Does Culture Affect the Effort to Endorse Technological Entrepreneurship?

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ABSTRACT

It is well-know in the literature, that culture may explain why some countries are more open to new things and innovate faster than others, or why some countries are more entrepreneurial than others. In the case of endorsing technological entrepreneurship, it is interesting to know whether culture also plays a role. One of the popular policies in endorsing the technological entrepreneurship is establishing a technology incubator. However, studies on culture or other factors that contribute to the incubator growth are relatively scare. In reality, factors such as culture and regional condition seem to be important and should not be neglected by policy makers. For this reason, I would like to explore these factors of how they support and inhibit the growth of technology incubators. Using the Hofstede's cultural framework, this study tries to assess the role of culture in the growth of incubators. This study also uses regional factors such as regional condition and stakeholders' involvement as a predictor of the incubator growth. As a sample, 31 case studies on the incubator are included in this study. Considering the small number of sample in this study, Rough set theory is applied as it is capable of transforming a collection of meta-data into structured knowledge. The result confirms the hypotheses that all the factors (culture, economic condition, and stakeholder support) contribute to the growth of the incubators. Therefore, it is important for policy makers to consider their regional condition before establishing an incubator

Key words: Entrepreneurship, Incubator, Culture

INTRODUCTION

Culture is something that is inherited from the mind of people and is influenced directly and indirectly by society (Hofstede, 1991). It explains why people in some countries differ from other people in other countries in several aspects. Many researchers have used culture to explain about a new phenomenon in economy, namely entrepreneurship. This aspect may explain why some countries are more open to new things and innovate faster than others, or why some countries are more entrepreneurial than others. It also clarifies why people in some countries dare to open or invest on a new business, whereas in other countries people prefer to stay on their job and feel safe by keeping their money in the bank.

In recent years, research on entrepreneurial culture has been flourishing. There are two main streams of study about entrepreneurship. The first stream focuses on the characteristics of entrepreneurs called the trait approach. The second focuses on the influence of social, political, and economic contextual factors and is called the environment approach. Both approaches mention culture as an important factor of entrepreneurship.

Entrepreneurship has developed and evolved from traditional entrepreneurship (e.g., buying and selling activities) into technological entrepreneurship (based on research and development). In addition, policy makers now believe that sustainable growth can be effectively achieved by enhancing the innovation capacity and bringing new technology to market. This goes to the emergence of a new type of entrepreneurs, namely technology entrepreneurs. They are the people who start their own business based on the development of specific high technology. Although they face more risk than traditional entrepreneurs, many evidence show that they can generate more jobs and grow faster. However, study on the technology entrepreneurs is still underway and there are many things to be explored. One of them is the influence of culture. While many researches have proved that culture influences traditional entrepreneurship, it is interesting to know whether this factor would also influence technological entrepreneurs. It is challenging to find out whether the countries with a strong root of entrepreneurial culture and are successful in developing traditional entrepreneurship will also succeed in developing technological entrepreneurship.

This question is relevant not only to academicians but also policy makers since many efforts have been done to accelerate the growth of technological entrepreneurs. One of the effective policies is establishing technology incubators. Therefore, in this study, the assessment on the effort to support technological entrepreneurship is measured by the performance of incubators. Incubators are a means of bringing research products from universities or research centers to market by providing a qualified environment for new technology-based firms to grow. In this study, the exploration of culture is merged with that of other factors, e.g., local economic condition surrounding the incubators and involvement of actors other than the local initiator. The reason for the combination is to study the role of culture in factual situation, for example, regions with high entrepreneurial culture but located in a peripheral area, does this composition support the development of new technology business? The involvement of other actors means that incubators receive support from them. The more actors involved, the more support can be provided by incubators. I hope by achieving this, some policy lessons can be learnt in order to copy the development of incubators.

In order to simplify the context and make it more readable, I present the paper in the following structure. First I explain briefly about the incubation concept. It is followed by the explanation of hypotheses that I use in this study and continue with the description of the research framework. In this section, I explain briefly about the rough set theory that I used as a Meta analysis tool in studying the contribution of some factors to the incubator growth. Next, the discussion follows together with the empirical findings and is ended with some policy recommendations.

