TRIPLE HELIX SCIENTIFIC NEWS

PROOF OF CONCEPT IN RUSSIA: EXPERIENCE FROM THE FIRST ROUND OF THE SKOLTECH INNOVATION PROGRAM



DMITRY PEBALK (Author)
CEI Program Manager
D.Pebalk@skoltech.ru

IGOR SELEZNEV (Co-author)
CEI Director of Research
I.Seleznev@skoltech.ru

ILIA DUBINSKY (Co-Author)
CEI Director of the Centre
I.Dubinsky@skoltech.ru

Center for Entrepreneurship and Innovation (CEI)
Skolkovo Institute of Science and Technology, Moscow, Russian Federation

ABSTRACT

This paper describes the experience from an attempt to establish the proof of concept approach in a Russian University environment. Starting with the general analysis of translational research and activities of the leading proof of concept centers, the authors present the development of the corresponding innovation support program at the Skolkovo Institute of Science and Technology (Skoltech). Special emphasis is put on the program structure, selection process, evaluation criteria, mentorship, and other related questions. The influence of several key aspects including project challenges, supporting infrastructure and innovation ecosystem on the proof of concept outcomes is considered.

INTRODUCTION AND STATE OF THE ART

Technology transfer from Universities to the marketplace faces a well-known gap of technology and market uncertainty at the early stages of development [1]. However, these uncertainties, or risks, may be significantly reduced with an approach known as Proof of Concept (PoC) [2]; PoC aims to demonstrate that scientific development or technology has the potential to be more than just an idea. In most cases, PoC starts with experimental results or early prototypes, and ends up with the development customized according to the needs of the market, and intellectual property in the form of patent application or know-how. Thus, PoC stands at the beginning of the innovation elevator which transforms scientific discoveries into market products and industrial technologies.

Nevertheless, the role of PoC should not be underestimated, as successful accomplishment increases the chance for technology transfer from University or research institute to either existing market player or newly created start-up. The research team receives a record of its ability to achieve a set of goals defined in close contact with industry and the expert community. The created prototype becomes the subject of demonstration for all interested parties, and may be further tested or scaled-up according to customer needs. The resulting Intellectual Property, which in most cases is a patent application, opens the road to license negotiations and corresponding agreements.

Moreover, the impact of PoC should be not limited to technology transfer of exact development. Its meaning and value is much broader, as it may help universities to identify new industry sponsors, expand research activities towards new horizons, initiate collaborative studies, attract attention from authorities, and ultimately, make a positive impact on society.

A very similar concept known as *translational research* is now widely known, and is a common approach in the healthcare/biotechnology space. It is most commonly defined as engineering research that aims to make findings from basic science useful for practical applications that enhance human health and well-being [3]. This term originally appeared in literature as early as 1993 [4]; since that time translational research has found tremendous support and attention. For example, the US National Institutes of Health (NIH) has made it a priority, forming centers of translational research at its institutes and launching the Clinical and Translational Science Award (CTSA) program in 2006. NIH gave a following definition: 'Translational research includes two areas of translation. One is the process of applying discoveries generated during research in the laboratory, and in preclinical studies, to the development of trials and studies in humans. The second area of translation concerns research aimed at enhancing the adoption of best practice in the community' [5]. Thus, it helps bridge the gap between basic research and a deliverable product.

Even though unlike the PoC approach the methodology of translational studies appears to be well developed, from the practical point of view both of them underline the importance of setting research targets with a consideration of further use. However, diffusion of this very important knowledge to scientific areas other than healthcare and biotech is relatively slow while being highly needed by the Universities who claim innovation and entrepreneurship to become the third component of their DNA.

For over a decade, the challenge of building PoC in a systematic way has been addressed by the leading world universities [6], due to their desire to see their ideas and technologies have real-world impact; additionally, governments have increasing expectations to see early stage funded research transition from the lab to yield greater impact on their economics. In most cases, PoC is implemented on a separate center or a long-term program. The Proof of Concept Center (PoCC) may be defined as an institution 'devoted towards facilitating the spillover and commercialization of university research' [7].

A recent paper by Bradley et al described several perspectives to look at PoCCs [8] while their key services are listed in i6 Green Challenge initiative at the US Department of Energy [9].

