Corporate Sustainability Tuning of National Innovation System: Research-Based Spin-Offs in Belarus

Anna Pobol

Institute for Economic Research, Ministry of Economy of Belarus

Address: Kulman Str. 15-171,
220100 Minsk
fon: +375 17 234 45 50
fax: +375 17 263 76 93
e-mail: AnnaPobol@netscape.net

Abstract

The paper investigates into the process of emergence and development of novel for the transitive economy organisational structures - research-based Spin-offs (RSO) - small technology-based researchers-launched firms, and networks of interactions with academic science and industry they are catalysts for. The role is considered they are acting of carriers of institutional and socioeconomic transformations in scientific sphere to advance the structure of innovation activity organisation in national innovation systems (NIS) in both economic and social terms, contributing thus to sustainability of NIS. As the empirical background for this paper serve the interviews by managers and case studies of small innovative enterprises around Physical-Technical Institute of the National Academy of Sciences of Belarus (PTI).

Introduction: Historical Background

Research-based Spin-off firm (RSO) which is the object of investigation in this paper may be in most general features defined as proposed by OECD (Corporate and Research-based Spin-offs, EU, 2001) as the "new innovative enterprise, which includes a public sector or university employee/ organisation as a founder, or equity investment, or technology license from them".

Fundamental knowledge of the RSOs' essence as a phenomena gained from the research for the European Union and transformation economies (Smallbone D., et al, 2002) is that Spin-offs, being a small subset of new technology based firms, and a very small subset of new firms, are the innovation-oriented enterprises, which as a rule are established by the scientists and researchers from public research institutes and universities with the purpose of finding market application for results of their research and development (R&D) activities. Sometimes the equity investments from the parent organisation are made, but always the ideas are transferred from the fundamental research level to practical application through being further developed in entrepreneurial activity. In such a manner the Spin-offs turn into the reliable linkage between the science and industry (EXIST, 2003), which is argued to be the most important role of RSOs' phenomena for the innovation process.

The assumption made in this paper is that this commonly greeted role of RSOs might be considered one of the most influential tools by advancing the structure of the National Innovation System (NIS) and its sustainable development through fostering of coherence and alignment between industrial networks and R&D scientific networks.

Being neither a spontaneous nor forced but a rather natural socioeconomic process, shaping of the small technologically-based enterprises' stratum acting in NIS of Belarus was caused by specific historical conditions.

Before gaining its independence in 1991, Belarus (namely, the staff of its 300 organisations involved into R&D) has been tightly integrated into the common structure of the single scientific

and technological space of the former Soviet Union (FSU) with its 3 thousand research institutes under 20 Academies of Sciences which was rather closed to the world. The links and cooperative relations between particular organisations

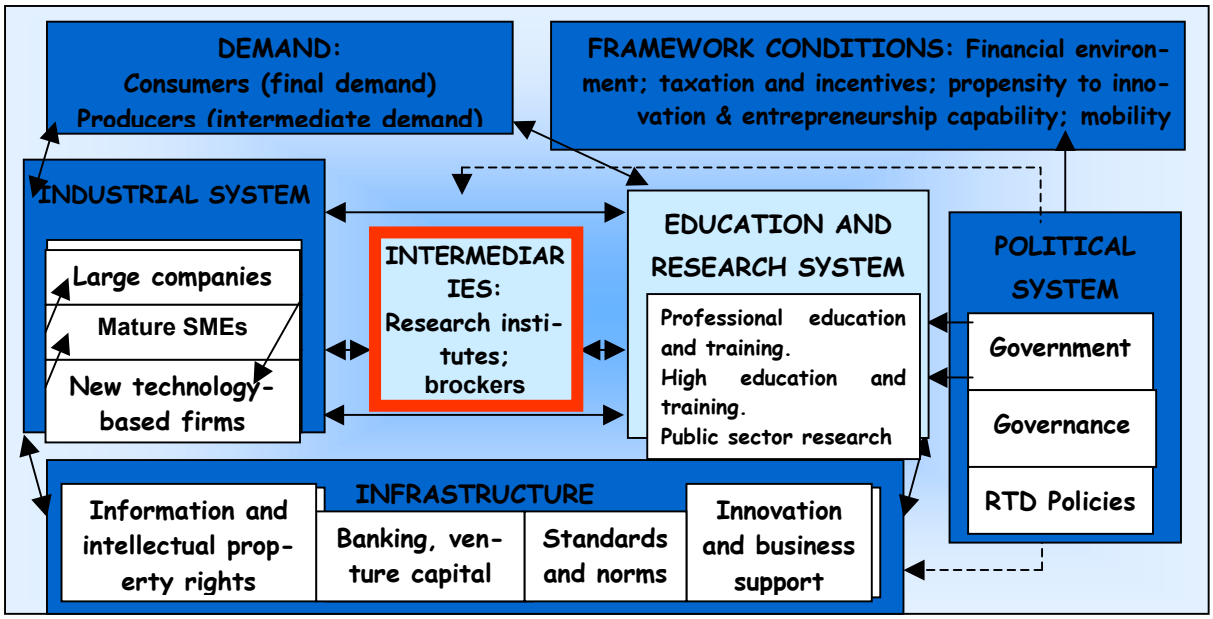

Figure 1. Research-based Spin-Offs in National Innovation System Model. Source: Arnold and Kuhlman, 2001. Citation from: Dermot O´Doherty and Erik Arnold. Understanding innovation: the need for a systemic approach. IPTS Report Volume 71, February 2003.

