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Sputnik enterprises:
high technology enterprise creation in Russia

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1. Introduction

"I hate uselessly precise figures of chaotic and absolute statistics, that tell nothing, and I rely on the reader's gratitude to whom I have not inflicted the pain to read them nor the mortification to skip them."
translated from G. Ciocca - Giudizio sul Bolscevismo, page 243[1]

The sprouting of high technology SMEs around Science Academy institutes have been spotted during on-field visits in Novosibirsk[2] - Siberia. We have defined euphemistically **Sputnik company creation** the creation of satellite enterprises from the scientific and research centres, due to the "maternal" link that persists throughout the life cycle of the new ventures with the parent organisation. Similar to the spin-off phenomenon in Western economies, this process shows very specific characteristics linked to the particular economic environment.

The studied process is a key element in the development of local, regional and national economy. This is even more relevant considering that Siberia is the richly endowed in natural resources still under exploited by a backward industry. By reflection, also the future of research in Russia is affected by this phenomenon.

The 1992 rupture has given the opportunity - it has compelled - to re-cast the rules of exploitation of the scientific organisation inherited from the socialist era. This revision was sanctioned by a tacit agreement between those who were in charge to administer and control and those who were administered and controlled.

To describe the process more emphasis was given to qualitative description rather than quantitative analysis. This seemed inevitable as the research was mostly based on case studies resulting from visits and interviews carried out in Novosibirsk oblast. Moreover, it is our belief that the opposite approach, where too much stress is given to figures, would not lead to a correct interpretation of the topic under survey.

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[1] "Io odio le cifre inutilmente precise delle statistiche caotiche e assolute, che non dicono nulla, e confido nella gratitudine del lettore a cui non ho inflitto nè la pena di doverle leggere nè la mortificazione di doverle saltare". Op. cit.

[2] The research in Akademgorodok, Novosibirsk was partially financed by the European Commission Programme for Cooperation in Science and Technology with CCE/NIS, INCO/COPERNICUS - 1995/96. Title of the project: Adaptation to the new environment of the Science Academy institutes in Russia. Analysis of the socialist and post-socialist situation of the Science Academy institutes in Russia and their mode of adaptation: the case of Akademgorodok.

2. The effects of the collapse of the soviet system on the research institutes

The rupture

In March 1990 the XXVIII Congress cancelled art. 6 of the USSR Constitution thus abolishing the Party as “leading force”. With the Party, the planification process also disappeared. In January 1992 the new monetary system was enacted and mass privatisation programmes undertaken. For the Science Academy institutes this implied a financial and structural rupture. The former mode of financing linked research plans and “budgets”. From then on, the institutes stopped receiving plans and research tasks to fulfil and, badly enough, most of the related funds: allocation in personnel and wages, material, equipment and so on.

The institutes:

- had to “earn one's bread”: find non-State means to finance their activity;
- were now free to select their own research projects and to link them to their own financing strategies;
- were free to look for financial resources and allot them as they pleased: free to buy their equipment from any company, decide the quota of revenues to cover cost items (wages, general expenses, social sphere expenditures, ...).

Up to 1992 all research financing came from the State. After the *rupture* these sources had to be diversified. As an example, the 1995 budget of the Boreskov Institute of Catalysis included the following items:

43%Contracts with foreign industries

25 % State Budget

20% Competitive programme

6% Contracts with Russian industries

3% Russia Fund for Fundamental Research

2% International Fund for Research

Contracts from industry summing up to nearly one half of the total.

The State Budget for research is voted each year by the Duma and allocated through the Ministry of Science and Technology to the Science Academy institutes. It is distributed among the different institutes with no counterparts. The Competitive Programmes are open research tenders of regional authorities (municipalities, oblasts) or of ministries (Ministry of Industry, Ministry of Economics, …). The International funds for research include sponsors such as the European Commission, the Soros Foundation, US AID, ISTC and so on.

In this situation the institutes had and shall have to face problems such as:

- difficulties to pay all employees an appropriate wage. The decrease of purchasing power of research institutes employees: by 1993 the average wage of scientists had already fell to 65% of the average wage in Russia (OECD figures). The decrease in State funding prevents the Science Academy to preserve real terms wage levels.

- impossibility to sustain the same amount of research projects. A strict internal selection of the research activities to be carried out. This selection is fierce as often linked to short term economic expectations of the research projects carried out.

- necessity to introduce new managerial and operative mechanisms into the institutes. The institutes' managers acquire new managerial skills to implement the changes needed: build their own restructuring strategy in terms of research domains and development of commercial applications. Financially and strategically they can no longer keep open all scientific fields explored so far, without linking them with a possible source of funding and hence of economic return.

