

Innovations and Knowledge Commercialization

Cooperative Resources, Integrated Science and Business

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Foreword

The year 2014 will be a momentous one. It has been 25 years since the transformation of our country's system and 10 since Poland's accession to the EU. These symbolic moments make one reflect on the condition of our economy, its accomplishments and weaknesses and compare our aspirations with the level of advancement achieved and the resulting standard of living for Polish people.

One of the key areas of this assessment is undoubtedly the level of innovation in the Polish economy. It is certain that the state of our economy is a key indicator of its future growth. It has been estimated that as much as two thirds of the economic growth of developed countries are linked with the introduction of innovations.

According to official data, we are the sixth largest economy in the EU. This is significant but undoubtedly our aspirations are still higher. What is worrying is the fact that as far as innovation and transfer of knowledge and technology from science to business is concerned, we find ourselves near the bottom, among EU countries, above only Lithuania, Latvia, Bulgaria and Rumania.

According to the annual Innovation Union Scoreboard (published by the EU), namely the list assessing the advancement of EU members, average EU innovation stands at about 0.540 on the scale from 0 to 1. Poland scores 0.300, which places it far below the average and it is classified among the group of moderate innovators, sadly, at the very bottom of it.

More innovations in the economy, through commercialisation of knowledge and technology, also seem to be the key to solving our social problems. The recent emigration of over 2 million, mostly young, people was triggered predominantly by economic reasons: lack of employment and low remuneration. The low salary rates in Poland (salaries are about 30% of the gross national product compared with highly developed countries) is one of the consequences of the low level of innovation in the Polish economy. Obviously, there is no single remedy for achieving success in innovation implementation. Our country should consider it a priority to dismantle the barriers hampering innovation advancement and the creation of favourable conditions allowing a speedier achievement of: at least the mean level of EU innovation, the construction of an economy based on knowledge, which is able to generate new places of employment and ensuring sustainable social development.

It is clear that the most innovative economies exemplify the strong link between the economy and science. A key indicator of EU innovation

leaders is also the effective commercialisation of their technological innovations.

Such an approach to the undoubtedly multi-faceted topic of innovations, a discourse focused on the commercialisation of knowledge and technologies are included in this monograph, which is a collection of works by a number of authors who, while representing mainly academic centres, also include experienced business people. This book is their contribution to finding solutions to the pressing socio-economic problems. This monograph has been structured around four topical issues.

The first deals with the issue of commercialisation and knowledge transfer, analysed in the context of cooperation between science and business. The authors identify how to bridge the gap between a business or organisation and the academic and scientific world as well as how to transfer knowledge from academic laboratories to the market. It is commonly believed that Polish science develops without any connection to the economic reality which is presented in the papers. The lack of understanding, and frequently trust, between science and business is one of the main challenges of the commercialisation of knowledge and technologies. Despite this, the authors emphasise the positive examples. Analysis of the Chartered Institute of Marketing operations proves that institutions which develop and promote personal qualification can become an effective mechanism of integration and transfer between the worlds of theory and practice.

The next problem area was entitled: innovations and new technologies. It focusses on the concept of open innovations and innovative solutions that support the procurement process, agri-sector innovations and eco-innovations. All the analysed areas of innovation implementation are interesting examples of innovative solutions in a variety of sectors of the economy, significant from the point of view of the search for optimal solutions.

Further on, the monograph is devoted to identifying the factors which determine cooperation between science and business and the results of frequently extensive and empirical research is presented. It is worth emphasising that the ability and motivation of entrepreneurs to constantly seek out and practically apply the results of scientific research are the essence of innovation. The authors also attempt to assess the effectiveness of the innovation processes. This part, to a degree, recommends actions that could be implemented by companies.