followed the patterns of labour division planned for all the republics of the FSU. With the part of technological innovations being adopted from Russia, Belarus has represented the strong technological fortress in metal-processing and new materials, micro- and optoelectronics and some biotechnologies. In the Soviet Union period, Belarus has been one of the most industrialised countries in the world with about 45% of industry in the GDP; whereas Minsk, the capital city, has been among the cities with the world´s highest scientific potential.

With this all, the scientific system was previously oriented on carrying out of large-scaled strategic state R&D tasks; the most significant expenditures were made on military purposes. In mid-90-es, it has been decided to refuse from such military orientation; hence the thematic directions of R&Ds should have been changed to the benefit of country's needs in building of the knowledge-based technological area. After splitting of the system, Belarus has inherited alongside with its independence the high energetic dependency from Russia on oil and gas, with the whole structure of economy leaning on low prices on energy and necessity to choose between falling in dependency from Russia again, or restructure for the less energy-intensive and more resource-saving technologies (which is proclaimed to be one of the priority directions of the state development).

The need has been felt for small-steps incremental technological innovations and actors being able to develop fundamental technologies for the low-solvent market, more small-sized projects with the shorter period of completing the science-intensive product and technological innovations which could help to modernize the

economic potential and integrate the country into the world economic structure.

New challenges of economic structure and changes in customers' demands could only be met by new forms of R&D process organising. Such novel forms are research-based small firms, which are spinning-off from large public research institutions (state laboratories) and involve in their activity the researchers and/or equity, and normally the ideas of technological innovations developed by these institutions.

An entrepreneurial activity in scientific and technological sphere was born in Belarus as early as in late 90s after the Law has been accepted in the former USSR legalising the cooperative form of companies' ownership (March 1987), the Decisions of the Council of Ministers that public scientific and technical organisations should transform their financing schemes for the own provision (September 1987), and others. On adoption of these laws the legislative base has been shaped for the process of commercialisation in scientific and technological (S&T) sphere could start.

First, S&T cooperatives have been formed under branch research institutes and under job shops, the results of R&D activity of which were most close to application phase and hence to market. Afterwards, this process has wider diffused among academic research institutes. Also, the centers for scientific and technical 'creativity' of the youth have started to work in large cities, where the young researchers could receive support for realisation of their potential in R&D.

Nowadays, the sector of entrepreneurship in scientific and technical sphere of Belarus embraces a rather wide diversity of various forms. More than 130 entrepreneurial structures have been created in Belarus under the structure of the National Academy of Sciences and the research organisations in its framework. Still, it seems to be a very limited number. The share of entrepreneurial structures acting in the sphere of R&D amounts to only one per cent of the SMEs. The share of innovatively oriented small enterprises and of employed researchers has in them in between an evident tendency to fall (Figure 2).

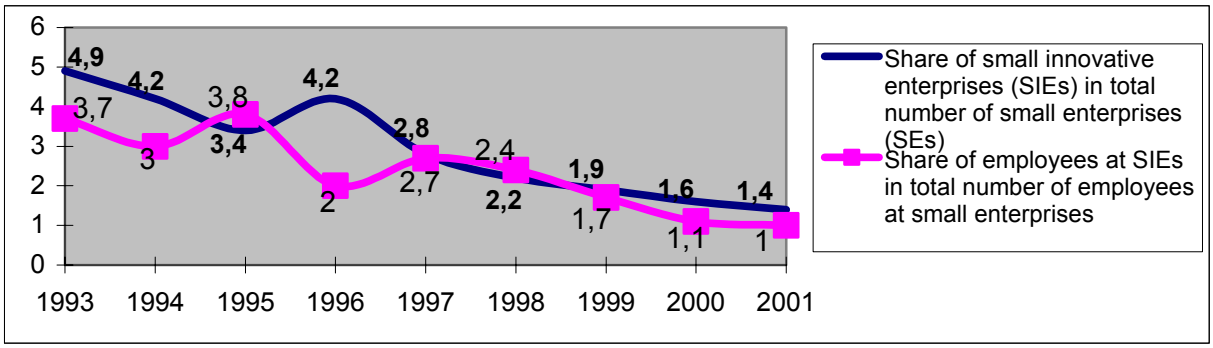

Figure 2: Small innovative entrepreneurship in Belarus.
Source: Statistics of Science (2003), Minsk: Ministry for Statistics.