Immediate consequences for the research institutes

Institutes had to reduce their research scope and support only those they assumed they should, and could afford. Decisions were taken according to financial constraints and therefore under an economic rationale. This is something new that had never before affected the socialist model of managing the institutes.

Funding of research work that was considered unworthy was stopped leaving researchers and technicians employed in institutes with the burden to find themselves the means and the ways to continue their activity. In most cases they continued to receive a wage devaluated in real terms and, though enrolled in the institutes, received little or no support for their scientific and research activity.

For many of the institutes' employees the situation they were facing was not of the most fortunate:

empty wallets: rapidly growing inflation with no salary correction;

frustration: professional skills no longer considered as useful under new economic criteria;

incertitude: end of a privileged situation in the new economic context;

disenchant: the system in which they believed and for which they worked had failed[3].

With this perspective, the 1992 rupture pushed many to leave the research institutes and look for opportunities in commerce and industry. A limited number preferred to continue their academic and scientific career overseas (700 for all Russia according to the President of the Science Academy[4])

Figures show (see graph below and tables in the Statistics appendix) that for the Siberian Branch of the Science Academy, the brain drain was limited (-17.1% between 1991 and 1996). The number of research fellows started to decrease in 1993 with an acceleration in 1995 (-6.8%) and 1996 (-5.9%).

Statistics on employment in the Siberian Branch RSA (Russian Science Academy) show a steeper decrease of technicians and non-scientific personnel (such as workers involved in the social sphere) than researchers. The total number of workers in the Siberian Branch research institutes lowered to 38.171 in 1996 from a peak of 52.736 in 1991 (-27,7%). The strongest decrease being in 1992 (-5.474 workers).

Why is the decrease of "less" educated categories steeper than that of scientists?

A few considerations could give an acceptable explanation[5]: Scientists and research fellows:

· were less attractive and are less attracted by industry and commerce which have a lower capacity of "absorbing" people whose major experience focus on academic and scientific research. On the other hand technicians and specialised support labour force working in research institutes are more easily convertible to cover position in productive sectors. Highly qualified engineers with hands-on experience in innovative technologies are strongly

[3] 10% to 50% of employees in Akademgorodok institutes " … extremely needed psychological support". This emerged from researches funded by the Federal Agency for Unemployment and carried out in 1992 and 1994.
Another survey carried out in May/June 1997 on 560 scientists found that 40% were living under poverty level and food was the main concern for 58% of them.
[4] Nezavissimaia Gazeta, 8 November 1997
[5] These considerations have emerged during the interviews carried out in Akademgorodok.

demanded by an economy in transformation.

- were freer to allocate their working time than the other categories of workers. Most of the institutes' executives understood that one way not to loose their main asset (scientific know-how) was to grant sufficient freedom. Researchers were allowed and even encouraged, for their personal economic benefit, to continue activities no longer supported by the institute.

- were generally paid in priority with respect to other workers. After 1992 institutes were free to adopt their own policy concerning the allocation of State budgets.

- had received considerable tangible advantages from working in science cities. If the economic transition hit the Russian scientific world hard, it struck even harder the unprivileged "soviet". Employees enrolled in the institute kept receiving a salary (even if harshly devaluated) and were still entitled to social services - schooling and child care, medical services, cultural facilities, food at lower costs and, in some cases, housing[6]. Everywhere workers were facing the same restrictions caused by the reforms enacted.

3. The "Sputnik" enterprise creation: recombination of inherited research assets into high technology enterprises

The social and economic situation laid the conditions for the creation of spin-offs from research institutes. A process labelled above as "Sputnik" enterprise creation: the establishment and development of a new independent entrepreneurial organisation[7]. The creation or the transformation of an existing organisation into a structure that combines in a new innovative way, highly skilled labour, S&T material and immaterial capital, with the ultimate objective of obtaining profit from its activity.

Independence, requires the newly established enterprise to maintain the capacity to adopt autonomous decisions concerning the activities carried-out. This is often the direct result of establishing new enterprises from "scratch", not linked to formal intervention from authorities or existing economic entities. It is therefore different from the mere privatisation of former State organisations, but includes privatised units if these were transformed as described.

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[6] After the privatisation law concerning houses, people leaving the institutes did not loose their assigned apartment. Housing was more a problem for the institutes. The fall of State budget for infrastructure investments stopped the construction of new houses. Many institutes could not (and still can not) include housing in the benefits offered to freshly enrolled researchers. This has discouraged the entry of new talented researchers. As the Director of the Institute of History and Philology of Akademgorodok said: "… living outdoor at -40°C is not a joke!"