The monograph is concluded with a chapter in which the authors analyse the role of European integration and business support institutions

in the commercialisation of knowledge and technology. It would be interesting to compare the deliberations in this section with the controversial and discussion-provoking thesis of Prof. Krzysztof Rybiński who claims that the influx of EU resources into the Polish economy destroys innovation. However, the reasons do not stem from the assistance given but in the Polish mechanisms of aid distribution. Moreover, Prof. Hauser strongly supports this thesis and asserts that EU assistance has become a kind of tool for usurping and gaining power and that bureaucratic proceedings have replaced strategic leadership. The authors of this monograph are obviously fully aware that the issues covered are not a comprehensive and effective recipe for the solution to problems in innovating the Polish economy, yet it is another voice in the ongoing discussion conducted in Poland and is worth discussing and extending as the future of our country, its competitiveness on the international market and, as a consequence, the wellbeing of the Polish nation is at stake. Each and every voice is valuable and may bring us closer to a better solution. Enjoy the read.

Prof. dr hab. Jacek Otto

***COOMMERCIALIZATION AND KNWOLEDGE
TRANSFER – COMPETENCE AND TECHNOLOGICAL
RESOURCES BUILDING***

BUILDING PROFESSIONAL QUALIFICATIONS AS A MODEL OF INTEGRATION AND TRANSFER OF KNOWLEDGE

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Abstract

The multi-faceted nature of transformations that occur in modern business encourages the evolution of concepts, methods and tools of competitiveness, as a result of which, dynamic changes are seen in the theory and practice of management. Marketing, one of the areas of management, encapsulates these changes. Created at the beginning of the 20th century as an academic field, management is based on adaptability adjustment processes. These should be accompanied by changes in the area of managerial education and their success is defined by knowledge transfer between theory and practice. The long established threefold rigid managerial education market (universities, training and consulting companies and so called Corporate Universities) does not guarantee the effective transfer of knowledge and, therefore, the effectiveness of managerial education. The idea of professional qualifications which draw from science as well as management experience, attempts to bridge that gap. Analysis of the operations of institutions that develop and promote professional qualifications, exemplified by The Chartered Institute of Marketing, proves that they may become, or perhaps already are, an effective mechanism for the integration and transfer of knowledge between the world of theory and management practice.

Key words: Knowledge transfer, professional education

Introduction

The worlds of managerial theory and practice overlap, influencing one another. One may even suggest that the two cannot exist separately. They are interdependent. At the same time however, the last few decades have witnessed more frequent and deeper chasms between the theory and practice of management. This is connected to management as a whole as well as its individual fields, including knowledge transfer and its flow from science to business. In its simplified version, it refers to the gap between business/organisations and the academic world/science.

Taking management and its separate areas into account, excluding practical fields (education, didactics, research, science, etc.), one can point to the three main groups which deal with aspects of management that are not only connected to business (which does not always mean purely

theoretical). This affects higher education (including universities and institutions created within universities which deal with education or research into management), training and consulting institutions (these are mainly training companies and consulting agencies that deal with research and various types of training and development in the area of management and business support) and training and development departments created within companies (this mainly is connected to structures built within a company responsible for the development of knowledge, qualifications and employee competencies). The latter is nothing new, although Poland cannot boast many examples of companies with such an approach to intellectual capital development within their organisations. Countries with a highly developed economy create many extensive systems for continuous education, which take the shape of Corporate Universities. Statistics show that in the 1990s in the USA only, the number of such centres increased from 400 to close on 1,800. Motorola University and the Bank of Montreal's Institute for Learning serve as examples [El-Tanmir, 2002]. The creation of such institutions obviously requires funds and resources. However, the development of such institutions is a manifestation of the importance that is attached to development and education.

This threefold market division of managerial competencies development, faces, at present, intensified changes in the business environment. This is in connection the areas of organisation, market, competition and conditions for company operations, and can be seen in economic, social, psychological and technological aspects, etc.. As a consequence, it is commonly believed that we live in the age of short-term non-continuity, caused by new, radical technologies and ideas [Płoszajski, 2005], within which, innovations from the field of IT gained critical mass of a strength that would allow a change of lifestyle and workstyle and the manner in which companies operate [Lachowski, 2010].