World experience shows the low survival rate for small technology-based firms – about 80 per cent of newly launched terminated their activity in first 5 years. They also do constitute only a very small share in the number of SMEs as whole, and Spin-offs that originate from research institutions and universities are much rarer than these from corporate business. These which do survive, anyway, occur to be very sustainable and perform much better (statistics reports the higher profitability level in R&D entrepreneurship than the average in the economy and particularly in most branches of it (only construction and trade are doing better).

What is it in the way they organise their activity that makes them effective and sustainable?

The recently undertaken in USA, Germany and Austria study (Elko Kleinschmidt, 2003) has empirically proved the significance of corporate culture as a factor of international new product development process success. Having identified four clusters of firm's schemes of behavior, the study revealed that in order to be effective and perform well, the firm needs to develop its behavior in three-dimensional space of corporate culture, management commitment, and involvement of resources, none of which is allowed to be underestimated or ignored. These culture and commitment and resources usage are different dimensions of behavioral schemes, reflecting the wish to innovate, the opportunities to do so, and the perception of way which would be coherent to the undisputed or shared norms and values of innovating organisation.

The factors of RSO success may be represented under the structure of these three dimensions, and help deepen the understanding of RSO' place in NIS structure which takes into account the economic, social and environmental dimensions of RSO performance.

Involvement of Resources

General scheme of organising the innovation process at the Research-based Spin-offs might be generally described as follows:

Belarusian research-based Spin-offs as a rule origin from state laboratories, being the subdivisions of LPRIs, which traditionally interact with the industry closer than research departments of the universities due to specialisation on applied research (in laboratories researchers concentrate on more narrow issues and make use of a much more limited spectrum of research methods). Their "statutory" activity is to create the ever newer variations and applications for technologies, installations, materials and other science-intensive products, so they need to be flexible and responsive on market changes. On the one hand, small-sized science-intensive firms can flexibly change their product profile in reaction to market needs; on the other hand, they can produce science-intensive innovations with the much lower overhead expenses, hence prices, than by large public research institutes (LPRI).

As basic sources of ideas, technologies are applied by Spin-off entrepreneurs that they have developed (together with appropriate equipments to implement these technologies) during their employment at the state laboratories of public research institutions. Being the authors of high-tech innovations, they employ their knowledge to develop the whole spectrum of innovations, which are connected by the essence of technologies applied (for example, development of installations primarily designed for cutting of materials with laser beam , into water-abrasive jet cutting). Thus, in fact, researchers just continue doing as entrepreneurs what they have done earlier as state employees.

As for the reasons for the Spin-off decision, one might distinguish between the 'institutional', and 'personal' motivations. From the institutional side, the changing economic conditions of functioning as well as the changing political situation have caused that the universities and the public research institutes experience lack in new mechanisms for organisation of continuous R&D activities; deriving from this is the need for them to restructure their activity and advance the way how they manage the research and co-operation patterns of actions.

As for the individual decisions about spinning-off (decisions of particular actors to 'follow' the needs and calls of institutions and economic sectors), these embrace the whole set of personal motivations of decision-makers - from a normal wish of material well-being (a need to find a new sphere of application for their skills and knowledge, where they would be worthy paid), ambi-

tions of preserving the managing power (usually the founders of Spin-offs are the former managers or informal leaders of the state laboratories), up to wish of employing their knowledge and research potential and scientific curiosity (which are very high appreciated among the Spin-off researchers).

Having gained independence in decision-making, and simultaneously the financial responsibility, public research institutes are looking for the new schemes to organise the R&D activity, which is the state level. On the other part, the initiative researchers search for the new schemes of effective application for their knowledge, which is an individual level. On the crossroads meet the social and the individual interests, and the novel organisationsl structure borns to life.

Small innovating firms construct their own schemes of behaviour which help them to cope with particular sets of problems of R&D innovation organisation, be these problems technology- and branch specific, or inherent to transitive period of development of national economy. Closer consideration of particular aspects of functioning and schemes of interactions of Spin-off firms would contribute to understanding of succession of technological knowledge and continuity of knowledge dissemination over the innovation system. The scheme can be disclosed in three blocks**,** addressing the issues of:

- Who are the sources of innovation,
- On whose account are the R&D carried out and innovations done, and
- What are the final innovations upon their directedness and forms (grade of development on stages).

Who creates?