THE INCUBATION PROCESS

Originally, the concept of incubators emerges as a tool to foster new technology business development. It can be achieved by merging it with the concepts of research commercialization from university (Phillips, 2002). Therefore some of them have a direct association with universities (Vedovello, 1997, Phillimore, 1999). Their association can be determined by their location or informal relation such as consultation with university staff, using university library or laboratories. Starting as a university incubator and located inside university property, soon incubators turned into a policy tool used in enhancing regional economic development. Driven by the desire of states or regional governments to encourage technology-based business in their areas, incubators have expanded their objective not only to commercialize university research but also act as a catalyst for the emergence of new

businesses. Thus, incubators become more attractive for firms outside region to join. Consequently, the number of actors involved in the policy also arises, from private business, business association, government to financial institution. Each of them has a potentially different interest on the growth of new technology firms. Accordingly, it is difficult to find a single definition that covers all kinds of incubators.

Despite the diverse characteristics of incubators, we may find several similarities. First, the main objective of every incubator is to support start-ups to survive and become independent. Sharing office or laboratories facilities, financial support and business mentoring are among the facilities offered by incubators to ensure the life of new start-ups. Second, as a policy instrument to the transfer and commercialization of technology, incubators have a link with universities or research centers. Research products from universities and research centers perform as a pool for new business ideas. Besides, universities and research centers have resources such as academics, libraries and laboratories that can support product development of new technology-based firms.

Last, it is universally accepted that incubators can be seen as an intermediate firm that performs a bridging function between promising start ups and resources required in their developmental stages while protecting them from any potential failure (Hackett and Dilts, 2004). Incubators may also act as a link between start-ups and other stakeholders that provide resources, such as governments, financial institutions, and business networks. In many ways, incubators perform as a mechanism of technology transfer while encouraging the development of small businesses. Based on the similarities above, I conceptualize the process of incubation as shown in Figure 1.

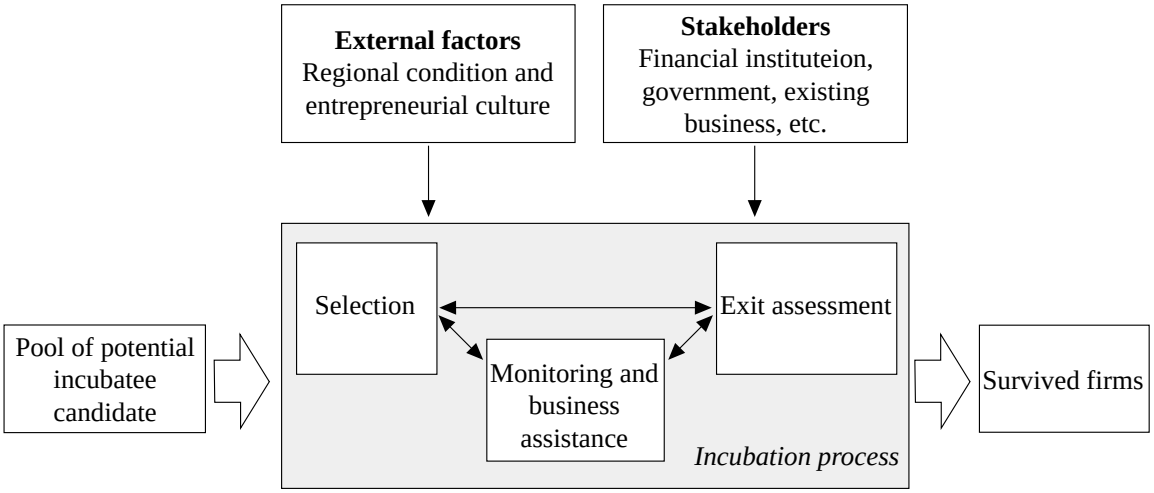

Figure 1. Simplified model of the incubation process and factors related.

I conceive the incubation process in a simplified way as a linear transformation of candidate start-ups to firms that have survived the early years. The model above indicates that the incubation process can be seen as a function of several factors, external and internal. The external factors include regional conditions and culture. Support from other stakeholders such as government, financial institution, existing business is believed to be able to enhance the growth of incubators. The relation with universities and research centers, as the main resources of knowledge and technology, also plays an important role in supporting the growth of incubators. The internal factors, on the other hand, are related with the capacity of incubator organizations themselves in managing their resources to support start-ups, including the

application of particular selection criteria, capacities in monitoring and business coaching, and exit assessment. Although incubators may have different objectives and strategies, all are engaged with this process.

