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RESEARCH-BASED SPIN OFF PROCESSES AND MODELS IN DIFFERENT ECONOMIC CONTEXTS

Key words

Technology transfer, research results commercialisation, research-based spin-offs, spin-off creation models.

Summary

The article presents various, globally applied models of spin-off venture creation. The authors of the article examine spin-off processes in different economic conditions, i.e. in the developed, developing or transferring economies, and on the basis of literature review and case study analyses, identify and present the two most common trends in the creation of scientific start-up companies. Following this investigation, a proposition of a model meeting the legislative, organisational and financial requirements of Polish non-academic research institutes is presented.

Introduction

In the modern age of globalisation, effective knowledge transformation and technology transfer processes are the foundation of knowledge-based societies and decide on the level of innovativeness and competitiveness of a given country. Hence, the creation or adaptation of suitable mechanisms and structures

that would support the processes of innovation dissemination and commercialisation as well as the flow of know-how between the R&D and the business sectors, should be a strategic mission of all governments, local authorities, and most of all research organisations themselves, as active participation in these processes helps generate increased research funding, engages more scientists and business people in the development and diffusion of innovations and brings socio-economic benefits, not only to the research organisation itself, but also to the entire region or the country [1]. There are numerous knowledge transformation and technology transfer mechanisms and structures available, and one that over the years has significantly gained in popularity is a spin-off company – a new business venture based on the knowledge gained by the scientific staff from their work at the university or a Public Research Organisation (PRO). There are different terms present in literature that are used with reference to scientific, particularly academic, business undertakings. These include university start-ups, academic spin-offs, spin-outs or university-run enterprises [2, 3, 4, 5]. Start-ups and university-run enterprises are broader terms. A start-up refers to business ventures created by the researchers, academics, students or alumnus of the university or a research institute, based on know-how and knowledge from the parent institution, where that knowledge is a key element in enabling the business to come into existence or to be competitive with its products or services [4]. University-run enterprises [5] are enterprises founded and run or managerially controlled by the scientific parent institutions. Spin-offs and spin-outs are much a narrower term and refer to companies based on intellectual property (IP) owned by the parent research organisation. However, the literature [2, 3] further differentiates between these two. Academic and non-academic research-based spin-off companies are independent of the parent institution and their creation is financed from external (e.g. venture capital) funds, whereas spin-out companies remain closely tied to the parent institution by means of financial or operational (i.e. shared professional and administrative) dependencies.

The authors of this article have decided to use the spin-off term with reference to IP-based enterprises established by the scientific staff of universities and PROs.

Spin-offs from higher education institutions and public non-academic research organisations have become a key issue for science and technology policy in all industrialised countries [6]. They have been a popular means of research results commercialisation in the USA since 1950s and in Europe since 1990s. The interest in research-based spin-offs is also growing in Poland. Their creation has already become a central point of numerous national and regional programmes and projects fostering entrepreneurial behaviour among academic and non-academic researchers [7].

The focal point of this article are scientific spin-offs, as they are the building blocks of knowledge-based economies. They channel intellectual property (IP) from the R&D sector directly to the industry, and thus facilitate regional and national innovativeness, competitiveness and economic development. Apart from making a significant direct contribution to innovation, they also have a great indirect impact on the cultural change in public research organisations [8]. Scientific spin-offs, both academic and non-academic ones, are of high importance to the institutional, regional and national growth as they encourage entrepreneurial behaviour amongst researchers and involve the inventors in the process of technology commercialisation, generate more income for the parent institution than licensing to established companies, and are an effective tool for the commercial implementation of emerging or breakthrough technologies originating from parent research institutions [9].