The actors may be described according to: a) sphere of activity, b) ownership form, c) and the size of the organisation. RSOs are generally established to produce a range of science-intensive (high-tech) product and process innovations closer to users (mainly these are the state enterprises and business sector). What concerns the sphere of activity in which RSOs are a most distributed phenomena and have shown the best and continuous performance, obviously the areas are leading which have for a long time been developed in the state scientific and technological sphere, (thus the best research capacities in form of both staff and equipment are accumulated there and the best primary results of research are already achieved), and which upon the character of their technologies are more closely brought till practical application. RSO's managers who have developed these technologies are therefore highly competent on their technological spheres. For example, the large part of RSOs origin from Physical Technical Institute which has a 70 years history of acting in close cooperation with industrial enterprises, being oriented on and carrying out research directly upon the customers needs in technologies or equipment.

Ownership form is a serious factor for performance of an innovating firm, being directly responsible for whether the functions in it are distributed right. Raising interest is the fact, that though many small innovating firms are primarily organised as the state enterprises on their ownership form (which means the managers do not perform all the ownership functions), it was the private initiative that has driven the firms. They are actually managed as being private ones (with the appropriate functions being charged to managers by parent research institutions), thus causing the higher responsibility, greater flexibility, and stronger commitment of all the staff, especially of managers who act as at the same time the major intellectual resource base, researching capacities, and disseminators of results (knowledge carriers, developers and introducers).

Size of a typical RSO is rather small, involving two-three main innovators, and some 4-8 work-

ers performing ordinary operations. It in most cases the same as the size of laboratories from which the Spin offs origin and obviously reflects the grade in which the technologies are developed, and their 'age': for the technologies which have gone the long route of development, the firms are much larger and continue to branch off. A bright example might be that of **c**ross wedge rolling of axis-symmetrical details with lengthened axis, - a technology with good economic and technological characteristics which is a world-level innovation. The basic technology has emerged in Physical-Technical Institute, and developed up to currently 50 per cent share of the world market works in this technological process, involve as many as 50 per cent of experts and possess about half of patents. The scientific school for this technological process has brought up the number of experts who started to work upon the process independently from PTI first in one small innovative firm launched by the 'fathers' of the process, and afterwards they have spun-off from this firm, launching their own "second-generation spin-off firm".

In this case of a 10 years story-line, highly demonstrative is the process of knowledge and contacts heritage being transmitted through the research-based entrepreneurship´ strata on a non-commercial base in the process of collaborative research, mutual learning, with the new generations of scientists being brought up.

Worth underlying, the people who left from first- for the second-generation Spin-offs, have benefited from not only the knowledge of technology itself (of which they have learned at PTI), and the knowledge of how to develop the basic technology in accordance to specific market needs (which was an experience gained by practical work after the breaking point in the historical process when the institutes were to count more on self-financing, and the first-generation branch off in the small innovative firm), but also the knowledge of contacts with customers and suppliers in given technological sphere, and of the new communication schemes how this contacts should be build and supported (from new authoritative position of an independent private innovative firm).

Similar to European RSOs, Belarusian Spin-off firms are also characterised by the slim organisational structure, when employed on a steady basis are only the researchers who are responsible for the core competence of the firm, and the many-level R&D&I process is provided by widespread outside contacts: outsourcing and hiring of external workers on a temporary basis for complementary jobs which require the not unique competences or only limitedly applicable knowledge.

Geographically, the historically emerged industrial structure and S&T organisation scheme have led to sharp concentration of R&D and science-intensive economic activity in some local points in the country: first, the shift is evident in favor of the capital city Minsk, where according to statistics 70-80% of all research facilities are accumulated, and second, powerful is the "factories' science", with its "town-shaping enterprises".

Also, there exist strong interdependencies between the social and economic development of particular regions in Belarus and the number of entrepreneurial structures (in particular innovating SMEs) in them, as the current investigations based on functional correlation analyses (Shehova, 2003) show. As far as it has been the case even for farming private firms, the factor of entrepreneurial spirit proves to be highly influential for the allocation of firms. The analyses has shown, that the ability and moral preparedness to innovate have been much higher in the regions with : cleaner ecological environment (where the negative influence of Chernobyl disaster has been less felt), higher level of educa-

tion, and historical close geographical position of regions to Western Europe (some assumptions are made that the border between the two areas of Belarus with the higher and the lower grades of innovating SMEs´ development coincide with the borders of regions of Belarus which were the parts of Poland and Soviet Union between the World War I and II, which has strongly influenced the mentality of the people, their preparedness to private initiative and braveness to innovations).

Who pays the bills?

Research costs money. And the lack of financial resources is considered to be an inherent feature of SME. With the question of fundamental and applied research financing long been the point of critical discussions of policy-makers, researchers and innovating entrepreneurs who experience the policy on themselves and general public who is actually paying, some diversities in opinions are still burning when it goes about the distribution of expenditures on R&D works in case of RSOs.

