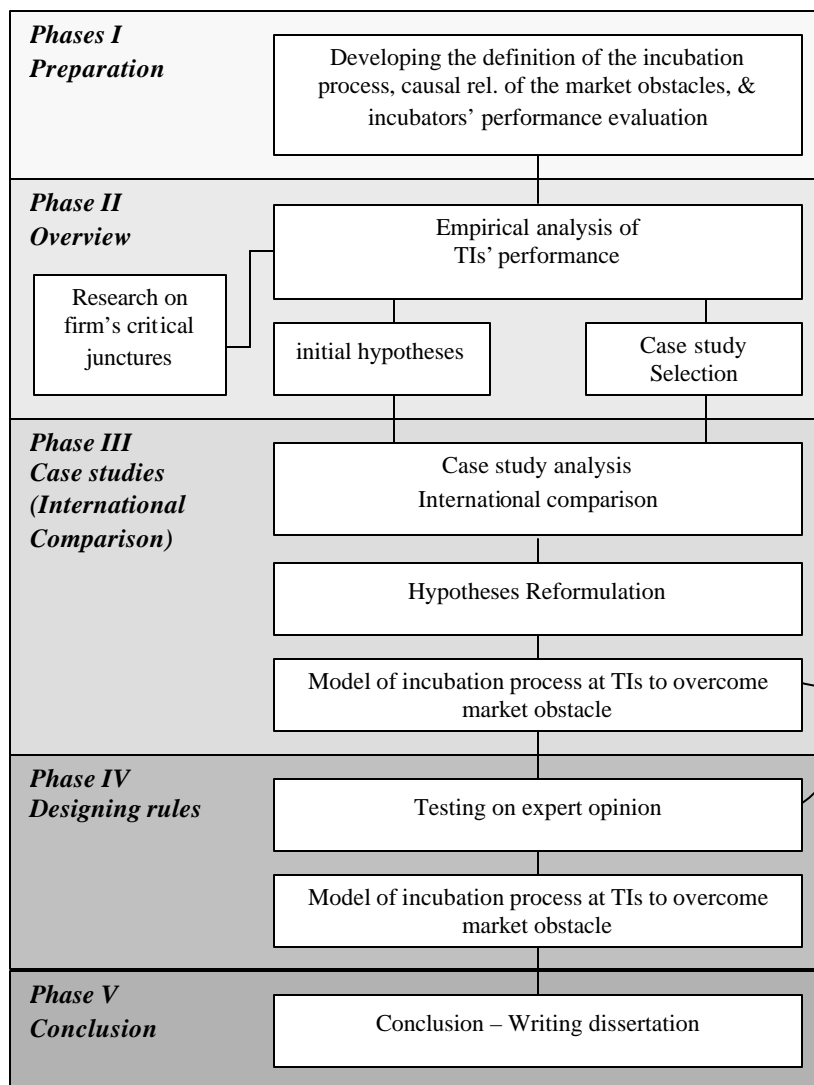


Figure 4. The flow of research project