In this study, I limit the exploration in the role of the external factors that is culture, regional economy and involvement of stakeholders in determining the growth of the incubators. In addition, I rather see the process inside the incubators like a 'black box'. However, it does not mean the internal capabilities such as incubator management team, network and type of support are not important in reading the growth of the incubators.

The reason to eliminate these components is based on the previous research that values of the process inside incubators are continually debated (Peters et al., 2004). For instance, studies have found higher survivals and success rates among graduates of business incubators (Allen, 1985; Campbell et al., 1988). Allen and Kahman (1985) in the studies of 12 incubators found that the entrepreneurs in this study overwhelmingly (87%) said they would have started their businesses without the incubators. Colombo (2002), when studying 43 Italian new technology-based firms, finds that innovative activities are only slightly different between on- and off- incubation firms. However, based on their same objective, we can label the process inside incubators as an entity, which aims to produce survived firms from potential entrepreneurs.

THEORY AND HYPOTHESES DEVELOPMENT

Entrepreneurial culture

Many researchers have tried to describe what an entrepreneur is. One of the earliest effort is from Schumpeter who defines entrepreneurs as an individuals who attempts to ". . .reform or revolutionize the pattern of production by exploiting and inventing. . ." (Schumpeter 1934). Many definitions and researches come after it to try to explain the characteristics of entrepreneurs. For instance Bygrave and Hofer (1991) define entrepreneurs as ". . .someone who perceives an opportunity and creates an organization to pursue it" (Bygrave and Hover, 1991). Furthermore, McClelland (1961) explains in more detail the characteristics of entrepreneurs as a high need of achievement, moderate risk-taking propensity, energetic, dare to face failure and success. Other personal attributes mentioned in several researches are high self-confidence, need for control, independence, and full initiative. According to Erez and Early (1993), personal values are forces to control and direct personal attributes. There are many definitions and explanations of entrepreneurs based on the personal characteristics but the consensus is not clear. Despite it, there is a universally accepted similarity, that an entrepreneur is defined as a self-motivated individual that is not afraid of taking initiatives to start an enterprise. It takes us to a question whether this characteristic is related to culture.

In the case of entrepreneurial growth, many researchers reveal the fact that entrepreneurial culture is closely related and can explain the differences on entrepreneurial growth across countries. Culture is an underlying system of value peculiar to a specific group or society that shapes the development of certain personal traits and motive. It supports the Hofstede's ideas (1991) that values like this can be 'programmed' into personal mind since early in life. Culture is a reflection of complex interaction of values, attitudes and behavior that are displayed on the activities of society, including economic activities.

In this research, I would like to examine whether the previous findings are also applicable for technological entrepreneurship. Does culture also influence the tendency of people

to be an entrepreneur, particularly technological entrepreneur? Some argue that technological entrepreneurs are quite different from traditional entrepreneurs. Their personal qualities and educational background may influence their decision to start up their own business. Compared with the challenges faced by traditional business, there are some challenges that may hinder people to be technological entrepreneurs such as huge investment, high risk and uncertainty.

The hypotheses will be based on the Hofstede's cultural framework. He constructs four distinct dimensions of culture as an underlying framework to identify differences in cultural pattern. Although Hosftede does not specify the relation of his works with entrepreneurship, his framework is useful in identifying the elements of culture, which is related with entrepreneurship. These dimensions are:

Power Distance (PDI):	The distance between individual at hierarchy
Uncertainty Avoidance (UAI) :	The need to avoid the uncertainty about the future
Individualism v.s. Collectivism (IDN):	The relation between the individual and his/her fellows
Masculinity v.s. Femininity (MAS):	A division of roles and values in society

