PRE-ACCELERATION OF START-UP COMPANIES AS A METHOD OF TRANSFERRING TECHNOLOGY FROM UNIVERSITY TO THE BUSINESS ENVIRONMENT[1]

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Abstract

This article presents the original concept of transferring technology created in academic environment to business. article discuss practical aspects of presented theoretical model, as it will be implemented in practice by 'Kraków Miastem Startupów' foundation and submitted to the Ministry of Science and Higher Education for 'Dialogue' program. Literature overview has been used to identify main determinants and hindering factors of commercialization process in Poland. SWOT analysis was employed to organize and present elements of environment that influences technology transfer process. A general assumption has been made, that designed model should, at least have a potential of becoming a profitable venture and should be recognize as such by private investors. Therefore Osterwalder's Business Model Canvas, a tool commonly used for measuring value of innovative ventures, was adopted as a basic framework for the model.

Key words: technology transfer, academic entrepreneurship, acceleration program.

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1. Introduction

The aim of this article is to present and discuss the original concept of transferring technology created in academic environment to business. Article will also discuss practical aspects of presented theoretical model, as it will be implemented in

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practice by 'Kraków Miastem Startupów' foundation and submitted to the Ministry of Science and Higher Education for 'Dialogue' program.

Main determinants and hindering factors of commercialization process in Poland has been identified and organized with SWOT framework. Analysis was based on literature overview and own qualitative research, such as individual in-depth interviews and experts panels. Statements of 11 people will be presented: six entrepreneurs (coded as: Ent01-Ent06) and five experts (coded as: Exp01-Exp05).

A general assumption has been made, that designed model should, at least have a potential of becoming a profitable venture and should be recognize as such by private investors. Therefore Osterwalder's Business Model Canvas, a tool commonly used for measuring value of innovative ventures, was adopted as a basic framework for the model.

As a result, the concept of commercialization of academic knowledge by forming and pre-accelerating heterogeneous new venture teams has been introduced. Team consisting of scientists and business developer, possessing unique technology and initially tested business model is considered to be the 'product' and occupies a central position in model. This product can be introduced and 'sold' to potential clients, which are venture capital and seed funds, willing to acquire it. Recruiting and assembling new venture teams and then conducting training and mentoring programs are considered to be the most important activities.

2. Commercialization process in Poland

2.1. Mechanisms of commercialization

Universities, traditionally focusing on teaching and research, are currently moving towards new great challenges, which are cooperation with private companies and supporting business ventures with new technologies (Hoffmann, Śnierzyński, 2015).

There are many ways in which business can acquire knowledge from universities, in most broad perspective it could be hiring graduates of university, exchanging staff, conducting joint research, consulting, acquiring products from spin-offs, buying patents or licensing intellectual property (Dawidko, 2012; Szarucki, 2012; Wachowska, 2016). However Pluta-Olearnik (2009), based on her research claims that in Polish practice only three ways of cooperation takes place: student internships, participation in scientific conferences and attending open trainings hosted by universities.

Those paths of technology transfer do not seem to be sufficient enough; therefore other ways of cooperation should be supported. Three most commonly mentioned methods of transferring new technologies into business practice are: selling (or licensing) patents, creating spin-off companies by universities and conducting

joint (or commissioned by business venture) applied research. First two mechanisms can be initiated inside university, third one requires action form external business venture. Some analysis of the last mechanism will be provided in the next section of article, however focusing on business ventures perspective is not the goal of this article, therefore two other mechanism are much more interesting from the academic point of view.

Government, university authorities and academic institutions encourages scientists to patent their work so it can be later sold and used in business practice, however interviews conducted by Wachowska (2016) revealed, that in many cases the only motivation for scientists to apply for patents is fact, that they are counted among the scientific achievements. In general academics are not interested in creating business value, so patent applications are submitted before estimating its market value. Further inspection revealed that 40% of 2119 granted rights of protection intellectual property can be considered as 'dead patents', that has no business value (Wachowska, Niklewicz-Pijaczyńska, 2015). Similar conclusion comes from audit conducted by (NIK, 2016).