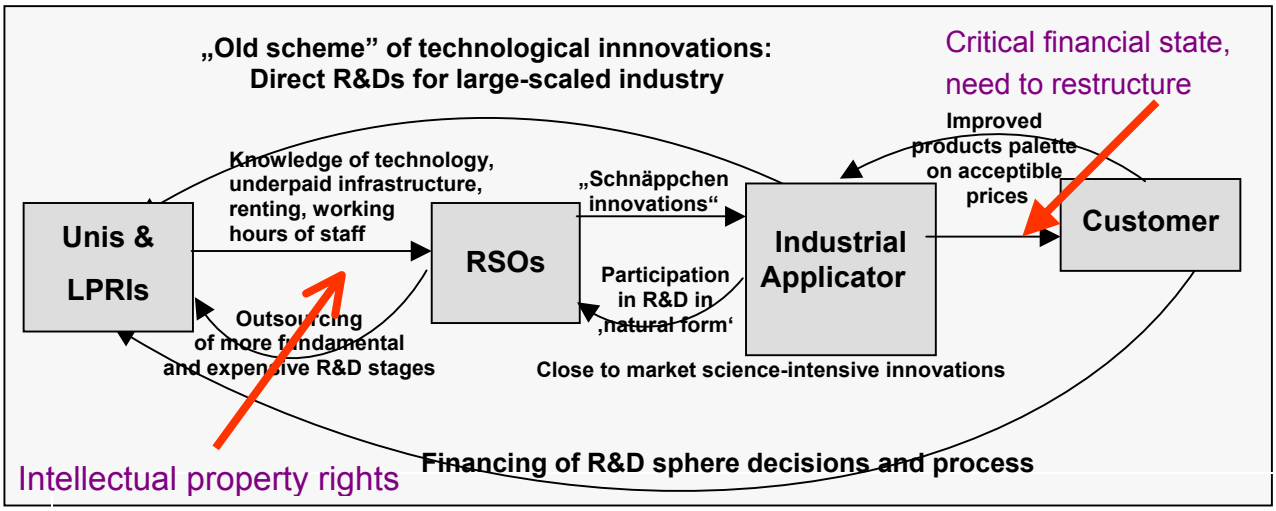

Figure 3. Flows of values.

From the point of view of sustainability, financial responsibility distribution is vital, which is evident because behind the social interests always does stay the financial engagement. Still, much is disputed on whether and how the know-how created at LPRI should be paid by RSO. The practice existing in the transitive countries is complicated by that the intellectual property rights are only merely preserved, and the financial situation stays to be very constraining. Practice existing for the RSOs in Belarus shows that far not all expenditures on the innovation process are paid by firms themselves and get included into the costs (such as renting, equipment and infrastructure, working time of staff); in the meanwhile the overhead expenditures are much lower in them than in large state research institutes, which all together leads to the lower and hence more competitive price of results of R&D. Practically, this becomes possible because of the phenomena which has been earlier studied by scientists in one of Russian's "cities of science" Novosibirsk: most first-generation RSOs are "Quasi-Spin-offs", - that is, they get separated from their parent organisations legally, but continue to use the infrastructure of "parents" for free or on minimal financial terms - which also implies a sort of technological and even managerial dependency. In exchange,

they provide to LPRIs, for example, the new contracts on R&Ds.

What is created (direct contribution of RSOs into innovation performance)

Innovators in SMEs typically execute small-steps incremental changes on the base of generic technologies, whereby the radical innovations in the given technological area may require several years.

Nowadays there are practically no small innovative enterprises in Belarus, which are executing only the scientific research and research-based innovations. Due to unstable economic conditions, lack of external financial support and the own start-capital, the innovating SMEs have to execute as well the commercial activities and mediating operations. There exists a small innovating firm which specialises on application of thin nano-sized hardening PVD vacuum coatings. This is an innovative method which provides advanced technical characteristics for the materials to be coated. The common transitive conditions and financial insolvency of customers have however required that researchers keen to provide the world with super thin and hard, intelligent coatings, have to leave these ambitious interests, and support their survival mode with the more "earthy" but also the more market-demanded application of innovative technology for decorative coatings.

Considering the overall distribution of thematic directions in which the RSOs do work, hardly any advices on priorities to render state support for RSOs should be given, how attracting wouldn't it be to vote for high technologies in ICT or bio-sphere. However, a doubtless use would bring the allowance to private small innovative firms to take part in the state research projects, executing particular practical application-oriented tasks. It would on the one side support the interactions between the industry and science at the micro-level, and on the other side, employ the intellectual potential and research capacities of individual innovators for the benefit of society, involving them into the flow of long-term scientific priorities. This mechanism would be a fine tool for making RSOs a target tactic tool for realization for R&D and innovation development strategy. The case of Al-graphite composite material provides a brilliant example of market-leading selection of technology development route. Being not called upon for 5 years, the unique technology of achieving the novel hi-tech material has been developed up to industrial level, introduced in manufacture, and mastered at the mass scale in a period of two weeks, when a market demand has appeared from an industrial enterprise which suddenly felt in need to be restructured.