[7] To describe the process of transformation of former combinates and production units into enterprises O.Bomsel (1996) minted the French neologism "enterprisation". However, it has not been included having no translation from the French.

This process has been observed to be the main way in which high technology entrepreneurial ventures have been set up in the Science City of Akademgorodok, Novosibirsk. It includes a wide range of cases: from the transformation of an existing research unit department into a *de jure* enterprise, up to the commercial exploitation of one innovative idea with a *de facto* but not legally recognised activity.

The common and basic feature in the observed high technology company creation is the transfer of know-how from research institutes.

The incubation phase

Autonomous ventures need a period of gestation. During this period the founders of a future enterprise usually remain employed in their institute while spending part of the working time to formulate the new business idea. The organisation for which they work is known as incubator where new ideas are conceived and developed. These have not yet committed entirely to the new venture, and the risk of failure is limited to the time, efforts and working capital already depleted. Up until the founders have left the mother organisation, failure in establishing the new venture has no dramatic effects, if not psychological.

In Akademgorodok, it often was that researchers remained employed in the institutes receiving a salary (even though devaluated and in several occasions paid after months) and services from the social sphere. Research personnel was allowed to remain in the institute's premises and freely[8] use its time between research (often no longer financed by the institute) and activities that could compensate the low income.

Soon after 1992, this status was advantageous for both parts: the institute and the researchers. The institutes could preserve skilled staff, equipment and facilities with a minimal financial effort. Scientists continued research work inside the institute in order to produce applications hoping to yield a profit from them. To do so they used the institute’s equipment, facilities and their colleagues' embodied know-how.

The situation secured social peace and reduced the risk of seeing mass defection of researchers whose project budget had been stopped or reduced. It was meant to be a temporary solution to preserve immaterial assets (knowledge) and physical assets (equipment, instruments) until better days to come. Institutes could not always adequately pay (above level of poverty) their researchers and feared an exodus towards more rewarding activities. Labour force was their most precious asset. Scientific and technical knowledge, as well as the entire relational network,

[8] It appears from interviews that a non conventional “entente cordial” existed between institutes and researchers. The latter were free to allocate half of their working time for activities others than research

was embodied in them. Loosing them could jeopardise the institutes.

Starting capital: founder's expertise and seizure of institute's scientific and technical knowledge

Many researchers chose to exploit research results and applications, outcomes of the institute's past activity and of their latest work. These researchers, often a team part of the same lab, would therefore decide to find their own way to the market.

In Soviet Union the State had the exclusive right to exploit S&T discoveries. Scientists and researchers whose scientific and technical findings were of some importance were rewarded with an *author's certificate*. These documents nominally[9] recognised the paternity and the granting of a limited economic compensation[10]. It entitled at the time no propriety rights for the author or for the institute, propriety being a concept absent in the Soviet system. The new legislation introduced property rights for inventions, discoveries, industrial designs, innovations and so on. Authors' certificates could be legally translated into patents, hence granting an "exclusive" right of property.

The amount of certificates compelled the institutes to convert only those that seemed economically more rewarding. The fees for the translation discouraged the institutes to engage into this procedure. Moreover, being nominal, many certificates were kept in the hands of the authors.

However, the legislation regulating the translation of author certificates into propriety rights generated conflicts between institutes and authors[11].

> *VORTEX was founded in 1991 with an initial working capital of 8.000 rubles (1990 value). The patents and know-how brought by the 8 starting founders were much more important for the venture creation. These were researchers at the Institute of Thermophysics of Akademgorodok (ITP). More precisely, they formed a research team carrying out studies in the same scientific domain in the same laboratory. The group was studying applications in the "swirling flew closed technology" (physics of the fluids), theorised in the '30s.*
>
> *The first applications for the industries were carried out by the ITP. However, the institute was not so effective in exploiting the scientific results and in the development of applications for the market. The researchers felt that the interest in their research was limited and the institute was not ready to commit to develop industrial applications. This*

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for the institute. This included research work carried out inside the institute for personal aspirations.

[9] The name of the author(s) was printed on the certificate.

[10] A symbolic pecuniary reward.

[11] See for example article 3 of the concluding provisions of the USSR Industrial Design Act law of the USSR, 10 July 1991 USSR Supreme Soviet Act No. 2328. USSR Supreme Soviet Decree No. 2399 USSR Industry Design: "[…] Enterprises, organisations and institutions using, prior to 1 January 1992, inventions for which certificates have been issued or claims for the issue of certificates retained, for the new legislation, the right of further use without concluding licence agreement. Being subject to the payment of compensation to authors.".

pushed the researchers to spin-off into a co-operative. VORTEX was not the first enterprise to be created by employees of the ITP.