As the role of spin-off companies in innovation commercialisation processes grows, the authors of this article, seek to contribute to the issue of spin-off venture creation processes. In the recently undertaken "Innovative Systems of Technical Support for Sustainable Development of Economy" Strategic Programme realised within the framework of the Polish Innovative Economy Operational Programme, they realise research tasks concerning Systems of knowledge transformation, advanced technologies transfer and commercialisation of innovative solutions, which are particularly concentrated on the identification, development and application of effective mechanisms and structures for innovation implementation into economic practice. The authors of the article identify the financial aspect of spin-offs creation as the most crucial one and on the basis of literature review and case study analyses, present different ways of creating scientific enterprises and incorporate them into two main models, that is downstream and upstream models reflecting the most common trends in the financing of start-up ventures originating from the academic and non-academic research institutions.

1. Spin-off process in the R&D sector

Research-based spin-offs are defined as new companies set up by a host scientific institution (national research institute, university, technical school, public or private R&D institution or laboratory) to transfer and commercialise inventions resulting from the R&D efforts of its researchers [10]. The literature divides between different types of research-based spin-off ventures [2, 11, 12, 13, 14], which can be differentiated according to:

– the type of the parent institution they are derived from;
– he motivation of the researcher;
– he links between the parent institution and the researcher;
– he means and sources of their financing;
– he institutionally applied models for their creation.

As far as the first of the above spin-off division criteria is concerned, there are two main types of spin-off companies, that is corporate spin-offs and scientific spin-offs. Corporate spin-off companies are set up by parent corporations with view of commercialising ideas, technologies, product or process solutions that are not within the main area of their activity, but are still considered to be marketable and profitable. Scientific spin-offs are established to commercialise innovations originating from parent research institutions. Depending on the kind of a research organisation, scientific spin-offs can further be divided into academic spin-offs, those established by university researchers, and non-academic research based spin-offs, established by the scientific personnel of public research organisations (PROs), i.e. research institutes or public laboratories.

Spin-offs established according to the motivation criterion include product oriented ventures and technology asset companies. The first ones are focused on innovation development, the creation of new products based on it, and own brand creation, whereas the latter aim at generating more value by means of licensing and strategic alliances with major industrial and business players [13].

The third above listed criterion, that is the parent institute-spin-off venture interaction criterion, includes direct research spin-offs and indirect companies that have been established either to commercialise IP arising from academic and non-academic research organisations, where the IP is licensed, usually through a patent from the parent institution to the newly established research-based enterprise, or commercialise know-how gained by the researcher at the parent research institution, in the case when there are no formal ties joining them to the parent institution anymore (that includes IP licensing, financial support or infrastructure) [12]. Direct spin-off ventures are thus companies established by the consent of the parent institution with view of commercialising already patented innovations developed by the researchers as a result of the responsibilities of the position they hold at the research centre. Indirect spin-offs, on the other hand are set up individually and independently by the researchers, who feel that their concepts cannot be developed further within the structure of the university or a non-academic research institute they work for.

As far as the fourth, that is the seed funding criterion, scientific spin-offs can be divided into independent enterprises financed by venture capitalists or supported by Business Angels – externally funded spin-offs, or new businesses dependant on the parent institution by means of financial and organisational ties – R&D financed spin-offs.

With reference to the last above listed criterion, there are a lot of scientific spin-off models available in different economic conditions, and their variety depends on the nationally applied systems for the support of innovation creation and practical dissemination, legal mandates governing research results commercialisation, technology transfer mechanisms and structures and

intermediary organisations supporting it. In the UK, for instance, a well-known and prominent model for the transfer of academic research results into practice by means of licensing and spin-off venture creation is that implemented at Oxford University [15], where the academia is not directly involved in the innovation commercialisation process, which is entirely in the hands of Isis Innovation Ltd. – a separate, but fully owned by the university, business entity functioning as the Technology Transfer Office (TTO) for university's inventions. Being organisationally and administratively independent of the parent institution, Isis Innovation Ltd. is free from university's internal regulations concerning time and duty management, and financing, and thus can provide better business advice for the support of innovation commercialisation that facilitates socio-economic development of the parent institution, region and the entire nation. Commercialisation strategies employed at Isis Innovation Ltd. include patenting, licensing, know-how sale and the establishment of spin-offs, but this is the licensing mechanism that is mostly promoted and generates most income for the company. Similar models can be observed in Israel, where the seven public universities[1] have set up their own Technology Transfer Companies (TTCs) which are primary vehicles for the commercialisation of their research results [16]. Israeli TTCs are fully university-owned, though independent for-profit companies that do not fall into the basic university structures, which ensures a relatively high level of their autonomy. Commercialisation strategies employed by the Israeli TTCs represent all available tracks: licensing, establishing spin-off companies, joint ventures and collaborative research.

