

INTERDISCIPLINARITY IN TECH STARTUPS DEVELOPMENT – CASE STUDY OF ‘UNISTARTAPP’ PROJECT

Sebastian KOPERA*, Ewa WSZENDYBYŁ-SKULSKA**, Joanna CEBULAK***

Jagiellonian University, Institute of Entrepreneurship, Cracow, POLAND

e-mail: {*sebastian.kopera, **e.wszendybyl-skulska, ***joanna.cebula}@uj.edu.pl

Sebastian GRABOWSKI

Orange Polska, Warsaw, POLAND

e-mail: sebastian.grabowski@orange.com

Abstract: Empirical data as well as scientific reports confirm that startups require diverse, in-house competencies in order to achieve market success. However, while technology-related competencies are usually brought to new tech ventures by their founders, there is a significant deficiency of market- and management-related competencies, which is reflected in the statistics of common startup failure reasons. In this context, a question arises: how interdisciplinarity of knowledge and competencies can be built into the very core of tech startups? The text addresses this question by zeroing in on the role of universities in this process. In the first part, the specificity of tech startups is analyzed. The next chapter overviews the hitherto academy-related startup education environment together with its shortcomings as far as interdisciplinarity is concerned. Finally, the case study of innovative and interdisciplinary academic ecosystem, which was built and tested within the project UniStartApp, is presented and discussed together with related lessons learned. The text is concluded with final remarks on challenges involved in embedding interdisciplinarity into startup education ecosystem.

Keywords: startup education, entrepreneurship, tech startups, education ecosystem, formal education, academic entrepreneurship, competencies, knowledge.

JEL: M13, L26, I23.

1 Introduction

In the perspective of the upcoming 15 years, IT is going to change the economic landscape while opening numerous opportunities for new entrants, “including individuals, outsider firms and entrepreneurs – to succeed in new markets” (OECD, 2016, p.24). However, a close observation of the contemporary trends in the IT-related innovation field confirms that a source of success is rarely technological superiority alone, but rather a business model that stays behind. Thus, in order to succeed in a market, it is necessary to gather various competences, from technological superiority, through customer and market knowledge, up to general management and leadership competencies.

The above statement refers particularly to tech startups, which are on their way to market, but the key to enter – and stay for longer – lies in their interdisciplinarity. However, this attribute is not as popular among startups as it should be. It is reflected

in the existing researches on startup failures (CB Insight, 2014), which show that the top setback causes are related to lack of business and management knowledge and competencies in new tech ventures.

In this context it is reasonable to ask the question on how interdisciplinarity of knowledge and competencies can be built into the very core of tech startups? The presented text challenges this question by zeroing in on the role of universities in this process. In the first part, the specificity of tech startups is analyzed. The next chapter overviews the hitherto academy-related startup education environment together with its shortcomings as far as interdisciplinarity is concerned. Finally, the case study of innovative and interdisciplinary academic ecosystem, which was built and tested within the project UniStartApp, is presented and discussed together with the lessons learned during its realization. The text is concluded with final remarks on challenges involved in embedding interdisciplinarity into startup education ecosystem.

2 Specificity of tech startups

Startup can be defined as a “temporary organization formed to search for a repeatable and scalable business model” (Blank & Dorf, 2013, p.648). More detailed definition, has been recently developed by the European Commission: “Start-ups, often tech-enabled, in general combine fast growth, high reliance on innovation of product, processes and financing, utmost attention to new technological developments and extensive use of innovative business models, and often, collaborative platforms.” (European Commission, 2016, p.2). Both definitions point out the most important aspect of startups: a dynamism of form and merit, which results from functioning in a very unstable, unpredictable environment. Most innovative startups are closely related to or even fully dependent on technology – not only as a core of the customer value and source of innovation, but also as a platform of developing and distributing this value (they will be further called “tech startups”). In this context, the technological envi-

ronment seems to be a quite obvious source of startup uncertainty, and a reference point for its development. However, not less important is market and economic environment, where customer needs and preferences change very dynamically, as do business models adopted by existing and aspiring market players.

In this context, in order to survive and grow, startups require not only technological expertise – which tech-startups usually have – but also extensive marketing and business knowledge. However, in the situation when ca. 75% of startups fail (Gage, 2012) (Blank, 2013), it is reasonable to ask if they really possess the necessary knowledge, and if not, what are the gaps in it that should be filled in to improve their survival rate.