VORTEX founders were able to take advantage of the new legal environment and the institute's indifference and incapacity. They left the institute with their author's certificate, converting it into a patent giving them an exclusive right to use the discovery although obstacles were raised by the ITP. Nevertheless, for its own projects VORTEX is still carrying out part of the R&D phases inside the ITP.

The launch of the high-tech venture: low initial working capital

The new independent enterprises are created with no venture capital from banks, financial or State / regional organisations. The working capital is entirely supplied by the founders' personal savings.

The developing, testing, prototyping of the applications[12] to be marketed are necessarily carried out with very low initial cash injection from the new entrepreneurs, initial working capital being limited to cover consumption material and low costs appliances. Clients' pre-payments cover expenses like purchase of parts for the construction of applications / prototypes, payment of subcontractors (for example the casting of metal parts of a machinery in foundries), etc. This is due to the high risk of insolvency of Russian firms and the difficulties to find legal means to cover this danger. Stocks too are limited to the basics (raw material, semi finished or components) for the completion of the production cycle.

To reduce to the limit all "unnecessary" costs, new ventures also avoid constituting themselves as formal legal entities at the beginning of their activity. They register only after their business has consolidated and / or when it seems necessary to increase their clients' portfolio.

Founders remain in close relations with the parent institute, exploiting their local intimate network of scientific, business and political connections. The link with the parent institute and with the local scientific community is an important feature throughout the entire life of the spin-off: before and after breaking away from the parent organisation.

The new high tech ventures in Akademgorodok can be well represented as a satellite orbiting around one or more research institutes. This revolution (orbiting) is very tight during the first phases of creation, gradually moving further during the consolidation of the new enterprise, though still receiving vital lymph from the research institute(s). The founders act as a co-operative[13] of professionals each conveying their scientific expertise in the new venture, often concretised by one or more author's certificates. These have a clear enough orientation and share

[12] Usually it was one application developed for a limited number of customers (often one for one client)
[13] "Les coopératives sont l'une des premières formes nouvelles d'organisation de la science industrielle en Russie les coopératives de S-T ont commencé à se répandre dès 1987 […]" CCET (1994) page 106 op. cit.

the way to exploit their scientific domain from common past work in the institute and gestation of the venture.

The first clients are known since the incubation phase. These are usually limited in number and soon new clients must be found and/or new products developed. New products are usually an improvement of original prototypes made to fit a new customer. Also for these, R&D phases are mainly carried out inside the parent research institute, limiting financial expenses to consumption material. New and old clients are asked pre-payments to cover larger expenditures for the completion of the applications ordered. The main input of the enterprise - S&T know-how - still originates from the founders.

Consolidation of high technology spin-offs

The situation described above initially contributes to lower entry barriers in the creation of new enterprises.

Re-arrangements of assets into new activities and new structures are not free of conflicts, more or less open, with the incubator institutes. Allowing their skilled personnel to independently find means to reward research was meant to be a “temporary” trade-off accepted in order to preserve the institutes’ assets: immaterial, material and skilled staff. If not, the researchers would have left in mass imploding an empty structure. This is exactly what the institutes wanted to avoid. A danger tangible up to present but with a risk now spread both on the institutes and on the newly created high tech enterprises.

1. the institutes are still relying mainly on financial resources that are a) low compared to their size and b) risky, consisting mainly of short-term contracts with industry and State budget and programmes.

2. the newly created enterprises are under-capitalised and able to carry out only a minimal part of the R&D for new applications outside the institutes’ premises.

Links with the incubator institute can weaken or strengthen. In either case they evolve into formal agreements that ruled the use of equipment and facilities of the institute, and sometimes, also arrange the use of its structure for business activities. The type and extent of agreements differ from case to case. In most simple cases the enterprise pays a rent. In other cases the enterprise and the institute become partners sharing profit for one particular business activity while remaining independent organisations.

Once created, these new SMEs use the institute’s network: relation with the affiliated design bureau (KB and Construction and Technology Institutes), with industry, with other research institutes. Marketing efforts are intensified through the existing network of contacts. For

instance, new clients are often connected or referred by the clients previously attended, technical and company brochures are printed, advertising is done in local specialised journals or even, articles related to the technology exploited are published in local and foreign scientific journals.