Another approach to commercialization are spin-off companies, business ventures established by university (or its employees) in order to commercialize (transfer to business practice) new technology developed within university walls. This is a relatively new form of cooperation with the business and yet not fully supported by universities and other public entities. Exp05, representative of university technology transfer office claims, that universities prefer selling patents over spin-offs because of financial reasons. Establishing spin-off requires funds to invest in it and does not guarantee revenue in the future, while selling patent creates immediate profit. Exp04, also representing technology transfer office (but other university than Exp05), supports that opinion. On the other hand Dawidko (2012) claims that lack of capital can be solved with usage of external funding, like venture capital.

However Exp04 mentions additional barriers to starting spin-off or science to business cooperation in general, dividing them in three groups: legislation, financing and human-related factors. Similar division has been used in the next section of the article.

2.2. Determinants and hindering factors

This section contains analysis of factors influencing commercialization process in Poland. They have been divided in three categories: Political and organizational factors, Economic factors and Socio-cultural and psychological factors. Analysis has been based on literature overview and own qualitative research, such as individual in-depth interviews and experts panels. Statements of 11 people will be presented: six entrepreneurs (coded as: Ent01-Ent06) and five experts (coded as: Exp01-Exp05).

Political and organizational factors

One of the biggest problem in context of commercialization in Poland is lack of structured long-term policy of cooperation between main actors, like students, scientists, business entities, graduates, universities, technology transfer offices (Grodzka, 2013; NIK, 2016; Pluta-Olearnik, 2009; Zajkowski, 2012). Despite of official declarations, policy makers did not created any complex system of supporting science and business cooperation. Although commercialization and cooperation with business has been stated as official purpose of universities, its financing is connected solely with education and number of scientific publications (Kuśmierz, Kirov, 2010; Pluta-Olearnik, 2009; Urmański, 2016). Researchers are evaluated on the basis of scientific achievements, so they are not motivated to implement their results into commercial use (Grodzka, 2013; Urmański, 2016). Therefore, despite of any efforts made by individual employees or academic managers, the actions conducted to build cooperation with business are not support on systemic level.

From the business point of view cooperation with universities is difficult and not very profitable. Universities are very centralized and bureaucratic organizations, what makes it hard to cooperate with flexible business units (Kuśmierz, Kirov, 2010; NIK, 2016; Pluta-Olearnik, 2009). Also access to infrastructure and laboratories is a problem, because there are no clear regulations about it (NIK, 2016; Urmański, 2016). During an interview with Ent01, who is running a start-up company based on innovative hardware technology and is currently looking for people with sophisticated scientific skills entrepreneur declared that he doesn't want to cooperate with university, because according to his opinion university structure is to stiff and to expensive. He prefers to hire someone and finance his research outside university. Ent05, who started his company during his PhD studies and cooperates with fellow researchers from university also prefer to deal with specific people, rather than university, as an institution, because of its bureaucracy and unnecessary indirect costs. Exp02, who is expert in promoting academic entrepreneurship, claims that cooperation with university authorities is the hardest part of his job.

Another problem from business perspective, which limits potential cooperation is fact that technology transfer offices do not have sufficient information about available technologies and research projects ran in the universities (Grodzka, 2013; Pluta-Olearnik, 2009). According to Ent02, who is a medical doctor and start-up co-founder, academics can't effectively exchange information within their community. Ent02's company managed finally to establish cooperation with two universities, however in both cases it was good will of specific people, rather than effect of deliberate procedures. Ent05, who knows both academic and business reality, as he started his business during PhD studies, strongly supports that opinion.

On the other hand, academic frequently mentions fact, that they are overloaded with teaching duties, on average, 230 hours per year. Whereas, for example in Stanford it is only 90 hours, what gives more time for scientific work and coopera-

tion with business entities (Dawidko, 2012; Grodzka, 2013; NIK, 2016; Urmański, 2016).