2. Resarch-based spin-off proccesses throughout the world

The matter of the creation of spin-off companies is governed by nationally or institutionally applied policies. The breakthrough governmental regulation in the field of scientific entrepreneurship is the US Bayh-Dole Act (1980) [17], which established a consistent patent granting policy and gave the small businesses and non-profit organisations, including universities, intellectual property control over their inventions, even if they were discovered with government's support or under federally-funded research programmes. As a result of its enactment, numerous intermediary organisations facilitating knowledge transformation and technology transfer between the R&D and the business sectors began appearing, which lead to the development of more

[1] These are: Bar-Ilan University, Ben-Gurion University of the Negev, Hebrew University of Jerusalem, Technion Israel Institute of Technology, Tel Aviv University, University of Haifa, Wezimann Institute of Science.

products and technologies based on university and PROs research results, and the number of start-up companies and patents has significantly increased as well. Many EU Member States, including Poland have also built a legal framework for the support of IP protection and innovation dissemination, according to which the employers (that is research organisations) are given the ownership of IP generated by their employees (researchers) [18, 19, 20, 21][2]. By right of national legal mandates introduced, research organisations in most EU Members States and USA are free to establish their own, internal policies concerning the creation of spin-off ventures, while in Poland, the issues of commercialising research results by means of innovation-based enterprises is regulated by governmental acts [22, 23] according to which universities are not allowed to be directly involved in the creation of a business, are forbidden from having shares in its activity and thus need to somewhat by-pass the law by creating academic foundations or TTOs which having the status of separate legal entities are to commercialise innovations originating from the university.

Scientific entrepreneurship is additionally advocated by means of numerous national programmes and projects. In most EU Member States, USA or Israel these programmes aim at bridging the gap between R&D sector and research funding, creating incubation possibilities and setting-up public funds that specifically invest in spin-off and high-tech start-up companies. Polish national programmes and initiatives are directed at supporting entrepreneurial behaviour at PROs and universities in general, and are not solely dedicated to providing funds for the creation of start-up and spin-off enterprises, but rather focus on consultancy services in the area of innovation commercialisation, with particular attention paid to legal and organisational aspects of new business creation processes and know-how exchange [24][3].

Due to nationally differing legal, organisational, institutional and socio-economic factors, spin-off creation processes vary not only between different categories of countries (that is developed, developing, emerging or transferring economies), but also within each of these groups as well (between the

[2] However, what is worth mentioning here is the fact that in some countries (i.e. Sweden, Finland, Italy) university teachers privilege still exists and IP is granted not to parent research institutions but to individual scientists – authors of innovative solutions, which means that the attempts to commercialise research results by means of spin-off venture creation has the character of individual entrepreneurial undertakings of a given researcher and does not influence the growth of innovativeness and competitiveness rate of the parent institution *per se.*

[3] These are for instance projects and initiatives undertaken within the Innovative Economy Operational Programme for Poland and programmes initiated by the Polish Ministry of Science and Education including, among others, the following:, Way to Entrepreneurial Poland Project within axis 5 of Innovative Economy Operational Programme (POIG) for Poland for the 2007–2013 period (Droga do Polski Przedsiębiorczej), Creator of Innovation – Support for Academic Entrepreneurship (Kreator Innowacyjności – wsparcie innowacyjnej przedsiębiorczości akadamieckiej) by the Polish Ministry of Science and Higher Education.

institutions they originate from), and thus the creation of a unified spin-off model characteristic for each economic development level poses a lot of difficulties. However, having analysed various international case studies, the authors have observed certain general similarities in the forms of financial and organisational support they receive and on that basis have come up with two original models, which depict and integrate these common aspects of spin-off creation processes. The models proposed can be considered to be a generalised characteristic for particular country types, but, if possible and suitable, can be applied in different economic conditions as well.