As seen, an existing client can very well ask for new applications needing more investment in R&D. Generally, the clients' portfolio is limited and has to be extended with tailored innovative applications. There is a natural demand for high tech products that exploit a similar S&T base but have differentiated applications and development phase. This forces the newly created enterprise to maintain their R&D effort high and have a very flexible (creative) approach to the resolution of the customers' needs. A creativity that has often been noticed in fast changing economic environments which lack in resources.

> *Vortex's "swirling flew closed technology" has been developed to apply for different end-uses: cleaning, grinding, heat transfer and even food industry (ecological clean technology for liquid smoke flavour (LSF) production, based on water absorption of the wood pyrolysis in the vortex gas-liquid reactor) and, for a wide range of clients (SMEs, power plants, households,*
>
> *New R&D axes were gradually introduced. The most relevant being the Laser-Doppler device for precise speed and length control since 1993. A technology brought in by new researchers of the ITP for applications others than the ones already developed with the "swirling flew closed technology".*
>
> *New researchers working for VORTEX grew to 30 (out of 36 total number of employed) in 1995, reducing to 25 at the beginning of 1997. The number of partners grew too, from 8 to 15. The participation to profits being a combination of the percentage of share owned and the financial success of the project in which each was involved. Several, if not the majority, of the people working in VORTEX remained enrolled as researchers in institutes, where they spent "half of their time[14]".*
>
> *The links with the ITP and with other institutes in the Science City remained strong and most derived from personal scientific contacts. The company however is not linked to the association "Heat of Siberia", a pool of firms founded, controlled or simply "connected" to the ITP.*

The need to enlarge beyond the institute's reaches encourages the introduction of more defined roles and responsibilities inside new firms. Founders gradually cover and / or specialise in one specific managerial position other than that of researcher or innovator. Although this does not imply a rigid definition of positions inside the enterprise, it helps to focus managerial efforts and be more effective. Emerging managerial needs could include, for example, prospection, advertise the firm's products, conclude new agreements with the parent institute or with other institutes in order to use their research facilities, consolidate networking with local enterprises or authorities…

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[14] Many interviewees referred to this concept which was discovered to mean that researchers involved in outdoor activities had a formal constraint to spend at least half of their working time continuing their duties for the institute.

In this environment, innovation is continuous and mass production does not exist. The demand for standardised products is weak. This proved to be a protective mechanism for high tech SMEs in Akademgorodok. When this is not the case, the amount of S&T and R&D fall, allowing fierce local, domestic and foreign competition: the sputnik firm transforms a "low rate" financial environment and murky business practices into a commercial enterprise doomed to suffer from its lack of economies of scales. On the other hand, high technology SME are by definition small, headed by scientists, under capitalised and not meant to be manufacturing firms relying on a single innovation.

> *This is the case of synthetic production of emeralds. It is not clear in which lab of which institute the technique for the growth of synthetic emeralds has been perfected. Different versions give the paternity to the KB of Monocrystal, which indeed seems to be the most appropriate. Once fine-tuned, the technology rapidly became known to many. It is known that scientists in Krasnoiarsk 26 were manufacturing their own emeralds. Moreover, in two adjacent labs of the same institute, two teams were managing their own business. The production cycle is apparently banal: put a small amount of aluminium silicate in an electric oven for 3 weeks / 1 month, depending if you want stones for industry (lasers) or for jewellery. Be sure that your garage where you are carrying out the experiment supplies you constant electricity, and that there are no external disturbances (as vibrations from a car parking) and you might well have artificial emeralds. Whatever the truth, several people entered the business (from researchers to Ph.D. students) saturating the market. There was no innovation in the process from the created ventures and it became a matter of prices. Initial high profits rapidly decreased and low quality production decayed the image of the entire production coming from Novosibirsk. The result was that most of the ventures disappeared from the market scene*

One important aspect is that a direct relation now exists with the clients, which are also the end-users of the innovation. This phenomenon did not exist during socialism and was one of the causes of the low effectiveness of diffusion of technology to industry (known as the *vnedrene* process). The market is competitive by nature and the SME are deemed to enter a continuous cycle of innovation. After the first project has gone from research to development, production and sale, SME launch new researches. At this stage the enterprise has stabilised, new slightly differentiated products based on the same S&T are developed for similar final uses and few workers are enrolled, when needed, to carry out the unskilled work.

High technology SMEs with a systematic[15] innovation activity have appeared with post-socialism.

Modes of spin-offs' growth

In the second stage of their development, SMEs have been observed to choose between two modes of growth:

1. **Growth by enlargement**: new researchers are *accepted* in the enterprise. They bring in new

[15] Spontaneously generated by the demand

skills and innovative applications and, as counterpart, the SME offers them scientific, technical, logistic and financial support. But the new individuals are usually not part of the SME and receive no wage. They eventually share profits from commercial activity limited to what they have developed.