Economic factors

Form the economic point of view European market of research and development has its limitation when it is compared to North American. Europe, in contrary to USA, has well developed research institutions and at the same time not very large domestic markets that limits the commercialization through patents and licenses. That argument encourages European policy makers to support more indirect methods of technology transfer, like creating spin-offs (Kuśmierz, Kirov, 2010). Although cooperation between universities and established business ventures is limited in whole UE, Polish economic situation, in particular, does not encourage such cooperation.

The main long-term Polish competitive advantage compared to Western Europe is based mainly on low labor costs (wages in the Polish manufacturing sector, measured at current exchange rates are five times lower than in Germany and France) and high labor productivity (only three times lower than in Germany and France). Therefore Polish business is not interested in innovations and only 0,03% of GDP is transferred from private companies to universities for scientific research (Orłowski, 2013).

On the other hand Polish universities have other sources of income. Most of academic funding comes from education (77% of universities budget in 2012). According to investors presence of public funding ('soft financing') discourages researchers to seek business opportunities (Orłowski, 2013; Urmański, 2016). Ent04 supports this opinion. He runs hi-tech company with a couple of friends whom he met in a student scientific circle. During studies they created first prototype of device they are currently producing. After receiving international awards for their project, they were invited to work in project ran by university as part of public grant. Ent04 is very critical about the way it was conducted. According to his opinion device that was created during that project was based on out-dated technology and it was clear that it will not have any business value from the beginning. He claims that academics prefer this kind of financing, because no one settles them with real effects.

It seems that both parties: entrepreneurs and academic have no incentives to cooperate with each other. However, this situation can change due to two factors: First one is economic development, which will increase demand for research and development services. Second is demographic decline forcing universities to search for alternative sources of income.

According to many academics problem is insufficient funds for research and commercialization process, a specially for building prototypes (Dawidko, 2012; NIK, 2016; Pluta-Olearnik, 2009; Zajkowski, 2012). However Ent06, who started his company, based on scientific project during his studies claims that financial support that he received from university was sufficient enough. Exp03, manager of

investment fund specializing in commercialization of academic technologies and Ent03 (Chief Finance Officer of one of Krakow's start-up) supports this opinion mostly blaming scientists for passivity in seeking funding. Also Wachowska (2016) gives examples of projects supporting cooperation between science and business financed by public grants, like 'Network Sunrise Dolnośląskiej Sieci Współpracy Nauki i Biznesu (2010–2012)' or 'Twoja wiedza – twoja firma (2009–2013)'. On the other hand Orłowski (Orłowski, 2013) claims, that in Poland we have limited number of business angels willing to invest in early stage business ventures. However there are some instruments, which provide 'smart money' with public support, like 'Bridge Alfa'[3] or 'ScaleUp'[4] programs.

Socio-cultural and psychological factors

Polish researchers have no business experience and are often unable to acquire investor or business partner. They usually see their invention as ready business model, ignoring the complexity of product and business development or often they are not motivated enough to search for external partners (Dawidko, 2012; Grodzka, 2013; NIK, 2016; Orłowski, 2013; Pluta-Olearnik, 2009; Urmański, 2016; Wachowska, 2016). Ent03, believes that a lot of technological potential on polish universities is wasted due to lack of business skills. According to his opinion academics has no business experience and they are simply afraid of risk. He claims that financing is not an issue. Exp01, expert in international business cooperation, claims that cultural factors are the most important blocking agent of commercialization process in Poland. Exp03 (manager of investment fund) supports that opinion and adds that many scientific projects cannot be commercialized due to lack of business developers – people capable of creating business model based on technology.

