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Master's Thesis

THE IMPACT OF NATIONAL INNOVATION SYSTEM ON ENTREPRENEURIAL VENTURE CREATION PROCESS

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ABSTRACT

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The important role of entrepreneurship in countries' economic development and overall society well-being is widely recognized by researchers, experts as well as policy makers. Every phase of the process of starting a new business is related to the interaction with at least one player of country innovation system and therefore the efficiency of this interaction may have an influence on the success of whole entrepreneurial process and consequently on the willingness of potential entrepreneurs to engage into this process.

The study proposes a System Dynamics model for studying the impact of National Innovation System (NIS) on the entrepreneurial venture creation process. The developed model also takes country population aspect into account and provides results for estimation the effect various demographic tendencies on the process performance.

The special impact is made on possible ways to facilitate the development of entrepreneurial framework conditions. Business incubators are seen as one of the effective tool for accomplishing such task. The study also provides the result for estimation of possible impact arising from properly functioned Business Incubators.

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Lappeenrnta, May 2013

Roman Teplov

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LIST OF SYMBOLS

MPE mean percentage error

n amount of observations;

X_i actual observation during time period i;

F_i forecast during time period i.

LIST OF ABBREVIATIONS

BI Business Incubator

GEM Global Entrepreneurship Monitor

GCI Global competitiveness Index

NIS National Innovation System

1 INTRODUCTION

The following chapter is the introduction to the Mastrer's Thesis project " The Impact of National Innovation System on Entrepreneurial Venture Creation Process". First, the general background of study and the problems are explained, then, actual research questions are stated, research design and applied methodology are described and further paper structure is presented.

1.1 Background of the study

The important role of entrepreneurship in countries' economic development and overall society well-being is widely recognized by researchers, experts as well as policy makers (Gilbert et al., 2004; Bosma et al. 2012). Entrepreneurial ventures are considered not only as remarkable sources of new workplaces (White and Reynolds, 1996; Morrison et al., 2003) but also as powerful generators for innovations (Acs and Varga, 2004). Taking into account such facts there are no doubts why the studying of entrepreneurship and particularly the process of new ventures initiation has achieved sufficient attention in recent decades.

Many researchers investigating the entrepreneurship phenomena focus more on individual's aspirations and perceptions, in other words, what leads person to establish its own company, how can such factors as personal attitudes, psychological characteristics facilitate this process (see for example van Gelderen et al., 2006; Townshed et al., 2010; Ferreira et al., 2012). At the same time, the role of external factors, directly connected with country National Innovation System (NIS) performance should not be neglected. Every phase of the process of starting a new business is related to interaction with at least one player of NIS and therefore the efficiency of this interaction may have an influence on the success of the whole entrepreneurial process. Consequently, in certain circumstances imperfect environmental conditions may prevent individuals from launching ventures even if their intention towards entrepreneurship is high (Bruton, et al., 2010; Misra et al., 2012).

Business incubators (BI) are one of recognized tools for facilitating entrepreneurial process (Löfsten and Lindelöf, 2002; Bruneel, et al., 2012). After the downturn in the beginning of the century caused by dot-com bubble burst the amount of BIs has started growing again (Dunaj, 2013). Though BIs may not improve the general performance of NIS in the country-wide scale, depending on their model, they can offer numerous supporting services as well as provide necessary infrastructure, trainings, enhance networking or ensure access to the finances (Dunaj, 2013). That allows us consider BIs as one of possible solution for improving local entrepreneurial environment.

Interestingly also, that, though, in theory, people of almost any ages can become entrepreneurs, researches reveal that such activities are most common for two age groups: 25-34 and 35-44 years (Bosma et al. 2012). Various explanations for such behavior can be considered (Shane, 2003, 89-91; Bosma et al. 2012), but coupling with current country demographic situation this may lead to certain problems in the near future. Thus, general trend of population ageing common for many developed countries may seriously diminish the pool of potential entrepreneurs.

In spite of significant amount entrepreneurship literature researchers seem to be more focused on identification impact factors rather than developing actual model of the venture creation process (Gries and Naude, 2009). In the beginning of the century, Shane and Venkataraman (2000) noticed the absence of solid framework which can be suggested as a tool for explaining the entrepreneurship phenomena. Nowadays, the situation with entrepreneurial models is still far from the ideal (Moroz and Hindle, 2012).

Additional set of problems arises from methods applied. Though traditionally used statistical and econometric approaches do have certain applicability they often unable to capture the behavior of complex non-linear system (Lyneis, 2000). That is why Shook et al. (2003) suggested application of additional, particularly simulation, methods to study the entrepreneurial process.

Taking into account above mentioned considerations a system dynamics simulation study is proposed to shed more light and increase understandings of processes relating to emergence of new firms within NIS. The study will examine

the possible impact of NIS in different demographical situation as well as under various economic circumstances (particularly in the situation of economic downturn). The role of BIs in the improving the local NIS performance is also estimated.

1.2 Research problem, objectives and limitations

The objective of the study is to examine the role played by the NIS-related factors in the entrepreneurial venture creation process. Therefore the main research question can be stated as:

How does NIS influence the success of entrepreneurial process?

Since the overall impact of NIS can be considered as a very complex and all-inclusive (taking into account that this system comprises all actors directly or indirectly connected with entrepreneurial process and actual firm formation as well as innovation creation), we are going to limit the scope of the study by observing two specific situations: (1) population ageing and (2) sudden decrease of NIS performance coupled with significantly enhanced intentions towards entrepreneurship. In other words we are particularly interested in such circumstances where high attitudes towards entrepreneurship might be not enough for proper process function. We are also going to explore the possible degree of impact on the venture creation success provided by entrepreneurial intentions versus entrepreneurial framework conditions. These objectives correspond to first and second research sub-questions consequently.

1) To what extent NIS can compensate the population ageing tendency and consequently possible decrease of potential entrepreneurs pool?

In order to find out the answer on this questions was conducted a comparison of Finland and Russia regions. The rationale was to examine different states of NIS development under opposite demographic tendencies, particularly high-performance Finnish NIS in situation with ageing population and oppositely underdeveloped Russian NIS coupled with growing amount of potential entrepreneurs.

2) What is the maximum possible impact of NIS factors on the entrepreneurial venture creation process success in comparison with the impact of attitudes towards entrepreneurship?

We explored second sub-question by conducting a sensitivity analysis (Monte Carlo simulation) where we allowed NIS-factors as well as an indicator representing entrepreneurial attitudes to change from minimum values to maximum.

3) How does poorly functioning NIS deal with increased potential entrepreneurs supply?

This question can be considered as a further extension of sub-question 2 with emphasis towards real-life situations. Was developed and run the scenario where the sudden increase of entrepreneur supply was combined with respective deterioration of NIS performance. Such changes may appear e.g. during economic crisis when the amount of potential entrepreneurs grows, partly due to increased supply of necessity-driven entrepreneurs (Bosma et al., 2012), whereas tough economic state leads to erosion of factors determining framework conditions.

After estimating the NIS behavior in such conditions the next logical step was to explore arrangements for improving its performance and overcome possible negative consequences. The specific emphasis in the work is placed to the role of BIs. That corresponds to the objectives of the OpenINNO ENPI project, part of which the current study appears. Therefore, in order to clarify the possible impact of BIs additional sub-questions were introduced:

4) By improving which factors of entrepreneurial framework conditions BIs can facilitate the entrepreneurial process?

On the basis of literature analysis and survey results we detected certain aspects of entrepreneurial framework conditions which can be improved by properly functioned BIs. Second task is to evaluate with the use of developed system dynamics model the possible impact which improvements in these factors may provide to the overall process performance. That corresponds to fifth sub-question:

5) To what extent BIs can support the success of new ventures creation?

The several limitation of the study should be accounted. First, though the model implies some factors representing performance of NIS, the aim of the study was to create the model of entrepreneurial process, but not the entire NIS. Therefore some relationships between NIS elements may not be properly captured. That adds certain bias in long-term scenarios forecasting, whereas should not affect current state countries comparison since the implied indicators (GEM, GCI) already represent the exact NIS performance caused also by relationships between NIS actors.

Additionally, since the study is theory-building by its nature, the developed model demands further validation (the conducted comparison with actual Finnish statistical data suggests in favor of the model validity, though). Moreover, since the system dynamic model always assumes certain degree of simplification, according to Sterman (2000) the complete validation is theoretically impossible. This statement, though does not mean that the model accuracy should not be assessed and if necessary improved.

Small sample size in the complementary survey also might be regarded as a limitation. Nevertheless, achieved results allows to test model and accounted lack of representativeness in the results can be improved in future by conducting more extensive survey. Therefore, the mentioned limitations should be considered as directions for further research rather than the actual drawbacks of the study.

1.3 Research design and methodology

According to Saunders et al., (2009) two main types of research methods can be distinguished: qualitative research and quantitative. The main difference between these approaches lies in the type of data used. The differences between quantitative and qualitative data presented in Table 1.

Table 1: Distinction between quantitative and qualitative data (Adopted form Saunders et al., 2009)

Quantitative data	Qualitative data
Based on meanings derived from numbers	Based on meanings expressed through words
Collection results in numerical and standardized data	Collection results in non-standardized data requiring classification into categories
Analysis conducted through the use of diagrams and statistics	Analysis conducted through the use of conceptualization

Considering data applied in this study (as input as well as output) it can be classified as quantitative study, however, certain amount of qualitative data gathered from literature analysis was also implied in the development the model and the creation of scenarios assumptions. The main method of the study is simulation, particular simulation approach-system dynamics. The purpose of the study is to build and explore the system behavior.

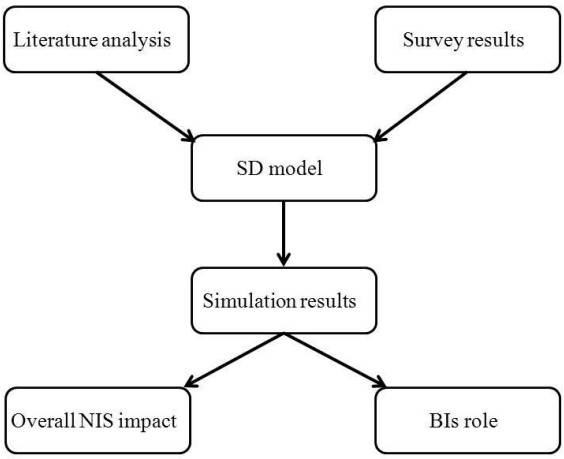

Figure 1: Research design

The research design presented in Figure 1. The key element of the study is the system dynamics model of entrepreneurial venture creation process which provides results for further analysis and exploring stated research questions.

The system dynamics is a part of larger group of simulation methods which in turn relate to the operational research. The distinctive feature of such methods is the common use of mathematical models in order to reach the solution. Therefore, simulation itself does not solve the problem, but rather provides information of the system behavior and possible outcomes which further can be used by researcher or decision-maker, depending on the initial purposes of the study (Robinson, 2004).

In their book Banks et al (2005) provide a generic structure of simulation process (Figure 2). According to them, after initial formulation of the problem and research questions statement follows the stage of model conceptualization. In System Dynamics this is accomplished by creation of casual loops diagram where relationships between further model components are captured (Sterman, 2000).

Data collection process should be undertaken during the whole project since the model is constantly upgraded and refined. Depending on model objectives various sources of data can be applied, such as existing databases, scientific literature, expert opinion or specially designed surveys.

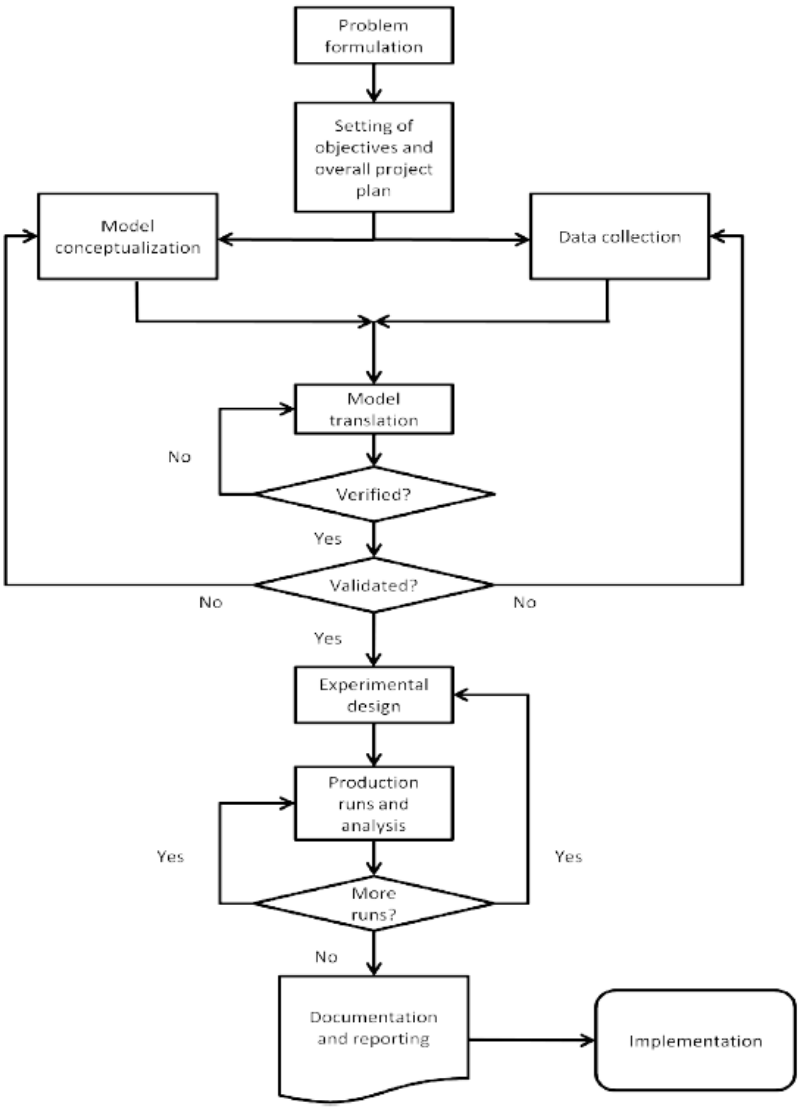

Figure 2: Stages of simulation process (Adopted from Banks et al., 2005)

For this study as the main source of information for the model building was used existing literature on entrepreneurship, particularly concerned entrepreneurship process and affecting factors. Existed entrepreneurial models were analyzed, phases of entrepreneurial process were detected and entrepreneurial framework conditions indicators were established.

There were also engaged several databases: Finnish and Russian official statistic databases (Tilastokeskus and Russian Federal State Statistic Service (Gostat) respectively) for demographical data as well as information about companies founded. The actual indicators characterized entrepreneurial framework

conditions and intentions towards entrepreneurship were derived from the Global Entrepreneurship Monitor (GEM) and Global Competitiveness Report databases.

In addition, secondary data from a survey was applied. The survey was conducted in parallel with the main thesis project during April-May 2013 among companies-residents of business incubators. The participants were 9 companies from Finland, Russia and Hungary. The data was analyzed with the use of SPSS software. The questionnaire and companies profile can be found in the appendices.

After the major data was collected, the conceptual model needs to be translated into the actual computer model. In this study the Vensim simulation software was applied.

The following steps are model verification and validation. Though due the nature of simulation the complete verification and validation are often impossible (Sterman, 2000) these steps should be accomplished in order to prove that model works as it is supposed and provides trustful results. In this study the verification was ensured by the explicit documentation of the model building process and comprehensive reviewing of the model (North and Macal, 2007), whereas for testing the validity was conducted the comparison of model results with actual statistical data.

Experimental design relates to the creation of simulation scenarios which further are run by computer. For our purposes four scenarios were developed (see chapter 5).

After the scenarios are run and results achieved they need to be properly documented and analyzed. In our study two main outcomes can be distinguished (see Figure 1). First group of results correspond to the exploration of the role of NIS in the entrepreneurial process. Second group provides several insights to the degree on what NIS performance can be improved by properly designed and functioning Business Incubators.

The final step of the simulation process is the actual implementation of the reached conclusions. It should be always noted that simulation per se does not provide the complete ready-to-use solution, but it gives additional information

which can be used decision-makers for justifying their perceptions and designing the actual actions.

1.4 The structure of the study

The study is organized in order to contribute the model building process (see Figure 2). The following table (Table 2) presents the study structure and describes the main inputs and outputs of each chapter.

Part 1 is the introduction part which describes the main objectives of the study, presents research questions and overall research methodology.

Parts 2 and 3 contribute to the theoretical groundings of the model. In second part the general concept of entrepreneurship is explored, whereas part 3explains actual model assumptions, such as stages of entrepreneurial process and factors affecting the success of venture creation.

Part 4 introduces the system dynamics approach, accounts benefits and limitations of simulation methods as well as presents generic elements of the system dynamic model.

Part 5 is devoted to the actual model building process. First, a casual loop diagram is created, than it is translated to the actual computer model. We explain the method for assessing model validity and develop the scenarios to be run in order to explore research questions.

Part 6 is the actual results presentation. After assessment of the forecast errors and describing the simulation outcomes follows discussion part which can be divided into two complementary streams: actual impact of NIS related factors on the entrepreneurial process performance and the positive effect derived by business incubators.

Part 7 contains final conclusions and also suggestions for further researches.

Table 2: The input-output structure of the study

Part	Input	Output
1 Introduction	Research area and background	Overview of the research objectives, methodology, establishing research questions, developing overall structure of the study
2 Entrepreneurship origins and definitions	Theory overview	Overview of the entrepreneurship theory, key definitions,
3 Entrepreneurship process	Theory overview, survey results analysis	Stages of entrepreneurship process, factors affecting the success of entrepreneurial process, importance of each factor to specific stage of the process
4 System dynamics	Theory overview	Presenting System Dynamics as a viable concept of studying complex systems, key elements of system dynamics model
5 System dynamics model of entrepreneurial process	Results gathered from theoretical investigations and survey analysis conducted in previous chapters	Actual model building; developing and running scenarios
6 Results and discussion	Simulation results	Presenting and analysis of simulation results
7 Conclusions	Entire study	Final conclusions and suggestions for further researches

2 ENTREPRENEURSHIP ORIGINS AND DEFINITIONS

The following chapter is devoted to representation of general theoretical background of the study. Firstly, the origins of the entrepreneurship as a scientific concept are discussed; second part aims to justify the chosen approach which is going to be followed in the rest of the study; the last part is concerned to the concept of entrepreneurial opportunity.

2.1 The origins of the concept

The roots of entrepreneurship theory can be traced back into XVIII century when the concept of entrepreneurs was first time brought into discussion by Cantillon. In the work "Essay on the nature of commerce in general" (Cantillion 1755/2001) he emphasized the active role of entrepreneurs in the market processes in opposite to rather passive landowners and hirelings. According to Cantillion entrepreneurs are risk-taking individuals willing to operate in the market-place under a high degree of uncertainty.

This concept was further developed by Knight, who distinguished between risk and uncertainty. The risk can be determined as a situation where the probabilities of further outcomes are known, whereas the uncertainty related to situations characterized by unknown probabilities of outcomes. Therefore, individuals willing to accept the uncertainty (when the probabilities of further outcomes are unknown) should be more inclined to engage into entrepreneurship (Gartner and Liao, 2012).

Another important feature of entrepreneurship-innovations, was first proposed by Baudeau and further developed by Schumpeter with his famous concept of "creative destruction" (Grebel et al., 2001). He also emphasized the role of entrepreneurs in the economic development: initiating innovations they constantly disturb the economic equilibrium and force established firms react on new-

emerged entrants. That process contributes to constant renewing of status quo, greater productivity and consequent economic growth (Levie and Autio, 2008).

At the other side, Kirzner focused on the role of entrepreneurs in creation market equilibrium. Thus, Kirzner's entrepreneur rather than introducing breakthroughs which may destroy the current state, attempts to discover existing but undervalued resources or unmet needs, which, in opposite to Schumpeter approach, trigger the process of returning to the market equilibrium (Levie and Autio, 2008).

Although Schumpeter' and Kirzner's concepts of entrepreneurs are often considered as opposite, they do not contradict but rather compliment to each other (Shane, 2003). In other words, in the real economy both types of entrepreneurs exist. Moreover as it was proposed by von Mises (1949, 253) "In any real and living economy every actor is always and entrepreneur". That view results in emergence of researches aiming to explore not the actual nature of entrepreneurs, but rather the features of entrepreneurial process (Shane and Venkataraman, 2000; Levie and Autio, 2008).

2.2 The definition and measurements of entrepreneurship

In spite of extensive research the concept of entrepreneurship is still under development. In fact, even the actual definition is the subject of arguments (Wennekers et al., 2005; Han et al., 2012). Thus, Shane and Venkataraman (2000) proposed that venture creation is not a necessary part of entrepreneurial process since entrepreneur may sell his or her idea (for example in forms of IPs) to big corporation and therefore receive certain revenues without actual new firm initiation. Additionally, Stenholm et al., (2013) noticed that traditional measurement of entrepreneurial activities only by the number of new ventures does not consider the quality of new-born enterprises (in other words is it a really innovative start-up or just a replicative firm).

Considering such two types of entrepreneurs we can draw the links to above discussed Schumpeter' and Kirzner's concepts where equilibrium-building Kirznerian entrepreneur mostly relates to replicative activities whereas Schumpetrian is capable to produce real breakthrough innovations. Of course, the

second type (Schumpetrian) may provide greater impact on the economy, but taking into account scarcity of these entrepreneurs we cannot neglect replicative entrepreneurs who, though, have lower economic impact, but being present in sufficiently greater amount may eventually produce similar effect (Levie and Autio, 2008).