2. **Growth by budding**: new independent subsidiaries are created for new business areas / projects. This step usually follows the entry of new researchers and the investment in new R&D axes. In this second case the SME is not endangered by the failure of a new project. The risk from including new business is spread between the new subsidiaries.

> *Former scientists from the Catalysis Institute of Akademgorodok founded INFRASPAC during the perestroika. It specialised in the development and manufacture of equipment for chemical and physical analysis for scientific investigation and experiments carried out in institutes and not covered by the Federal budget and not found on the market. Today's INFRASPAC President was in charge of developing equipment for chemical and physical analysis for the Catalysis Institute. In USSR all special equipment needed for research activities of the institutes were developed and produced by the institutes themselves, by teams that included scientists, and technicians (engineers).*
>
> *With time, the co-operative company started to expand its activity so to include development of equipment for water environmental treatment with applications others than research institutes. INFRASPAC used institutes' equipment and facilities and managed to save some money to be re-invested in several scientific and technical research activities. Various projects were started in different domains distributing the enterprise's effort, the main difficulty remaining the lack of cash to be used as working capital. The State or other public programmes gave no help. Some of the projects died without success.*
>
> *Several of the projects survived and were profitable allowing further investments in R&D. It is at this point that the company decided not to bear the entire risk in carrying out new projects. Though maintaining a participation, new ventures were established: INFRASPAC LAB Ltd specialised in the development of equipment for air and water cleaning, INFRASPAC ANALYTICAL enterprise that develops analytical equipment, SIBEL Ltd involved in security apparatus manufacture (for example explosive detection). INFRASPAC continuing to supply the organisational support, contacts (market, institutes, local authorities, … ,) and seeing the cross participation of partners in the mother company and the daughter spin-offs.*

The high technology enterprises are likely to develop as industrial research laboratories initially organised according to the first scheme: several departments of a unique legal organisation. The following step is the transformation into independent subsidiaries. This second step is taken when the risk increases with the inclusion / enlargement of R&D projects. New projects imply a high level of risk for a small under-capitalised enterprise due to the time needed to complete the R&D cycle, the financial incidence of new investments and the uncertainty of the outcomes.

In both cases the SMEs grow thanks to new recruits offering to carry on the research work they have started in their own institutes. Researchers that are unable to convince the institute of the potential economic outcomes of their work, or who do not rely in the institute, in other words who are not able to find financial means, turn to existing SMEs. In several cases they know one or more founders from previous scientific exchanges while working in the Academy structure. This acquaintance is not sufficient to open doors: SME's managers have to be convinced of the

potentiality of the proposed applications and suggestions made on marketing and financing aspects to take on the project.

At this stage the enterprise possesses a mix of R&D projects involved in different S&T domains. New researchers are supported to develop new applications. The client portfolio is more ample and possibly more heterogeneous (industrial firms, institutes, households, …) and geographically broader. Investments in innovation remain strong and the enterprise maintains its links to the scientific structure. The risk of failure has overall decreased even though the financial structure of the venture remains weak.

The other face of the orbit: enterprise creation in institutes

The creation of enterprises has also been observed to scatter directly from the research institutes. In this case the process focus on the transformation of part of the institutes' structures and assets (departments, design bureaux, production units) into enterprises more market oriented. The initiative originating from the institutes' managers themselves.

The determination to create profitable enterprises to exploit the results of research has boomed after 1992. However, several key actors in the institutes' management had already created, before this date, new structures focusing on scientific applications for industrial uses before this date. These cases match the "Sputnik" process described above: founding of an enterprise strongly linked to the parent institute for know-how and research work to be carried out but managed independently.

> *This process is well illustrated by the case of the Hydro Impulse Institute (HII): In 1991, the former Director constituted a firm exploiting "explosive welding technology" on the basis of its own author's certificate. This was a time (perestroika) when " … control by the city's administration was rather lax and it was easy to create ones own company … " [quoted from the interview to the Company founder, former Director of the HII].*

Drifts to externalise those activities directly linked to industry out of institutes were already present in Akademgorodok since long (in socialist times).

- One of the Presidium's objectives was to create a ring of KBs involved in R&D intermediate around research institutes (test discoveries, application innovation, prototyping, …). These design and technical units orbiting around and controlled by the institutes were meant to transfer technology from S&T into industrial production.