A good reference point for answering such questions can be an analysis of the main reasons why startups fail. One of the well-known reports lists 20 of the most widespread failure causes (CB Insight, 2014).



Figure 1. The main reasons of startups failure
(Source: CB Insight 2014)¹

¹ Numbers does no add up to 100% because of the option to provide more than one reason for each failure.

Even a very general overview of the results presented in Fig. 1 indicates that only in few situations, failure could result from technological reasons. Although the figure does not state it explicitly, a deeper dive into accompanying cases (CB Insight, 2014) reveals that technical and technological reasons could be related to team structure (lack of technical experts²), poor product or – to some extent – legal challenges.

Relatively lower presence of technological issues may stem from the very basic fact, that most of the founders bring their knowledge on board and build the startup on it. It means that tech startups are mostly built around technological knowledge of their founders. What such startups lack is very well visible in the presented results. The most important issues can be grouped into 6 general categories:

- 1) marketing (with incorrect identification of market needs, non-listening to customers, poor marketing, which relates not only to marketing communication, but also product design and pricing);
- 2) product mistiming;
- 3) strategic management (lack of business model, disharmony with investors, uncompetitiveness, bad location);
- 4) finance management (run out of cash, no financing);
- 5) project management (lack of focus, problems with following the startup methodology (pivot issues));
- 6) leadership (team formation and integration, lack of passion, burn out, but also inability to cooperate with external network and advisors).

The analysis of the above results indicates very clearly, that the main and the most painful problems of contemporary tech startups originate not from technological, but from business field. A business-oriented knowledge in technological environment of new ventures acts as “bottleneck” for startup development. In other words, tech startup growth is possible only when it possesses sufficient interdisciplinary knowledge covering both technical and technological issues of products and processes, as well as business and management knowledge.

² However, some startups in their post-mortem declared lack of business experts on board.

3 Role of universities in stimulation and facilitation of entrepreneurship

As stated above, if tech startups suffer from internal non-technical knowledge shortages, it is worth looking closer on external knowledge sources that they utilize. In the first place, the Polish startups use mentoring activities and attend industrial meetings, hacking competitions (e.g., HackYeah or Startup Weekend), and other forms of training, however, not related with Academia (Beauchamp, et al., 2017, p.37). The latter forms – including academic incubators, academic courses or tech transfer centers – have been appraised as less important by the Polish Startup Report 2017 respondents. Those results picture the Polish status quo of startup education. However, its analysis should not lead to a straightforward and simplified conclusion that education structures and mechanisms created by academic institutions or co-created in networks, where academia plays an important role, are obsolete. More adequate conclusion is that co-creative role of educational sector requires adaptation to the requirements of startup market, what finds confirmation in multiple cases of successful academic entrepreneurship programs from various countries. Improving and strengthening the role of education sector in the European Union is also one of the postulates included in StartUp Manifesto (ScaleUp Europe, 2016, p.29).

There are many international examples of successful startup/entrepreneurship programs organized by or in cooperation with universities. Worth noticing is a fact that most of those successful programs are facilitated by business-oriented universities and networks, or with an important contribution from their part. What is more, they are usually based on an extensive cooperation of academic and nonacademic institutions. It guarantees sufficient portion of interdisciplinary, business and management-oriented knowledge for tech-startups to succeed.

Modern universities facing the challenges of today’s world and knowledge-based economy are made to change their current model from the entrepreneurial one (created in the twentieth century) to the so-called new, third generation university (Wissemma, 2005), (Łobejko & Sosnowska, 2013) at (Tomaszewska-Lipiec, 2017), also known as creative,

proactive and innovative (Andrzejczak, 2015). In this model, a university fulfills three following missions (Woźnicki, 2015; Leja, 2015):

- Mission I: education,
- Mission II: research and development activity,
- Mission III: creating mutual relations with the environment.

The third-generation university is the one that stimulates entrepreneurship and commercialization of knowledge, combining education and research with the implementation of innovations and business, mainly through the so-called academic entrepreneurship (Barski & Cook, 2011).