Above the limited internal resource base (finances, management resources, knowledge base), the organisational structure, which stems from ownership form and management, there is one more important conceptual feature, typically characterising the SME: the lower ability to shape or influence the external environment relationships. Because RSOs origin from the state laboratories, or university research groups, which previously conducted the not-repeating one another R&D, the people have turned to be the unique carrier of the novel technological knowledge in the system and in the world. This provides the monopolistic position of most RSOs in their technological sphere. RSOs in comparison with other small firms are able to shape the environment they act in: the technological structure of the economy, and relations between the industries, or different levels of production process. Still, this exclusive position doesn't provide them the monopolistic profit, because the market position is constantly influenced by many supply and demand factors. On demand side, one could mention the technolo-

gies-substitutes (for example, some details do not necessarily need to be manufactured from this particular material, but can be done from any material which characteristics lay in some desirable range). Constraining can also be the demand factors as ecological requirements and standards acting in the country, financial state of enterprises which are the customers and their strategy. A vivid example of policy as the assisting demand factor is for example the conversion from military production to civil. On the other hand, from supply side, the factors influencing the costs are the R&D costs at previous stages of research, the equipment employed, the staff, raw materials and energy supplies, costs on experimental parties, and also the overhead expenditures, sources of financing (state budget, or contacts, and, again, contacts with organisations being financed from state budget, (which often occurs with significant delay), or firms with the independent accounting).

Coherence and adhesion in between the participants of the innovation process (high educational establishments, research institutions, and industry (esp. SMEs), and innovation infrastructure organisations) is thus created due to mobility of knowledge, and schemes of interactions they implement.

Managers' Commitment: Knowledge as the Background of RSO's Success

That the top management is intimately committed to the whole process, also on the local level of creation knowledge, proves to be among the driving forces of the RSO success: they possess the adequate skills, and have the adequate stimuli supported by wide contacts in scientific and industrial sphere, which enable managers to arrange the implementation of results to the market.

Historically, the R&D cooperation with 64 countries has been established in Belarus, the main of which is with Russia, the Ukraine and former Yugoslavia. This cooperation exists not only about the raw resources supply, but also about the joint fundamental and applied research, and development of technologies for specific requirements of partnering customers. Specifics of Belarus causing the appropriate structure of R&D and economic relations in the country is that it has been the "assembly shop" for the whole FSU – and inherited the large scaled production, on the one hand, but also the broad collaborative contacts with the other newly independent states (including scientific and technological). Extremely important for sustainable development of the innovation system is also that the common information system of cooperation with Russia has been developed. During the last years these interrelations have been kept, and with the different grade of integration the researchers and the managers of R&D&I process continued to communicate with suppliers and customers within and outside the country in order to support their activity. With the contacts carrying the due to long communication informal comradeship character, being a sort of tacit knowledge type "know who", they occurred to be an important factor of survival for the R&D sphere organisations, and which is even more appropriate in context of current paper, has turned into one of most value-adding production factors for organisation and successful operation of research-based Spin-offs or new small innovating firms. "These who have early been friends, kept their friendship".

This fact is extremely important for the RSOs success, and for their contribution to linking of science and industry in the innovation system. These contacts serve as framework conditions enabling the strong cooperation and production of science-intensive innovations close to real industrial needs, on the one hand, but these

contacts have a strict geographical character, that means, they are limited by the previously developed circle of communication (mostly inside the country, in Russia and Ukraine). And, at the same time, these developed contacts also act as the local borders for the further rapid progress. When the communication between the actors of the innovation process is no more supported by previous collaboration (which must not necessarily be the direct acquaintance, but can also be used to find the road for contacting the proper partner), - the opportunities for further diffusion of activity rapidly loose in weight, and the "historical contacts" factor sustaining RSOs doesn't act.

Case studies show that these contacts between the scientists of different scientific institutions assist strongly to these of them who started their own business. They might also be the explaining reason for the unofficial agreements with competitors of "non-interference into the business of one another" and of sharing the technological areas, as it has been, for example, with production of armor jackets (in Belarus, there is the one monopolist producer of them on the scientific base). Alternatively, these informal contacts between the scientists may provide the possibility of consultation with former/present colleagues on scientific issues, and explain the loyal attitude to sharing of the new-technology-market with competitors who at the same time develop this market promoting among potential customers the opportunities of a new technology.