- The institutes and the Science City had grown uninterrupted in size and in number of research axes, catered by growing State Budget allocation. This had implied a raise in the complexity of organisation management and a greater difficulty to control (i) the institutes by the SBRSA administration body (ii) peripheral components of an institute (departments, KBs, production sites, labs…) by the institute management.

However, this structure did not work during socialism because of the planning system preventing units to contract directly. It caused the addition of new institutes / attachments of institutes with new “research mission” and an increasing financing from the State.

After the collapse of socialism and the decrease of State funding research institutes, KB and other SKTB (Construction and technological research institutes) facing the threat of bankruptcy and of closing down, also grasped the possibility to market research results.

Three main processes can be spotted:

1. **Development of research contracts:** contact of Russian and foreign enterprises, and verify their interests in having research being carried out. This can involve one or more labs / departments of the institute. It can be regarded as a usual research contract and no enterprise creation. This includes the sale of patents and past research results.

2. **Constitution of an enterprise:** participation to the creation of an enterprise focused in exploiting research results. The new enterprise has the status of a joint closed stock company owned by the institute, several researchers and sometimes a bank. The latter supplies the necessary starting capital in return for a share in the new venture. In other cases it takes the form of a joint venture with a foreign company.

> *This is how TAIRUS, a company specialised in the growth and commercialisation of synthetic gems, was created. It started as a joint venture between the Institute of Geology and a couple of thailandese trading companies. The institute needed the foreign partner for the starting capital and the commercial network while the Thai's companies were interested in the institute's technology and scientific knowledge as well as the right to set up a business in Akademgorodok, town owned by the Russian Science Academy.*

The creation of enterprises from the institutes’ ribs was not exempt from internal tension. As seen, an institute embodies a large number of researchers involved in domains which, in many cases, are linked only by an old classification convention but follow independent paths. An organisation that suffers severe financial problems and risks to collapse can nevertheless include in its structure potential profit-earning units.

It is from these profitable units that centrifugal momentum is generated to split away from the parent organisation. This was particularly strong in the ring of KBs (dating back from the socialist era) which statutes were to develop “semi-industrial” products from research carried out in the institutes’ labs, and diffuse them to the local industry. A case has been surveyed of KBs that, in the long run, started selecting and refusing work coming from institutes to develop and trade only outputs with potential higher returns. The KBs have to integrate applied research capacities to develop old or new applications.

Monocrystal Joint Stock Company was created from a former design bureau of the Institute of Geology. The success with which it marketed its products (automatic and semi-conductors) pushed it to refuse works coming from the institute and developing its own business. It transformed into a private company, owned by the institute for 30%. Scientists and researchers own the rest while remaining employed in the institute.

The transformation of former KBs and production units into joint stock high technology enterprise was common after 1992.

These have some competitive advantages. They

- own material assets (equipment and machinery) from which to start a venture;
- have closer links with industry / consumer market;
- have an existing network of contacts to obtain non-State contracts, domestic and foreign;
- can rely on an institute back up and in several cases in banks participation for the working capital necessary to launch the venture,
- attracts enthusiastic scientists and researchers interested by the idea of becoming managing partners of profitable organisations.

3. **Participation to an existing venture:** participation to a venture still strongly dependent on the institute's structure and unable to metamorphose into a stable independent enterprise. Researchers involved in a venture offer institutes to participate in their business in exchange for support and help.

4.Conclusion

The phenomenon of spin-offs has been observed in all economies that reward entrepreneurial initiative. It is a natural process that allows industry to renew, strengthen and consolidate itself. The structure of the Russian economy exhibits features that can mortify the constitution of SMEs. Most of them are due to the soviet heritage:

- dinosaurs: large and technically outdated former combinates with large immobilised capitals and low quality output
- low entrepreneurial culture[16]
- non-responding capital market for SMEs.

[16] The distinctive competencies resulting from performing in a competitive mature arena.

Having observed that civil research organisations have fed the creation and consolidation of high technology SMEs seems particularly encouraging for the evolution path of the Russian economy. It assumes the birth of a more heterogeneous and fluid industrial system endowed with multiple innovating forces. It constitutes a stratum of entrepreneurs not merely basing their activities on short-term speculation. Paradoxically, it is the accomplishment of the *technology diffusion ring* between S&T and industry production ...The long lasting objective of civil science in socialism.

It emerges that success or failure of the entreprisation "Sputnik" process is strongly related to the history and the evolution of the parent research organisations, for both independent spin-offs and joint-stock enterprises.