At the same time, traditional measurement of new businesses rates is a common indicator applied by majority of researchers as well as policymakers (Atherton, 2007). Therefore in this paper we are going to follow Hart (2003) who described entrepreneurship as a "process of starting and continuing to expand business". Though such definition cannot be regarded as all-inclusive it emphasizes the importance of starting process. The actual venture creation is a key issue of entrepreneurial process (Gartner, 1988; Bygrave and Hofer, 1991; Shook et al., 2003) is also the central objective of our research.

2.3 Entrepreneurial opportunity

Considering the actual venture creation act as a core of entrepreneurial process we also going to follow Shane (2003) and emphasize the importance of the entrepreneurial opportunity. In fact, the process of firm initiation can be viewed as consequence of individual's decision to explore opportunity (Shane and Venkataraman, 2000; Shane 2003) which allows some researches to put the opportunity in the center of entrepreneurial process (see Figure 3).

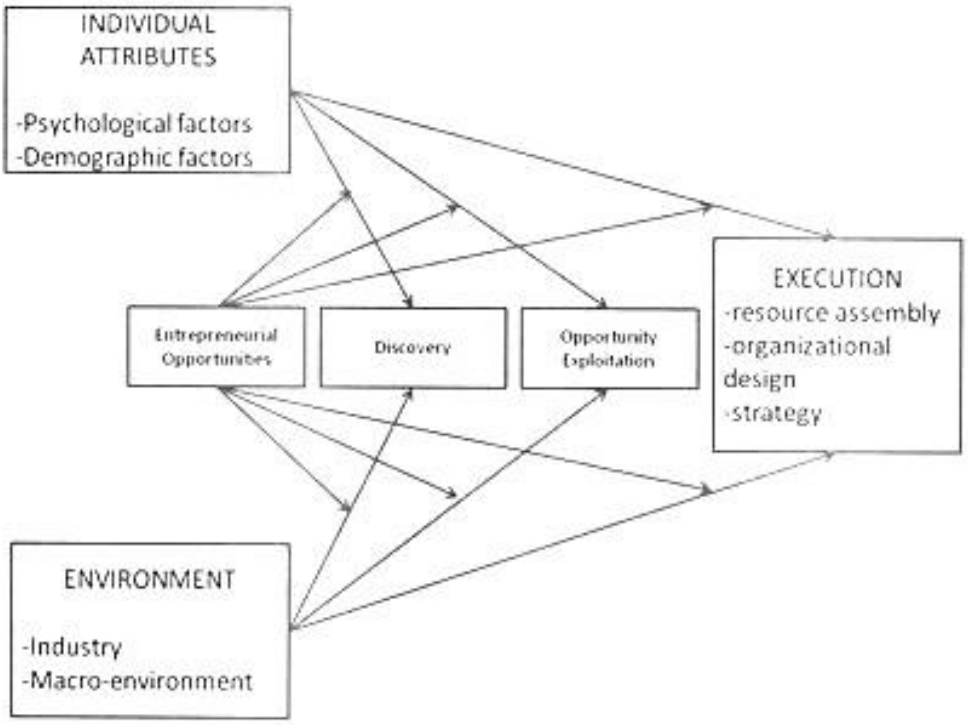

Figure 3: Opportunity-centered model (Adopted from Shane, 2003)

The problem with such approach is that we cannot measure the opportunities (especially those which are applicable for equilibrium disturbing Schumpetrian entrepreneurs) unless they are explored. That is why we are going to use the amount of new firm created as the main indicator of process success, though assuming the opportunity recognition as a necessary prerequisite for proceeding to the next stages of the process.

The differences between two types of opportunities (consequently to the type of entrepreneurs-Schumpetrian and Kirznerian) are presented in Table 3.

Table 3: Two types of opportunities (Adopted form Shane, 2003)

Schumpetrian opportunities	Kirznerian opportunities
Disequilibrating	Equilibrating
Requires new information	Does not require new information
Very innovative	Less innovative
Rare	Common
Involves creation	Limited to discovery

Though both types of opportunities are presented in the economy (Shane and Venkataraman, 2000), Schumpetrian, due to their nature which implies undertaking of radical innovations, occur sufficiently rarely though their value is higher. Simultaneously, the risk connected with exploration of such rare and equilibrium breaking opportunities are greater than in case of Kirznerian opportunities which mostly demand market analysis activities rather than actual new knowledge creation (Shane, 2003).

There are various sources of opportunities. Thus, Kirznerian opportunities are mostly connected with mistakes made by other market operators who overlooked possible resources to explore. On the other hand, political and regulation changes, technological breakthrough as well as demography dynamic provides room for Schumpetrian type opportunities (Shane, 2003).

3 ENTREPRENEURIAL PROCESS

This chapter elaborates on the entrepreneurial process and factors affecting it. First, the stages of the process are introduced. Then we present the Global Entrepreneurship Monitor model which entrepreneurial framework condition indicators are partly applied also in our simulation. Further parts are devoted to more comprehensive explanation of the applied indicators. In the end of the chapter we explain the embeddedness of the entrepreneurial process within country (or region) innovation system and also the role played by Business Incubators in the improving NIS conditions and consequent facilitating the ventures emergence process.

3.1 Stages of entrepreneurial process

The process of starting new business can be divided into several stages. Van Gelderen et al., (2006) discovered four main phases which are in certain extent common for the majority of proposed models of entrepreneurial process:

1) Entrepreneurial intentions emergence;
2) Opportunity recognition and venture planning;
3) Actual venture creation activities;
4) Operations on the market.

Subsequent classification of entrepreneurs consists from potential entrepreneurs (who active on first phase of the process); nascent entrepreneurs (second and third phases); and starting entrepreneurs (fourth phase) (van Gelderen et al., 2006). Two limitations of such classification should be accounted. Thus, it does not distinct between entrepreneurs, just recognized a viable opportunity to explore and those who are actually involved in firm creation process. Additionally, proposed classification assumes that potential entrepreneurs pool contains individuals with already evolved intentions towards entrepreneurship, therefore the process of engaging in the entrepreneurial process remains outside the model boundaries.

To overcome these inconsistences can be used the classification suggested by Rotefoss and Klovereid (2005). Their classification consists from aspiring, nascent entrepreneurs and business founders. Considering these two papers together (van Gelderen et al., 2006 and Rotefoss and Klovereid, 2005) we can infer that after finalizing the first stage, an individual can be regarded as an aspiring entrepreneur with emerged intentions towards further self-employed career. Successful opportunity recognition (stage 2) and earlier attempts to establish own business (e.g. venture planning) develop a nascent entrepreneur, whereas further (successful) creation of own venture and engaging into market operations (stages 3 and 4consequently) relate to business founder (Figure 4). Applying such hybrid classification allow us to consider various population samples (or even the whole population) as a potential entrepreneurs pool.

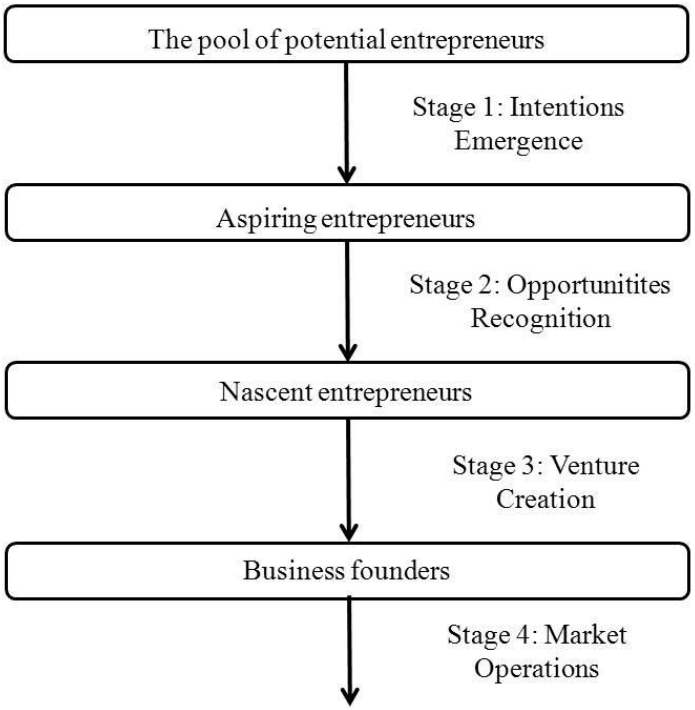

Figure 4: Entrepreneurial process (based on Rotefoss and Klovereid, 2005; and van Gelderen et al., 2006)

Though, some researchers tend to emphasize the importance of individual attitudes and perception as well as psychological features which distinguish entrepreneur from other people (Atherton, 2005; Armstrong and Hill, 2009;

Townshed et al., 2010; Ferreira,et al., 2012) other prefer more balanced approach and include also environmental conditions (Shane, 2003; O'Gorman, 2003; Levie and Autio, 2008; Gries and Naude, 2009; Stenholm et al., 2013). At the same time since each phase of the entrepreneurial process imposes its own requirements, the actual impact of particular factor may vary depending on the stage (Shane, 2003; Rotefoss and Kolvereid, 2005). Thus, at earlier stages individual characteristic of entrepreneur play important role whereas later external factors may achieve greater impact (Rauch and Frese, 2000; Shane, 2003). Hence, in order to create a realistic picture both set of factors should be included.

3.2 Global Entrepreneurship Monitor model

In our simulation we are going to imply factors proposed in the Global Entrepreneurship Monitor (GEM) model (Reynolds et a., 1999; Levie and Autio, 2008). Being embedded into existing theoretical framework this model introduces relationship between businesses (new as well established) and country economic growth (Levie and Autio, 2008). The most recent version of the model presented in the Figure 5.

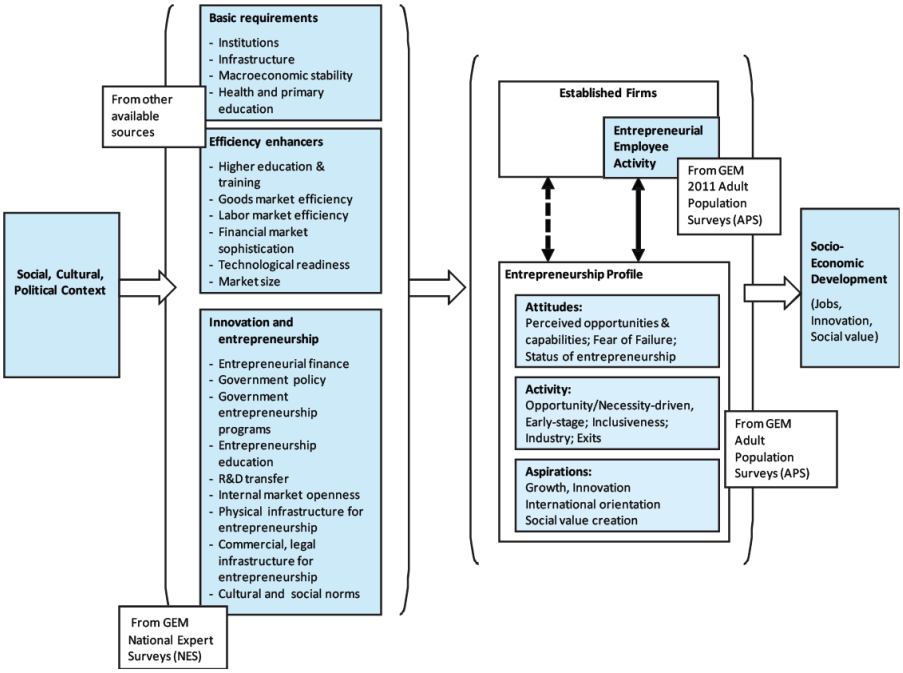

Figure 5: GEM conceptual model (Adopted from Bosma et al., 2012)

As it can be seen the model takes a complex approach by implying a broad set of entrepreneurial framework conditions. In addition to environmental factors GEM model includes also entrepreneurial attitudes and aspirations (Bosma et al., 2012). Consequently, though the model recognizes that Schumpetrian entrepreneur might have greater economic, impact in comparison with Kirznerian, it considers both types (Levie and Autio, 2008). Additionally, since GEM reports have been published for more than 10 years, we gain access to a broad database and are able to make longitudinal observations.

At the same time several limitations of GEM model should be accounted. Thus, in spite of extensive development the relationships between variables still lack the theoretical groundings (Levie and Autio, 2008). That results in the situation when though the model clearly demonstrates the existence of relationships between entrepreneurial framework conditions, emergence of new firm and consequent economic growth the certain caution should be paid to consideration of actual indicators impact since they have not been properly tested for construct validity and therefore may have certain inconsistences and overlapping (Valliere, 2010).

Moreover, the model does not consider the stages of entrepreneurial process and consequently does not distinguish which factor provides greater effect on which phase. To overcome mentioned limitations the following actions were undertaken:

1) All proposed GEM entrepreneurial framework condition indicators were investigated against existing entrepreneurial literature in order to find out to which exactly phase of entrepreneurial process they should relate and what effect (positive or negative) they could provide;

2) In order to investigate the importance of each indicator for the specific phase of entrepreneurial process was conducted a survey among small firms.

The results are presented in following chapters.

3.3 Factors affecting entrepreneurial venture creation process

This chapter presents factors applied in the model. First a literature-based overview is provided whereas second part is devoted to assessment of the importance of each factor in the entrepreneurial venture creation process.

3.3.1 Factors overview

The GEM model contains several framework condition indicators (Bosma et al., 2012): 1) Finance; 2a) National Policy-General Policy; 2b) National Policy-Regulation; 3) Government Entrepreneurship Programs 4a) Entrepreneurial Education-Primary and Secondary level 4b) Entrepreneurial Education-Post School; 5) R&D Transfer; 6) Commercial and Legal Infrastructure; 7a) Internal Market-Dynamics; 7b) Internal Market-Openness; 8) Physical Infrastructure; 9) Cultural and Social Norms.

Finance is an important issue for new firms (Levie and Autio, 2008; Cumming and Knill, 2012). The proper supply of capital becomes especially critical in firms earlier stage until it is capable to generate sufficient revenues (Shane, 2003; Gries and Naude, 2009). Markova and Petkovska-Mircevska (2009) provided extensive list of possible financing options for start-ups which are summarized in Table 4.

Table 4: Financing options for entrepreneurial ventures (Based on Markova and Petkovska-Mircevska, 2009)

Internal sources of finances	
3Fs	Founder's personal savings and loans from friends and family
Bootstrapping	Also bricolage, a highly creative acquisition and use of resources without raising capital from traditional sources. May not provide enough money to ensure the desired competitive level of the firm.
Business Alliances	So-called "cooperative agreements" with another firm to generate revenues and reduce costs.
External sources of finances	
Business Angels	The term relates to the successful business people willing to invest their own money in the venture. They generally provide relatively small funds to the
Venture Capitalists	Financial intermediaries, investing directly in portfolio companies. In opposite to business angels they operate with investor's capital, not with their own.
Corporate Investors	More often considered as an exit opportunity rather than a source of financing. By acquiring small firms, corporate investors compliment their product or service offerings and small firms can use this funding for further expanding
The Equity Markets	Allows attract additional capital. However it can be considered as a funding option only to small amount of entrepreneurial firms.
Banks	Are important source of financing only for established and creditworthy firms.

In spite of such high number of possible alternatives not all of them are applicable on the earlier stages of entrepreneurial process. Thus, bank credits and equity market are more common in the later stages and in fact should be considered mainly as option for already established firms (Figure 6), whereas at the earlier

stages the potential entrepreneur in addition to own savings can rely mostly on support from family or friends (Petkovska-Mircevska, 2009). At the same time such forms of self-financing as well as bricolage (Baker and Nelson, 2005) are very case-specific and cannot be generalized. Therefore, venture capitalists and business angels seem to be the only reliable option of external financing for earlier stages of entrepreneurial process.

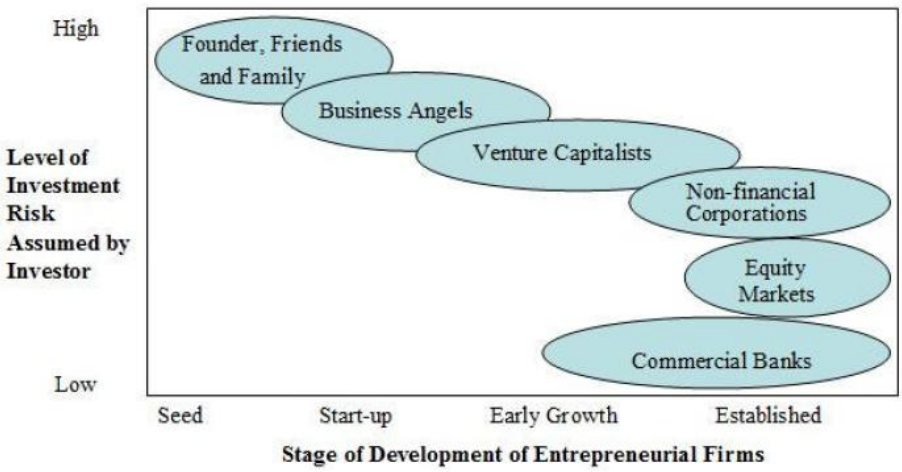

Figure 6: Funding sources for entrepreneurial ventures (Adopted from Markova and Petkovska-Mircevska, 2009)

General policy being all-inclusive concept can in certain extent influence all aspects of everyday life. This is also considered as an important regulator factor in GEM model (Levie and Autio, 2008). Thus, some authors discovered relationships between such factors as level of corruption (Lim et al., 2010), economic concentration or trade-unionism (Choi and Phan, 2006) and the rates of new ventures formation as well as entrepreneurial intentions emergence. At the same time there are still arguments that entrepreneurial phenomenon can be assigned into any special policy box (Acs and Szerb, 2007).

However, practical representation of government policy, particularly, *policy regulations* may affect many steps of actual firm establishing. Thus such factors as taxes, labor market regulations, actual venture registration process (number of steps potential entrepreneur should accomplish in order to get an official status) can influence the rates of start-ups emergence (Choo and Wong, 2006; Acs et al.,

2008; Misra et al., 2012). In addition, unfavorable conditions may increase the time of the process of venture creation (Klapper et al., 2006; Misra et al., 2012), which in turn may affect the actual amount of new firms creates since some people may give up during exhaustive process or, alternatively, the opportunity just expires (Levie and Autio, 2008). At the same time regulations may have also indirect impact, thus, Cumming and Knill (2012) demonstrated that more robust regulation policy attracts venture capitalists which in turn results into increased new venture rates.

Government entrepreneurship programs are another way for the government to influence the entrepreneurial ventures emergence. The government may launch programs aiming to support entrepreneurs on financial basis by direct subsidies or by establishing new opportunities, correcting market failures (Shane, 2003; Dahles, 2005; Levie and Autio, 2008). Alternatively such programs may increase information flow and contribute by developing human capital of potential entrepreneurs (Delmar and Shane, 2003).

The GEM model separates *entrepreneurial education* from *general education.* Moreover, in fact GEM model consider only entrepreneurial education and trainings as a factor of environmental conditions (Levie and Autio, 2008). Following the extensive corpus of literature dedicated to the entrepreneurship-specific trainings we recognize their positive effect particularly in

-improving the skills level necessary to start and run the venture (Honig, 2004);
-enhancing the outlook and facilitating the opportunity recognition (DeTienne and Chandler, 2004);
-increasing overall intentions towards entrepreneurship (Peterman and Kennedy, 2003).

At the same time the general education has more complex effect (Shane, 2003). Though we have numerous evidences that education positively correlates with opportunity recognition and consequent venture creation and further company performance (Rotefoss and Kolvereid, 2005; Lim et al., 2010) its impact on intentions emergence is rather negative, since better educated person has better chances to find high-paid job in the company (Shane, 2003).

The technological development plays an important role in Schumpetrian theory of entrepreneurship. Therefore, the high-tech enterprises based on knowledge-spillovers demand not only valuable knowledge to be created but also properly functioned *R&D transfer* mechanisms (Acs, 2006; Levie and Autio, 2008). In order to achieve the real commercial value, the knowledge, created in the universities or research centres need to be transferred into business sector where it may become a real innovation (Acs, 2006). Entrepreneurs searching for new opportunities, undiscovered market niches are important part of such process (Acs and Varga 2005). However, the success of the process is governed by the overall level of development of R&D transfer mechanisms.

Commercial and legal infrastructure relates to various supporting business services such as consultants, legal accounting, financial and banking services. Though the professional support is helpful at every stage of the process the particular benefits can be achieved at later stages during actual establishing and further management of the venture (Levie and Autio, 2008).

Internal market openness and dynamism are two important factors determining entrepreneurship activities in Austrian economic school. First factor relates to the ease of entering market and therefore impacts mainly on later stages of the entrepreneurial venture creation (Levie and Autio, 2008). On the other hand second factor defines the degree of speed of market changes and have more complicated relationships with venture creation rates. Thus, many researches emphasize the life cycle effect, where the new market or technology niche attracts new entrants and consequently, can be characterized by high rates of entrepreneurial ventures (Carree and Thurik, 2000; Klepper, 2002; Shane, 2003). Therefore, the self-reinforcing mechanism can be observed: new firms by boosting rapidity, creating innovations enhancing market dynamism which in turn act as an attractive factor for new entrants (Levie and Autio, 2008).

Access to physical infrastructure such as necessary transportation or communication facilities is essential precondition for company functioning (Shane, 2003; Levie and Autio, 2008).