- Firstly, at the select phase the Deshpande Center receives proposals from MIT research teams, led by MIT faculty, with an interest and willingness to attempt to commercialize their inventions. The Center, through a rigorous two stage proposal process, selects projects which meet the judging criteria for PoC funding;
- Next, at the direct phase the selected project teams further their research under the direction of experienced mentors (called ***catalysts***). The role of the catalyst is to support the technology and market risk reduction to a proven result;
- Finally, participants are connected with potential end users, industry, government, and private investors, to get feedback and make further improvements to their target development or even find additional support, sometime monetary, from them for the projects' further development stages.

At present, one can find University PoCCs of various ages, scope of project and methodologies. For example, unlike the Deshpande Center, the von Liebig Center at University of California, San Diego (UCSD) used paid part-time mentors and made their advisory services available to all researchers at the Jacobs School of Engineering [7]. Moreover, a PoCC shouldn't necessarily place itself at a single university, but it may act as an innovation hub [8].

Although the United States seems to be a leader in the number of University based PoCCs, the EU pays a lot of attention to their support and cultivation. Noticeable differences between Universities are explained as resulting from institutional features such as university autonomy, personnel mobility, and the principal investigator, stand out [10]. Critical analysis of the European PoCCs activities at a national scale is available [6, 11].

The SATT network, established in France in 2012, is an excellent example of a strong initiative to support a PoC at the national level. Twelve non-government organizations were created as regional innovation hubs for local Universities. Each SATT acts as an interface between public research laboratories and the industrial sector, and has strategic objectives to increase the innovation level of companies and to foster regional economic development [12].

A comparison of the PoC model of the MIT Deshpande Center, von Liebig Center, SATT, and the Skoltech Innovation Program is given in Table 1, showing that there is no common way to build a PoC center.

It should be noted that the current trend emphasizing the importance of PoC and translational research studies is disputed [13]. However, there is certain evidence of a positive relationship between the inventive activities of scientists and their performance as researchers [14]. Thus PoC should not be considered as a threat to faculty and scientific activities of University in general.

Program Description

In February 2012, the Center for Entrepreneurship and Innovation (CEI) at Skoltech for the first time launched the Innovation Support Program (renamed as Skoltech Innovation Program or SIP). It was based on MIT Deshpande Center methodology to identify research projects with a high potential for commercialization and provide the conditions to accelerate them to market. The application process consisted of two major steps, the submission of pre- and full proposals. Following MIT Deshpande Center standard pre-proposal forms [15], the applicants were requested to submit a document of up to five pages with the following sections:

- Executive Summary: brief overview of the technology and problem it might solve, major goal of the team within the grant period.
- Opportunity: description of the key problem, so called customer "pain", to be addressed in the project with clear definition of potential societal, academic and market impact.
- Proposed Approach: technical explanation of how the project addresses the problem including benefits and novelty of the project, with respect to the team's prior work and prior art, the current status of the innovation and any related IP.
- Commercialization: path and key steps towards making impact with the project results including definition and analysis of both the technical and market uncertainties (risks) that might be preventing this idea from proceeding along that path.
- Deliverables: expected outcomes to be obtained within the proposed time line of the project (code, prototype, data proving feasibility or similar)
- Team and Collaborations: team members, their role in the project, existing and potential collaborators, with disclosure of the financial interest or affiliation between them and the team.
- Resources and Budget: people, equipment and service cost required to accomplish the work.

After careful peer review process, less than one third of the applicants were suggested to prepare full proposals with the same content but overall size extended to ten (10) pages. The final selection of the program participants was done on the basis of their projects in-depth analysis by the international review board comprising of Skoltech and MIT experts in technologies and entrepreneurship. The following major selection criteria were used to define the winners of the contest:

- Novelty, exceptionality, and disruptive nature of technology.
- Market potential and chance to get a realistic reward if successful.
- Potential implications of the technology.
- Opportunity for creating new IP.