According to Hofstede (1991), societies with a high score on individualism and on power dimension have higher economy growth and are not resistant to new things. In this particular society, there is a tendency to innovate. In their research, Thomas and Muller (2000) find that in collective society, people are more likely to identify within the group and diminish their degree of control that they feel over their environment. This action alludes to entrepreneurial spirit. In individualist society, competition is acceptable and people work hard to achieve their ambition. However, in collective society, people tend to cooperate and are afraid that their action will harm others. Therefore, entrepreneurial activities grow flourishingly in individualist society. Moreover, a combination of weak uncertainty avoidance, individualism and low power dimension would encourage pro-innovative culture and entrepreneurship. Unlike individualism, masculinity is unrelated to a country's degree of economic development but still questionable with entrepreneurship intention among people. Masculinity pertains to societies in which social gender role is clearly distinct. Femininity pertains to societies in which social gender roles is overlap on another. Masculine society has values such as assertive, ambitious and tough. It seems that these values endorse entrepreneurship, since business competition is always tough and only an ambitious people seem to be successful. Based on the explanation above, the hypotheses will include all of the Hofstede' s culture dimensions and formulize them as follows:

> T*echnology incubators that are located in Individualistic, high power distance, low uncertainty avoidance and masculine are likely to have a better growth, compared with incubators located in feminist, collective societies with low power distance and high uncertainty avoidance culture.*

Regional economic condition

Regional scientists and geographers are keenly interested in how and why enterprises cluster in a certain geographical space, and particularly how such a clustering influences the regional development path. There are two conceptual approaches that dominate the literature used to understand the benefits to the concentration. First is the industrial location theory in which the benefits are called the agglomeration economies. Second is the Marshallian perspective (1920) that takes as its point of departure, Marshall's analysis of the external

scale economies and their presence in "industrial districts." This study is emphasized by Porter (1990). Porter's readable account of the sources of national competitive advantage, which includes a key role for geographic proximity, is largely consistent with a growing body of literature on how the interdependence between firms, existing industries and public institutions affects the innovation and growth in the regional agglomerations.

Based on this theory, I assume that the location and the economic condition surrounding incubators play an important role in determining the performance. Incubators located in the area which is relatively new with no adequate infrastructure and remote from other industrial clusters are certainly slow in their development. On the contrary, it is believed that incubators located in the middle of industrial clusters possess a competitive advantage. This area is more attractive for new firms and venture capitals. I therefore propose the following hypothesis:

Technology incubators located in attractive regions are likely to have better growth compared with incubators located in less attractive regions.

Stakeholder's involvement

Some incubators originate from local initiatives such as from a university or research center. These incubators grow and survive without the involvement of other stakeholders. However, Monck et al. (1988) argue that in order to grow, incubators need support from other stakeholders. There are four potential stakeholders to be involved in the incubation process: (1) universities, (2) local authorities, (3) government development agencies and (4) private sector institutions. All these stakeholders offer different resources to support the growth of new firms. I assume that the number of stakeholders affects the incubator growth. I therefore propose the following hypothesis:

Technology incubators, which have different stakeholders involved in their process, are likely to have a better performance compared with incubators which have one single stakeholder involved.

To conclude the hypotheses, figure 2 shows the causal model of the differences in the incubator growth.

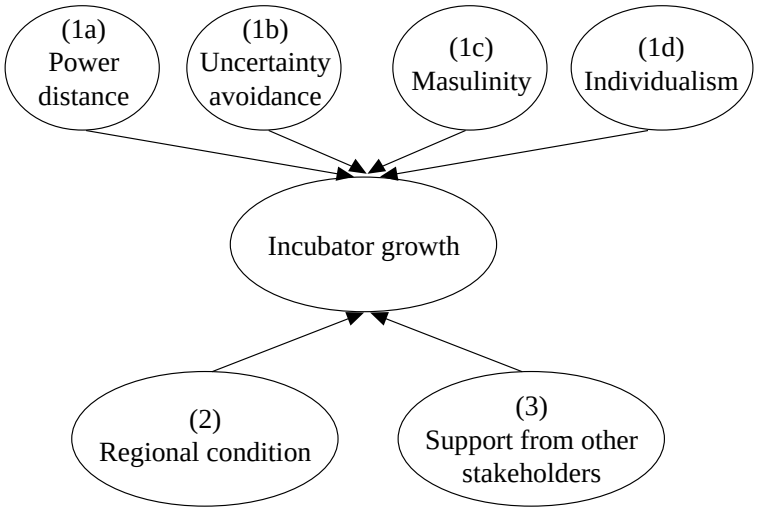

Figure 2. The determinant factors of incubator growth.