2.1. Developed countries

Regardless of the difference, what the spin-off models applied in developed economic conditions have all in common is the fact that they have innovative solution at the basis of their creation and are established with view of commercialising research results. This common feature of the aforementioned spin-off models applied in developed countries formed the core for the downstream spin-off creation model proposed by the authors of the article, in which the global trends in research and technology-based enterprise creation models are depicted.

Spin-offs that follow the downstream development process begin with a core proprietary technology and gradually learn how to manufacture and market commercial, innovation-based products. Figure 1 depicts the stages of a downstream spin-off creation process [7].

Fig. 1. Stages of a downstream spin-off creation process
Source: Authors.

First two stages of the aforementioned process consist of the identification, assessment and protection of technologies with a commercial potential. At those stages it is still possible for the researchers and the PROs to decide whether the creation of the spin-off venture is going to be the most effective and profitable form of technology commercialisation or whether the selection of other options would turn out to be more beneficial (i.e. licensing or a one-off sale). Stage two is also the stage where business proposals and plans are drawn. The third stage is the stage at which PROs need to channel their spin-offs towards potential sources of funding (internal and/ or external). It is the stage of seeking business advice and initial (seed) funding. Once financial support is obtained, the venture can formally be incorporated, and spin-off start up process undertaken:

prototypes can be promoted and business models and markets validated. Although in practice, the founding of spin-offs is not as linear a process as the one presented in Figure 1, the model offers a clear insight into a spin-off creation process.

Depending on the sources of seed funding, whether it comes from the government, the parent institution or private investors, the downstream spin-off creation model can be further divided into two sub-models [7] (Figure 2): the R&D financed spin-off model and the externally financed spin-off model.