Table 1: Comparison of PoC Center Models

	von Liebeg Center at UCSD (USA)	MIT Deshpande Center (USA)	Skoltech Innovation Program (Russian Federation)	SATT (France)
Source of funding	Gift of William J von Liebig Foundation	Gift from philanthropists (Deshpande family)	Institute funds	National program
University affiliation (external/internal)	Separate entity of Jacobs School	Separate entity of MIT	Skoltech program activity	Each SATT acts as regional innovation hub
Services (outsourcing/ insourcing)	IP, contracts and other services are provided by the institute (university)			SATT has its own legal and contracting team
Mentors (used/not used, paid/volunteers)	Paid advisors (part-time)	Catalysts are the key component, all are volunteers	Catalysts are the key component, paid project support approach tested*	Mentors rarely used, industry feedback and expertise is preferred
Involvement of the PoC office staff in projects	Monitoring and consulting	Monitoring only	Monitoring and consulting	Monitoring, consulting and direct participation through hiring of a project manager
Projects Focus	All research directions as submitted by applicants			Regional growth engines
Participants	UC San Diego, some programs to other universities in Southern California	MIT only	Skoltech and teams from partner institutes**	All universities in the area / region

* started in 2013 as a trial, ** to be limited to Skoltech participants only in 2015

- Likelihood of technological success.
- Justification of a connection between the project scope its budget and time frame.
- Principal Investigator's involvement in the project.
- Likelihood that the program will help moving the technology towards commercialization.

Thus the selection process was aiming to support the projects combining excellence of research, motivated team, and good market potential for proposed development. In general, it also reflected well-known ideas of project management through a request for a clear definition of the project scope, budget, milestones, key deliverables, and risk assessment [16].

Another distinct feature is related to early identification of critical intellectual property (IP), including background IP in possession of the research team, their home University, or belonging to some third party, as well as foreground IP to be created within a project. The last should be necessarily studied and evaluated in comparison with competing technologies. A strong accent on IP is one of the clear borderlines between methodology of PoC studies and a common approach to basic research.

As the result of the selection process, four research teams were chosen and received financial support for one (1) year to realize PoC. The areas of research varied widely from team to team and comprised of ideas for: developing new materials (two groups); creating optical electronic sources for modeling radio signals with a millimeter diapason; and identifying new biomarkers for early diagnostics of atherosclerosis.

An important part of the program methodology also following the best practices from the MIT Deshpande Center, included regular interaction of the research teams with their mentors. To distinguish mentors who contribute to the support of start-ups (more mature phase compared with one being addressed by PoC) Deshpande Center is using the special term 'catalyst', which became commonly applied by Skoltech. In order to support the early stage of the program at Skoltech, several MIT catalysts agreed to be involved in new projects in the Russian Federation. All of them were seasoned entrepreneurs with strong technical backgrounds, profound skills, and years of work in high-tech industries, and a deep understanding of markets and venture capital. Their role in the program should not be underestimated, as they delivered regular advisory for the research teams and helped to realize 'direct' and to some extent 'connect' functions as core elements of the Deshpande Center methodology.

In order to provide additional support for the teams, Skoltech decided to link a second catalyst from the Russian Federation with every team. It was necessary from a standpoint of better understanding local markets and opportunities, as well as to support the 'connect' function which requires personal knowledge and links with at least some industry companies and market players. The role of the catalyst in advancing researchers to have early meetings outside of their labs is considered by MIT as one of most important as it is one of the best ways to set accurate goals for their projects.

Another important element of the program was represented by regular half-year conferences. All program participants, including the research teams and their catalysts, were invited to spend two days in Moscow to discuss progress of the supported projects. These events included:

- Education and training for the program participants.
- Sharing knowledge and best practices.
- Networking with invited guests and other participants.
- Creative mind storming during group discussions.

PoC projects in their initial research phase were performed in the time frame from December 2012 till November 2013. Since that time, the participating teams continue efforts to develop their projects within the commercialization phase, which includes both necessary R&D steps and entrepreneurial activities to bring their developments to the market, while Skoltech is taking responsibility for the IP protection and general commercialization advisory.

Two successful accomplishments resulting from these activities should be briefly described:

1. Skoltech submitted its first international patent application (#RST/RU2013/0011720) describing structure, composition, and production method for a new ultra low-k dielectric material. The agreement for samples transfer was prepared for advanced testing by a foreign partner. Marketing information on the invention was presented for interested companies in leading world technology databases and at Skoltech website.
2. One of the participating teams developed a new composite silicon-carbon anode for lithium-ion power sources. A functioning prototype of a thin-film Li-ion battery, using an anode with improved performance (increased capacity and number of charge-discharge cycles) was demonstrated in November 2013. The team also started negotiations with companies potentially interested in implementing this technology.