RESEARCH FRAMEWORK

The main feature of this study is capturing the role of some factors decomposed into several different sub-factors as the main predictors of the growth of some technology incubators. By using secondary data collected through several resources, I will conduct a Meta analysis study. This method is used to compare the results from different investigations and originally applied to process the quantitative information. However, recently several scientific contributions of social science, which is qualitative in nature, have made use of the application of the Meta analysis. Some studies have proved to be successful in using this method, among which are the studies in sustainable development (Nijkamp et al., 2002), and fiscal policies (Nijkamp and Poot, 2002).

However, to conduct a Meta analysis study with qualitative information, we need an alternative tool that is the rough set (Pawlak, 1982). With the help of this approach, it is possible to transform a collection of data, both quantitative and qualitative, into structured knowledge. Besides, the rough set is a non-parametric statistical set, which is also able to deal with small samples. The brief concept of the rough set will be explained in the next section.

I conducted a literature study to select some case studies about the incubator growth. The data were collected from journals, proceedings, annual reports, incubator websites, and other literature resources. In a refinement of the selection, the following requirements were used:

- The incubators have particular characteristics in one or more of the previously discussed determinant factors of the incubator growth. The composition of six determinant factors in such a way is present in proportion and no one factor is dominant in the total sample of incubators.
- The incubators have support from more than one source of literature and are presented in scientific and objective ways. By doing this, I ensure that every single data of incubators has a reference of comparison to increase the accuracy and validity

Another problem with the validity of data is the different period of studies by researchers. To avoid the bias of changes in macro economic factors, I collected data on incubators from 1998 to 2004. I also encountered a problem of the scarcity of empirical studies about less successful incubators, since most researchers tend to publish reports on success stories of incubators. Annual reports produced by incubators tend to mention successful incubates and failed incubates are not mentioned. Besides, studies on the incubator growth are often based on reports and comments from incubator managers who are potentially biased because of the self-reported nature.

The problems could not be solved directly, since this study is based on the secondary data. As a solution, I decided to use an indicator that assesses the ability of the incubators to grow. It is measured by the number of new firms entering the incubation process per year. As a result, 31 incubators from 23 countries are selected (see the appendix). In the next section, I will explain briefly about the rough set.

Introduction to rough set

In a rough set analysis, data are presented in an information table. Objects arranged in the information table are based on their condition attributes (C) and decision attribute (D). In our study, the condition attributes (C) are the determinant factors of the incubator growth as formulated in the hypotheses whereas, the decision attribute (D) is the incubator growth.

The concept of indiscernibility is fundamental to the rough set theory. Two objects in a decision table are indiscernible if they cannot be distinguished on the basis of a given set of attributes. Cases or objects that can be clearly distinguished in terms of the condition attributes are defined as belonging to a specific concept. The rough sets divide the sets of cases or objects in the information table into a number of equivalence classes.

In this study, cases or objects are all information about the incubators. The information includes the factors that may influence the performance and the indicator of the incubator growth. In this study, the incubator growth is categorized into three levels of growth, slow, medium and fast. Literally, it is very difficult to find some specific factors that influence the incubator growth on each level. It is because they may be overlapping in their nature. For instance, incubators, which receive strong support from many stakeholders, may fall into the level of slow and medium growth performance and fast growth as well. Therefore, the pattern of factors that contributes to the incubator growth can only be roughly defined. We can approximate them from:

- The lower approximation, defined as the collection of cases whose equivalence classes are fully contained in the sets of approximate cases.
- The upper approximation, defined as the collection of cases whose equivalence classes are at least partially contained in the set of approximate cases.

The upper approximation will always include the lower approximation.