Academic entrepreneurship can be considered in a more narrow sense as "involvement of employees of knowledge in business activity, e.g. by creating new spin-off enterprises", or in a wider sense as "encouraging any individual somehow related to the university to create a business, as well as entrepreneurship of the university which acts as a provider of new technologies and know-how" (Antonowicz, 2007).

Academic entrepreneurship has changed dramatically since the first technology transfer centers were created in the 1980s and 1990s (Lockett, et al., 2015). Initially, it was focused mainly on the undue narrow emphasis of academic entrepreneurship on the transfer of scientists' inventions from the laboratory to licenses and start-ups, particularly in relation to formal intellectual property (IP), such as patents and licenses (Siegel & Wright, 2015). However, due to factors – such as many new opportunities for academic entrepreneurship arise from the development of informal IP, creation of new forms of entrepreneurial ventures, the number of different stakeholders increases, they play various roles in university missions (Clark, 1983) – academic entrepreneurship has evolved (Martin, 2012) and its scope has significantly expanded. Today, marketization of research results becomes just as important for universities as education and research activities, and academic entrepreneurship is a specific combination of Humboldt's (unity of education and research) and Schumpeter's ideas (creative destruction) (Matusiak, 2006). The key elements of the university ecosystem

that stimulates and facilitates academic entrepreneurship are (Siegel & Wright, 2015):

- the rise of property-based institutions, such as incubators/accelerators and science/technology/research parks, to support technology transfer and entrepreneurship,
- substantial growth in the number of entrepreneurship courses and programs on campus (in multiple colleges/schools),
- the establishment and growth of entrepreneurship centers,
- a rise in the number of "surrogate" entrepreneurs on campus to stimulate commercialization and start-up creation,
- a rapid increase in alumni support of various aspects of this entrepreneurial ecosystem, including alumni commercialization funds and student business plan competitions.

The role of institutions supporting the development of academic entrepreneurship is to provide space, resources and mentoring in order to facilitate the creation of research workers, students and alumni start-ups. In some cases, they are even integrated with educational programs.

Pre-incubators are units specialized in handling the needs of potential entrepreneurs at the initial stage of enterprise creation. They are usually created as part of higher education institutions and constitute a continuation of the didactic process in the field of entrepreneurship with the possibility of preparation to practical operations on the market and verification of knowledge and skills in the company. Pre-incubators are an offer of support for students, doctoral students, researchers and graduates in practical market activities. The role of the institution is to evaluate and improve the submitted ideas in terms of market opportunities and launch in the form of a new enterprise. In these institutions, business ideas mature, and the future start-up entrepreneur is shaped. The services offered by pre-incubators enable proper shaping of competencies of the future entrepreneurs and maturing of business ideas.

On the other hand, entrepreneurship incubators offer help programs to start a business and to strengthen competitive position of new forms on the market.

They usually include legal support, premises, training, billing, and so on.

However, science/technology/research parks established at universities or as part of cooperation promote research conducted at universities helping to develop new ventures and contributing to economic growth and supporting the transfer of technologies and business skills between the university and emerging branches of industry.

Universities also create technology transfer centers (CTT) constituting an organizationally diverse group of non-profit advisory, training and information units that implement programs to support transfer and commercialization of technologies and all tasks associated with this process. The activity of CTT at the interface between science and business enables the adaptation of modern technologies by small and medium-sized enterprises operating in the region, and therefore, contributing to the improvement of innovation and competitiveness of enterprises and regional economic structures. CTT provide a kind of buffer to reconcile the implementation of the three university missions.

When analyzing academic entrepreneurship activities undertaken by universities, an increasing number of entrepreneurship courses and programs can be noticed. Education for the development of academic entrepreneurship is carried out at universities in various ways, including (ICF-GHK, 2011):

- horizontal approach – used in various subjects and not limited to one module or course,
- compulsory education module,
- optional subjects chosen by students,
- additional activities (voluntary or providing additional points or becoming a part of the required practical training).

The most common initiative at universities is also creating entrepreneurial schools (Gründerskolen in Norway, JA-YE, IFTE in Austria). There are also entrepreneurship centers that have the role of disseminating academic entrepreneurship at the university, as well as to consolidate all related initiatives. The centers most often offer entrepreneurial trainings to all members of the academic community, assist researchers in the study of commercial research capabilities and services similar if not identical to those

offered by incubators and technology parks, thanks to close cooperation with them.