In general, the ultimate success of the project is determined as licensing the results to an existing company or a newly established start-up, while intermediary achievements may include effective fabrication of prototypes based on industry or market requirements, positive test results, patent applications, and collaboration agreements with interested parties.

Methodology and Research Focus

The present research is an attempt to analyze the results of the first round of the Skoltech Innovation Program and share the knowledge within the Russian and International communities of entrepreneurial Universities, in order to facilitate and speed-up the development of similar PoC programs, and with the ultimate goal of increasing economic, academic, and social impact. The analysis is based on the results of personal in-depth interviews with the SIP participants including research teams, their catalysts, and MIT experts, as well as achieved project results within the time frame from December 2012 till the end of 2013. More than one hundred written feedback forms were collected and processed during this period of time. The project results monitoring was realized on a monthly basis.

The authors strove to find answers to the following questions:

- What are the major difficulties and barriers of implementing the Deshpande Center methodology in a Russian University?
- How one could arrange and monitor PoC activities in the most efficient way?
- How should a University interact/engage with the program participants after the end of the financing round?

Findings and Interpretation

According to the results of the first round of the Skoltech Innovation Program, by the end of 2013 most projects had made visible progress towards the commercialization of their scientific developments. All research teams had performed market analysis, received feedback from the industry and revised target properties of their prototypes, while half stated the development of patentable IP. However, it should be noted that during the past year the Center for Entrepreneurship and Innovation at Skoltech faced noticeable challenges to manage PoC projects accordingly to the Deshpande Center experience. One could sort these challenges into three groups: associated with the projects themselves; then the supporting infrastructure; and finally the innovation ecosystem.

Projects Challenges

The first challenge in this group is undoubtedly related to the perception of PoC financial support, which might be considered and treated by researchers just as another research grant. If this is the case, supporting certain projects will most likely result in a higher rate of IP protection activity, but will hardly initiate further licensing and/or start-up creation. Thus regular communication with researchers to explain the PoC approach is of vital importance at a very early selection stage.

The second challenge is the lack of certain skills in research teams that are needed for project management and the effective promotion of developments. In this sense, universities with business schools on their campus (such as the Sloan School at MIT) are likely to gain a clear advantage over the rest. Easy access to business schools should expand opportunities including, for example, classes in innovation and entrepreneurship, mixed teams comprising skills in research and business, professional evaluation and support in risk management, market studies. If such an option is not available, the PoCC management should make efforts to provide at least minimum level of training to the participants.

The third challenge is to facilitate interaction between the teams and their catalysts. Despite well-known psychological barriers, proper communication may be influenced by many other factors, including different perceptions of time management in the academic community and business. For example, one of the catalysts (acting as a CEO at a mid-size commercial company) at a personal interview explained that he was offended by the fact that his team once arrived almost thirty minutes late to the meeting without any attempt to provide a reasonable explanation. The frequency of communications and the way things are done may be very different and there is no common way to measure productivity. In general one phone call or e-mail per month should be considered as a minimum level. Personal meetings of the teams with their catalysts are of major importance, as they allow for the most effective discussion, brainstorming, etc.

Intellectual property questions, especially with background IP, represent a separate subgroup. All the value of a PoC may be lost without proper IP management, because further technology transfer will hardly be possible. Historically, in Russia patents are commonly considered by university researchers either as a reporting tool or as a record in a CV. Accumulating background IP and managing the corresponding IP portfolio is not standard for local universities and research institutions [17]. However if an entity has accumulated some background IP, the corresponding IP portfolio which includes foreground IP, it will be more attractive for potential licensees.

Another significant obstacle is the lack of success stories and local experience in PoC which could be used as a reference. The importance of this factor could be underestimated if one happens to be in a situation where there is no evidence to compare project efforts vs outcomes with any relevant experience.

Supporting Infrastructure

In order to build an efficient PoC program or PoCC, every university requires a qualified team with a set of unique skills. The PoC management team should have a strong academic background allowing it to communicate easily with the research community, combined with experience in a start-up, venture capital firm, or in industry. Managers with both PhD and MBA degrees are the best candidates to create a backbone of the PoCC acting as interpreters from the language of science to the language of business. However, hiring such a professional may become a challenging task especially at a regional level and it cannot be achieved in a short time.