Cultural and social norm, in opposite, by forming individual attitudes and perceptions have greater impact on earlier stages of entrepreneurial process (Ferreira et al., 2012). It should be noted that GEM model introduces the distinctions between universal culture values (particularly, Hofstede's cultural dimensions (Hofstede, 1980)) and entrepreneurship-specific attitudes (Levie and Autio, 2008).

Another important indicator which is not directly captured by GEM model is the *country wealth*, often measured in GDP per capita. Thus, Misra et al., (2012) found that it is the only non-institutional factors affecting the rates of entrepreneurship. Thus, wealthier economies are capable to provide easier access to finance for emerging firms. At the same time potential entrepreneurs in such countries seem to be less dependent on external finances. This results into overall more positive attitudes towards entrepreneurship (Shane, 2003).

On the other side, several studies revealed U-shaped relationship between the rates of nascent entrepreneurs and income per capita (see for example Wennekers et al., 2005). That allows us to theorize that mentioned positive effects do not have linear relationship with country wealth. In other words, in poorer countries high amount of necessity-driven entrepreneurs can be detected (Bosma, et al., 2012); unfavorable labor market conditions and lack of working places force people to choose self-employment as a more preferable (or even, the only possible) career option. In wealthier countries, due to above discussed effects people are more willing to explore entrepreneurial opportunities and have more chances to do that. However, in countries with average income potential entrepreneurs may not have enough own savings to establish venture, access to external capital may is also relatively difficult. At the same time due to relatively well-developed (but not enough well) economy regular employment might provide a good option for the majority of population (Wennekers et al., 2005; Bosma, et al., 2012).

The individual attributes (for example, psychological features (Shane, 2003; Van Gelderen et al., 2006), values, perceptions (Herron and Sapienza, 1992; Ferreira, 2012)) tend to demonstrate greater influence on the earlier stages of

entrepreneurial process, e.g. actual decision to pursue entrepreneurial career, whereas on the latter stages their impact is not enough to overcome unfavorable institutional conditions (Shane, 2003). Moreover, Capelleras et al., (2010) noted a feedback loop between perception about framework conditions and venture creation time. Therefore, following Misra et al., (2012) we can propose that institutional factors may not only affect on the process of venture creation but even in some extent shape initial perceptions towards entrepreneurship.

3.3.2 Assessment of the importance of the factors

The following figures present average importance of the framework condition factors at each stage of entrepreneurial process (Figure 7a, 7b, 7c). The respondents were asked to evaluate the importance of certain institutional factors at specific stage of entrepreneurial process:

1) entrepreneurial intentions emergence;
2) entrepreneurial opportunity recognition;
3) actual venture creation.

The Likert-scale was used, the respondents could chose 7 alternatives from 1-Not Important to 7-Most Important.

Interestingly, that average numbers for the first phase of entrepreneurial intentions emergence (Figure 7a) are greater that for the later stages, particularly for the actual venture initiation (Figure 7c). That can be regarded as additional support of propositions made by Bruton, et al., (2010) Lim et al., (2010) and Misra et al., (2012) that institutional environment can not only facilitate (or hamper) the actual practical activities undertaken by entrepreneurs but affect the overall perceptions formation.

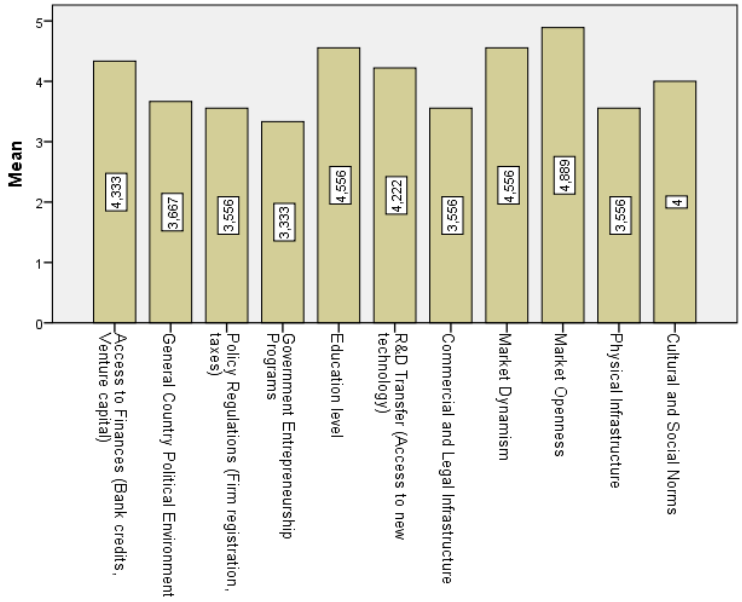

Figure 7a: Average importance of institutional framework factors at the stage of entrepreneurial intentions emergence

At the first stage of entrepreneurial process all institutional factors are perceived to be important. However, the greater scores achieved by market characteristics (Market Dynamism-4,556 and Market Openness-4,889). That supports our initial assumptions about the ability of favorable market conditions to attract new entrants (see chapter 3.3.1). Education level factor was also evaluated quite high (4,556), but taken into account our previous considerations we cannot determine whether its effect is positive. It is clear that educated person has better access to information, viable opportunities and can evaluate and explore them in the more thorough way (Shane, 2003). At the same time these features make him or her a more attractive employee and allow claiming a higher salary level. Therefore, the high level of education cannot per se act as an incentive to engage into entrepreneurship.

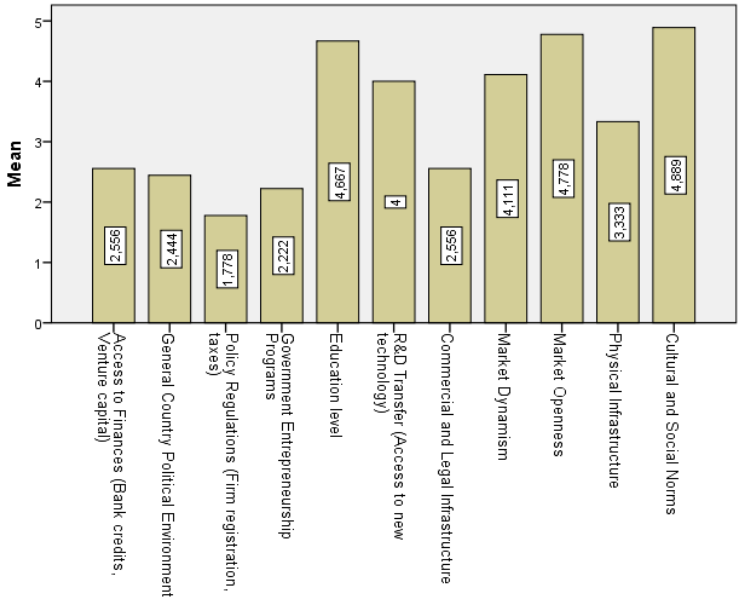

Figure 7b: Average importance of institutional framework factors at the stage of entrepreneurial opportunity recognition

The second stage (Figure 7b) reveals greater dispersion between factors. Thus policy and finances considered relatively low impact at this phase of entrepreneurial process whereas education and market characteristic again account high score. In addition we should mention R&D Transfer which becomes important at this stage, particularly in case of high-tech university spin-offs and Cultural and Social Norms which though do not relate directly to the NIS performance seem to be important at the stage where the potential entrepreneur make a decision about further exploration of the detected opportunity.

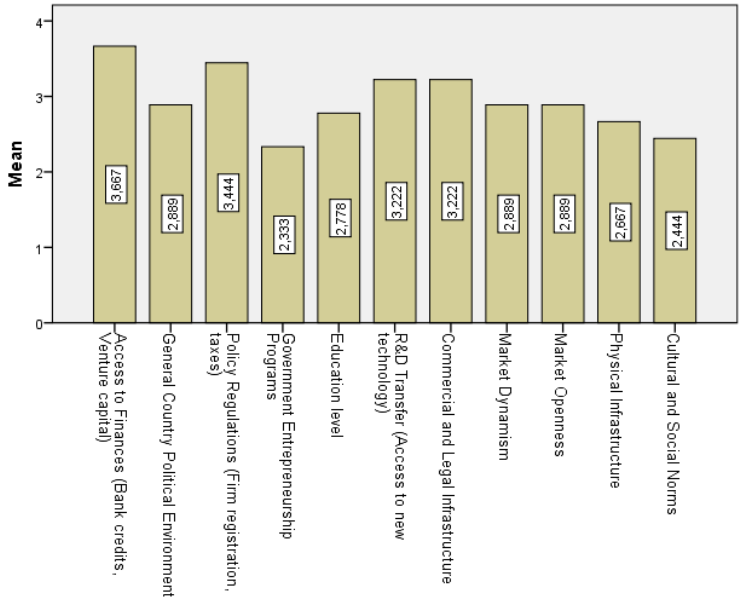

Figure 7c: Average importance of institutional framework factors at the stage of actual venture creation

At the stage of actual venture creation (Figure 7c) all factors achieve appropriately equal level of importance, though finances and policy regulation factors are leaders. Therefore, in general the survey reveals the same pattern which was initially proposed by the theoretical review (chapter 3.3.1). We can assume that all factors have certain impact on the each stage of entrepreneurial process, but the degree of such impact is different between factors as well as for the one factor depending on the stage. The calculated average values will be further implied in the actual system dynamics model in order to assess the weight of each entrepreneurial framework factor.

Additionally, since the results of the survey reflect individual perceptions concerning the importance of institutional framework conditions we are able to gain some more interesting insights. Thus, one of respondents noted that they did not actually considered most of these factors during venture creation process. That reveals the fact that entrepreneurs may not necessary evaluate all objectives while making decision about opportunity exploration. At the same time that does not mean that these, at some extent, unnoticed factors do not affect on the eventual success of the process. Even if they remain unnoticed by entrepreneurs, their actual condition may have impact on decision taken by entrepreneurs, particularly

by applying for decision to entering Business Incubators (Figure 8). Therefore, we can propose that Business Incubators through their support can to certain extent compensate unfavorable economic conditions and facilitate the development of NIS at least at the regional level.

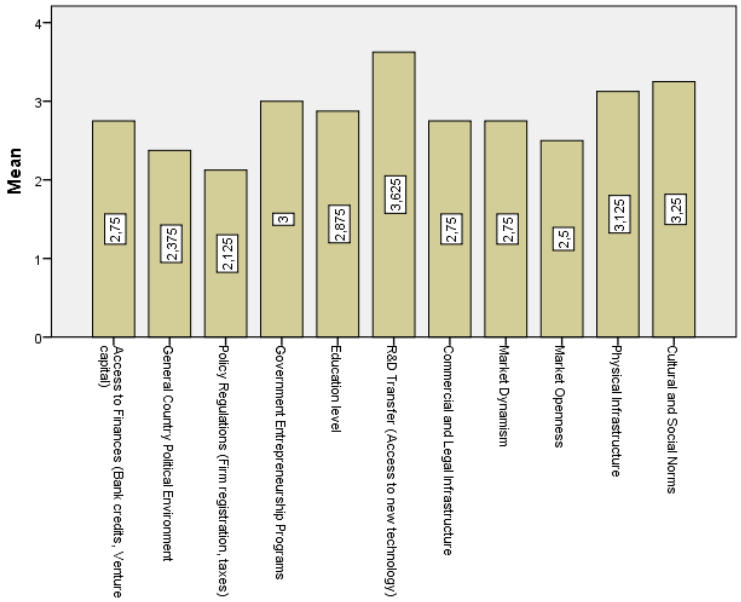

Figure 8: Average importance of institutional framework factors for the decision to enter Business Incubators

3.4 National Innovation System

It should be noted that most of framework condition indicators implied by GEM model depend on country National Innovation System performance (Valliere, 2010). The concept of NIS started emerging since 1980s in works of such authors as Freeman (1982, 1987), Lundvall (1992) and Nelson (1993). According to Balzat and Hannush NIS can be explained as a structure within the country economy consisted from various actors (institutions and organizations) which by interacting with each other create the environment for accomplishing innovation activities, creating and expanding new firms.

Further development of the concept led to creation of various models such as e.g. Triple-Helix (Etzkowitz and Leydesdorff, 2000) and later Quadruple-Helix (Jensen and Tragardh, 2004) as well as projecting NIS on the regional level (Cooke, 1992) and combination with the concept of Open Innovation (Torkkeli et al. 2007, Santonen et al. 2008, Savitskaya and Torkkeli, 2011).

Figure 9 demonstrates a typical model of Triple-Helix NIS. In comparison with the original developed by Etzkowitz and Leydesdorff (2000) this version has better clarity and emphasizes the linkages between actors, maintaining at the same time all the basic assumptions of the initial model.

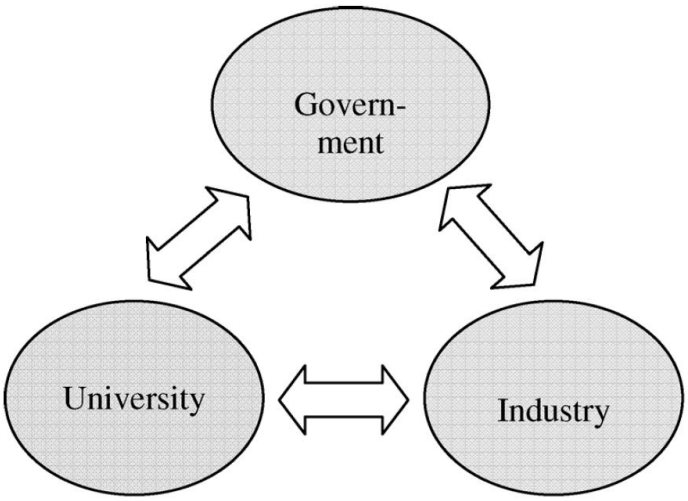

Figure 9: Triple-Helix model of university-industry-government relations (Adopted from Savitskaya and Torkkeli, 2011)

Government plays stimulating and regulative role in the system. The key areas of government innovation policy for business are: 1) IPRs policy; 2) Tax policy, e.g. corporate tax policy and R&D tax concession; 3) Competition policy; 4) Government- business targeted funding of specific research, technology, and small business; 5) Standard setting e.g. for safety and measurement; 6) Procurement polies (Greenhalgh et al. 2010 103-104). However, the overinfluence of government may have negative impact on the system performance (Kaartemo 2009, Zhebit 2010).

The main duties of *Academia sector* in the Triple-Helix NIS framework are to maintain the necessary level of education and prepare specialists with demanded qualification for business sector and at the same time conducting research activities. Oppositely to mostly applied character of researches undertaken by companies, universities research projects may have more long-term oriented general character (basic research) which though may not result into the finished product provides the groundings for further breakthrough innovations (Savitskaya, 2011).

The *Business sector* is the main customer of Academia sector products (educated specialists and results of researches) and simultaneously the main subject of policy regulations. It acts as an actor accomplishing available resources within given environment and creating actual innovation. Therefore, the presence of new firms is vital for proper functioning NIS and consequent economic growth (Levie and Autio, 2008).

Consequently, the value of indicators is dependent on how well each of actors performs its functions and how well established linkages between authors, in other words, it depends on NIS performance.

3.5 Business Incubators

This part is devoted to the describing the role which BIs play in the process of new ventures emergence. We first present the overall concept of BIs and then define which exactly factors of entrepreneurial environment can be affected by them.

3.5.1 Business Incubator concept

New born enterprises often struggle with resources constraints (tangible, such as physical facilities or office equipment and intangible-expertize sharing), lacking of business and management skills, imperfect networking (Abduh et al., 2007; Dunaj et al., 2012). Business Incubators can be regarded as a supporting element in the entrepreneurial environment aiming to help ventures to overcome such

problems and achieve sustainable growth rates, which allows Rice (2002) to define them as actual producers of business assistance programs.

Though some researches demonstrate that in order to achieve positive effect BI management team should carefully align their own objectives with potential residents aims (Hacket and Dilts, 2004) as well as constantly develop the service portfolio (Bruneel et al., 2012) the major corpus of existing literature support the positive impact of BIs. Thus, Löfsten and Lindelöf (2002) noticed improvements establishing linkages with universities and consequent R&D transfer, Colombo and Delmastro (2002) suggested the overall enhancement of collaboration between ventures, whereas Mian (1997) and Retian (1997) provide evidences of greater rages of sales, employment and survival respectively.

Moreover, Löfsten and Lindelöf (2002) emphasize the embeddedness of incubators in the NIS structure (Figure 10) and consequently their role in the region innovation development.

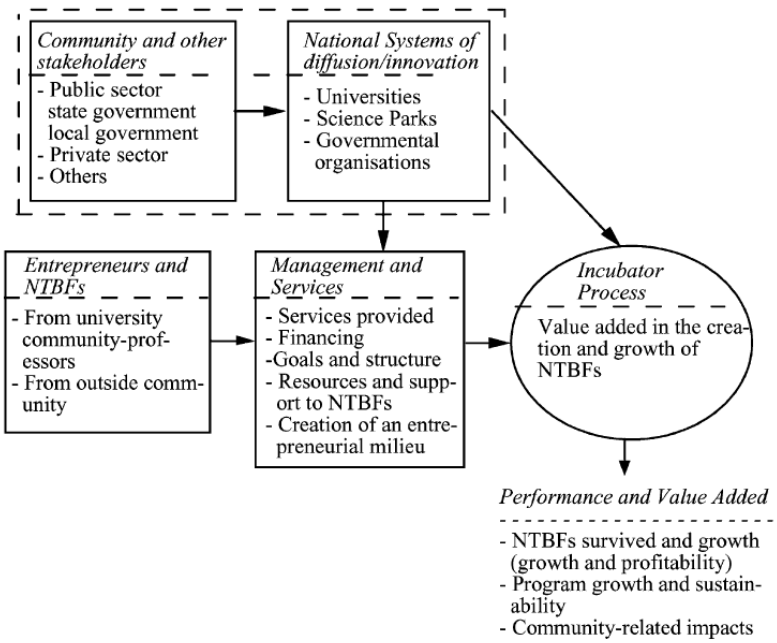

Figure 10: Actors and their roles behind the incubation process (Adopted from Löfsten & Lindelöf, 2001)

The prerequisites of incubation process are therefore: 1) service provided; 2) financing; 3) goals and structure; 4) resources and support; 5) creation of

entrepreneurial milieu. The performance of incubators can be assisted via: 1) ventures survival and growth rates; 2) overall program growth 3) community-related impact (Löfsten and Lindelöf, 2002).

3.5.2 Business Incubator impact on entrepreneurial process success

There are various forms of support BIs may offer to startups. Thus, Scilitoe and Chakrabarti (2010) emphasized the role of BI in entrepreneurial education, particularly in the improving business skills. By interacting with BI management and engaging into its networking BIs may also contribute to improving technical skills of entrepreneurs and learning technological know-how from local universities via R&D transfer mechanisms (Löfsten and Lindelöf, 2002). Abduh et al, (2007) also emphasizes the role of BI in providing technical infrastructure and facilities as well as support in accessing to finances and managing of IPR.

For further investigation we apply results of a survey conducted among BIs residents. They were asked to evaluate the reasons of entering incubator, usefulness of services offered and the overall impact of BI on the success of the company. The respondents were asked to evaluate the importance of reason to enter the incubator as well as the usefulness of offered services with the use of Likert scale from 1 to 7, where 1 is Not important and 7 is Most important.

Figure 11 represents the reasons to obtain the premises at the incubator. As it can be noted the quality and availability of professional business support services is regarded as the main reasons to become a BI resident. Additionally, facilities quality and rent terms perceived as an important issue. At the same time networking opportunity is underestimated. However, since the question assumed clustering and linkages with similar businesses such results do not really provide insight about perceiving the importance of linkages between start-ups and universities and consequent R&D transfer. The factor of image achieved the lowest scores which suggest on more practical orientation of ventures founders.

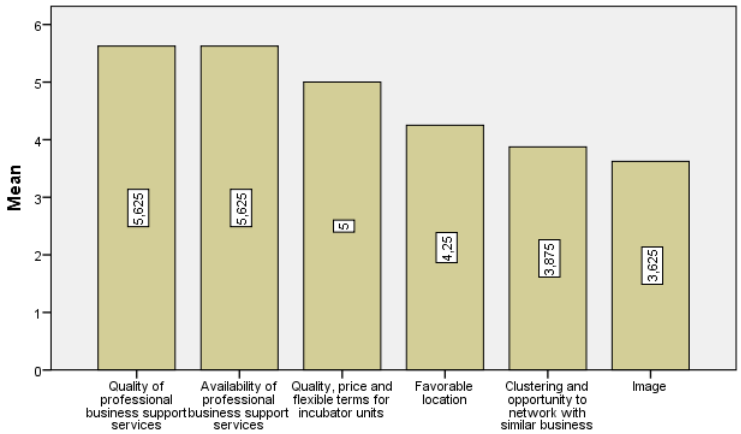

Figure 11: Reasons to obtain premises at the incubator

Considering the perceived usefulness of services (Figure 12) we can assume that services related to the commercial and legal infrastructure as well as to entrepreneurial education appear to be the most useful for ventures. Considering the importance of services 75% of respondents evaluated the support of incubator as important or very important, meaning that BI residence has been very helpful for company survival and success.