Universities offer more practical classes, combining the theory of traditional economic literature with the specific needs of everyday business management. Entrepreneurship education at universities is becoming more and more empirical, practical and action-oriented. It is possible thanks to: changes in methods of education, cooperation with enterprises or organizations, inviting managers and introducing technology issues and its role in the development of entrepreneurship into the program.

Changes in methods of education. There is an application of such methods as teamwork, learning through projects, learning through direct experience, methods of self-development and self-evaluation, case studies. In turn, case studies are an effective method of stimulating students’ curiosity making them face real business situations. By studying future and present corporate success stories, students can explore the processes and procedures implemented by management in order to make decisions. The method teaches us a new model of thinking formulated by a manager by analyzing the situation, evaluating alternatives, choosing a solution and cracking progress over time.

Cooperation with enterprises/organizations. Making partnership agreements with enterprises or organizations gives possibility to organize a part of a program of the course or module within the company outside the already tested internships. Student-in-residence programs are comparable to internships, except that students get hands-on experience, work a specific number of hours at the host company – say, 20 hours a week – and complete coursework that ultimately is graded and counts towards the course’s final. Similar to entrepreneur-in-residence programs, student-in-residence programs allow students and experienced professionals to learn from each other while discussing and solving real-world business challenges. Student-in-residence programs facilitate merging the success of entrepreneurs and founders of start-ups, who serve as mentors and give lectures by offering students a real perspective of business and entrepreneurship.

Inviting managers (who are also university graduates) to run courses, partially or as a whole. During

this type of classes, managers share their knowledge and experience with the participants of the course. In this way, teaching entrepreneurship is more interesting, credible and effective.

Introducing technology issues and its role in the development of entrepreneurship into the program. It is not about introducing programming classes or computer courses into the programs. It is about teaching strategic methods in which companies and entrepreneurs use technologies to make innovations, communicate and promote making money.

Introduction of compulsory module of entrepreneurship education for all university students irrespective of the level and form of undertaken studies is aimed at shaping their mentality and creating awareness of an alternative career option as an entrepreneur. Optional and voluntary courses organized for students of various faculties and disciplines involve them in the teamwork in the implementation of projects as well as are a useful way to popularize entrepreneurship at various faculties at the university. Crossing the boundaries between different fields of study and various faculties is the key to the development of interdisciplinary laboratories in which business students help other business students of partner faculties and universities to implement business ideas.

The highest education, educating graduates with a well-defined profile, intellectual property management at the university (patent protection, copyright, licenses, legal regulations), transfer of innovations and technologies by creating technological companies such as start-up or spin-off by students, doctoral students or university employees, intensification of cooperation between universities and enterprises (internships, services and expertise, access to scientific equipment and library resources) are basic activities that make up the concept of academic entrepreneurship. They lead to closer links between higher education and the economy for the benefit of both parties.

The role of universities in stimulating and facilitating academic entrepreneurship is therefore (Matusiak, 2010):

- shaping creativity and proactive attitudes open to entrepreneurship among employees and students,
- cooperation with business, developing knowledge and technological and organizational solutions for the needs of the market and small and medium-sized enterprises,
- initiating partnership and network relations with local business, administration and social sector.

Stimulating entrepreneurship and commercialization of knowledge are undoubtedly the trends that set development challenges for universities today. Emphasis on R+D, transfer of knowledge and academic entrepreneurship should be focused on all fields of science, without exception. Each of them has a potential to create innovations and the combination of these potentials, among others, through the development of cooperation, gives even greater chances and opportunities of development in the entire economy. According to Leja (2011), the leading principles, the application of which is the prerequisite for managing an innovative university, include the principle of interdisciplinarity. This principle should be the basis in fulfilling the role of universities in stimulating and facilitating the development of academic entrepreneurship.

4 Case study: Project UniStartApp

Previous chapter overviewed existing academia-related activities aimed at improving the entrepreneurship education, most of which was strongly business-oriented. However, they do not exhaust all the possibilities in this field. There is still a lot of room for new, innovative approaches and projects, which – based on academic resources of knowledge, competence and infrastructure – would support startup education. Beneficiaries of such actions can be in the first place the current students, who are already “in touch” with schools and universities. However, while it is quite easy to provide students with adequate single-disciplinary knowledge – usually consistent and congruent with the university profile – interdisciplinarity is still difficult to achieve. Difficult but not impossible, which has been proven by projects like UniStartApp.