Huge problem is lack of communication between science and business (Grodzka, 2013; Orłowski, 2013). Business representatives emphasize the importance of trust and good cooperation between specific people, not institutions. However both parties are yet unprepared to cooperate: researchers do not fully believe in the good intentions of business and entrepreneurs are reluctant to invest equity (Grodzka, 2013; Urmański, 2016). According to Pluta-Olearnik (2009) informal relations between researchers and entrepreneurs are however better developed than formal cooperation between institutions.

Some investors claims, that chances of successful commercialization decrease with age of scientist, so the most desirable group for cooperation are PhD students (Urmański, 2016). Ent05, PhD in technical science who started his company during doctoral studies believes that PhD candidates have a great skill-set to be entrepreneur: They have to plan and execute their own research plan, present it and defend

[3] See: http://bridge.gov.pl/bridge-info/nasze-programy/bridge-alfa/

[4] See: https://poir.parp.gov.pl/scaleup/scaleup

their point of view. In most cases they also have to acquire funding, which includes creating schedules, budgets and a lot of paper work, which is even harder than finding investor. Orłowski (2013) mentions lowering the amount of young scientists working on universities as a problem for cooperation with business. According to Central Statistical Office of Poland in 2000, 10 professors accounted for 17 assistant professors and 11 assistants. In 2012, it was still 17 assistant professors, but only as 5 assistants. On the other hand, between 2006 and 2013 number of PhD students has increased by 40%, although in the same period of time, number of granted doctoral degree has grown only by 26% (NIK, 2015). It is possible that lack of job opportunity after PhD and tendency to combine PhD studies with commercial work could be beneficial for technology transfer process.

Table 1. SWOT analysis

Strengths	Weaknesses
S1. Good research infrastructure S2. Large number of PhD students S3. Many patents on universities	W1. Researchers and universities aren't encouraged to cooperate with business W2. Unclear legislation and overprotective attitude towards intellectual property W3. Universities are also very centralized and bureaucratic organizations W4. Unclear rules access to infrastructure W5. Academics are overloaded with teaching duties W6. Lack of communication (and trust) between science and business
Opportunities	**Threats**
O1. Presence of public funding (programs like 'Bridge Alfa' or 'ScaleUp') O2. Economy growth O3. Increasing demand for R&D O4. Demographic decline forcing universities to put more effort in R&D	T1. No long-term policy T2. Insufficient funds for commercialization, limited number of business angels T3. Polish companies generally aren't interested in cooperation with research facilities T4. No stable job after PhD

Source: own elaboration based on literature review

2.3. Recommendations and good practices

Based on analyzed literature some recommendations and good practices can be presented. Most experts emphasize importance of supporting entrepreneurial

culture in academic environment and many forms of academic entrepreneurship, mainly through education and action learning, like on Stanford University (Grodzka, 2013; Kuśmierz, Kirov, 2010; Orłowski, 2013).

Successful commercialization also requires both technological and business experience. Grodzka (2013) describes successful project implemented in between 2009 and 2013 which proves, that networking and organizing meetings between entrepreneurs and academics makes good effects, especially if technology transfer animator is present. This external animator is crucial and should be equipped with soft skills enabling him enhance intercultural communication.

Dawidko (2012) also proved importance of intermediary, as he described a common model of technology transfer in biotech, which requires three parties: universities (where discoveries and basic research takes place), dedicated intermediary company (where technology is further developed) and corporation (where technology is converted into a product and put onto the market).

Orłowski (2013) on the other hand believes that supporting young scientists is crucial, especially making it possible for them to combine research activities with running own company. He also suggests that start-up companies could be considered as a good transfer mechanism between science and business.

As shown above, Polish model of cooperation between business and universities isn't well developed yet. Simple attempts to import solutions directly from other countries don't seem to work. We need time to evaluate which elements can be implemented and which need to be customized (Grodzka, 2013). Some authors believe, that there should be created technology transfer model from scratch concordant with local legal, social, organizational and institutional factors (Hoffmann, Śnierzyński, 2015).