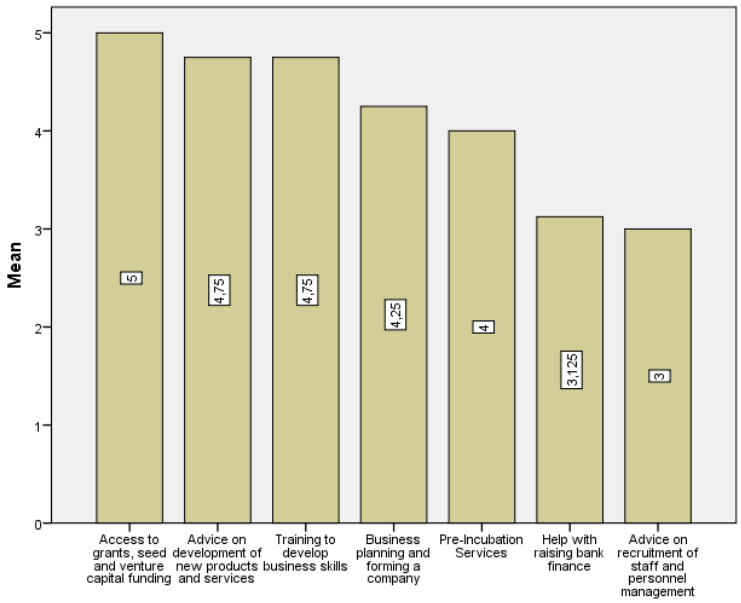

Figure 12: Usefulness of incubator services

To summarize, though BIs cannot improve the whole set of entrepreneurial framework conditions, they are capable to facilitate the access to facilities and equipment, offer support and mentoring, improve networking with universities

and finance organizations enhancing, therefore, R&D transfer, as well as access to finances. This can lead to improvement several institutional indicators:

- Access to Finances;
- Entrepreneurial Education;
- R&D Transfer;
- Commercial and Legal Infrastructure;
- Physical Infrastructure.

4 SYSTEM DYNAMICS

This chapter provides overview of the system dynamics concept. First part explains origins and basic philosophy of system dynamics as well as advantages and limitations of simulation methods. Second part is devoted to explanation of key elements composing a system dynamics model.

4.1 Features and advantages

System dynamics methodology has been developing since 1960s (Forrester, 1989) and was proved as a powerful tool for studying complex systems (Sterman, 2000). Being initially created for exploring supply chain behavior it can be applied also for management and organization studies (Harrison et al., 2007; Gary et al., 2008; Kortelainen, 2011).

The prerequisite of system dynamics-system thinking is an approach assuming pervasive interconnections between parts of the system (Sterman, 2000). In other words, as it was formulated by Roberts (1978), the philosophy of the system dynamics is based on a "belief that the behavior (or time history) of an organization is principally caused by the organization's structure. The structure includes not only the physical aspects of plant and production process but, more importantly, the policies and traditions, both tangible and intangible, that dominate decision-making in the organization". Therefore, system dynamics deals more with dynamic complexity, where the non-linear system behavior results from the constellation of feedback loops, rather than with detailed complexity which occurs due to multiplicity of possible alternatives (Sterman, 2000).

Due to cognitive limitations people often cannot predict the behavior of system even with small degree of dynamic complexity which makes the simulation an important tool for studying complex systems (Sterman, 2000). Moreover, even a relatively simple system can generate such non-linear type of behavior (Simon, 1996). The most common reasons for dynamic complexity described in Table 5.

Table 5: Reasons for dynamic complexity (Adopted from Sterman, 2000)

Dynamic	Change in systems occurs at many time scales, and these different scales sometimes interact
Tightly coupled	The actors in the system interact strongly with one another and with the natural world. Everything in connected with everything else
Governed by feedback	Because of the tight couplings among actors, our actions feed back on themselves. Our decisions alter the state of the world, causing changes in nature and triggering others to act, thus giving rise to a new situation which then influences our next decision
Nonlinear	Effect is rarely proportional to cause, and what happens locally in a system often does not apply in distant regions
History-dependent	Many actions are irreversible. Taking one road often precludes taking others and determines where you end up (path dependence)
Self-organizing	The dynamics of systems arise spontaneously from their internal structure. Often, small, random perturbations are amplified and molded by the feedback structure, generating patterns in space and time and creating path dependence
Adaptive	The capabilities and decision rules of the agents in complex systems change over time
Counterintuitive	In complex systems cause and effect are distant in time and space
Policy resistant	The complexity of the systems in which we are embedded overwhelm our ability to understand them. The result: many seemingly obvious solutions to problems fail or actually worsen the situation
Characterized by trade-offs	Time delays in feedback channels mean the long-run response of a system to an intervention is often different from its short-run response

Table 6 contains list of benefits of use simulations methods in general. Most of them can be directly translated to the system dynamics simulation. However, for the study objectives following advantages should be emphasized:

1) Better understanding of complex non-linear systems behavior;
2) Possibility to run numerous scenarios in order to explore how various system conditions may affect on its performance;
3) More reliable forecasting comparing to traditional statistic models (Sterman, 2000; Lyneis, 2000).

Table 6: Advantages of simulation (Adopted form Banks, 1998)

Chose correctly	Testing every aspect of a change before committing resources
Compress and expand time	Short time periods can be analyzed thoroughly or long time periods can be expanded to short ones
Understand why	Allows analyzing why a certain phenomenon occurs in a system
Explore possibilities	Allows comparing different policies
Diagnose problems	Allows diagnosing problems by understanding underlying interactions in the system
Identify constraints	Possibility to perform bottleneck analysis to discover the causes of delays
Develop understanding	Aid in clarifying to others how a real system works
Visualize the plan	3D simulations may be able to notice problems which cannot be noticed in a 2D environment
Build consensus	It is possible to achieve buy-in with simulations, as potential changes can be modeled, tested, validated, and presented visually
Prepare for change	Allows creating what-if-scenarios, which test how the system performs in potential future situations
Invest wisely	The cost of a simulation study is only a fraction of the total amount of investment required in expensive machinery or facilities
Train the team	Simulations can be used to provide training
Specify requirements	Allows testing potential requirements for a single machine in a complex environment in order to meet certain criteria

At the same time simulations methods have several disadvantages which may hamper proper implementation or interpretation of results. Thus according to Banks (1998) and Robinson (2004) certain limitations should be mentioned:

1) Accurate model building requires expertize;
2) Model building process is time consuming and requires lot of data;
3) Analysis of simulation results might be difficult;
4) Simulation results might be used inappropriately in order to prove rather that test initial assumptions or decisions.

Therefore, though simulation as a method, and particularly system dynamics simulation, is a powerful tool for analyzing complex system it is always should be remembered that model per se does not provide any ready-to-use solutions for the problem, but rather allows investigate the system more deeply and from another angle than traditional methods which results in better understanding of relationships between the system elements and processes caused by these relationships.

4.2 Key elements

The actual system modelling normally requires establishment of casual relationships between elements which then converted into stock and flow diagram. The main system dynamics elements can be listed as follows: stocks, flows, casual loops, sources/sinks, valve, variables. A simple system dynamics model is presented in Figure 13.

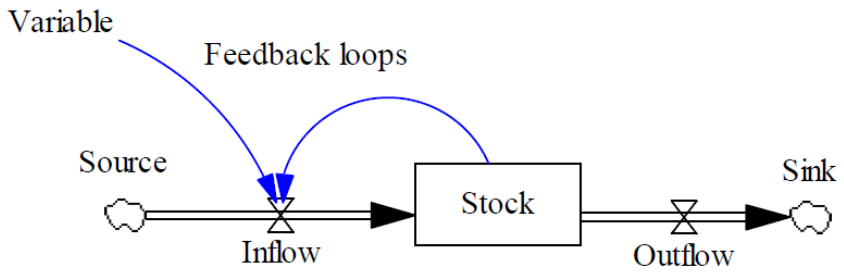

Figure 13: A simple system dynamics model (Adopted from Lättilä, 2011)

Stocks- elements where the entities are accumulated. The best visual representation of stocks can be a bathtub. The stocks therefore characterize the state of the system. By accumulating the difference between inflow and outflow they provide the system inertia and memory (Sterman, 2000).

Flows (inflow/outflow)-rates of change of the stocks. According to the name inflow represents the flow into stock whereas outflow is the flow out. Depending on the model structure outflow from one stock may act as inflow for other (Sterman, 2000).

Casual loops-also called feedback loops, determine the information flow within the system. Depending on their direction they can be positive or negative. The positive, reinforcing feedback loops amplify the process whereas negative, balanced have an opposite effect. Normally, in the system both types of casual loops are presented which coupling with possible presence of delays makes its behavior quite complicated (Sterman, 2000). Six archetypical modes of behavior are presented in Figure 14.

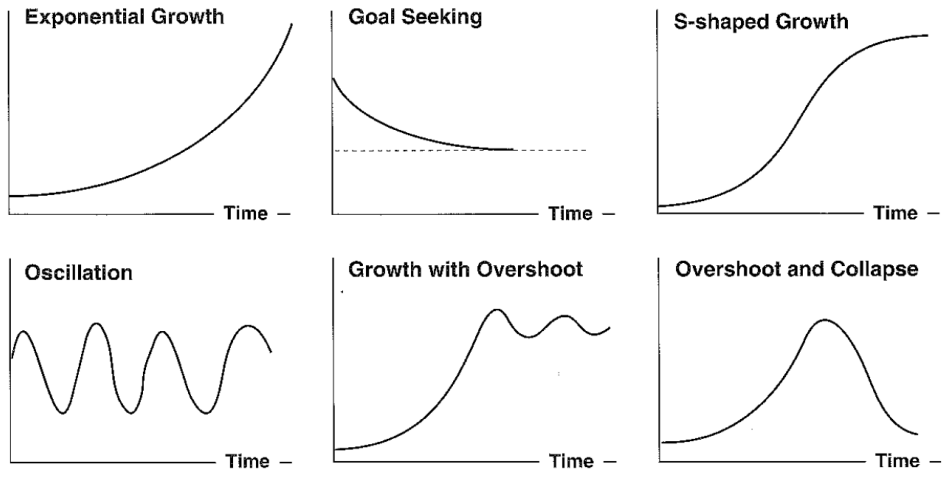

Figure 14: Common modes of behavior in dynamic systems (Adopted from Sterman, 2000)

Sources/Sinks-relate to stocks outside the system boundaries. Sources represent the stock from where inflow originates. Sinks oppositely represent the stock into which outflow leaves the model. Sources and Sinks are assumed to have infinite capacity and they can never constrain the flows they related to (Sterman, 2000).

Valve-again can be associated with a bathtub valve which regulates the amount of water flowing into. Simultaneously in the model valves being a part of stock determine the rules and actual quantity for the entities flowing through (Sterman, 2000).

Variables-for clarity of the model and ease of modifications is often helpful to use additional variables which are connected through casual loops. They may consist of functions of stock, constants or exogenous inputs (Sterman, 2000).

By combination of these elements it is possible to create a system having a rather complex behavior which is difficult to understand simply analyzing each element separately. Moreover, not all elements are necessary. In general, system behavior can be captured without use of variables, only by combination of stock and flows and casual loops, though in this situation the model might be difficult to understand and modify. Alternatively, the model can consist only from variables if there is no need to aggregate flows during simulation period (Sterman, 2000).

If some of model elements appear to have stochastic (random) character the single simulation run is not enough for proper observing all possible outcomes. In such cases should be conducted Monte Carlo simulation or sensitivity analysis which allows explore the model behavior at all possible values for variable in question (Sterman, 2000).

Interestingly, though modern simulation software applications such as Vensim or Anylogic allow conduct sensitivity analysis it is not so widespread in the simulation studies (see Lättilä (2008) for overview of system dynamic papers containing Monte Carlo simulation). Nevertheless, such method has various useful implications:

-analysis of all possible scenarios with the certain degree of confidence;
-allows construct purely theoretical models when the actual values for the one or several variables are uncertain;
-can be used for the test of model robustness (model should have adequate and logical behavior in the whole range of possible values).

Since Monte Carlo simulation demands numerous model runs (at least 100-200) it might be hard to analyze results in the form of individual traces. In such cases used dynamics confidence intervals for the output variables (Sterman, 2000).

5 SYSTEM DYNAMICS MODEL OF ENTREPRENEURIAL PROCESS

In this chapter the actual model is presented. We start with casual loops diagram than explain the model structure and method to assess validity. The second part is devoted to the explanation of scenarios which were developed to explore stated research questions.

5.1 The model

This subchapter explains the model building process. We describe the applied relationships and weights of factors presents actual model view and also account on the method to assess the validity of the model. By explicit documentation of the model structure and the assumptions lied behind the proposed relationships this subchapter also contributes to the model verification and overall study reliability.

5.1.1 Casual relationships diagram

The model was created using Vensim simulation software. The simplified casual structure is presented in the Figure 15. The arrows with "+" denote positive relationship and ones with "-", negative. The entrepreneurial process is divided into several stages in accordance to van Gelderen et al. (2006) and Rotefoss and Kolvereid (2005). In our model we focus only on relatively young people, so-called "generation Y", therefore the initial pool of potential entrepreneurs determined by the actual country (or, in our case, particular regions) population is restricted by the share of 25-34 years old people. The actual population dynamic is captured by birth and death rates.

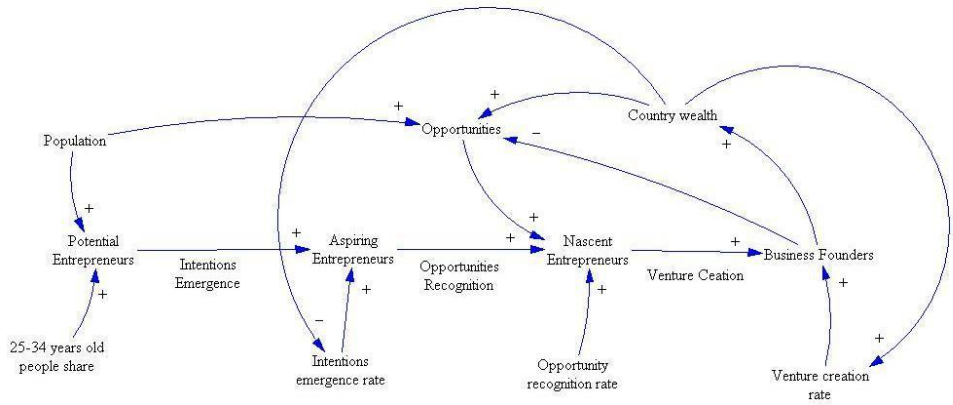

Figure 15: The casual diagram of entrepreneurial venture creation process

After confirming the initial intentions towards entrepreneurship (the process is moderated by the intentions emergence rate) an aspiring entrepreneur must recognize the possible opportunity to explore. In addition certain factors impact on the success of this process (summarized by the opportunity recognition rate) there is need in actual opportunity to be presented.

The amount of opportunities depends on the various set of factors. In his book, Shane (2003) explains how demographical, political and technological changes may act as sources of new opportunities. Thus, it is clear that greater population provides more unmet needs which can be considered as viable alternative for further exploration. Simultaneously positive growth and population as well as increased mobility also have positive effect on opportunities genesis.

Technological breakthroughs create new markets (or niches in the existing markets) and may even lead to emergence of new industries. This results into increase of market dynamism degree and consequent growing amount of new entrants. Moreover, the beginning of technology life-cycle is generally characterized by the absence of dominant design which facilitates also market openness and creates chances for new firms to become market leaders.

Also changes in political environment may significantly extend the pool of entrepreneurial opportunities (think, for example, about dissolution of Soviet Union and consequent collapse of Communist regimes in Eastern Europe). On the

other side, even not so dramatic changes in regulations may lead to exploration of previously untouched resources.

However, we implied only the population and country wealth effect on the opportunities. The rationale is that such single event as e.g. technology breakthrough or dramatic regulation or political change may not be always predicted with the adequate degree of accuracy and it seems to be more easily to estimate their impact by running dedicated scenarios rather than trying to incorporate their probability to occur into the generic model.

Nascent entrepreneur in order to explore the opportunity engages in the process of establishing new venture. In case of success (determined by the venture creation rate) the new-born business founder starts market operations. The increasing amount of new firms leads to diminishing free opportunities, since the market becomes more saturated, but simultaneously facilitate to certain extent country wealth growth which in turn may lead to improving NIS conditions (i.e. environmental conditions) and intentions towards entrepreneurship.

We also assume that certain part of nascent entrepreneurs failed to establish own venture may enter the process again. Similarly, some business founders after leaving the firm (due to e.g. bankruptcy or for the new project) might become so-called “serial entrepreneurs” and engage in another firm initiation activities. These processes (in other words the amount of people decided to entering the entrepreneurial process again) are determined by Giving Up Rate and Serial Entrepreneurship Rate respectively.

In order to model the real-word behavior the model contains several delays. Particularly, all stages of entrepreneurial process are delayed similarly as the flows of entrepreneurs entering the process again.

5.1.2 Phases success rates

The rates of successful accomplishing each of entrepreneurial process phases (namely Intentions emergence, Opportunity recognition and Venture creation) are determined by the set of framework conditions factors and also by individual

intentions towards of entrepreneurship (see chapter 3 for overview). On the basis of survey conducted among firms-residents of BIs was gathered data concerning the importance of each factor in the certain stage.

In order to be applied in the model this qualitative evaluation need to be transformed into weight for each indicator. The used Likert-scale from 1 to 7 is equivalent to the scale from 0 to 6, where 0-relates to “not important” (0% or zero weight) and 6 is the “most important” (100% or weight factor equal 1). For calculation was used formula:

$$Weight = \frac{value-1}{6} \qquad (1)$$

Where,
Weight-is the weight of each factor;
value is the actual average value from the survey results (see chapter 3.3.2).

After the initial calculation weight factors should be normalized. The results are summarized in Table 7.

Table 7: Normalized weight factors for framework condition indicators

Factor	Intentions emergence	Opportunity recognition	Venture creation
Access to finances	0,100	0,059	0,124
General country political environment	0,080	0,055	0,088
Policy regulations	0,077	0,030	0,114
Government entrepreneurship programs	0,070	0,046	0,062
Education level	0,107	0,139	0,083
R&D transfer	0,097	0,114	0,104
Commercial and legal infrastructure	0,077	0,059	0,104
Market dynamism	0,107	0,118	0,088
Market openness	0,117	0,143	0,088
Physical infrastructure	0,077	0,089	0,078
Cultural and social norms	0,090	0,148	0,067

Since the main focus of the study is exploring the process of venture creation the fourth stage of the entrepreneurial process-market operations was not modeled in details, but rather determined simply by venture death rate (estimated on the basis of country/region statistic).

Taking into account that conducted survey did not capture the importance of individual attitudes towards entrepreneurship and paying homage to the significant corpus of literature emphasizing the value of such factors in the success of venture creation we assumed their weight as 1 for all stages.

The success rates are therefore can be presented as an average of Intentions towards entrepreneurship, Framework conditions and Country wealth factor. The actual model presented in Figure 16.

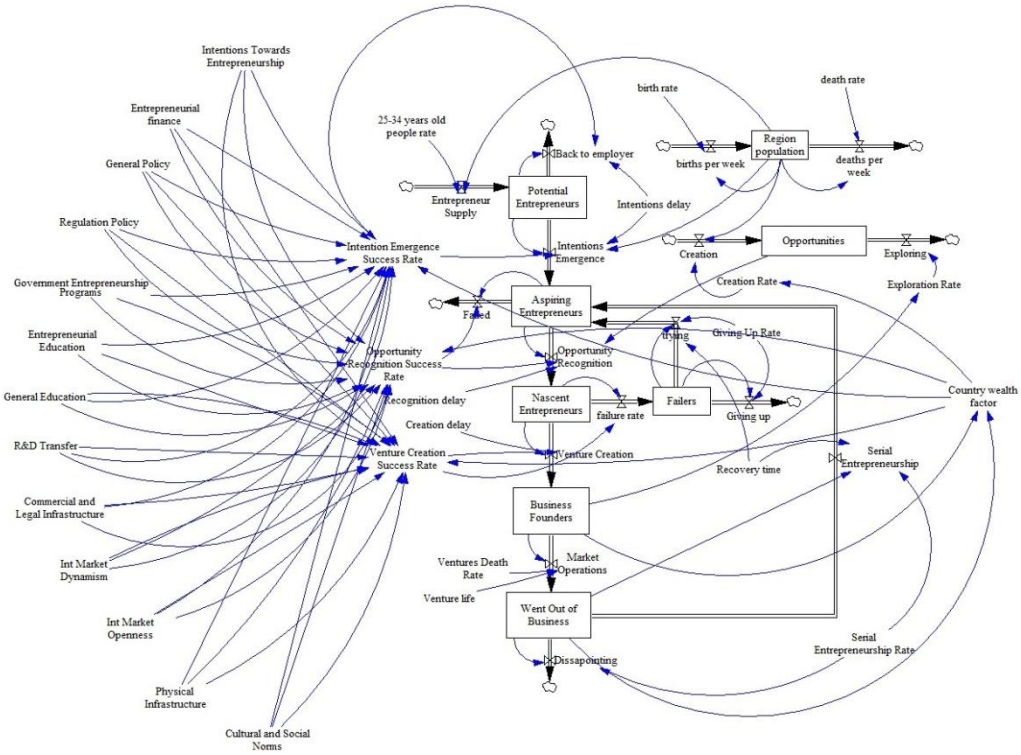

Figure 16: System Dynamics model for entrepreneurial venture creation process

5.1.3 Validity assessment

For assessing model validity was used data on Finnish enterprises for the period 2005-2011. The model output was compared with real numbers and necessary adjustments were made. The same data served as a source for estimation the ventures death rates. Unfortunately, we were unable to gather similar statistic regarding Russian firms, therefore we have to admit that possible error in the trend forecast for Russian regions might be greater.