The main idea behind UniStartApp was interdisciplinarity understood as an amalgam of programming, analytical and managerial competencies. Such a combination is crucially important not only for – being discussed here – tech startup success, but also a development of the whole ICT domain. Constantly progressing digitalization of a business space requires various competencies from employees and entrepreneurs, often quite distant from each other. This phenomenon is well visible i.a. in a law-related professional development, where to the most popular subjects belong: new technologies and programming. In this context, it is perfectly clear that in order to prepare students to succeed on the contemporary and future market, universities should teach them not only entrepreneurship, but also effective and efficient cooperation within multi-competence teams.

With this premise in mind, UniStartApp project created an education ecosystem in which students with technical, economic and social-science background could work together with their colleagues within interdisciplinary and inter-institutional teams. The ecosystem was built into curricula at each and every participating university, but at the same time, it remained congruent and consistent with the startup creation methodology.

To make it happen, a letter of intent was signed by all the participants with Orange Polska as a coordinating partner, providing additionally some infrastructural support. The coordination was one of the biggest challenges, because of the fact that the initial consortium included academic institutions from 4 distant cities:

- Warsaw University of Technology
Faculty of Electrical Engineering,
- Jagiellonian University in Krakow
Faculty of Management and Social Communication,
- Poznań University of Economics
Faculty of Informatics and Electronic Economy,
- Technical University of Gdańsk
Faculty of Electronics, Telecommunication and Informatics.

Worth mentioning is also the contribution of venture capital firms: Black Pearls and SpeedUp, which supported the project with their knowledge and expertise

on building and funding of tech startups. Their participation was very important for the project because the ecosystem was meant to provide close to real-life business conditions for students’ teams. The teams worked on technological solutions, bringing their projects to the stage of pitching their working prototypes to potential investors.

UniStartApp commenced in the early 2016 with the recruitment of students from participating universities – last years of undergraduate programs at technical universities and first year of postgraduate programs at others. Participation in the project was interwoven into education process of students at home universities, what gave them ECTS points for their academic scoring. At first, all the participants (33) were invited to the initial workshop, which took place in early March 2016 at the Orange Labs in Warsaw, where they formed 5 interdisciplinary teams. Each of them consisted of a number of programmers (2–6), business analysts (1–2), and marketing specialists (1–2). During the workshop, they received an intensive business modeling training (run by a VC expert), followed by some team building activities. To each of the teams, a mentor was assigned – usually academic teacher from partner institutions or an expert from Orange. All the mentors formed a project management council, which had the task of monitoring the progress and facilitate the work of the teams.

The project was run through some defined stages, and to each one, a milestone was assigned: from the application (product) idea, through competitor analysis, identification of user requirements, creation of the final product vision, together with supporting business model, requirement specification, summary of business-system analysis, and final programming workshop. The project was generally meant to be based on the Scrum methodology, with 1-week sprints; however, their actual length varied due to conflicting obligations of team members and resulting problems with coordination.

UniStartApp concluded in November 2016 with the final Gala event at Warsaw University of Technology, attended by all the project partners as well as the representatives from: The Ministries of Development and of Digitization, the Office of Electronic Communications, venture capital organizations, tech

companies and the Polish Agency for Entrepreneurship Development. During this event, the students' teams were pitching their ready-to-go applications and received a very positive feedback from the audience.

5 Lessons learned and challenges for the future

The UniStartApp project was a unique and innovative endeavor in times, when interdisciplinarity of education was required and desired by the business, and at the same time, missing in formal university curricula, as well as in most of the hitherto academy-related entrepreneurship building initiatives. Interdisciplinarity that does not only mean possessing various competences by individuals – potential startup founders – but also the ability to work and communicate effectively with coworkers of a different background. The symptomatic in this context is exactly this: interdisciplinary communication within teams (particularly between programmers and not-tech participants) was reported by students as a single most important issue in the first weeks of the project. It was also mentioned as the most important and valuable experience that they got within its course.