University administrative infrastructure is a significant issue: the support of various divisions is required for effective realization of the program. A short list in most cases would include legal, IP protection and licensing office, finance and accounting.

As mentioned earlier, courses in entrepreneurship and innovation available at the host university would be useful to provide basic education for at least some members of the research team who take the challenge of communication with the industrial and business community, venture capital firms, and business angels. If such contacts are removed from the team, the PoCC should support it with a capable manager as described in this section.

Finally, an active position of the universities in innovation support via various student competitions, hackathons, and other competitive challenges, seems to form the natural environment for the further involvement of young scientists in PoC studies.

Innovation Ecosystem

As every PoC project aims to bridge scientific development with real-life application, it may become possible only in the case of good industry networking, including links to the base of sponsored research projects, studies of industry needs, and opportunities and analysis of actual trends in goods and technologies. It is highly recommended to invite industry representatives and experts at early project stages starting from the selection phase. Their contribution will be of primary importance to define technical tasks for the project and further evaluate milestones. Without tight collaboration with industry, PoC will be limited to the lab borders.

Mentors (catalysts) are the second vital element. One of the questions for every PoC: should you pay them, or they should they act as volunteers? As already mentioned there is no single answer to this question. Nevertheless, in both cases it is of great importance to be sure that they have skills to create additional value for all program participants. Thus proper mentor selection plays a key role in the success of the PoC approach in general.

Access to additional financial support and investment appears to become crucial at the later stages of PoC, as in most cases successful prototypes have to be scaled-up and are subjected to various tests and control measurements. In this sense, if the university is not surrounded with industrial R&D centers, offices of VC companies, business angel clubs, or they are not accessible in the same city or area, it is unrealistic to expect efficient technology transfer and impact on society.

Thus, the aforementioned three groups of challenges are considered to have critical importance for the successful and well-organized arrangement of PoC. It is important to understand how a university represented either by a PoC program administration, other functional units or special entrepreneurial programs will interact with researchers after the initial financing is closed. Judging on the experience of the Deshpande Center and the present results of the Skoltech Innovation program, few teams are able to achieve all target goals within the one year period of performance. Thus a university should define in advance its role towards the support of PoC projects at the stages of technology transfer and allocate required resources. However, it is too early to speculate on possible answers to this challenge in the Russian context before getting at least several years of real experience.

Conclusions

For more than a decade, the goal of creating PoC programs or Proof of Concept Centers has been recognized and accepted by the majority of the top world universities. One of the most successful practices can be found in the USA from the example of the Deshpande Center for Technological Innovation at MIT. This fact became a starting point to transfer this approach to Russia in the framework of the Skoltech innovation program.

Proof of concept management in the local environment, and adoption of established methodologies from leading world universities, face difficulties which can be divided into three groups relating to: project challenges; supporting infrastructure; and the innovation ecosystem. All have to be seriously considered while planning PoC projects and addressed by universities and local government authorities.

Skoltech managed to establish a PoC approach in Russia and proved its usefulness to accelerate knowledge transfer from lab to market. Support of PoC projects in after-grant stages started at Skoltech in 2014 and is now an area of uncertainties and opportunities to be discovered within the next couple of years.

Direction for Further Research

Important questions and directions for further research can be formulated as follows:

- How should PoC project candidates be tested at the selection phase in order to confirm their commitment and ability to change their common attitude towards using this funding similar to research grants?

- What should be done in order to provide efficient communications between research teams, their catalysts, and the PoC program administration?
- Which success stories and benchmarks should be used to communicate with PoC project teams at various stages of their research and entrepreneurial activities?
- How could the PoC program administration support interaction of the projects with local and/or international academic, mentor and business communities, in order to fill in possible gaps?

Acknowledgement

The author would like to thank his colleagues from Center for Entrepreneurship and Innovation at Skolkovo Institute of Science and Technology for their contribution to the realization of the innovation support program and valuable discussion of the present paper. Brendan Smith, Education Program Manager at CEI, who supported the paper with final proofreading. Special acknowledgment should be given to the MIT Deshpande Center team for their intelligent support and implementation of the best practices at Skoltech. Finally, the program would never have been possible without the active support and regular feedback from the catalysts in USA and Russia.