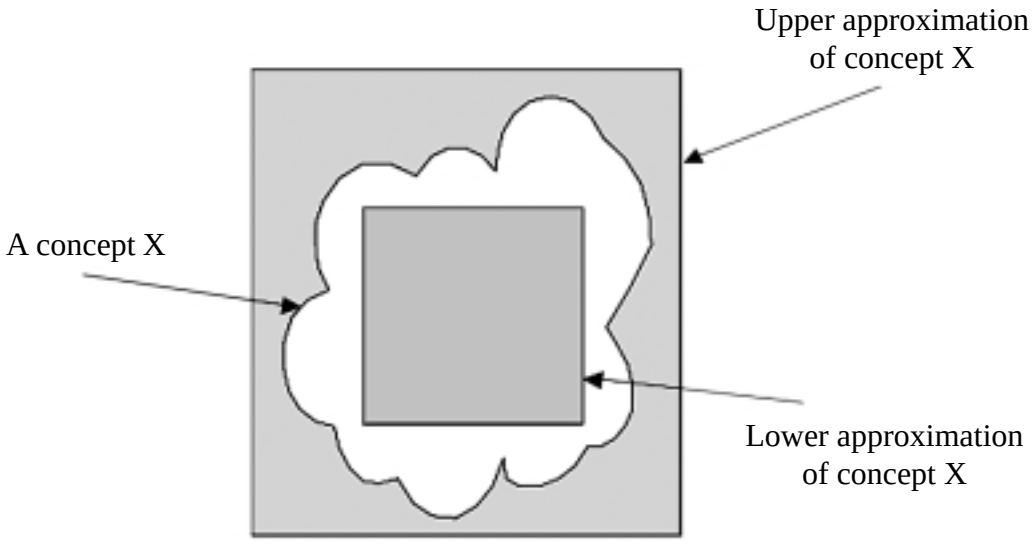

Figure 3. Rough set approximation.

In the rough set, the process of finding a smaller set of attributes with the same or close classificatory power as the original set is called *attribute reduction*. Through this process, redundant attributes, called superfluous attributes are removed without losing the classification powers of a reduced information table. The result of this process produces *reduct* and *core*.

A *reduct* is an essential part of the information table (related to a subset of attributes), which can discern all objects discernible by the original information table. As an illustration, in this study the *reducts* are all combinations of factors that can completely determine (or explain) the variation in the incubator growth, without needing other explanatory variables. It is possible that the rough set produces several reducts, which are composed of different

combination of factors. A *core* is a common part (intersection) of all reducts. The *core* is a set of variables that are in all *reducts*. Without these factors, it is impossible to classify the results of the performance of the incubators studies according to the considered categories.

After employing the attribute reduction process, the rough set will construct the most important applications of the rough set, which is the generation of decision rules. The rules could be found by determining the decision attributes value based on the condition attributes values. The rules are presented in an "IF condition(s) THEN decision(s)" format. If the condition(s) in the IF part matches with the given fact(s), the decision(s) in the THEN part will be performed. Accordingly, the contribution of factors to the incubator growth will be discovered by studying the rules.

Findings

In this research, the analysis was conducted using ROSE2 software. ROSE2 is a modular system implementing the basic elements of the rough set theory and the rules (Predki and Wilk, 1999). By applying the rough set step-wise procedure, I present the outputs as reducts, core and decision table.

***Reducts* and Cores**

Table 1 shows the *reducts* created from the information tables. There appears to be only one competitive *reduct* to explain the variance in the estimated performance of the incubators. The *core* consists of all the factors. This means that all of the factors are important to define the variety of the incubator growth. The total accuracy of the classification is 0.7152. The values are quite high meaning that the study, based on the chosen determinant factors, is discernible regarding the three classes of the performance.

Table 1. Reducts and Core.

Reduct	1: {PDI, UAI, IDN, MAS, regional economy, involvement from other actors}
Core	PDI - Power distance index UAI - Uncertainty avoidance index IDN - Individualism index MAS - Masculinity index Regional economy Involvement from other actors
Accuracy of classification for all attribute :	0.7152
Accuracy of classification for core attribute	0.7152

Further, the analysis produces a decision table. It is noticeable that not all decision rules are equally important for this analysis. To test the significance of the rules, I use the strength of the rules as a means of simplifying the decision table.