Another important challenge was a virtualness of teams. The teams' structure was purposefully designed by joining together not only students with different competencies, but also from various universities and cities. The purpose of it was to improve cooperation capacity in virtual environment – competency highly expected in a digitalized business environment. It took some time for the participants to get used to a “drill” of formal virtual team meetings and status meetings with team mentors. While their technological side was not generally considered a problem, time management and motivation level were. Probably assigning higher priority to the project (in the context of students' curricula) and more selective recruitment process could be helpful.

Finally, there were two main organizational and formal issues that should be addressed in case of similar future projects. The first one refers to the previously mentioned students' curricula, and the role/place of such initiative within them. They should be for-

malized (dedicated module/project with assigned ECTS score) and unified among participants. Another issue relates to the IPRs of the value created within such interorganizational students' teams – approaches to this issue may differ between the participating organizations. It is suggested that for scaling up a model introduced by UniStartApp, a unification of regulations should be agreed beforehand.

6 Conclusions: Interdisciplinarity as a challenge for startup support ecosystem

Any startup, tech startup included, requires diverse competencies to succeed. Some experts suggest, that if the startup is not self-sufficient as far as the knowledge and competences are concerned, and it is forced to outsource anything, it is a predicative for it to fail³. It is not only the issue of costs of external services, but rather the inability to judge correctly their quality.

Interdisciplinarity fosters both creativity of each and every team member, and a team as a whole. It also promotes collectivity, because all involved individuals can see a value of working in a group. Teams with mixed knowledge and competences on board, covering not only technical, but also business and marketing-related fields, are more self-sufficient, which limits their environmental dependency, as well as improves cost structure. It also results in a better product design and its business model configuration. Additionally, exchange of diversified experiences protects against the risk in business and project layers. However, interdisciplinarity of knowledge and competencies alone is not enough. It should be complemented with the social competencies enabling effective communication and cooperation of individuals with different backgrounds.

Interdisciplinarity, that is of such importance to the success of tech startups, can be achieved in multiple ways, and formal education is one of the most prominent ones. The academic environment has a great potential in this matter. The potential, that is currently under- and poorly utilized. In order to change this

³ According to startup expert Agnieszka Lewandowska (CEO of Startup School), the insight expressed during Research Seminar at the Warsaw University of Technology, 9.01.2018 Warsaw.

situation, new, innovative and rule breaking approaches are necessary because traditional university structures and programs are not ready for interdisciplinarity and interorganizational cooperation that are at the core of future startup leaders’ formation process. It requires a specific ecosystem to be created. An important element of such ecosystem are shared project tools and methodology that constitute a joint interface of the whole structure and facilitate its monitoring and controlling. Ecosystems like the one tested within the UniStartApp project can be a valuable reference point for similar initiatives in the future.