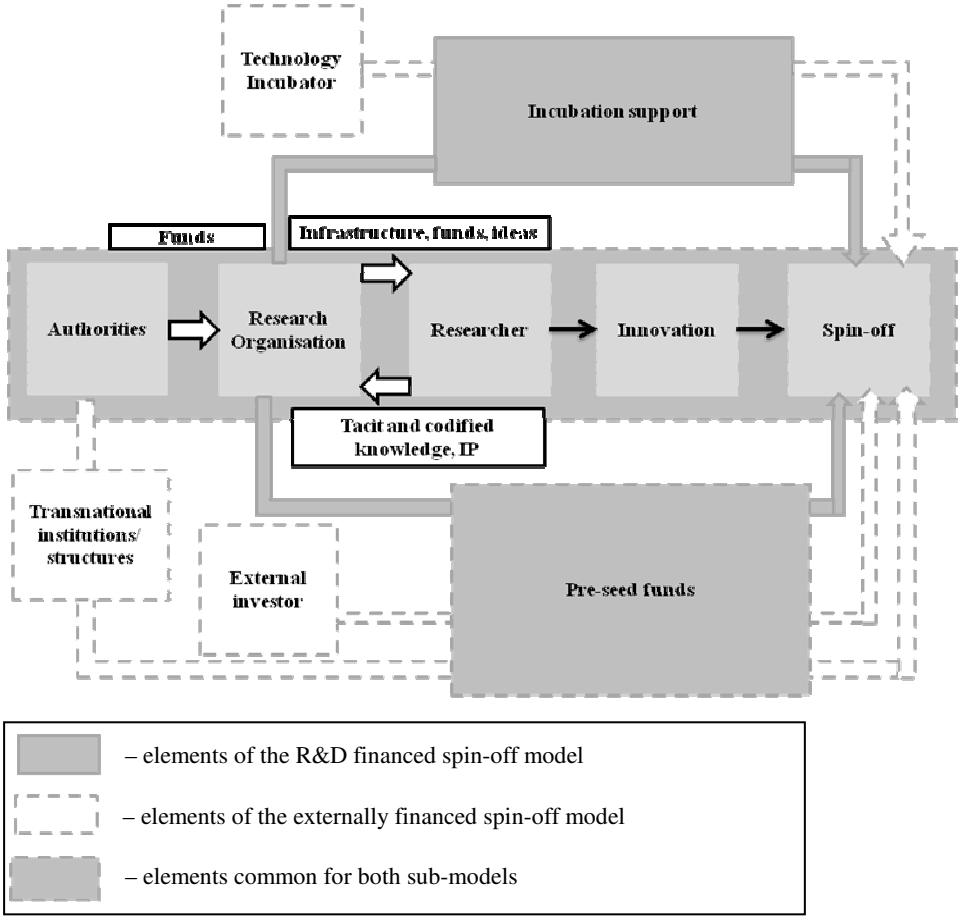

Fig. 2. Downstream spin-off creation models and its sub-models
Source: Authors.

In the R&D financed model, the parent institution plays an active role in supporting the process of establishing a spin-off venture, by means of providing it with scientific, infrastructural and financial help. However, not all spin-off

ideas are provided with the same level of support, and only these research results that are viewed by the parent research organisation to be of high commercial potential can benefit from it. In the R&D financed model the researchers engaged in the creation of a new business retain their position as scientific workers and divide their time to working both in a spun off venture and at the parent institution.

In the externally financed model, on the other hand, parent research organisations are passive actors in the start-up creation process, and the newly created companies are thus independent business entities referred to as spin-offs. In this model the financing of the spin-off creation process comes from external sources (i.e. Business Angels, Venture Capital Funds, private investors) or national or regional authorities, as well as transnational institutions or structures (i.e. the EU or the World Bank), that by means of different initiatives and projects facilitate entrepreneurial behaviour among scientists and provide them with advice and finances necessary for the start up of a new company.

2.2. Developing countries

Contrary to developed economies where there is quite high public investment in the R&D activity and the access to funds for the support of innovation development and commercialisation does not pose a lot of difficulties, in developing economies academic and non-academic scientific and research institutions frequently battle with insufficient funding and cannot support entrepreneurial behaviour of their researchers and their innovation commercialisation attempts by means of the creation of start-up ventures. Due to the lack of external funds financing their functioning, research institutions need to be highly selective in assessing the disclosures and requests for spin-off processes, but at the same time they are willing to support such proposals in terms of providing the researchers with necessary infrastructure needed for the spin-off incubation, which the spun off business is more than welcome to use, but for the exchange of shares and equities, for example. The newly established venture is a means of income generator that can later on be directed towards internal R&D activities that might lead to the creation of innovative solutions, which means that in the case of developing countries the spin-off creation is a reverse process and does not have innovation at the basis of its establishment. This trend has been depicted by the authors in the upstream model (Figure 3) which is the opposite of the downstream model and represents a reverse development from sales and services to innovation creation.

As aforementioned, in the model proposed, there is no core propriety technology on the basis of which the spin-off is created, and the new enterprise is launched in order to generate income for the development of internal R&D infrastructure, which will then lead to new marketable inventions. Spin-off

companies developed in China, for example, follow this spin-off creation model (e.g. Lenovo) [25].