References

1. Auerswald, P and Branscomb, L M. Valleys of Death and Darwinian Seas: Financing the Invention to Innovation Transition in the United States. Journal of Technology Transfer, 28, 3-4: 227-239.
2. Wikipedia. http://en.wikipedia.org/wiki/Proof_of_concept.
3. Woolf, S H. The Meaning of Translational Research and Why It Matters. JAMA, 2008;299(2):211-213.
4. Rubio, D McG, Schoenbaum, E E, Lee, L S, Schteingart, D E, Marantz, P R, Anderson, K E, Platt, L D, Baez A and Esposito, K. Defining Translational Research: Implications for Training. Acad Med, March 2010; 85(3): 470-475.
5. National Institutes of Health. Definitions under Subsection I (Research Objectives), Section I (Funding Opportunity Description), Part II (Full Text of Announcement) of RFA-RM-07-007: Institutional Clinical and Translational Science Award (U54) March 2007.
6. Maia C and Claro, J. The role of a Proof of Concept Center in a university ecosystem: an exploratory study. J Technol Transfer (2012).
7. Gulbranson, C A and Audretsch, D B. Proof of concept centers: accelerating the commercialization of university innovation. J Technol Transfer (2008) 33:249–258.
8. Bradley, S R, Hayter, C S and Albert N. Proof of Concept Centers in the United States: an exploratory look. J Technol Transfer (2013).
9. Green Challenge at the US Department of Energy, EERE Information Center, December 2011 https://techportal.eere.energy.gov/commercialization/pdfs/i6_green_challenge_factsheet.pdf.
10. Franzoni, C and Lissoni, F. Academic entrepreneurship, patents, and spin-offs: critical issues and lessons for Europe. WP / CESPRI ; 180, September 2006.
11. McAdam, R, McAdam, M and Brown, V. Proof of concept processes in UK university technology transfer: an absorptive capacity perspective. R&D management, 39, 2, 192-210, March 2009.
12. Satt Paca Corse Press Kit, January 23, 2012 - 2.
13. Jogalekar, A. The perils of translational research, November 26, 2012, SA Blog Network, http://blogs.scientificamerican.com/the-curious-wavefunction/2012/11/26/the-perils-of-translational-research/.
14. Buenstorf, G. Is academic entrepreneurship good or bad for science? Empirical evidence from the Max Planck Society, Papers on Economics and Evolution, 2006-17. Max Planck Institute of Economics, Evolutionary Economics Group.
15. The original forms are available for download at: http://deshpande.mit.edu/grants-resources/how-apply.
16. Chatfield, C. A short course in project management". Microsoft. http://office.microsoft.com/en-us/project-help/a-short-course-in-project-management-HA010235482.aspx.
17. Ulyakhin, S. The Specifics of Technology Transfer in Russia. Proceedings of XII Triple Helix International Conference, 11-13 September 2014, Tomsk, Russia.

Authors

Dmitry Pesbalk has experience in basic research with a PhD degree in polymer chemistry from Moscow State University and in R&D management with an MBA from the Academy of National Economy under the President of RF (Moscow). During his career he has been involved in technology consulting and management of corporate R&D center. Since 2013, he joined Skoltech to manage the Innovation Support Program as a core part of the Center for Entrepreneurship and Innovation (CEI). He is a board member of the non-profit association for support of chemical and ecological education.

Igor Seleznev has more than fifteen years of managerial and research experience. At Skoltech he leads research projects within the Center for Entrepreneurship and Innovation (CEI) and also acts as a director of the institute's Knowledge Transfer Office. During his career he had been involved in large-scale transformation projects, developing strategy, creating R&D system development, and leading diversification initiatives. He is a co-founder of a start-up company in the field of advanced materials for the electronic packaging industry.

Ilia Dubinsky has a wealth of experience in managing startups and overseeing several venture funds and startup incubators in Russia and the US. He was employed by Skoltech to build up the Center for Entrepreneurship and Innovation (CEI). He holds a PhD degree from MIT, an MSc degree from CUA in Washington, DC, and a MSc degree from Moscow Institute of Physics and Technology.