There are number of various possible methods for calculating errors. However, we applied the mean percentage error. The rationale was that we were mainly interested in differences between estimate and the actual observation. The formula for calculation is:

$$MPE = \frac{\sum_{i=1}^{n} \frac{X_i - F_i}{X_i} \times 100}{n} \qquad (2)$$

Where,

MPE-mean percentage error;

n-amount of observations;

X_i-actual observation during time period i;

F_i-forecast during time period i.

5.2 The scenarios

In this subchapter we describe the scenarios developed to explore the research questions. The scenarios assumptions are summarized in the tables.

5.2.1 Scenario 1: Regions comparison

In order to answer on first research question we conducted a comparison between Finland and Russia regions, particularly between regions Kymenlaakso, Etelä-Karjala, Päijät-Häme from Finnish part and St. Petersburg and Leningrad region from Russian. There are several reasons for such choice.

First, both countries reveal almost equal and quite low attitudes towards entrepreneurship (Bosma et al., 2012), whereas the level of NIS performance is noticeable different. Thus, though Russia in general and focus region in particular still can capitalize on inherited from the Soviet period excellence in the science and technology, the current level of NIS, in spite of recent government programs, is low (MES 2009; Dirks & Keeling 2009). On the other hand, Finland provides an example of rapid progress from primarily rural country to the one of the most competitive economies. According to Global Competitiveness Report 2012-2013 it has been ranked on 3rd place, being outscored only by Switzerland and

Singapore (WEF, 2012). Therefore, comparison between Finland and Russia allows us to emphasize the impact of system conditions on the venture creation success.

Second, is the countries' demography: according to official statistic, demographical trend for Finland is population decreasing and ageing (Figures 17 and 18), Russia, in general follows the same path, whereas for focus regions the share of young people is actually growing, which gives us an opposite demographic tendency (Figures 19 and 20). Additional rationale for our choice is geographical closeness and well-established economic linkages between focus regions. That result into sufficient amount of collaboration projects focused on developing the infrastructure for cross-border partnership. The model is supposed to serve as additional tool to be applied in such project, e.g. at preparatory stages, for benchmarking analysis or at final stages for assessment of the results.

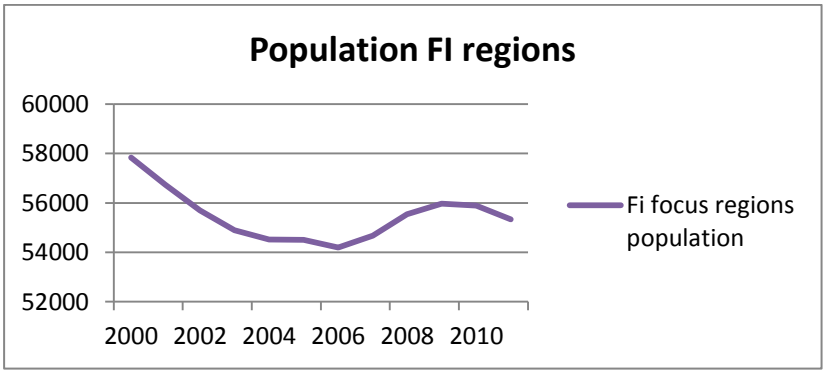

Figure 17: Population dynamic of Finnish focus regions

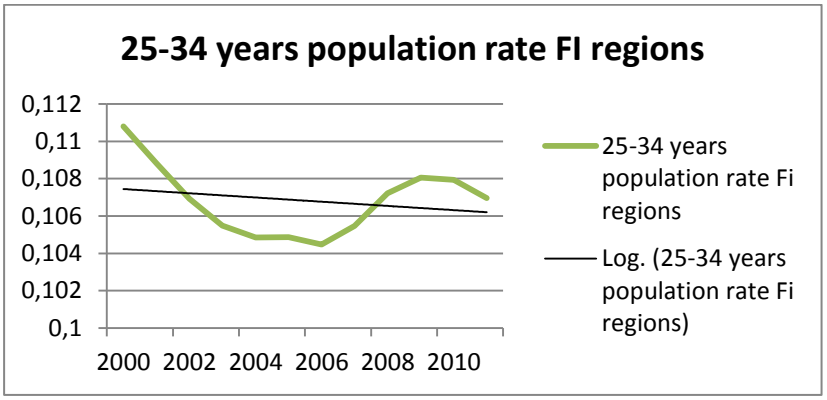

Figure 18: The share of 25-34 years old people in Finnish focus regions

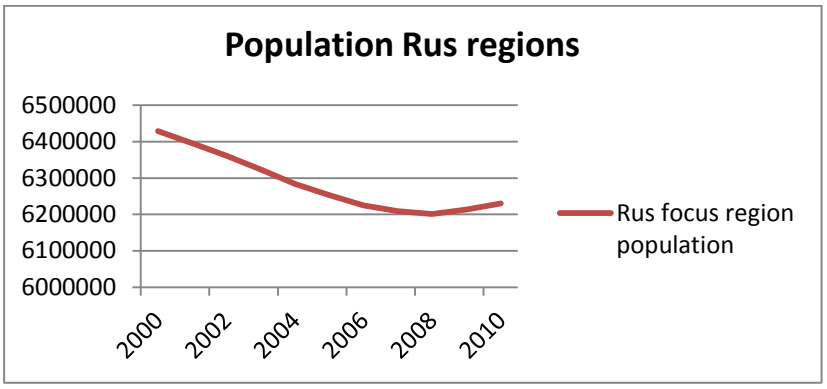

Figure 19: Population dynamic of Russian focus regions

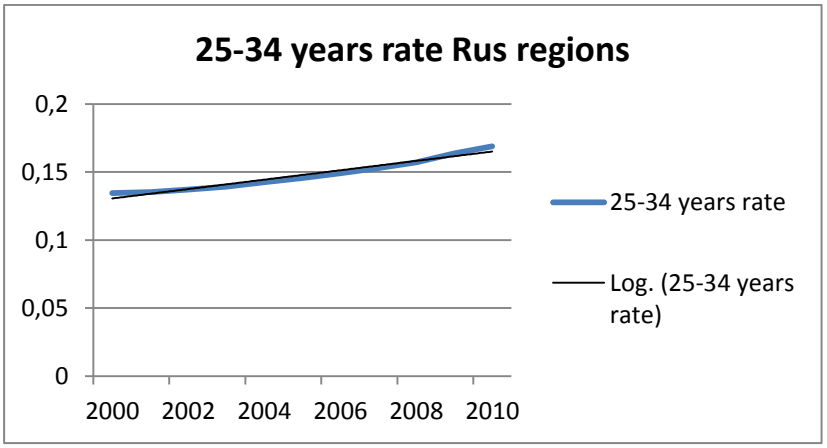

Figure 20: The share of 25-34 years old people in Russian focus regions

The demographic data for comparison was drawn from official country statistics databases, Tilastokeskus for Finland (http://www.tilastokeskus.fi/) and Russian Federation Federal Statistic Service for Russia (http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/en/main/). The data for Finland was gathered for the period 2000-2011, for Russia 2000-2010. The forecasting of further population dynamic for the sake of simplicity was made by applying trend lines. The logarithmic regression type was chosen due to better fit to the given statistical data. Though such method (trend lines) cannot be regarded as very accurate, the reason for its use is that at this stage the main aim is not to capture the actual values with the best possible accuracy, but rather to discover the general trend (is the population actually ageing or not).

The indicators of entrepreneurial intentions and framework conditions were drawn from GEM report for 2011 (Bosma et al., 2012), with exceptions of Education which was derived from the Global Competitiveness Report 2012-2013 (WEF, 2012). Though, applying average country indicators will inevitably result in certain inconsistency we propose that the error is not critical. Since all the regions brought into analysis have relatively well developed industry and universities we assume that their actual scores are at least as high as country average.

The model main output is the amount of new-born enterprises. In order to eliminate the population size bias and make actual countries comparison possible was implied a relative indicator which is a rate between new firms amount and the country (region) population (amount of new firm created/overall population).

The overall scenario assumptions are summarized in Table 8.

Table 8: Scenario 1 assumptions

Simulation period	20 years: 2000-2020
Time units	weeks
Time step	0.125
Regions of analysis	Finland: Kymenlaakso, Etelä-Karjala, Päijät-Häme Russia: St. Petersburg, Leningrad region
Indicators	GEM and GCI-based
Population dynamic	Forecast (trend line) based on actual statistic data
Main output	Amount of new firms created (amount of new firm created/overall region population)

5.2.2 Scenario 2: Sensitivity analysis: NIS factors versus entrepreneurial intentions

The aim of this scenario is to find out the answer on second research question and to explore possible degree of impact provided by NIS-factors on the success of entrepreneurial venture creation process in comparison with the impact derived from the actual individual's intentions toward entrepreneurship.

Since this scenario assumes the exploration of stochastic values, Monte Carlo simulation was chosen. First was conducted univariate sensitivity analysis for the indicator of intentions towards entrepreneurship where it was allowed to vary between minimum and maximum values (0 and 1 respectively). The second run was devoted to exploration of the impact provided by similar variations in the NIS performance. Due to the multiple factors applied in the model multivariate analysis was conducted.

As a basis for simulation was used model of Russian regions and Finnish values were used for benchmarking. The scenario assumptions are summarized in Table 9.

Table 9: Scenario 2 assumptions

Simulation period	20 years: 2000-2020
Time units	weeks
Time step	0.125
Regions of analysis	Russia: St. Petersburg, Leningrad region For benchmarking: Kymenlaakso, Etelä-Karjala, Päijät-Häme (Finland)
Indicators	GEM and GCI-based
Sensitivity analysis	Indicators: 1st run: Intentions towards entrepreneurship 2nd run: all entrepreneurial framework conditions indicators altogether (see Table 7) Distribution: random uniform Values interval: 0-1 Number of runs: 500 Noise seed: 1234
Population dynamic	Forecast (trend line) based on actual statistic data
Main output	Amount of new firms created (amount of new firm created/overall region population)-dynamic confidence intervals

5.2.3 Scenario 3: Economic downturn

This scenario is devoted to provide data for resolving third research question- How does poorly functioning NIS deal with increased potential entrepreneurs supply? Was developed and run the scenario where the sudden increase of entrepreneur intentions was combined with respective deterioration of NIS performance. Such situation may appear e.g. during economic crisis when the amount of potential entrepreneurs grows, partly due to increased supply of

necessity-driven entrepreneurs (Bosma et al., 2012), whereas tough economic state leads to erosion of factors determining entrepreneurial framework conditions.

Due to better validation the model of Finnish regions was chosen as a basis for the scenario. Initially all indicators and population trends remained the same as in the Scenario 1, but at certain point in the middle of simulation period the intentions towards entrepreneurship increased by 50%. This is supposed to represent the situation similar to the one described in chapter 3.3.1, when people due to the shortage of regular workplaces are forced to enter entrepreneurial career.

At the same time such factors related to the NIS conditions (Table 7) decreased by the same 50%. Due to their nature (see chapter 3.3.1) these factors seem to be the first affected by the sudden economic downturn. Simultaneously increased the death rate for established firms and diminished the pool of opportunities.

The assumptions of the scenario are presented in table 10.

Table 10: Scenario 3 assumptions

Simulation period	20 years: 2000-2020
Time units	weeks
Time step	0.125
Regions of analysis	Finland: Kymenlaakso, Etelä-Karjala, Päijät-Häme
Indicators	GEM and GCI-based
Indicators change	Intentions towards entrepreneurship: up by 50% Ventures death rates: up by 50% Entrepreneurial framework conditions (see Table 7): down by 50% Entrepreneurial opportunities pool: down by 50%
The moment of change	The middle of simulation period, week 468, which corresponds to the year 2008
Population dynamic	Forecast (trend line) based on actual statistical data
Main output	Amount of new firms created (amount of new firm created/overall region population)

5.2.4 Scenario 4: Business Incubator impact

Fourth scenario aims to explore the degree of possible positive impact which can be provided by properly functioning BIs. In chapter 3.5 certain entrepreneurial framework conditions which can be affected by BIs we distinguished:

- Access to Finances;
- Entrepreneurial Education;
- R&D Transfer;
- Commercial and Legal Infrastructure;
- Physical Infrastructure.

In order to evaluate the degree of impact of these factors to the overall performance of entrepreneurial venture creation process the multivariate sensitivity analysis was conducted. In simulation the parameters were allowed to change from the minimum possible value (0) to the maximum possible (1) capturing therefore the whole area of possible changes caused by such factors.

As a basis for the analysis was applied the model with Russian institutional conditions indicators. Results for Finland were therefore used for benchmarking. Similarly to the scenario 2, due to theoretical character additional assessment of the model validation was not conducted.

The assumptions of the scenario are presented in table 11.

Table 11: Scenario 4 assumptions

Simulation period	20 years: 2000-2020
Time units	weeks
Time step	0,125
Regions of analysis	Russia: St. Petersburg, Leningrad region For benchmarking: Kymenlaakso, Etelä-Karjala, Päijät-Häme (Finland)
Indicators	GEM and GCI-based
Sensitivity analysis	Indicators: Access to Finances; Entrepreneurial Education; R&D Transfer; Commercial and Legal Infrastructure; Physical Infrastructure Distribution: random uniform Values interval: 0-1 Number of runs: 500 Noise seed: 1234
Population dynamic	Forecast (trend line) based on actual statistic data
Main output	Amount of new firms created (amount of new firm created/overall region population)-dynamic confidence intervals

6 RESULTS AND DISCUSSIONS

This chapter is devoted to the presentation of the simulation results. First we assess the model validity, then we describe the outcomes of scenarios simulation runs. We finalize this chapter by discussion on achieved results.

6.1 The model validity assessment

We examined the model validity by comparison of simulation results with the real statistic data. Unfortunately, we were unable to access the data relating to the Russian regions, therefore the process of validation can be considered only as partly accomplished. Nevertheless, the following figures (Figure 21, 22, and 23) represent the comparison of venture creation and death rates as well as overall amount of active ventures derived from the simulation with real data for Finnish focus regions. The comparison was conducted for years 2005-2011. The unit of measuring is ratio of amount of ventures to the region population.

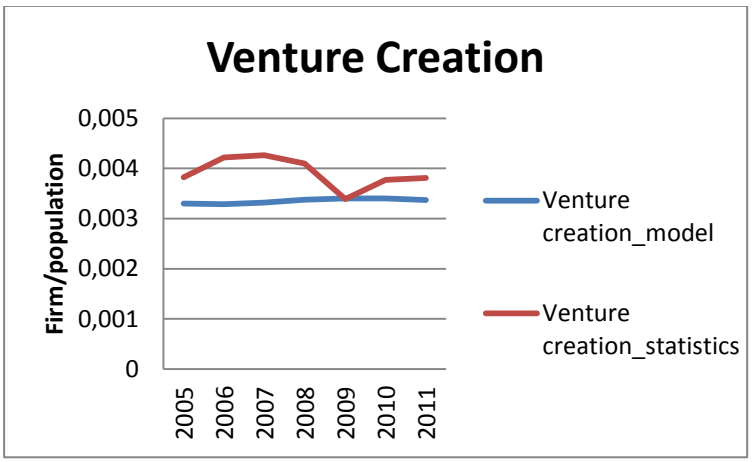

Figure 21: Venture creation, the model versus actual statistic

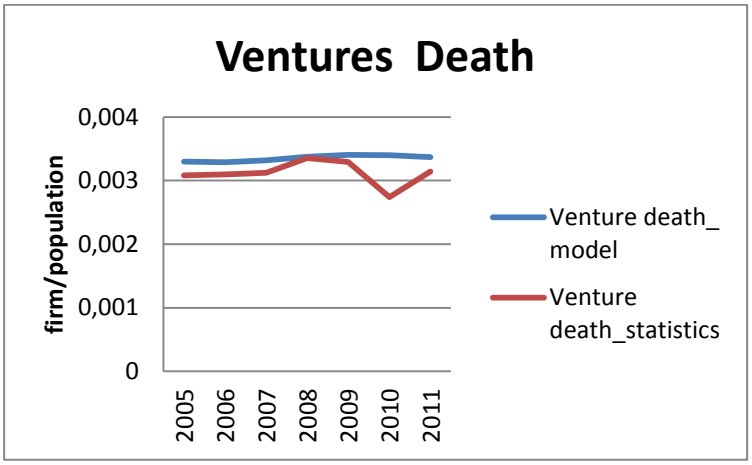

Figure 22: Venture death, the model versus actual statistic

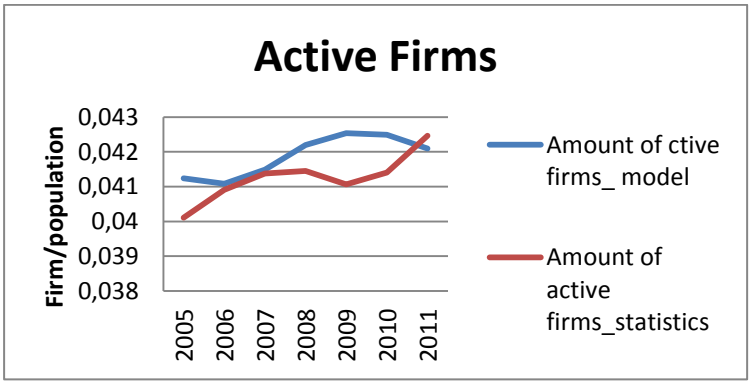

Figure 23: Amount of active firms, the model versus actual statistic

As it can be seen from the figures the model does not capture the occasional fluctuations which can be caused by certain external factors. Such factors may be not considered in the model. Thus, the model does not automatically undertake the economic downturn of 2008 and its consequences. Therefore, the discrepancy between the values at some specific unit of time might be quite significant.

Nevertheless, the model captures the general tendency of values change as well as the rate of change, which allows it to be used as tool for analysis the system behaviour though limits its ability to forecast the actual numbers since we have to admit certain error in the results produced by the simulation. The following table (Table 12) provides the average errors (see chapter 5.1.3 for overview of the calculation method).

Table 12: The average errors

Indicator	Error
Venture creation	13,81
Venture death	-7,81
Active firms	-1,52

6.2 Scenarios results

This subchapter presents the results of scenarios run. In accordance with the number of created scenarios is contains four parts.

6.2.1 Scenario 1: Regions comparison

The results of regions comparison are presented in the following figures. Finland regions in general demonstrate better initial performance which though does not change during the time whereas values for Russian regions are steadily growing. This can be viewed as the result of population dynamic and consequent change of potential entrepreneurs pool.

Thus, though the overall forecasted population decrease in Finnish regions is not so dramatic (Figure 24a) in comparison to Russian (Figure 24b), the tendency of population ageing reveals into stagnation of potential entrepreneurs pool (Figure 25a). Russia, on the other side, due to the increasing share of young people, even in spite of the actual diminish of the overall regions population is able to demonstrate constant growth in the numbers of potential entrepreneurs (Figure 25b).