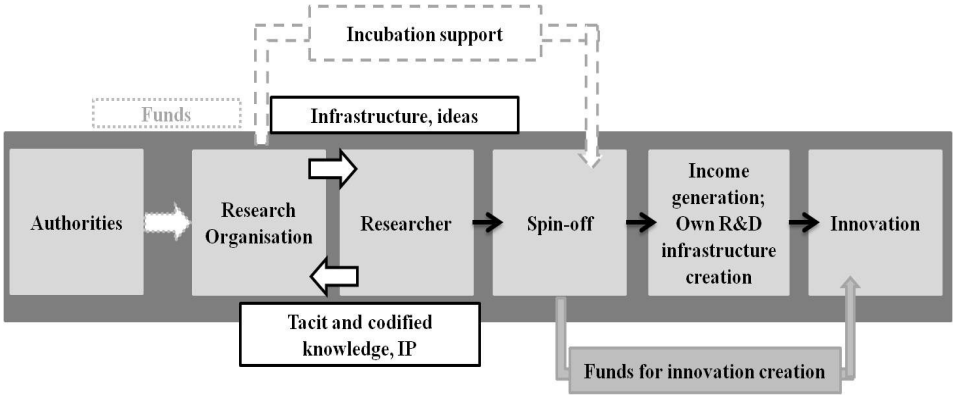

Fig. 3. Upstream spin-off creation model
Source: Authors

3. Spin-off processes and models in poland

For the past two decades, Poland has experienced significant and substantial changes in the organisation of its innovation system supporting knowledge transformation and technology transfer processes, which resulted in significant changes in the traditional models of academic institutions functioning and their role in the creation of ties with the industry and thus stimulating the growth of the knowledge-based economy [26]. However, due to numerous legislative, organisational, structural, financial and psychological hampering factors innovation commercialisation in Poland, particularly by means of spin-off company establishment, is still not a very common phenomenon yet, even though there have been numerous attempts to commercialise university originating research results in Poland, however, with very few success stories in this field[4]. The creation of academic spin-offs in Poland is regulated by the Law on Higher Education [27] as per which Polish universities cannot be directly involved in the creation and functioning of businesses and in order to commercially deploy their research results can establish Academic Entrepreneurship Incubators or TTOs, which being separate business entities can have profits in newly created ventures[5]. As far as non-academic research institutions are concerned, their functioning is regulated by

[4] This for instance include Vigo System from the Military University of Technology in Warsaw, Unisil from Adam Mickiewicz University in Poznan or Pharmena from Technical University of Lodz.

[5] Section 86 of the Act.

the Law on Research Institutes of April 30, 2010 [23]. The Act does state that PROs are allowed to diffuse research results[6], create capital companies, purchase shares and stock in such enterprises and attain income from them[7], but only with the supervisory ministry's (the Ministry of Science and Higher Education) official consent. Without the Ministry's consent PROs cannot engage in this form of business activity.

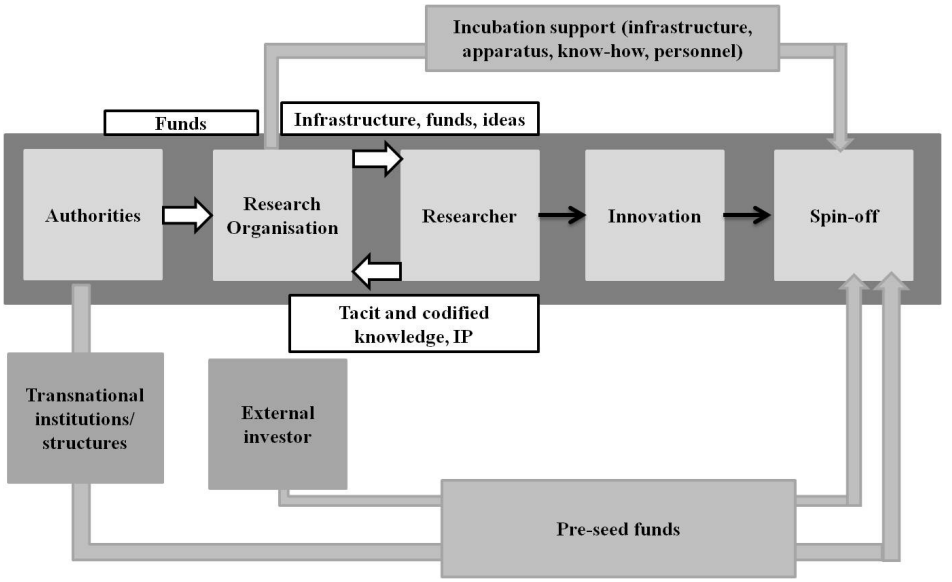

Fig. 4. Spin-off creation model for Poland
Source: Authors.