How long and how intensive will the described process be and what will be the survival rate of the newly born high technology SMEs? A two figures correct answer is rather difficult to figure out and would be of marginal interest. As long as the institutes will not be able to pay high enough wages, researchers will be ready to take some risks for a better living and the described phenomenon is likely to continue. The financial risk to set one's venture is often minimal and limited to the initial working capital, as researchers remain employed in the institute and are free to develop their own high technology business concept. However, this questions the pauperisation of institutes, the durability of the new SMEs, the development of local and regional industry.

It seems important to understand how and what factors can strengthen the effectiveness of the "Sputnik" enterprise creation process. The success of the described phenomenon is linked to a non-myopic reorganisation of science in Russia. This means safeguarding the research potential of institutes by supplying them with managerial skills, know-how, support structures and a legal environment to challenge the new scenario. The stake of high tech SMEs development is central to the future of Russia. Indeed, success of high tech SMEs is based on a new model linking industry and S&T assets inherited from the past. Vice versa, the ways these assets are capitalised can imply the survival of the S&T Russian structure.

Working force in institutes (1993 and 1995)

Siberian Branch RSA / Institutes in Akademgorodok	Total employees 1993*	Total employees 01/94	Total employees 01/95	Total employees 01/96	? 96/93
All research institutes			**28 505**	**27 681**	
All SKB et SKTB			572	380	
All non scientific activities			11 360	10 244	
All institutes			**40 437**	**38 805**	
Institute of mathematics	512	497	485	475	**-7,2%**
Group of institutes for maths and computer					
incl. calculation center	538	436	411	389	**-27,7%**
incl. Inst. KT of the calculation center			320		
incl. Inst. for calculation technologies			148	115	
Inst. for computer systems. Ershova	188	176		167	**-11,2%**
Inst. for Nuclear Physics. Budker	3 752	3 360	3 159	3 147	**-16,1%**
Inst. of semi-conductors				898	
Inst. KT applied micro electronics	402	315		248	**-38,3%**
Inst. thermophysics Kuteladze	808	699	649	576	**-28,7%**
Inst. lasers	164	163	191	243	**48,2%**
Inst. applied and theoretical mechanics			549	518	
Inst. for mining affairs	584	478	561	575	**-1,5%**
Group of inst. Hydrodynamics Lavrentev					
Inst. hydrodynamics Lavrentev	463	451	436	447	**-3,5%**
Inst. KT for hydro impulse technics	282	233	234	238	**-15,6%**
Group of inst. automatics & electrometrics					
Inst. automatics & electrometrics	562	547	516	485	**-13,7%**
Inst. KT experiment instruments	309	272	235	200	**-35,3%**
Inst. minerology and petrography	250	244	212	207	**-17,2%**
Inst. geophysics	199	197	177	157	**-21,1%**
Inst. KT monocristals	229	197	177	170	**-25,8%**
Inst. geology	478	487		389	**-18,6%**
Inst. of Novosibirsk of organic chemistry	499	461	445	447	**-10,4%**
Inst. kinetic chemistry	389	346	304	301	**-22,6%**
Inst. catalysis. Boreskov	967	921	1 061	1 067	**10,3%**
Inst. inorganic chemistry	800	729	691	644	**-19,5%**
Inst. chemistry for solids & transformation of raw materials			254	241	
Inst. for bio-organic chemistry			346	303	
Inst. for cytology & genetics	934	926	910	883	**-5,5%**
Inst. for systematic & ecological zoology			228	219	
Botanic garden	329	307	295	282	**-14,3%**
Inst. for soil and agrochemistry	177	156			
Inst. for economics and industrial engineering	505	453	411	393	**-22,2%**
Group of inst. history, phililogy, philosophy,				19	
Inst. history	79	75	71	67	**-15,2%**
Inst. phylosophy and law	82	77	66	66	**-19,5%**
Inst. philology	55	52	63	63	**14,5%**
Inst. archeology & ethnography		259	282	242	
Administration			162	242	

Source: authors' elaboration of internal data of the Siberian Branch of RSA Præsidium (1997).

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List of institutes and Sputnik Firms visited

Institute of Catalysis Boreskov

Budker Institute of Nuclear Physics

Institute of Thermophysics Kuteladze

A. P. Ershov Institute for Informatic Systems

Institute of Mineralogy and Petrography

Group institute of Geology, Geophysics and Mineralogy

Entreprise E3D studio

Entreprise Sibel Ltd

Entreprise Infraspac Ltd

Entreprise Hydro Impulse

Entreprise TaiRus

Entreprise Emeralds

Entreprise Vortex

Entreprise Monocristal

The Annex on the situation of institutes visited in the frame of the research project "Adaptation to the environment of the science academy institutes in Russia - The case of Akademgorodok, Novosibirsk", can be asked to the authors if required.