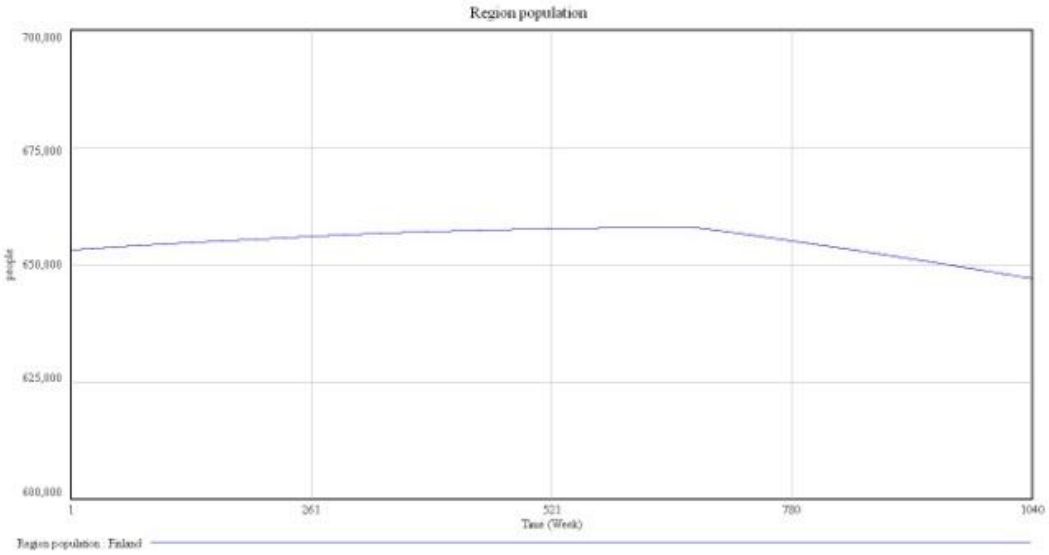

Figure 24a: Population dynamic: Finland

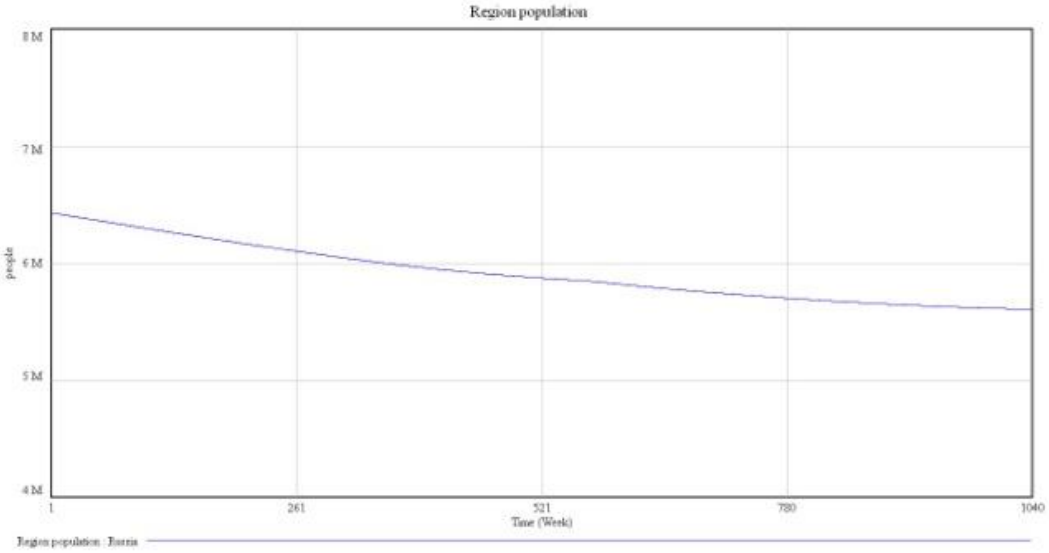

Figure 24b: Population dynamic: Russia

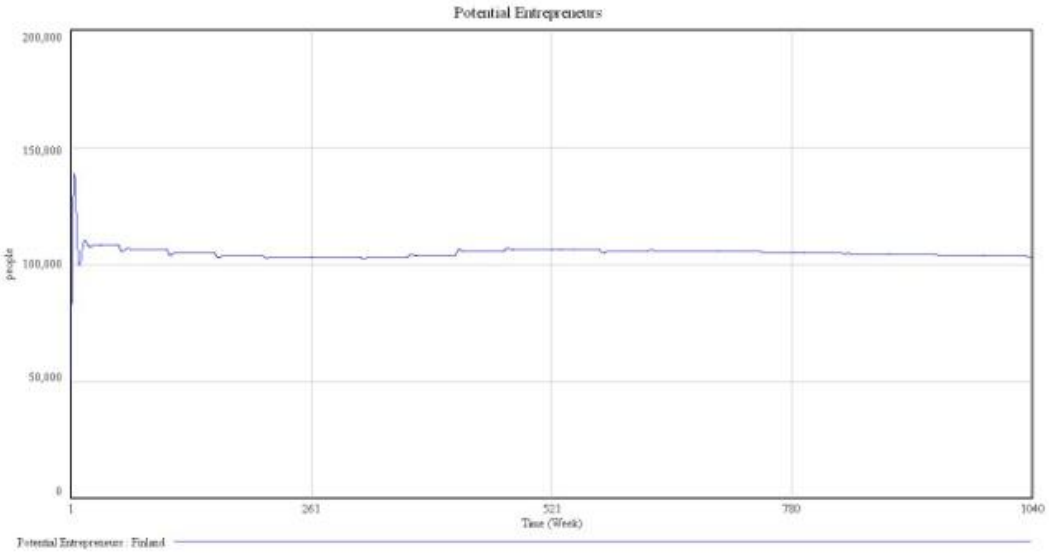

Figure 25a: Potential entrepreneurs: Finland

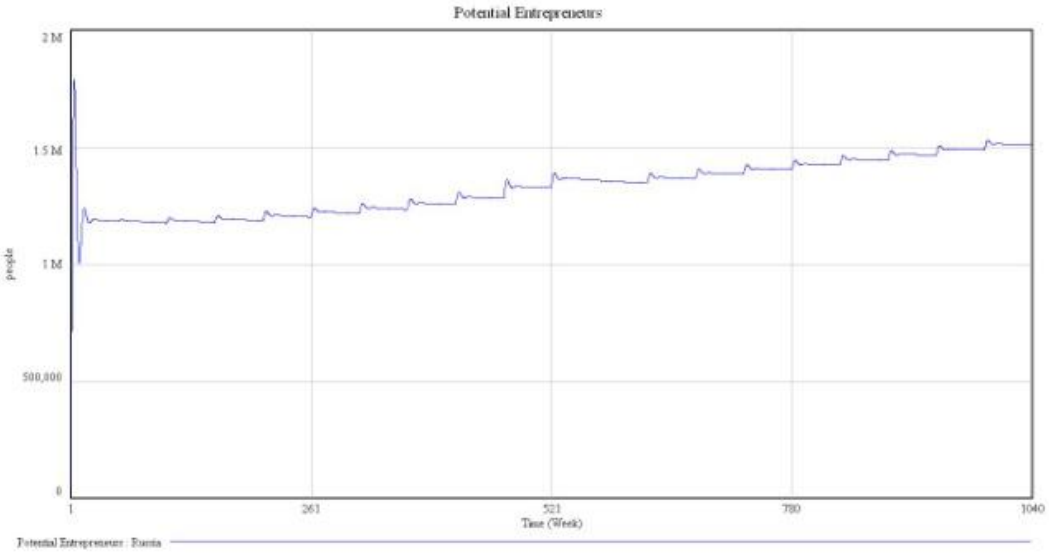

Figure 25b: Potential entrepreneurs: Russia

Such positive tendency allows Russian regions quickly overcome Finnish regions and eventually achieve sufficient advantage in the amount of aspiring entrepreneurs, or in other words individuals willing to explore entrepreneurial career further (Figure 26).

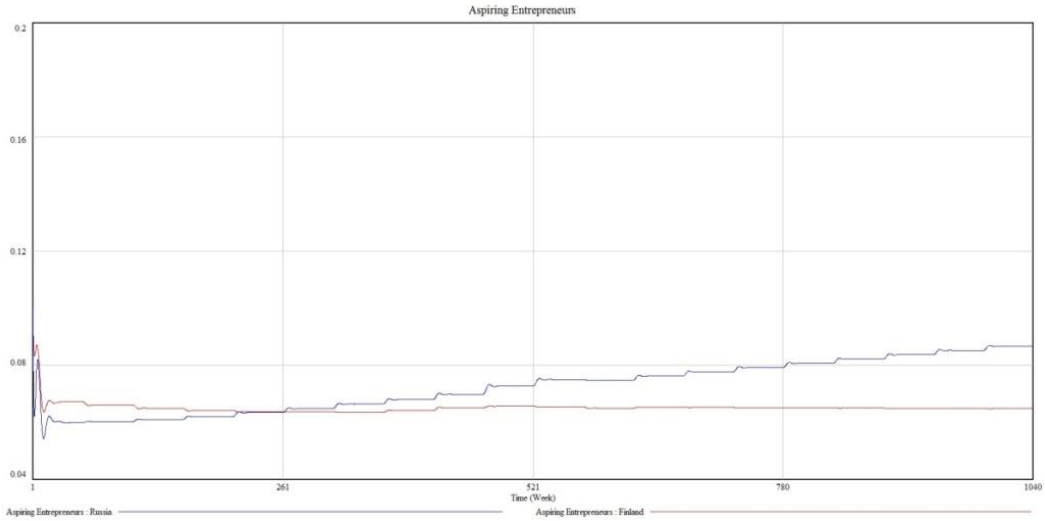

Figure 26: Aspiring entrepreneurs pool

However, in later stages of entrepreneurial process Russian regions demonstrates sufficiently lower performance which eventually results into situation when they are not able to provide significant growth rate and by the end of simulation period are still lagging behind Finnish regions in terms of new ventures created (Figure 27), (Note, that in order to be able to compare regions with different population was applied relative indicator characterized by ratio of amount of firm created (or entrepreneurs on earlier stages of the process) and overall region population).

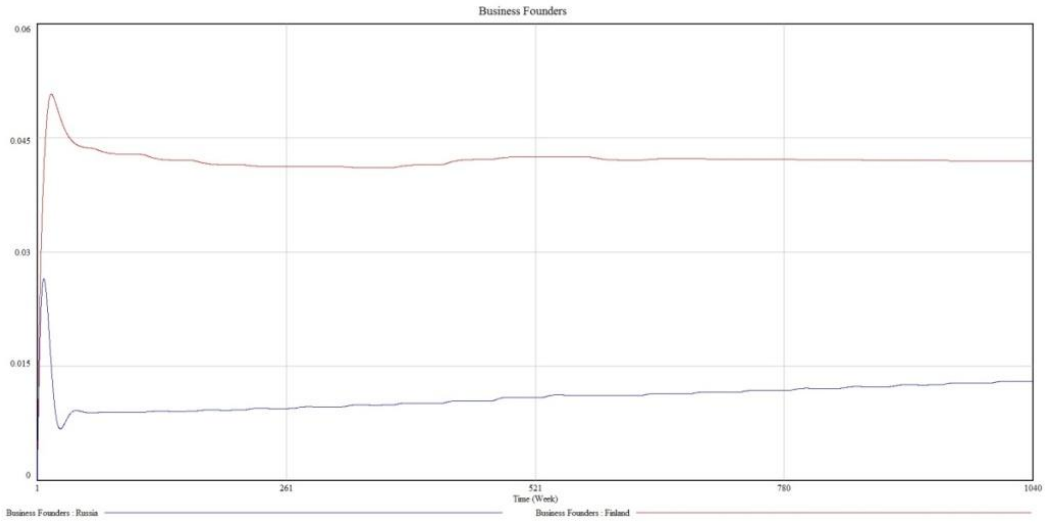

Figure 27: Amount of actual business founders

The overall results of the scenario are summarized in the following table.

Table 13: The results of Scenario 1

	Changes for the simulation period (%)		*Leading region*		*Difference between the regions (%)*	
	Finnish regions	Russian regions	In the beginning	In the end	In the beginning	In the end
Regions Population	-0,7	-14,54	NA	NA	NA	NA
Potential Entrepreneurs	-4,68	+21,89	NA	NA	NA	NA
Intentions Emergence	-3,62	+30,77	FI	RU	7,05	28,48
Aspiring Entrepreneurs	-3,68	+30,75	FI	RU	12,06	25,15
Opportunity recognition	-3,84	+31,04	FI	RU	41,48	6,05
Nascent Entrepreneurs	-3,90	+31,18	FI	FI	52,07	0,72
Venture Creation	-4,07	+31,42	FI	FI	95,56	29,87
Business Founders	-4,15	-30,8	FI	FI	391,02	266,26

6.2.2 Scenario 2: Sensitivity analysis: NIS factors versus entrepreneurial intentions

The main interest in this scenario was to evaluate the possible impact derived by NIS related factor in comparison with the entrepreneurial intentions effect. The results of sensitivity analysis are presented in Figure 28. For the sake of picture readability, only the maximum possible results are represented.

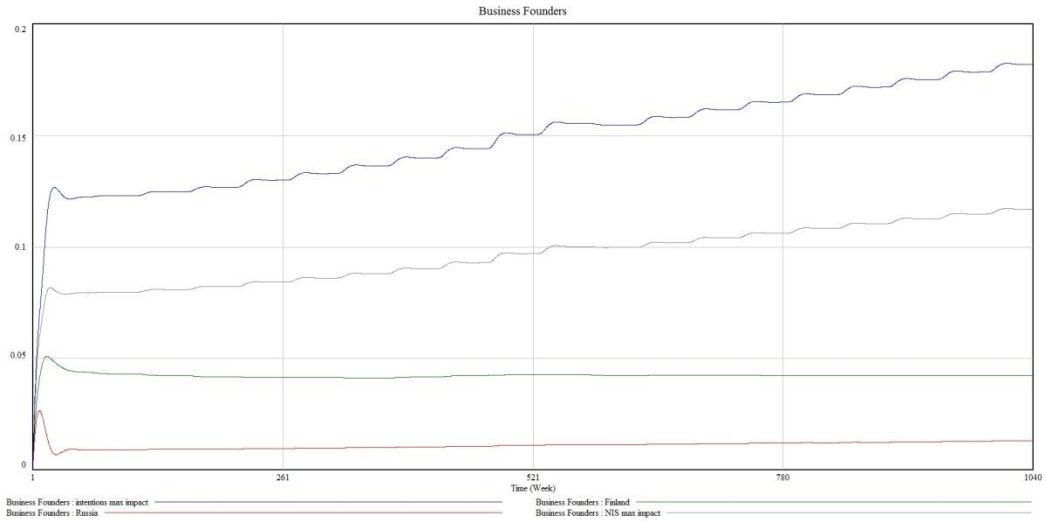

Figure 28: Impact of entrepreneurial attitudes and perception versus NIS factors on the amount of new ventures created

As it can be seen the NIS-related factors have lower impact on the process performance. The maximum possible outcome resulted from the improvement the intentions towards entrepreneurship is approximately two times greater. The same tendency reveals also at earlier stages of venture creation process. Nevertheless, even the improvement of only NIS performance in our simulation will allow Russian regions outperform Finland by the end of simulation period.

The results of the scenario are summarized in the following table.

Table 14: The results of Scenario 2

	Max possible improvement by the end of simulation period (%)	
	Intentions towards entrepreneurship	Entrepreneurial framework conditions
Intentions Emergence	58,93	45,24
Aspiring Entrepreneurs	63,96	49,12
Opportunity recognition	83,15	63,90
Nascent Entrepreneurs	85,75	67,85
Venture Creation	93,53	82,76
Business Founders	93,56	82,84

6.2.3 Scenario 3: Economic downturn

This scenario was supposed to model an abstract economic crisis situation where due to shortage of regular workplaces more people are forced to enter entrepreneurship career, but due to harsh economic condition country (or region) innovation system cannot provide enough level of support to new emerging firms.

The results demonstrate that though at earlier stages (for example intentions emergence-Figure 29) of the entrepreneurial process no dramatic changes appear, but when the process goes further the deteriorated NIS starts acting as a limiting factor which does not allow the entire flow of entrepreneurs successfully accomplish the final stage of venture creation process (Figure 30).

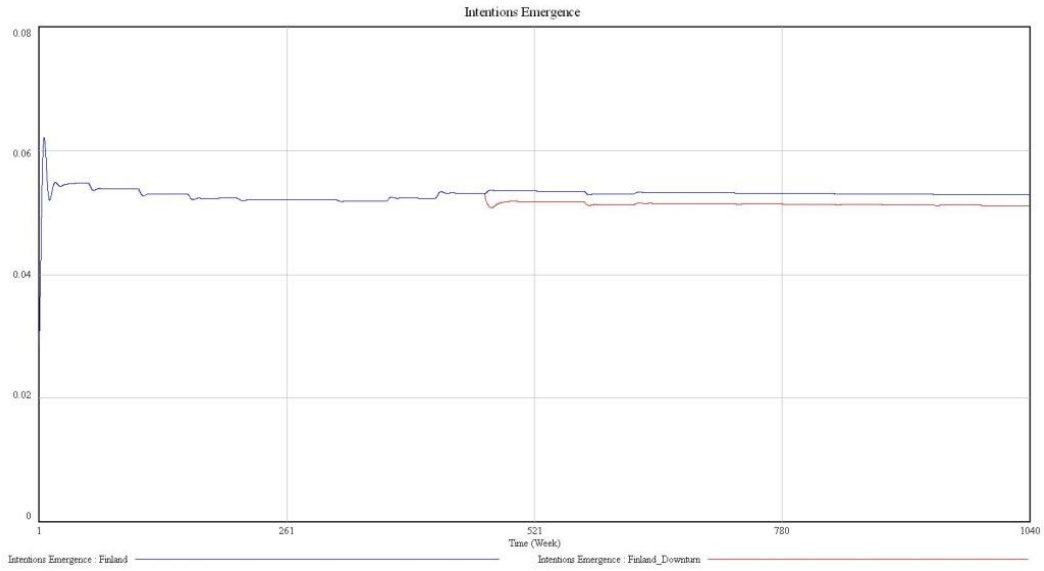

Figure 29: Intentions Emergence (results of normal settings run added for comparison)

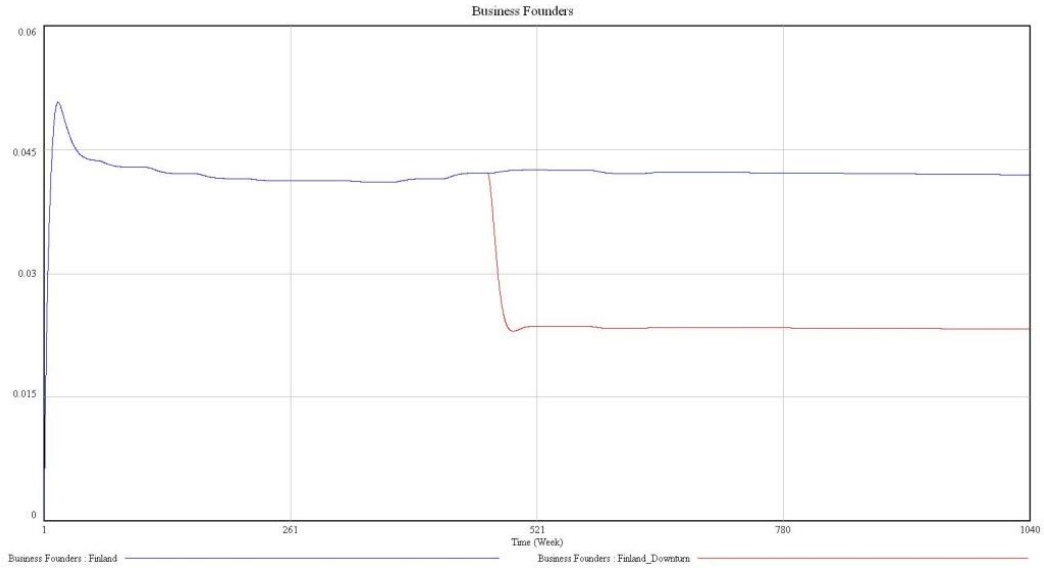

Figure 30: Business Founders (results of normal settings run added for comparison)

The results of the scenario are summarized in the following table.

Table 15: The results of Scenario 3

	Change in comparison with normal settings run (%)	
	Year after downturn	End of simulation period
Intentions Emergence	-3,39	-3,42
Aspiring Entrepreneurs	-4,94	-4,96
Opportunity recognition	-12,42	-12,42
Nascent Entrepreneurs	-14,33	-14,32
Venture Creation	-20,53	-20,50
Business Founders	-80,64	-80,78

6.2.4 Scenario 4: Business Incubator impact

The aim of the scenario was to estimate the possible positive impact on entrepreneurial framework conditions provided by Business Incubators. In order to achieve the scenario objectives was conducted Monte Carlo simulation for following set of factors:

- Access to Finances;
- Entrepreneurial Education;
- R&D Transfer;
- Commercial and Legal Infrastructure;
- Physical Infrastructure.

The simulation results reveal that properly functioning Business Incubators are able to noticeable improve the effectiveness of entrepreneurial venture creation process which reflects into consequent growth in the amount of new firms founded (Figure 31). For the sake of picture readability, only the maximum possible results are represented.

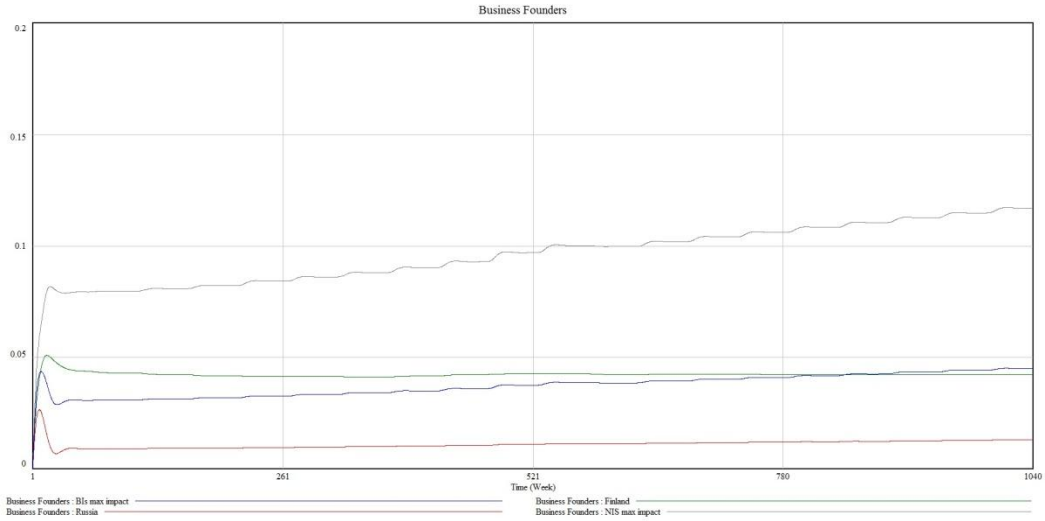

Figure 31: Business Founders (BIs impact)

Similarly, the positive impact of BI appears also at earlier stages of entrepreneurial process, moreover in these cases the positive changes may be even more significant (Figure 32).