Author believes, that searching for one best model of technology transfer, that could be implemented in whole Polish academic environment is pointless. Instead, author proposes implementing one of many possible theoretical models in small scale and test results, according to Action Research methodology (Chrostowski, Jemielniak, 2008). Based on SWOT analysis (see Tab. 1) author makes some specific recommendations for commercialization system in Poland that can be implemented in proposed model (references to particular elements of the SWOT analysis are given in brackets):

1. Lack of long-term policy limits cooperation (S1-T1, S2-T1), therefore all actions should employ cooperation with business ventures, NGO-s, and usage of existing instruments, not trying to invent new ones.
2. Universities are not able to fully use funding (W1-O1, W3-O1) and business opportunities (W1-O3, W3-O3, W6-O3). Academics and entrepreneurs are not interested in cooperation (W1-T3, W6-T3). Therefore more initiatives should be made by external third-party organizations.

3. One way of maximizing potential in research infrastructure (S1-O3) and available technologies (S3-O3) leads through combination of smart money (S1-O1) with potential of PhD students (S2-O1).
4. Unclear rules for accessing scientific infrastructure limits potential cooperation with business (W4-O3). To overcome this issue more effort should be made to commercialize technologies already created during academic research.
5. Due to lack of job opportunities, PhD students should be interested in technology transfer and starting new ventures (S2-T4).

3. Pre-acceleration as a method of transferring technology

Based on above recommendations, author proposes theoretical model of technology transfer based on pre-acceleration program for new venture teams consisting of scientists and business developers. Program should be conducted by independent non-profit organization with presence of private investors and existing institutions supported by public funding.

Acceleration programs are rather new instruments of supporting innovative venture teams or early stage companies by providing them with trainings and mentorship, easing access to investors and first clients. Accelerators, in contrast to business incubators, are cohort-based programs which mean that supported start-ups (teams or companies) are recruited in the same time, subjected to predefined actions for period of about 3–4 months and presented to potential investors during so called 'demo day' (Cruz, 2016).

Most accelerators support small innovative companies or at least existing venture teams with business idea. Proposed model of pre-acceleration works on earlier stage of start-up development, when team is being created. A general assumption has been made, that designed model should, at least have a potential of becoming a profitable venture and should be recognize as such by private investors. Therefore Osterwalder's Business Model Canvas (Osterwalder, Pigneur, 2010), a tool commonly used for measuring value of innovative ventures, was adopted as a basic framework for the model (see Tab. 2).

To maximize potential of already existing programs and institutions dedicated to support innovation and technology transfer, like seed funds or corporate accelerators, those organizations has been considered as 'customer segments' of the model. It is assumed, that they have right tools and enough resources to support existing early stage start-ups, however great challenge for them is reaching technology created within universities, because of reasons described in previous section. Overcoming those organizational and cultural barriers is the main goal of described model.

Table 2. Pre-acceleration business model

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Proposition</th><th>Customer Relations</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">– Universities, technology transfer offices and incubators
– PhD students
– Student organizations
– Scientific associations
– Existing start-ups</td><td>– Recruiting and assembling venture teams
– Training and mentoring
– Holding events
– Establishing relations with customers and partners</td><td rowspan="3">Tech pre-startup
(new venture team with business model based on innovative technology)</td><td>– Co-creation of training and mentoring program
– Consulting and evaluating project</td><td rowspan="3">– Other big accelerators
– Business angels and seed funds
– Beneficiaries of public programs like ‘Bridge Alfa’ or ‘ScaleUp’</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td>– Good knowledge about entrepreneurship and innovation management
– Relations in business and academic environments
– Training skills</td><td>– Usage of personal contacts
– Direct contact during business meetings
– Direct on-line or phone contact</td></tr>
<tr><th colspan="3">Cost Structure</th><th colspan="2">Revenue Streams</th></tr>
<tr><td colspan="3">– Physical space (co-working place for new ventures)
– Trainers and mentors costs
– Administration costs</td><td colspan="2">– 5-10% of equity in new ventures
– Public funding, grants and sponsors
– Fee for services provided by trainees</td></tr>
</table>

Source: own elaboration based on Osterwalder, Pigneur, 2010

Therefore team consisting of scientists and business developer, possessing unique innovative technology created within university and initially tested business model (called pre-startup) is considered to be the ‘product’ and occupies a central position in the model. This product can be introduced and ‘sold’ to potential clients, which will invest in it and give further support.