Polish scientific spin-off companies usually follow the downstream spin-off creation model and are set up in order to commercially deploy technologies or product or process solutions that have been developed by the researchers in the course of their employment at the parent research institution. The most commonly applied strategy is that of breaking ties with the parent institution, which means that the researchers give up their positions at the parent institution and devote all their attention to the development of their own, research-based business. Academic spin-offs can be established when the researchers feel that further development of their ideas is impossible within the structure of the university (i.e. insufficient funds, lack of necessary apparatus and infrastructure) or when they simply do not have permission to perform research other than that defined in the statuary act. The authors have not come across many examples of

[6] Section 2.2 of the Act.
[7] Section 13.17 point 5 of the Act.

spin-offs from Polish non-academic PROs, and taking into consideration the specific legal and socio-economic conditions in which these institutions function, they have designed a spin-off model, that in the opinion of the authors, would meet the requirements and needs of Polish non-academic research institutes. The model is presented in Figure 4.

Since public R&D investment in Poland remains at a low level, Polish PROs still battle with financial difficulties and frequently do not have sufficient funds to finance their statutory research activity. For that reason, the above model suggests that the entrepreneurial researcher should seek external funds that would finance the creation of the spin-off venture. The PRO would retain its shares or royalties on future sales of commercial products based on technologies and innovations originating from them, as the Polish law concerning IP ownership indicates that the IP generated in publicly funded research belongs to the employer not an individual researcher. This would generate additional income for the parent institution. Additionally, through having shares in spun off ventures Polish PROs would be able to accumulate funds that could then be of help in the process of supporting the creation of future research-based enterprises. In that way, Polish PROs could be more proactive, and highly selective towards their spin-off projects and would be capable of providing greater incubation capabilities to the ventures spun out from them. The establishment of the structurally and organisationally dependent spin-off venture (or more appropriately, with regard to previously customised terminology, a spin-out company) within the PRO seems to be the most advantageous solution, as it would provide the newly created entity with the possibility to use the know-how and the infrastructure of the parent institution. Of course, in the business development process, the spin-off would be encouraged to expand and become independent of the PRO, but the PRO would still benefit from having its shares in the company.

Conclusions

The creation of research-based spin-off companies is governed by internal policies and regulations of each country, and thus, the processes and procedures that are extremely efficient and successful in a given economic context may simply not work at all when taken out of it and applied abroad. That is why, when commercialising research results, it is important to develop original or to adopt modified models of spin-off creation that would be tailor made to the economic, legal and organisational requirements and needs of a given country, region or institution. Despite decades of policy reforms introduced in the Polish R&D sector and a growing interest in the issues of research results commercialisation, industrial implementation of innovations by means of the creation of spin-off ventures is still at the infancy stage in Poland. The problem

is not of financial or organisational nature only. Polish legal regulations concerning functioning of all research institutions are not coherent and different rules apply to different pillars of the Polish R&D sector (universities, Polish Academy of Sciences institutes and public research organisations). Along the legislative obstacles, there also are numerous organisational, financial and psychological and behavioural factors that additionally prevent the researchers from commercialising their research results, especially by means of setting up business ventures. For that reason, people's thinking and perception of the role of research organisations needs to be changed, further reforms modernising the Polish innovation system need to be introduced, and original spin off models tailor made to the unique situation they function in need to be adopted by the Polish academic and non-academic research institutions.

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Recenzent:
Jacek GULIŃSKI

Procesy i modele tworzenia firm typu spin-off w różnych kontekstach gospodarczych

Słowa kluczowe

Transfer technologii, komercjalizacja prac badawczych, firmy typu spin-off, modele firm typu spin-off.

Streszczenie

Celem artykułu jest zaprezentowanie stosowanych na świecie modeli tworzenia firm typu spin-off. Na podstawie studiów przypadku i przeprowadzonej analizy literaturowej zaproponowano dwa podstawowe modele tworzenia firm typu spin-off charakterystyczne dla krajów rozwiniętych i rozwijających się. Następnie zaproponowano model odpowiedni dla warunków polskich.