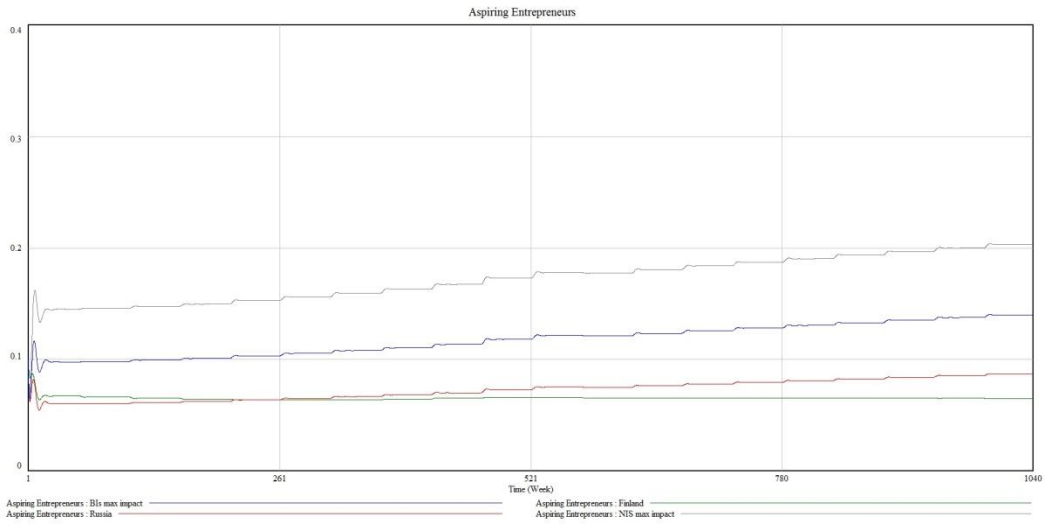

Figure 32: Aspiring Entrepreneurs (BIs impact)

The following table summarized the results of scenario.

Table 16: The results of Scenario 4

Indicator	Max possible improvement by the end of simulation period (%)
Intentions Emergence	28,92
Aspiring Entrepreneurs	30,80
Opportunity recognition	43,84
Nascent Entrepreneurs	51,01
Venture Creation	60,22
Business Founders	60,39

6.3 Discussion

In the following part we discuss achieved results. The discussion can be divided into two parts: firstly we consider overall impact of NIS factors on the entrepreneurial venture creation process and then we focus on positive effect which properly functioned Business Incubators can deliver.

6.3.1 Overall NIS impact

Though, overall individual perceptions and intentions towards entrepreneurship appear to demonstrate greater impact which supports position of such researchers as Tötterman (2006) or Armstrong and Hill (2009) who emphasized individual features and so-called “entrepreneurial drive” as a key prerequisite for success, our study reveals that properly developed NIS may also contribute significantly.

Moreover, since individual perceptions are deeply embedded into national culture they cannot be changed quickly. Thus, Finland in spite of well-developed NIS and extensive supporting programs still demonstrates relatively low entrepreneurial intentions which are, in fact, just slightly higher than in Russia (Bosma, et al., 2012).

Therefore, NIS conditions improvement is able to bring positive results in the shorter period of time. Though, the positive effect may not be so significant it is still noticeable. Thus in our study (Scenario 2) Russia was able to outperform Finland in situation with properly developed NIS as well.

Especially critical NIS improvement may become in case of population ageing when the pool of potential entrepreneurs decreases. Though Finnish focus regions do not suffer from severe population decrease, existed decline coupled with ageing trend appears to be enough to hamper the growth of potential entrepreneur pool. Nevertheless, such stagnation does not reveal in the immediate diminishing pool of newly established enterprises, because, due to well-developed NIS the number of process failures is relatively low (in other words, high percentage of individuals once entered entrepreneurial process end up with created venture).

However, if such demographical trend continues it can be predicted that even well-developed NIS will not be able to compensate the shortage of entrepreneurial pool and the decline begins. Russia, on the other hand, cannot properly realize its demographical advantage. Even though at initial stages of entrepreneurial process Russian regions are able demonstrate even better performance than Finnish regions, by the end of simulation period they are still lagging behind Finland in terms of ratio of new firm created to the actual region population. Such discrepancy between rates at earlier and later stages of venture creation process may suggest existence of certain bottlenecks which result into high amount of process failures.

Third scenario (economic downturn) provides additional insights on the relationship between NIS-related factors determining entrepreneurial framework conditions and individual attitudes towards entrepreneurship. Though in extreme cases individual perceptions are able to demonstrate greater impact, under more realistic arrangements they appear to be unable to compensate imperfect environmental conditions.

Again similar pattern reveals when at earlier stages the system have almost untouched performance but by the end of the process the flow of potential entrepreneurs decreases dramatically. In other words, the deteriorated NIS cannot

process the whole amount of individuals aiming to establish own firms which results into growing amount of failures.

We should notice, though, that at current stage the model does not take into account that an entrepreneur may still establish a company and survive in the market, even in contempt of harsh economic conditions (see for example case study by Tötterman, 2006). The simulation results present only the general tendency which occurs in such circumstances, and emphasize the importance of entrepreneurial support (or at least properly working NIS), especially when the amount of necessity-driven entrepreneurs is growing.

6.3.2 Business Incubators role

As it was proposed above the improvement of individual intentions towards entrepreneurship may provide better results on the overall new venture creation process performance. However, due to their nature they cannot be changed quickly. Moreover it seems to be difficult to affect them directly (Levie and Autio, 2008; Bosma et al., 2012).

At the same time focus only on intentions growth without paying attention to the simultaneous NIS development may not provide desirable result. Taking into account propositions of such researchers as Shane, (2003), Levie and Autio (2008) that perceptions about framework conditions may to certain extent shape perceptions about entrepreneurial career we can suggest improvement of framework conditions as a viable option for facilitating the entrepreneurial process.

Business incubators can be considered as an instrument for achieving such task. Even if they cannot change the whole country NIS, acting at regional level they improve local entrepreneurial environment. Our study reveals, though, that, BIs are capable to improve only certain framework conditions. Their impact on other factors, particularly those which are directly connected with the government (for example policy regulation or presence and content of special entrepreneurial programs) remains uncertain.

However, even the impact of improving the part of framework conditions is noticeable. Moreover, we can propose that BIs may facilitate also market dynamism by supporting the high tech start-ups which are able to produce radical innovations. Hence, the actual positive impact of BIs may be even greater.

At the same time, it should be always remembered that in this study we considered only the maximum possible outcome which may be unreachable in practice. Therefore, according to such scholars as Abduh et al., (2007), Bruneel at al., (2012), Dunaj et al., (2012) in order to work properly BIs should be properly managed, harmonize their aims and objectives in accordance to the residents' needs, offer balanced portfolio of services which should be constantly reviewed and if necessary upgraded.

Moreover, as Löfsten and Lindelöf (2002) noticed in order to function properly BIs should establish and maintain tight linkages with other actors of regional innovation system, particularly with universities. That allows achieve good R&D transfer which in turn facilitates the emergence of innovative highly productive ventures and therefore contributes to overall country economic growth.

7 CONCLUSIONS

The final part of the study intended to provide overall conclusions and answers on the research questions. We discuss study contribution and, taking into account existing limitations, also draw several directions for further research.

7.1 Final conclusion

The target of the study was to explore the possible degree of impact provided by NIS related factors on entrepreneurial venture creation process. We were particularly interested in system behaviour under certain circumstances such as potential entrepreneurs pool decrease and economic downturn resulted into eroding NIS performance. The additional objective of the study was to explore the possible ways of facilitating NIS performance, particularly by emergence of Business Incubators.

In respect to stated objective we introduced several research questions:

The main research question:

How does NIS influence the success of entrepreneurial process?

Sub-questions:

1) To what extent NIS can compensate the population ageing tendency and consequently possible decrease of potential entrepreneurs pool?

2) What is the maximum possible impact of NIS factors on the entrepreneurial venture creation process success in comparison with the impact of attitudes towards entrepreneurship?

3) How does poorly functioning NIS deal with increased potential entrepreneurs supply?

4) By improving which factors characterized entrepreneurial framework conditions BIs can facilitate the entrepreneurial process?

5) To what extent BIs can support the success of new ventures creation?

In order to answer these questions was conducted extensive literature analysis, and built the system dynamic model of the entrepreneurial venture creation process. The information from the recently conducted survey among firms BIs residents was applied as complementary source of secondary data. The developed and run scenarios allow make several conclusions:

1) Well-functioned NIS is able to maintain existing process performance (rates of new firm creation) in situations when population decrease is not severe. However it might be proposed that in more extreme cases the potential entrepreneurs pool may diminish to such extent that additional steps for improvement of NIS performance are required, otherwise the decline may start.

Alternatively, imperfect NIS does not allow regions realize their demographical advantage (in terms of the number of potential entrepreneur). In such situation increased flow of individuals willing to establish own venture results into growing amount of process failures which eventually may have negative feedback on the initial perceptions towards entrepreneurship.

2) The maximum impact provided by NIS-factors is noticeably lower than possible positive effect derived from high attitudes towards entrepreneurship. That conclusion goes in line with numerous research articles as well as with real-life examples which suggest that highly-motivated individual may overcome imperfect system environment and achieve the success.

On the other hand, the impact provided by NIS-factors is still noticeable. Moreover, since the individual attitudes and perceptions are largely embedded into country and national culture context they cannot be changed quickly, whereas NIS conditions appear to be relatively more flexible. That allows us make a proposition that positive effect from NIS conditions improvement might reveal in the shorter time period.

3) Importance of institutional framework reveals also in situations characterized by sudden increase of potential entrepreneurs pool, e.g. in case of economic downturn, when due to the shortage of regular working places more people are forced to enter entrepreneurial career, so-called necessity driven entrepreneurs.

Such people may not have strong entrepreneurial intentions and appropriate education as well as relevant previous experience. In such situation favorable framework conditions may bring noticeable contribution in facilitating the process.

4) On the basis of existing literature combined with survey results analysis we identified several entrepreneurial framework conditions factors which appear to be the most affected by BIs:

- Access to Finances;
- Entrepreneurial Education;
- R&D Transfer;
- Commercial and Legal Infrastructure;
- Physical Infrastructure.

5) Being able to directly affect only certain factors BIs have relatively moderate (but still noticeable) effect on the entrepreneurial venture creation process performance. However even such small improvements may trigger positive process of regional innovation system development and due to the relationships between NIS elements and actors facilitate the overall system advancement.

Therefore, our study reveals that well-developed NIS may provide positive effect on the entrepreneurial process performance and to certain extent compensate the shortage of potential entrepreneurs pool. Moreover, in some conditions NIS performance may have even greater importance to the process success than actual entrepreneurial intentions. BIs, though, being unable to radically change the whole entrepreneurial framework conditions, can be considered as a viable tool for improving the innovation system at local level.

7.2 Contribution

The study contributes by presenting system dynamics as a viable approach for studying entrepreneurial process. Due to several advantages over conventional methodologies applying system dynamics allows achieve additional insights and increased understanding of processes relating to emergence of new firms within NIS. It can be applied in combination with other tools for assessment of NIS

performance and elaborating policy recommendations for further system development.

The proposed model implies indicators based on well-established GEM-model, which in addition to increased reliability and validity provides access to rich database collected for more than 10 years (first GEM report was published in 1999). That spread model application area also to practitioners.

Policy makers could use the model for distinguishing the weaknesses of innovation system support for entrepreneurship and taking measures for addressing the most critical ones. The model can be also used in various benchmarking studies since it provides a very explicit view in what extent certain country NIS facilitates the entrepreneurial process.

7.3 Suggestions for further research

The major limitation of the developed model arises from the fact that, though it implies some factors representing performance of NIS, the actual NIS is not modelled. Therefore the relationships between NIS elements are not properly captured. That may add certain bias in long-term scenarios, whereas should not affect current state countries comparison since the implied indicators (GEM, GCI) already represent the exact NIS performance caused also by relationships between NIS actors.

Therefore, the valuable direction for further research can be an expansion of the system dynamic model aiming to capture actual NIS behaviour. Though modelling of country NIS appears to be a complex task, being properly accomplished it increases the degree of model dynamic and allows to achieve more reliable forecasts.

REFERENCES

Abduh, M., D'Souza, C., Quazi, A., and Burley, H., T. (2007) Investigating and classifying clients' satisfaction with business incubator services. *Managing Service Quality*, Vol 17, No. 1, pp. 74-91

Acs, Z. (2006) How is entrepreneurship good for economic growth? *Innovations*, 1, pp. 97-107

Acs, Z., J., Desai, S., and Klapper, L., F. (2008) What does "entrepreneurship" data really show? *Small Business Economics*, 31(3)

Acs, Z., and Szerb, L. (2007) Entrepreneurship, economic growth and public policy. *Small Business Economics*, 28 (2/3), pp. 109-122

Acs, Z., J. and Varga, A. (2005) Entrepreneurship, agglomeration and technological change. *Small Business Economics*, 24(3), pp. 323-334

Armstrong, S., J. and Hill, A. (2009) Cognitive Style and Entrepreneurial Drive of New and Mature Business Owner-Managers. *Journal of Business and Psychology*, 24, pp. 419-430

Atherton, A. (2007) Preparing for business start-up: "pre-start" activities in the new venture creation dynamic. *Journal of Small Business and Enterprise Development*, Vol. 14 No. 3, pp. 404-417

Baker, T. and Nelson, R., E. (2005) Creating Something from Nothing: Resource Construction through Entrepreneurial Bricolage. *Administrative Science Quarterly*, 50 pp. 329–366

Banks, J. (1998). "Principles of Simulation", in Banks, J. (ed.), *Handbook of Simulations – Principles, Methodology, Advances, Applications, and Practice*. USA: John Wiley & Sons, Inc.

Banks, J., Carson II, J.S., Nelson, B.L. and Nicol, D.M. (2005) *Discrete-Event System Simulation. 5th edition*, USA: Pearson Education.

Bosma, N., Wennekers, S. and Amoros, J., E. (2012) Global Entrepreneurship Monitor 2011 Extended Report. GERA

Bruneel, J., Ratinho, T., Clarysse, B., and Groen, A. (2012) The Evolution of Business Incubators: Comparing demand and supply of business incubation services across different incubator generations. *Technovation*, 32, pp. 110-121

Bruton, G. D., Ahlstrom, D., and Li, H. L. (2010). Institutional theory and entrepreneurship: where are we now and where do we need to move in the future? *Entrepreneurship Theory and Practice*, 34(3), pp. 421– 440.

Busenitz, L., W. and Lau, C., M. (1996) A cross-cultural cognitive model of new venture creation. *Entrepreneurship, Theory and Practice*, 20, pp.25-39

Bygrave, W., D., and Hofer, C., W. (1991) Theorizing about Entrepreneurship. *Entrepreneurship Theory and Practice*, 16, pp. 13-22

Cantillon, R. (1755/2001). *Essay on the nature of commerce in general*. New Brunswick, NJ: Transaction Publishers.

Carree, M., A., and Thurik, A., R. (2000) The life cycle of the U.S. tire industry. *Southern Economic Journal*, 67(2), pp. 254-287

Choi, Y., R. and Phan, P., H. (2006) The Influences of Economic and Technology Policy on the Dynamics of New Firm Formation. *Small Business Economics*, 26, pp. 493–503

Choo, S., and Wong, M. (2006) Entrepreneurial intention: Triggers and barriers to new venture creation in Singapore. *Singapore Management Review*, 28 (2), pp. 47-64

Colombo, M.G., Delmastro, M. (2002) How effective are technology incubators? Evidence from Italy. *Research Policy*, 31, pp.1102–1122

Cooke, P. (1992) Regional innovation systems: competitive regulation in the new Europe, *GeoForum*, Vol. 23, pp.365–382

Cumming, D., and Knill, A. (2012) Disclosure, venture capital and entrepreneurial spawning. *Journal of International Business Studies*, 43, pp. 563–590

Cunneen, D., J. and Mankelow, G., J. (2007) Towards a Process Model of Independent Growth Firm Creation. *Small Enterprise Research: The Journal of SEAANZ*, Vol. 15, Issue 1

Dahles, H. (2005) Culture, capitalism and political entrepreneurship: Transitional business ventures of the Singapore Chinese in China. *Culture and Organization*, 11(1), pp. 45-58

Delmar, F., and Shane, S. (2003) Does business planning facilitate the development of new ventures? *Strategic Management Journal*, 24(12), pp. 1165-1185

DeTienne, D., and Chandler, G. (2004) Opportunity identification and its role in the entrepreneurial classroom: A pedagogical approach and empirical test. *Academy of Management Learning and Education*, 3(3), pp. 242-257

Dirks, S., Keeling, M. (2009) Russia's productivity imperative. IBM Global Business Service. Executive Report.

Dunaj, M., Narielvala, Y., and Arunov, E. (2012) Reviewing Corporate Incubation Success Factors – An Exploratory Study. Proceeding of *The XXIII ISPIM Conference – Action for Innovation: Innovating from Experience* – in Barcelona, Spain on 17-20 June 2012. Conference paper

Dunaj, M. (2013) Business Incubation – Four Models for Future Success of Start-ups? *The ISPIM Magazine* (2) [online] Available from: http://magazine.ispim.org/2013/03/business-incubation-four-models-for-future-success-of-start-ups/ [Accessed 07.05.13]

Etzkowitz, H. and Leydesdorff, L. (2000) The dynamics of innovation: from National Systems and 'Mode2' to a Triple Helix of university–industry–government relations, *Research Policy*, Vol. 29, pp.109–123.

Ferreira, J., J., Raposo, M., L., Rodrigues, R., G., Dinis, A., and do Paco, A. (2012) A model of entrepreneurial intention: An application of the psychological and behavioral approaches. *Journal of Small Business and Enterprise Development*, Vol. 19, No. 3, pp. 424-440

Forrester, J.W., (1958) Industrial dynamics - a major breakthrough for decision makers. *Harvard Business Review*, 36(4), pp.37-66

Forrester, J., W. (1989) The System Dynamics National Model: Macrobehaviour from Microstructure. Paper read at Computer-Based Management of Complex Systems: International System Dynamics Conference, at Stuttgart.

Freeman, C. (1982) Technological infrastructure and international competitiveness, Draft paper at the OECD Ad Hoc Group on Science, Technology and Competitiveness, August 1982

Freeman, C. (1987) *Technology policy and economic performance: lessons from Japan*. London: Printer Publishers.

Gartner, W., B. (1988) "Who is an entrepreneur?" Is the wrong question. *American Journal of Small Business*, Vol. 12, Issue 4, pp. 11-32

Gartner, W., and Liao, J. (2012) The effects of perceptions of risk, environmental uncertainty, and growth aspirations on new venture creation success. *Small Business Economics*, 39, pp. 703-712

Gary, M., S., Kunc, M., Morecroft, J., D., W. and Rockard, S., F. (2008) System dynamics and strategy. *System Dynamics Review*, 24(4), pp. 407-429

Grebel, T., Pyka, A. and Hanusch, H. (2003) An Evolutionary Approach to the Theory of Entrepreneurship. *Industry and Innovation*, Vol. 10, Issue 4, pp. 493-514

Greenhalg, C. & Rogers, M. (2010) *Innovation, Intellectual Property, and Economic Growth*. USA: Princeton University Press.

Gries, T. and Naude, W. (2009) Entrepreneurship and regional economic growth: towards a general theory of start-ups. *Innovation-The European Journal of Social Research*, Vol. 22, No. 3, pp. 309-328

Gilbert, B., A., Audretsch, D., B and McDougall, P., P. (2004) The Emergence of Entrepreneurial Policy. *Small Business Economics*, 40, pp. 313-323

Hackett, S.M, Dilts, D.M. (2004) .A systematic review of business incubation research. *Journal of Technology Transfer*, 29(1), pp55–82.

Han, Jing-Yuan, Yang, Yan-Bo and Zhao, Yun-He (2012) Evaluation of Entrepreneurial Environment Based on Fuzzy Comprehensive Evaluation Method. International Conference on Machine Learning and Cybernetics, Xian, 15-17 July, 2012. Conference Paper.

Harrison, J., R., Lin, Z., Caroll, G., R. and Carley, K., M. (2007) Simulation modelling in organizational and management research. *Academy of Management Review*, 32 (4), pp. 1229-1245

Hart, D., M. (2003) Entrepreneurship policy: what it is and where it came from. *In*: D.M. Hart, ed. *The emergence of entrepreneurship policy: governance, start-ups and growth in the US knowledge economy*. Cambridge: Cambridge University Press, 3-19.

Herron, L. and Sapienza, H., J. (1992) The Entrepreneur and the Initiation of New Venture Launch Activities. *Entrepreneurship Theory and Practice*, Vol. 17, No. 1, pp. 49-55.

Hofstede, G. (1980) *Culture's consequences: International differences in work-related values*. Beverly Hills, CA: Sage Publishers

Honig, B. (2004) Entrepreneurship education: Toward a model of contingency-based business planning. *Academy of Management Learning and Education*, 3(3), pp. 258-273

Jensen, C. and Tragardh, B. (2004). Narrating the Triple Helix concept in "weak" regions:lessons from Sweden, *International Journal of Technology Management*, 27(5), pp. 513-530.

Kaartemo, V. (2009) *Russian innovation system in international comparison-the BRIC countries in focus*. Electronic Publications of Pan-European Institute. [online] Available form: http://www.utu.fi/fi/yksikot/tse/yksikot/PEI/raportit-ja-tietopaketit/Documents/Kaartemo_Russian%20innovation%20system%20in%20international%20comparison_2209%20web.pdf [Accessed 07.05.13]

Klapper, L., Laeven, L., and Rajan, R. (2006) Entry regulation as a barrier to entrepreneurship. *Journal of Financial Economics*, 82, pp. 591-629

Klepper, S. (2002) The capabilities of new firms and the evolution of the US automobile industry. *Industrial and Corporate Change*, 11(4), pp. 645-666

Knight, F. H. (1921). *Risk, uncertainty and profit*. Boston, MA: Houghton Mifflin Company.