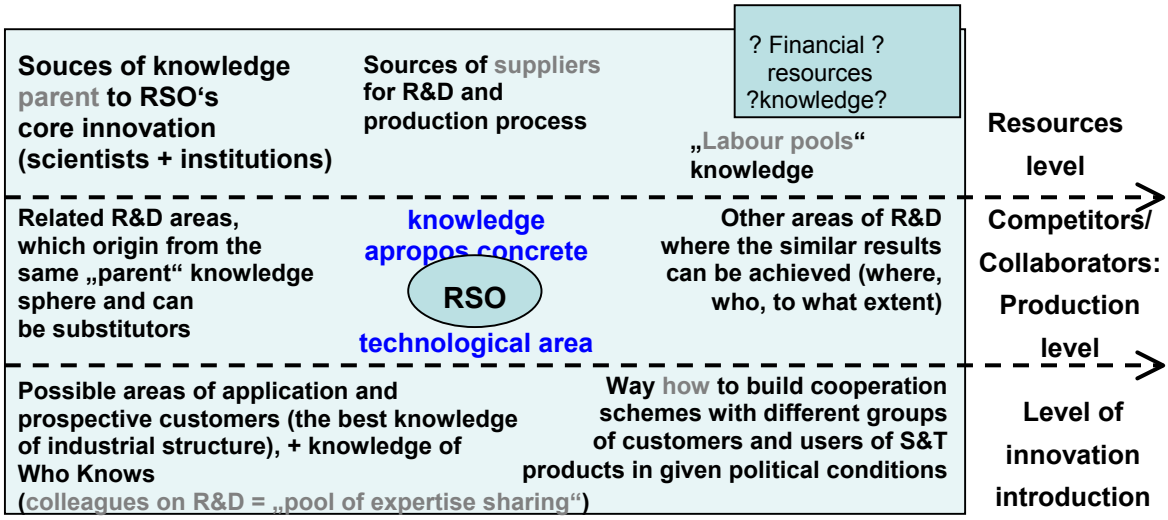

Figure 4. Knowledge of contacts (Know-who).

The essence of RSOs sustainable success is thus: person's knowledge is doing innovative products; person's contacts are doing business.

Networks

With the contacts being both the tacit and implicit (as well-earned trust) knowledge of entrepreneurs, the networks between different organisations take shape, while the knowledge gets transmitted together with people. Indeed, these interactions lead to that the interorganisational networks are built, based on the contacts which have previously been established in R&D activity of public research institutes and universities, with the difference that they are used now more effectively from the viewpoint of practical usage of results.

The need for such networks in the economy is vital. Both the system of R&D activity organisation and the industrial system are rather developed in Belarus. And, strong collaborative links within both systems have been inherited from past. Still, what is lacking now, is the continuous interaction between these two networks and with external environment, which are to provide the alignment processes between these networks, leading to coherent and sustainable efficiency of the innovation system.

The recent study concerning the emergence of industrial networks (S. Radoshevich 2003 carried out for analyses of successes for newly associated countries in their catching up with the economic growth shows that it is the coherence of industrial and political networks which is responsible for the successes in building of a strong innovative economy. The innovation system involves different types of networks, and at the sublevels of network organisation, the need is evident in some types of reliable and flexible intermediary links between the science and industry. RSOs provide such a link which has proved to be rather efficient.

RSOs may be thus argued to perform as the network suborganisers for NIS. In most Central and Eastern European countries the international industrial networks are organised by multinational corporations, which are mainly intra-firm type constituting from a parent firm and local subsidiaries. The way how RSOs contribute to development of networks in the innovation system is that due to their activity the parent research institutes and universities, on the one part, and the industrial enterprises, on the other are involved into the continuous process of innovation, and participate in it by sharing efforts and outcomes.

Some supportive and confrontation motivations of the interest groups of parent institutions' management can be identified. At the social level, clash of interests is evident at the organisations' level (capacities of LPRIs (equipment, buildings) are used by Spin-offs on a under/not paid base, as well as the intellectual property. But aside from this contradiction do stay the individual interests, and these might be mutually beneficial, but might also be contradictory, and this correlation of interests matters for whether RSOs emerge and how they perform. The explanation may partially been found in the specifics of the transitive economy where the institutional structure underlies significant transformations and does not act as the powerful limitating force as it is the case for an economy with stable institutions. Underlying the appropriate schemes for dissolution of these contradictions is the "social consensus" which forms the background of RSO's relevance in NIS.

The mechanism how networks are doing is a fine example of how RSOs contribute to social consensus in NIS due to changing social roles the scientists do play in the modern economy – mediating knowledge they have gained, but not just by commonly awaited popularization of it and making it available for general public discussion and decision-making as for further research policy, but also through arranging tight feedback collaboration with industry, which takes into account the specific needs of customers and leans them to joint applied research and even to fundamental research projects with public research institutes. Being the carriers of technology knowledge and driving forces for developing them for market introduction, Spin-off entrepreneurs do not just constitute an additional link in the innovation process chain – they extend the participation rate of various actors in this chain, creating the possibility that the individual spheres of interests of them get intersected. The knowledge flow involves thus more actors, and necessarily leads to taking into account the internal interests and goals of all of them, which

evidently makes the innovation system far more coherent and sustainable.