7 References

- [1] Andrzejczak, A., 2015. Uniwersytet przedsiębiorczy i odpowiedzialny społecznie (An Entrepreneurial and Socially Responsible University). *Edukacja Ekonomistów i Menedżerów (Education of Economists and Managers)*, 4(38), pp.117-130.
- [2] Antonowicz, G., 2007. Wsparcie innowacyjnej działalności akademickiej (Support for Innovative Academic Activity). In: Materiały konferencji: *Rola Inkubatorów Technologicznych w rozwoju przedsiębiorczości i globalizacji biznesu (Conference materials: The Role of Technology Incubators in Development of Entrepreneurship and Business Globalization)*, 27.09.2007. Politechnika Łódzka.
- [3] Barski, R., Cook, T., 2011. *Metodyka identyfikacji projektów do komercjalizacji na wyższych uczelniach (Methodology of Identification of Projects for Commercialization at Higher Education Institutions)*. Zielona Góra/Oxford.
- [4] Beauchamp, M. Kowalczyk, A., Skala, A., Ociepka, T., 2017. *Polish startups report 2017*, [online] Available at: http://startuppoland.org/wp-content/uploads/2017/10/StartupPoland_raport_17_ENG_singlepages_lr.pdf. [Accessed 10 November 2017].
- [5] Blank, S., 2013. Why the Lean Start Up Changes Everything. *Harvard Business Review*, 91(5), p.64.
- [6] Blank, S., Dorf, B., 2013. *Podręcznik startupu. Budowa wielkiej firmy krok po kroku (The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company)*. Gliwice: Helion.
- [7] CB Insight, 2014. The Top 20 reasons Startups fail, pp.1-9.
- [8] Clark, B.R., 1983. *The Higher Education System: Academic Organization in Cross-national Perspective*, Berkeley: University of California Press.
- [9] European Commission, 2016. Europe’s Next Leaders: the Start-Up and Scale-Up Initiative. [online] Available at: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0733&from=EN>. [Accessed 10 January 2018].
- [10] Gage, D., 2012. The Venture Capital Secret: 3 Out of 4 Start-Ups Fail. *The Wall Street Journal*, Sept. 20. [online] Available at: <https://www.wsj.com/articles/SB10000872396390443720204578004980476429190>. [Accessed 10 January 2018].
- [11] ICF-GHK, 2011. Mapping of Teachers’ Preparation for Entrepreneurship Education. *Report for DG EDUCATION AND CULTURE*, August.
- [12] Leja, K., 2011. *Koncepcje zarządzania współczesnym uniwersytetem (The Concepts in Contemporary University Management)*. Gdańsk: Wydawnictwo Politechniki Gdańskiej.
- [13] Leja, K., 2015. Trzy misje uczelni, trzy ścieżki kariery (The Three Missions of University, the Three Career Paths). *Forum Akademickie (Academic Forum)*, 1, p.21.
- [14] Lockett, A., Wright, M., Wild, A., 2015. The Institutionalization of Third Stream Activities in UK Higher Education: The Role of Discourse and Metrics. *British Journal of Management*, 26(1), pp.78-92.
- [15] Łobejko, S., Sosnowska, A., 2013. *Komercjalizacja wyników badań naukowych. Praktyczny poradnik dla naukowców (Commercialization of Research Results. A Practical Guide for Researchers)*. Warszawa: Urząd Marszałkowski Województwa Mazowieckiego.
- [16] Martin, B.R., 2012. Are Universities and University Research under Threat? Towards an Evolutionary Model of University Speciation. *Cambridge Journal of Economics*, 36(3), pp.543-565.

- [17] Matusiak, K.B., 2010. *Budowa powiązań nauki z biznesem w gospodarce opartej na wiedzy: Rola i miejsce uniwersytetu w procesach innowacyjnych (Creating Linkages Between Science and Business in Knowledge Based Economy: The role and Place of University in Innovation Processes)*. Warszawa: Szkoła Główna Handlowa-Oficyna Wydawnicza.
- [18] Matusiak, K.B., 2006. *Rozwój systemów wsparcia przedsiębiorczości. Przesłanki, polityka i instytucje (Development of Entrepreneurship Support Systems. Premises, Policy and Institutions)*. Radom-Łódź: ITE.
- [19] OECD, 2016. Start-ups and innovative entrepreneurship. In *OECD Science, Technology and Innovation Outlook 2016*. Paris: OECD Publishing. [online] Available at: http://www.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-innovation-outlook-2016/start-ups-and-innovative-entrepreneurship_sti_in_outlook-2016-25-en. [Accessed 5 January 2018].
- [20] ScaleUp Europe, 2016. A Manifesto for Change and Empowerment in the Digital Age. [online] Available at: <http://scaleupeuropemanifesto.eu/>. [Accessed 15 December 2017].
- [21] Siegel, D.S., Wright, M., 2015. Academic Entrepreneurship: Time for a Rethink? *British Journal of Management*, 26(4), pp.582-595.
- [22] Tomaszewska-Lipiec, R., 2017. Współpraca nauk społecznych z gospodarką – wybrane konstatacje (Cooperation of Social Sciences with the Economy – Chosen Ascertainments). *Problemy Profesjologii (Problems of Professorism)*, 1, pp.49-59.
- [23] Wissema, J.G., 2005. *Technostarterzy – dlaczego i jak? (Technostarters – Why and How?)*. Warszawa: PARP.
- [24] Woźnicki, J., 2015. *Program rozwoju szkolnictwa wyższego do 2020 r. Deregulacja w systemie szkolnictwa wyższego (Program of Higher Education Development by 2020. Deregulation in Higher Education System)*. Konferencja Rektorów Akademickich Szkół Polskich. Fundacja Rektorów Polskich (Conference of Rectors of Academic Schools in Poland. Polish Rectors Foundation).