Kortelainen, S. (2011) *Analysis of the Sources of Sustained Competitive Advantage: System Dynamics Approach*, Acta Universitatis Lappeenrantaensis 421, Lappeenrannan teknillinen yliopisto, Lappeenranta, Finland

Learned, K., E. (1992) What happened before the organization? A model of organizational formation. *Entrepreneurship, Theory and Practice*, 17, pp. 39-48

Levie, J. and Autio, E. (2008) A theoretical grounding and test of the Gem model. *Small Business Economics*. 31, pp. 235-263

Lim, S., K., D., Morse, E., A., Mitchell, R., K., and Seawright, K.,K. (2010) Institutional Environment and Entrepreneurial Cognitions: A Comparative Business Systems Perspective. *Entrepreneurship Theory and Practice*, pp. 493-516

Lundvall, B., A. (1992) *National Systems of Innovation. Towards a Theory of Innovation and Interactive Learning*. London and New York: Printer Publishers.

Lyneis, J., M. (2000) System Dynamics for Market Forecasting and Structural Analysis. *System Dynamics Review*, 16 (1), pp. 3-25

Lättilä. L. (2008) Combining Advanced Forecasting Methods with System Dynamics – the Case of Finnish Seaports. *Master's Thesis*. Lappeenranta University of Technology.

Lättilä, L. (2011) Modelling Seaports with Agent-Based Modelling and System Dynamics. *International Journal of Logistics Systems and Management*, 10(1), pp. 90 -109

Löfsten, H., and Lindelöf, P. (2001) Science Parks in Sweden— industrial renewal and development? *R&D Management* 31 (3), pp. 309–322.

Löfsten, H., and Lindelöf, P. (2002) Science Parks and the growth of new technology-based firms—academic-industry links, innovation and markets. *Research Policy*, 31, pp. 859-876

Markova, S. and Petkovska-Mircevska, T. (2009) Financing Options for Entrepreneurial Ventres. *The Amfiteatru Economic Journal*, Vol. 11, Issue 26, pp. 597-604

MES (2009) *National Innovation System and state innovation policy of the Russian Federation.* Ministry of Education and Science of the Russian Federation. Moscow

Mian, S. (1997) Assessing and managing the university technology business incubator: an integrative framework. *Journal of Business Venturing*, 12, pp. 251–285.

Misra, K., Memili, E., Welsh, D., H., B., and Sarkar, S. (2012) The determinants of venture creation time: a cross-country perspective. *International Entrepreneurship and Management Journal*

Moroz, P., W. and Hindle, K. (2012) Entrepreneurship as a Process: Toward harmonizing Multiple Perspectives. *Entrepreneurship Theory and Practice*, Vol. 36, Issue 4, pp. 781–818

Morrison A., Breen, J., and Ali, S. (2003) Small Business Growth: Intention, Ability, and Opportunity. *Journal of Small Business Management*, 41(4), pp. 417-425

Naffziger, W., N., Hornsby, J., S. and Kuratko, D., F. (1994) A proposed model of entrepreneurial motivation. *Entrepreneurship, Theory and Practice*, 18, pp. 29-42

Nelson, R. (1993) *National Innovation Systems: A Comparative Analysis*. New York and Oxford: Oxford University Press.

Newbert, S., L. (2005) New Firm formation: A Dynamic Capability Perspective. *Journal of Small Business Management*, 43(1), pp. 55-77

North, M.,J., and Macal, C.,M. (2007), *Managing Business Complexity – Discovering Strategic Solutions with Agent-Based Modeling and Simulation*, USA: Oxford University Press.

O'Gorman, C. (2003) Stimulating high-tech venture creation. *R&D Management* 33, 2, pp. 177-187

Peterman, N., and Kennedy, J. (2003) Enterprise education: Influencing students' perceptions of entrepreneurship. *Entrepreneurship Theory and Practice*, 28, pp. 129-144

Rauch, A. and Frese, M. (2000) Psychological approaches to entrepreneurial success: A general model and an overview of findings. *International Review of Industrial and Organizational Psychology*, 15, pp. 101-143

Reitan, B.(1997) Fostering technical entrepreneurship in research communities: granting scholarships to would-be entrepreneurs. *Technovation*, 17(6), pp.287–296.

Reynolds, P., D., Hay, M and Camp, M., S. (1999) *Global entrepreneurship monitor 1999 executive report*. Babson Park, MA: Babson College; London, UK: London Business School.

Rice, M., P. (2002) Co-production of Business Assistance in Business Incubators. An Exploratory Study. *Journal of Business Venturing*, pp. 163–187.

Roberts, E.B., (1978) *Managerial applications of system dynamics*, Cambridge, England: Productivity Press

Robinson, S. (2004), *Simulation: The Practice of Model Development and Use*. England: John Wiley & Sons

Rotefoss, B., and Kolvereid, L. (2005) Aspiring, nascent and fledgling entrepreneurs:
an investigation of the business start-up process. *Entrepreneurship and Regional Development*, 17, pp. 109-127

Santonen, T., Kaivo-oja, J. and Antikainen, M. (2008) National open innovation system (NOIS): Defining a solid reward model for NOIS, Conference paper, 1st ISPIM Innovation Symposium, 14-17 December Singapore.

Saunders, M., Lewis, P. and Thornhill, A. (2009) *Research methods for business students*. Essex, England: Pearson Education Limited

Savitskaya, I (2011) Environmental Influences on the Adoption of Open Innovation: Analysis of Structural, Institutional and Cultural Impacts. *Acta Universitatis, Lappeenrantaensis*, 439

Savitskaya, I. and Torkkeli, M. (2011) A Framework for Comparing Regional Open Innovation Systems in Russia, *International Journal of Business Innovation and Research*, Vol. 5, No.3.

Scillitoe, J., L., and Chakrabarti, A., K. (2010) The role of incubator interactions in assisting new ventures. *Technovation* (30), pp. 155-167

Shane, S., and Venkataraman, S. (2000) The promise of Entrepreneurship as a Field of Research. *Academy of Management Review*, Vol. 25, No. 1, pp. 217-226

Shane, S. (2003) *A General Theory of Entrepreneurship: The individual-opportunity nexus*. Cheltenham, UK.: Edward Elgar Publishing

Shook, C., L., Priem, R., L., and McGee, J. (2003) Venture Creation and the Entrepresing Individual: A Review and Synthesis. *Journal of Management*, Vol. 29, Issue 3, pp. 379-399

Simon, H.A. (1996) *The Sciences of the Artificial*. 3rd ed. Massachusetts Institute of Technology

Stenholm, P., Acs, J., Z. and Wuebker, R. (2013) Exploring country-level institutional arrangements on the rate and type of entrepreneurial activity. *Journal of Business Venturing*, 28, pp. 176-193

Sterman, J., D. (2000) *Business Dynamics. System Thinking and Modeling for a complex world.* Boston: Mc Graw Hill Higher Education.

Torkkeli, M., Kotonen, T. and Ahonen, P. (2007) Regional open innovation system as a platform for SMEs: a survey, *International Journal of Foresight and Innovation Policy*, Vol. 3, No. 4,

Townshed, D., M., Busenitz, L., W., and Arthurs, J., D. (2010) To start or not to start: Outcome and ability expectations in the decision to start a new venture. *Journal of Business Venturing* 25, pp. 192–202

Tötterman, H. (2006) The Design Venture Creation Process: From Theoretical Conceptualization to Empirical Indication. Proceeding of *3rd EDP Workshop*, Universitat Autònoma de Barcelona, 6-7th April, 2006. Conference paper

Uriona, M., Pietrobon, R., Varvakis, G. and Carvalho, E. (Forthcoming) A Preliminary Model of Innovation System.

Valliere, D. (2010) Reconceptualizing entrepreneurial framework conditions. *International Entrepreneurship and Management Journal*, Vol. 6, Issue 1, pp. 97-112

Van Gelderen, M., Thurik, R. and Bosma, N. (2006) Success and Risk Factors in the Pre-Startup Phase. *Small Business Economics*, Vol 26, Issue 4, pp. 319-335

Von Mises, L. (1949) *Human action*. New Haven: Yale University Press.

WEF (2011) *The Global Competitiveness Report 2011-2012.* World Economic Forum.

Wennekers, S., van Stel, A., Thurik, R. and Reynolds, P. (2005) Nascent Entrepreneurship and the Level of Economic Development. *Small Business Economics*, 24, pp. 293-309

White, S., B. and Reynolds, P., D. (1996) Government programs and high growth new firms. In P. D. Reynolds, S. Birley, J. E. Butler, P. Davidsson, W. B. Gartner & P. P. McDougall (Eds.) *Frontiers of entrepreneurship research* (pp. 621-635). Wellesley, MA: Babson College.

Zhebit, M. (2012) Razvitie innovaciy v goskompaniyah otstayet ot plana. *Izvestia*. [online] Aailable from: http://www.izvestia.ru/news/517995
[Accessed 10.04.12]

APPENDIX 1: QUESTIONNAIRE

Learning from Best Practices of Business Incubation of High-Tech Start-Ups

SURVEY 2013

1. COMPANY

1.1. Company Name	
1.2. Location	
1.3. Incubator, where company is located (name and location)	
1.4. The Interviewee (name, position in the company)	

2. COMPANY DETAILS

2.1. What is the company main activity, product or service?	
2.2. Industry	
2.3. Legal Status	☐ Public entity ☐ Private company ☐ Other _____
2.3.1. Please, mark the share of governmental ownership, in %	
2.3.2. Please, mark the share of foreign ownership, in %	
2.4. Is the company a subsidiary of another organization?	☐ Yes ☐ No
2.5. When you company entered incubator? Year	
2.6. What was the status of the company when it first started operating at the incubator?	☐ Start-up ☐ Existing firm
2.6.1. If it was existing company, when it moved to incubator, where did it come from?	☐ Same area ☐ Elsewhere in country ☐ Another country
2.7. Is the company's main site in incubator?	☐ Yes ☐ No
2.8. Does the company have operations elsewhere?	☐ Yes ☐ No
2.9. How many people does the company employ at the incubator location? Please, provide details for the last three years **2.9.1. Number of full time staff** **2.9.2. Number of part time staff**	**2011** / **2012** / **2013** [ ] / [ ] / [ ] [ ] / [ ] / [ ]
2.10. How many people does company employ at other locations?	**2011** / **2012** / **2013** [ ] / [ ] / [ ]
2.11. What type of qualifications does your company's staff has?	☐ No qualifications ☐ Vocational qualifications ☐ University degree

	☐ Other _____
2.12. Where does most of the company's staff come from? Please, indicate the approximate proportion (%)	**Same area** / **Elsewhere in country** / **Another country** _____ / _____ / _____
2.13. What is the company's turnover? Please, provide details (euro thousands) for the past 3 years	**2011** / **2012** / **2013** _____ / _____ / _____
2.14. Approximate what proportion of company's turnover is invested in R&D (R&D Intensity)? Please, choose the most appropriate answer	☐ 0 – 0,5% ☐ 0,5 – 1% ☐ 1- 1,5% ☐ 1,5 – 3% ☐ 3 – 5% ☐ 5-10% ☐ More than 10 %
2.15. Approximate what proportion of company's turnover is invested in training? Please, choose the most appropriate answer	☐ 0 – 0,5% ☐ 0,5 – 1% ☐ 1- 1,5% ☐ 1,5 – 3% ☐ 3 – 5% ☐ 5-10% ☐ More than 10 %
2.16. Where are the company's main customers located?	☐ Same area ☐ Elsewhere in country ☐ Another country
2.17. Where are the company's main competitors located?	☐ Same area ☐ Elsewhere in country ☐ Another country
2.18 What was your company's goal when entering incubator?	
2.18.1. Has this goal been realised?	☐ Yes ☐ No
2.18.2. If yes, how has it been realised?	
2.18.3. If not, why has it not been realised?	
2.19. What are the core problems your company face to achieve stable growth rate?	
2.19.1. How do you think, can these problems be overcome by incubation?	

3. ROLE OF INCUBATOR

3.1. Why did your company decide to obtain premises at the incubator? A) Please rank the following reasons for locating at Incubator in grey boxes below (1 most important, 2, 3, 4, …7 least important)	**B) Please, evaluate the importance of each factor from 1 to 7** **1 – Not important, 7 – Most Important**						
☐ **Favorable location**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
☐ **Image**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
☐ **Quality, price and flexible terms for incubator units**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

☐ **Availability of professional business support services**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
☐ **Quality of professional business support services**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
☐ **Clustering and opportunity to network with similar business**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
☐ **Other factors:_____**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

3.2. Which incubator services have been particularly useful? A) Please rank the following services in grey boxes below (1 most important, 2, 3, 4, …8 least important)	**B) Please, evaluate the importance of each service from 1 to 7 1 – Not important, 7 – Most Important**						
☐ **Pre-Incubation Services**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
☐ **Business planning and forming a company**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
☐ **Training to develop business skills**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
☐ **Advice on development of new products and services**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
☐ **Help with raising bank finance**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
☐ **Access to grants, seed and venture capital funding**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
☐ **Advice on recruitment of staff and personnel management**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
☐ **Other professional services: _____**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

3.2.1. Has your company been required to pay for professional services?	☐ Yes ☐ No
If yes, do you think that charges are reasonable?	☐ Yes ☐ No
If no, would your company be prepared to pay?	☐ Yes ☐ No

3.3. Please, evaluate the incubator's support services. A) Please rank the following services in grey boxes below (1 most important, 4 least important)	**B) Please, evaluate the importance of each service from 1 to 7 1 – Not important, 7 – Most Important**						
☐ **Secretarial and office services**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
☐ **Cleaning and maintenance**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
☐ **Meeting rooms, restaurant**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
☐ **Other support services:_____**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

3.4. How would you rate the incubator units in terms of price and quality?	**Please, evaluate from 1 to 7 1 –Poor, 7 – Excellent**						
☐ **Quality of incubator units**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
☐ **Rental changes for incubator units**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

3.5. How important has the support of incubator been to the development of your company? Please, tick the box that best describes your view?	☐ Critical – Without support, our company would not survive ☐ Very Important – The support has been very helpful for our company survival and to achieve stable growth rate ☐ Important – The support has been helpful, but not critical for company survival, but crucial for company's success ☐ Not very important - We see some benefits of location in incubator

	☐ Not important – Our company would have do as well elsewhere

3.6. Please, use the pace below, to explain how the business incubator has contributed to your company's success and how the business incubator might improve its services in the future?

4. GRADUATE COMPANIES

4.1. When did your company leave the incubator? Year	

4.2. Why did your company leave the incubator? A) Please, rank the following reasons in order of importance (1 most important, 4 least important)	**B) Please, evaluate the importance of each reason from 1 to 7 1 – Not important, 7 – Most Important**						
☐ **Tenancy was for a fixed period**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
☐ **Company needed more room to expand**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
☐ **Company found better and / or cheaper premises elsewhere**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
☐ **Other reasons:_____**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

4.3. Where did your company move to?	☐ Same area ☐ Elsewhere in country ☐ Another country
4.4. At the time when the company left the incubator, how many people did it employ and how many people does it employ now? Number of employees when left incubator? Number of employees now?	
4.5. Looking back, how important was the support provided by the business incubator on your company's development? Please, tick the box that best describes your view?	☐ Critical – Without support, our company would not survive ☐ Very Important – The support has been very helpful for our company survival and to achieve stable growth rate ☐ Important – The support has been helpful, but not critical for company survival, but crucial for company's success ☐ Not very important - We see some benefits of location in incubator ☐ Not important – Our company would have do as well elsewhere
4.6. Have your company experienced growth since graduation?	☐ Yes ☐ No
4.6.1. If yes, how much has the company grown (e.g. turnover, rate of export, etc)?	
4.6.2. If not, what has been the major obstacle for growth?	

5. EXTERNAL FACTORS

5.1. Estimate the role of external factors in the decision to <u>become an entrepreneur</u> A) Please, rank the following factors in order of importance (1 most important, 11 - least important)	B) Please, evaluate the importance of each factor from 1 to 7 1 – Not important, 7 – Most Important						
1. ☐ Access to Finances (Bank credits, Venture capital)	1	2	3	4	5	6	7
2. ☐ General Country Political Environment	1	2	3	4	5	6	7
3. ☐ Policy Regulations (Firm registration, taxes)	1	2	3	4	5	6	7
4. ☐ Government Entrepreneurship Programs	1	2	3	4	5	6	7
5. ☐ Education level	1	2	3	4	5	6	7
6. ☐ R&D Transfer (Access to new technology)	1	2	3	4	5	6	7
7. ☐ Commercial and Legal Infrastructure	1	2	3	4	5	6	7
8. ☐ Market Dynamism	1	2	3	4	5	6	7
9. ☐ Market Openness	1	2	3	4	5	6	7
10. ☐ Physical Infrastructure	1	2	3	4	5	6	7
11. ☐ Cultural and Social Norms	1	2	3	4	5	6	7

5.2. Estimate the role of external factors in the <u>opportunities recognition and evaluation process</u> A) Please, rank the following factors in order of importance (1 most important, 11 least important)	B) Please, evaluate the importance of each factor from 1 to 7 1 – Not important, 7 – Most Important						
1. ☐ Access to Finances (Bank credits, Venture capital)	1	2	3	4	5	6	7
2. ☐ General Country Political Environment	1	2	3	4	5	6	7
3. ☐ Policy Regulations (Actual firm registration, taxes)	1	2	3	4	5	6	7
4. ☐ Government Entrepreneurship Programs	1	2	3	4	5	6	7
5. ☐ Education level	1	2	3	4	5	6	7
6. ☐ R&D Transfer (Access to new technology)	1	2	3	4	5	6	7
7. ☐ Commercial and Legal Infrastructure	1	2	3	4	5	6	7
8. ☐ Market Dynamism	1	2	3	4	5	6	7
9. ☐ Market Openness	1	2	3	4	5	6	7
10. ☐ Physical Infrastructure	1	2	3	4	5	6	7
11. ☐ Cultural and Social Norms	1	2	3	4	5	6	7

5.3. Estimate the role of external factors in the <u>firm creation process</u>. A) Please, rank the following factors in order of importance (1 most important, 11 - least important)	B) Please, evaluate the importance of each factor from 1 to 7 1 – Not important, 7 – Most Important						
1. ☐ Access to Finances (Bank credits, Venture capital)	1	2	3	4	5	6	7
2. ☐ General Country Political Environment	1	2	3	4	5	6	7
3. ☐ Policy Regulations (Actual firm	1	2	3	4	5	6	7

registration, taxes)							
4. ☐ Government Entrepreneurship Programs	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5. ☐ Education level	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6. ☐ R&D Transfer (Access to new technology)	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7. ☐ Commercial and Legal Infrastructure	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8. ☐ Market Dynamism	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9. ☐ Market Openness	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10. ☐ Physical Infrastructure	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11. ☐ Cultural and Social Norms	**1**	**2**	**3**	**4**	**5**	**6**	**7**

5.4. Estimate the role of external factors on the <u>decision to enter the business incubator</u>. A) Please, rank the following factors in order of importance (1 most important, 2, 3, 4 least important)	**B) Please, evaluate the importance of each factor from 1 to 7 1 – Not important, 7 – Most Important**						
1. ☐ Access to Finances (Bank credits, Venture capital)	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2. ☐ General Country Political Environment	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3. ☐ Policy Regulations (Actual firm registration, taxes)	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4. ☐ Government Entrepreneurship Programs	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5. ☐ Education level	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6. ☐ R&D Transfer (Access to new technology)	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7. ☐ Commercial and Legal Infrastructure	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8. ☐ Market Dynamism	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9. ☐ Market Openness	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10. ☐ Physical Infrastructure	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11. ☐ Cultural and Social Norms	**1**	**2**	**3**	**4**	**5**	**6**	**7**

5.5. What form of government involvement did you experience most as the start-up company?	

5.6. Was this influence of government on your business…	☐ Positive ☐ Negative ☐ No influence ☐ I don't know

5.7. Do you feel that you company succeeded thanks to the favourable governmental policy?	☐ Yes ☐ No ☐ I don't know

5.8. What do you think government / regional authorities do to support start-ups?	

APPENDIX 2: RESPONDENTS PROFILE

	Finland			*Hungary*			*Russia*		
	1	2	3	1	2	3	1	2	3
When you company entered incubator? Year	2010	2013	2006	2012	2007	2013	2011	2013	2012
Is the company's main site in incubator?	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes
Does the company has operations elsewhere?	No	No	No	Yes	Yes	Yes	No	No	Yes
Personnel: How many people does the company employ at the incubator location? Number of full time staff 2011	1	0	2	0	12	-	0	0	3
2012	2	0	3	0	13	-	6	0	5
2013	4	1	3	0	18	0	4	1	5
Number of part time staff 2011	0	0	2	-	1	-	2	0	0
2012	1	0	3	1	1	-	0	0	0
2013	3	2	3	1	1	0	2	3	0
How many people does company employ at other locations?	2	0	0	1	8	7	0	0	0
What type of qualifications does your company's staff have? U-university degree	U	U	U	U	U	U	U	U	U
Turnover (euro thousands) 2011	20	0		16	1000	-	0	0	
2012	100	0		116	900	-	0	0	
2013	150	10		N/A	1100	N/A	1	0	
Approximate what proportion of company's turnover is invested in R&D (R&D Intensity)?	10% and more	3-5	0-0.5	0-0.5	10% and more	N/A	10% and more	n/a	10% and more
Approximate what proportion of company's turnover is invested in training?	10% and more	0-0.5	0.5-1	0-0.5	1-1.5	N/A	0,5-1	n/a	10% and more
Where are the company's main customers?	FIN	FIN	FIN, INT	HU	INT	N/A	RU	RU	RU
Where are the company's main competitors?	INT	INT	FIN, INT	HU	INT	N/A	RU	RU	RU