Corporate culture: Educational Background and Social Responsibility

The role of institutional culture of Spin-off entrepreneurs gains particular importance in a transitive economy in connection with specifics of knowledge required in their activity.

While the novel for Belarus type of interorganisational links and interactions of innovation activity organisation is taking shape, the objective necessity is evident in developing the new knowledge, but also in bringing up of new culture of the entrepreneurship, with its specific inherent norms, values, basic assumptions and perceptions, and convictions of appropriate behavioral schemes.

Active discussions are carried out and the activities are undertaken in many countries in order to educate the strata of innovating entrepreneurs, also research is made on educational needs of them. Generally in European Union, because Corporate-based Spin-offs (CSO) are much more mature as a phenomena (being estimated for around 13% of new firms formation), and have accumulated an advanced practice of organising the innovation process, their experiences are considered to be a relevant source of market behavior for the managers of Research-based Spin-offs, who, as genuine 'inborn' scientists, usually lack knowledge and competencies in commercial affairs. In Belarus, CSOs are trade-oriented rather than research-leaned, and not much 'older' and experienced in innovation than the firms having spun-off from research institutes (the legal opportunities for emergence of private enterprises in general as a phenomena in the economy of Belarus arose only some few years earlier than for entrepreneurial activity in science sphere).

Logical is the question, what kinds of knowledge are primary to be developed for research-based entrepreneurship. First, the practice has shown much more success in educating the people who have earned first technical education to entrepreneurship, rather than to educate the social scientists to technological details up to the grade of being creative rather than only be able to accept and apply. In the meanwhile, it is extremely important that the RSO managers do possess deep understanding of the process to be able to be committed to their business at the most local level. In practically all RSO firms, the top managers were at the same time the creative force. And, having stepped to the scene with the novel, radical innovation (technology, or product), they grow up afterwards thanks to ability, curiosity, and desire of 'bringing up' their 'own child' incrementally, improving it, or up-building for sophisticated requirements.

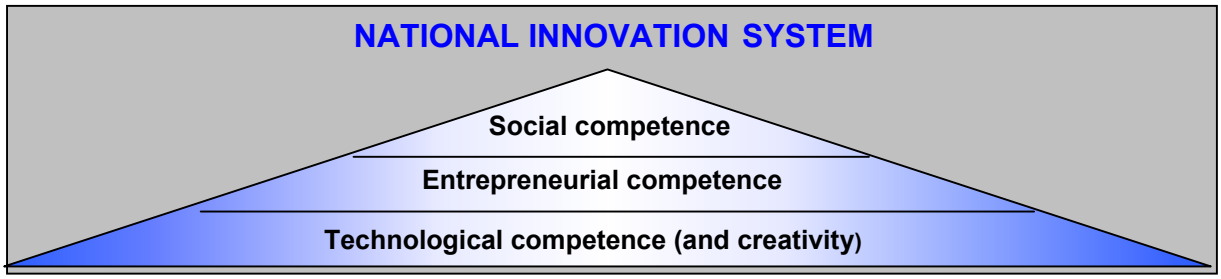

Figure 5. Corporate innovation culture.

The technical competence, or even to say, the technological vision, occur thus to be the base the "RSOff-er" education, whereas the economic and business skills serve as the necessary 'up-building' for them, which decides upon how does their business succeed. Even more high, occur to be the social skills of building contacts with the representatives of both scientific community, and the industrial circle (also from the viewpoint of international communication), the personality, and the structure of person's motivations to follow this road of 'research with financial responsibility'. The grade of development of these characteristics decides about the grade how deep can the particular RSO firm become integrated into the innovation system with its many-level structure of networks, and act as the catalyst of these networks' integration by itself.

Aside from the needs to save the accumulated material and intellectual scientific and technological potential of the country for the system could coherently develop, the RSOs answer to needs of the NIS to develop the innovative consciousness in wide public, being thus socially responsible for dissemination of innovation-oriented mode of mind by people who directly pay technological progress or who decide of the directions which are to be paid, but also among those who implement the technologies in practice.

Conclusions: Tuning the National Innovation System: Coherence and Alignment throughout the Networks

The ground of Spin-offs success consists of professional and social experiences and competences of their leaders, and the knowledge of where the appropriate knowledge is to be found. This diversity and variety of well-established contacts all through the relevant sectors and social spheres by Spin-off entrepreneurs constitute the ground for achieving of 'social consensus', which is the essence of Spin-offs' phenomena success in the modern history of technolical development. Thus, the role of RSOs in the NIS building and its sustainable development is that of creation of coherence and alignment between industrial networks and R&D scientific networks.

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