Recruiting and assembling new venture teams and then conducting training and mentoring programs are considered to be the most important activities. The goal is to choose students with entrepreneurial skills and then equip them with

the necessary business knowledge to run an innovative new venture. This will be achieved through parallel training and internship programs. Trainings will be similar to post-graduate studies, while internships will take place in close cooperation with existing small tech companies and will be focused on business process.

After about 3 month trained students, called 'Junior Startup Developers' will be matched with young scientist (mostly PhD candidates) working on innovative technologies with business potential. For the next three months new venture teams will work under supervision of mentors in order to create, test and present business model to a potential investor.

Key resource necessary for implementing described model are mostly intangible. Core competence of organization implementing this model is ability of intercultural communication between academic and entrepreneurs, which requires both knowledge and established relations in both environments.

4. Conclusions

Based on literature review and own qualitative research (statements of six entrepreneurs and five experts has been presented) the phenomenon of science and business cooperation in Poland has been analyzed. Factors influencing technology transfer process has been divided in three groups: First ones are political and organizational factors (legislation, universities structure, level of bureaucracy etc.). Second group are economic factors, connected with financing of Research and development. Third group are socio-cultural and psychological factors, like level of trust among academics and entrepreneurs or managerial skills of academics. Then SWOT analysis has been used to organize those factors and to present relations between them.

After analyzing and presenting existing situation of science and business cooperation in Poland a theoretical concept of commercialization of academic knowledge by forming and pre-accelerating heterogeneous new venture teams has been introduced. Osterwalder's BMC framework has been used as a tool for building the described model. Team consisting of young scientists and business developer, possessing unique technology and initially tested business model is considered to be the 'product' and occupies a central position in the model. This product can be introduced and 'sold' to potential clients, which are venture capital and seed funds, willing to acquire it and subject to further support.

Presented concept of pre-acceleration is an example of theoretical model of technology transfer. Author does not claim that created concept is the best or most efficient way of technology transfer, therefore further research in this area should be conducted. However, described concept has been initially implemented in practice by 'Kraków Miastem Startupów' foundation, so it will be observed and analyzed according to Action Research methodology.

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PRE-AKCELERACJA PRZEDSIĘBIORSTW TYPU START-UP JAKO METODA TRANSFERU TECHNOLOGII Z UCZELNI DO ŚRODOWISKA BIZNESOWEGO

Streszczenie

W artykule zaprezentowano koncepcję transferu technologii powstałej w środowisku akademickim do otoczenia biznesowego. Oprócz przedstawienia modelu teoretycznego, dyskusji poddano możliwość jego zastosowania w praktyce przez fundację Kraków Miastem Startupów w ramach realizowanego przez Ministerstwo Nauki i Szkolnictwa Wyższego programu „Dialog". Główne determinanty i bariery procesu komercjalizacji w Polsce zostały zidentyfikowane na podstawie przeglądu literatury. Do ich uporządkowania i dalszej analizy wykorzystano analizę SWOT. Przyjęto założenie, iż opracowany model będzie postrzegany przez inwestorów, jako potencjalnie dochodowe przedsięwzięcie, stąd jako ramę teoretyczną wykorzystano koncepcję Business Model Canvas, która jest powszechnie stosowanym w środowisku biznesowym narzędziem do oceny potencjału rynkowego innowacyjnych przedsięwzięć.

Słowa kluczowe: transfer technologii, przedsiębiorczość akademicka, program akceleracyjny.

Klasyfikacja JEL: O31, O32, O34.