Table 2. Decision rules

Rule	IF	THEN	Strength (%)
1	(Power distance = 1) and (individualism = 3)	Slow	28.57
2	(masculine = 1) and (Economic condition = 1) and (Support from stakeholder = 1)	Slow	14.29
3	(Uncertainty avoidance = 3) and (masculine = 2) and (Support from stakeholder = 2)	Slow	14.29
4	(Uncertainty avoidance = 1) and (Support from stakeholder = 1)	Medium	18.75
5	(Power distance = 1) and (individualism = 2)	Medium	6.25
6	(masculine = 3) and (Economic condition = 1) and (Support from stakeholder = 1)	Medium	25
7	(Uncertainty avoidance = 2) and (masculine = 1) and (Economic condition = 2)	Medium	6.25
8	(Power distance = 2) and (Uncertainty avoidance = 3)	Medium	6.25
9	(masculine = 3) and (Economic condition = 2) and (Support from stakeholder = 1)	Fast	30
10	(Power distance = 3) and (individualism = 2)	Fast	10
11	(Uncertainty avoidance = 2) and (Support from stakeholder = 2)	Fast	10

Note : The strength of the rules is related with a number of cases that supported by the rule

As shown in the beginning that all of the factors are included in the core, these factors also appear in the decision rules and play as a predictor of the incubator growth. From Table 2, we can see that the fast performance incubators are in line with the higher power distance and lower individualism. Another finding is the location factors. The incubators that are located in the economically attractive regions seem to grow faster compared with those located in the less attractive regions. Moreover, if we take a deeper look into the rules that have the strongest support in each performance, we will find that the incubators which receive the strong support from other stakeholders grow faster compared with those that are receive only small support from other stakeholders. This type of incubator usually starts their initiative locally, from university or research center without support from other actors. These findings prove that the combination of some factors influence the incubator growth.

DISCUSSION

In this paper I have explored the factors that influence the performance of the incubation policy. More specifically, I have addressed the influence of culture in determining the performance of some incubators. In particular, I have attempted to increase the understanding on the diversity of the incubator growth by combining culture with other regional factors and incubators' capacity. The more precise we know about the factors contributing to the

incubators' success, the more relevant the incubator policy can be applied.

In the empirical part of the study, I made use of the data from several incubators in the world to study the role of some factors. The application of the rough sets method, has derived several rules in determining the incubator growth. By studying the rules, it proves that some hypothesized factors play a role in determining the incubator growth.

The rules created by the rough set show that the incubators located in the country which has an individualistic characteristic and high power distance show a better performance compared with those located in a feministic and low power distance country. This evidence supports the findings from the previous research that these two factors contribute to the development of entrepreneurship. However, the findings fail to confirm the role of uncertainty avoidance and masculinity in determining the performance of incubators. On the contrary, the rules reveal that the incubators located in the feminine country show fast growth. The same case goes with uncertainty avoidance.

The findings show that besides culture, the location is important for the growth of the technological entrepreneurs. The regions located in the well-structured area and attractive for business are fertile environment for the development of the incubators. The incubators in some countries are part of the government's project and therefore they receive some additional support. The findings also confirm that the support significantly influence the performance of the incubators.

In conclusion, the paper has proved that entrepreneurial culture is also important for the development of technological entrepreneurs. The role of culture in traditional entrepreneurship is absolutely applicable for technological entrepreneurship. Contrary to other researches which only focus on culture, in this research I introduce other factors (regional economy and involvement of other actors) and study their contribution. The findings show that these two factors are important and in combination with entrepreneurial culture, they will endorse the development of technological entrepreneurs. The findings could also be read that culture is indeed important but it does not work alone. There are other factors that also contribute to the growth of technological entrepreneurs. Altogether, this result should be seen as a stepping-stone for analyzing the capability of several countries in catching up their growth especially in technology development.

This study can be extended for further research to include other important factors that could enhance the understanding of any relationship between the incubator growth and its determinant factors. By testing other determinant factors based on some specific theories and applying the same procedure, we can test whether the empirical evidence corresponds with the prediction from the theories.

Appendix

List of incubator used in this study	
Surrey, United Kingdom	Budapest, Hungary
Cleveland, Ohio, United States	Baia Mare, Romania
Leuven, Belgium	Fortaleza, Brazil
Chemnitz, Germany	St. Petersburg, Russia
Austin, United States	Shanghai, China
Munchen, Germany	Singapore
Enschede, The Netherlands	Crete, Greek
Arhus, Denmark	Hong Kong, China
Lisbon, Portugal	Queensland, Australia
Cambridge, United Kingdom	Xian, China
Zurich, Swiss	Tartu, Estonia
Skone, Sweden	New Delhi, India
Georgia, United States	Hsinchu, Taiwan
Delft, The Netherlands	Taejon, South Korea
Salzburg, Austria	Haifa, Israel
Kouvola, Finland	

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