And yet, it has been noticed that in this 'new' approach, which was intended to lead to rapid economic growth and free us 'forever' from the perennial problems of social and economic development, and that the dilemma of inflation – unemployment would die a natural death, in reality never happened [Kołodko, 2001]. Not even in the USA - the most advanced country, which was the birth place of the 'new economy' and where most development took place. Moreover, in the area of economy, the last ten years has seen at least 3 periods of economic crisis and today we appear to be on the verge of the fourth. We haven't managed to avoid spells

of recession in the economy, and profitability cycles have shortened and are now of a briefer though more intense nature.

Undoubtedly, the changes taking place in business have a major impact on competition and existing business models, however they also determine the manner and methods of building managerial competencies. The traditional boundaries of market division into three groups have clearly blurred and shifted. This leads to universities entering areas so far restricted only to training companies far more vigorously, whereas training companies, through various alliances, encroach on the, until now, territory of academic fields (research, publishing, etc.). Taking the above into account, this article aims to analyse the operations of the managerial education market and the processes occurring from the point of view of integration, transfer of knowledge, experience and good practice. Firstly, the author identifies the changes in the contemporary business environment, next, he analyses the process and development of marketing as a management field, complaints aimed at marketers and the main deficits in their knowledge and skills, which give the background to the presentation of the professional norms and standards that have been created over the last decades, in particular in the area of marketing (CIM, IPR, MRS, etc.), on one hand, as a result of change in the evolution of business boundaries of the managerial education market, on the other the model of the transfer of knowledge between theory and practice of management, marketing in particular. The article is based on the analysis of the literature covering the subject matter and almost fifteen years' of experience of the author and his peers of cooperating with The Chartered Institute of Marketing in London and other institutions that build professional qualifications.

The evolution of the business environment

Change is an inherent feature of the economy, economics and management sciences. Traditional methods of market activities, based on a disciplined approach to planning and forecasting, and based on complex rules and forecasts, have lost their battle against the market and the chaos that currently prevails [Eisenhardt, Sull, 2001].

A few decades ago, Ansoff came up with the concept of a turbulent (highly volatile and complex) environment. On the one hand he pointed out the multifaceted nature of the disturbances occurring in the business environment, on the other, the need to include such changes in strategy building [Ansoff, 1984]. Other scientists, notably, T. Peters [1987], C. M. Christensen [2004] and Ph. Kotler [2009], subscribe to this idea, emphasising its importance and developing the concept further.

Today, nobody doubts the fact that the pace and strength of change determine the current and future condition of an organisation or that we are witnessing a number of market changes and trends which foretell that the World in a few years will be different to now. These changes will affect economic, social, psychological, and technological transformations. Some of them are:

- The arrival of new social groups – referring on the one hand to Y or C generations, on the other a trend dubbed the ‘silver tsunami’. Generation Y includes people born between 1977-1997. In two years’ time every second employee will belong to this group [Meister, Willyerd, 2010]. Currently in Poland, there are roughly six million people that belong to the age group 16-24 and they have several key features from the point of view of being both a client and co-worker. R. Zydel claims that the Polish Y generation is not homogenous, that young people are not rebels or idealists, do not live in a virtual world and work is not an aim but a means which allows them to combine work with leisure pursuits. In contrast to group Y, generation C’s features are the desire for power and control as well as a higher than average creativity, communication and the number of connections with other people. The consumers that are a part of C generation are contemporary artists who create, comment and exchange views. This is particularly noticeable on the internet – the success of such networks as Youtube (I create and show to millions across the World) or Facebook/nasza-klasa.pl, linked to the strong desire for networking, is ascribed to the C generation. Apart from merely some examples of social groups among the younger segment of our generation, there is also a dynamically developing elderly group (65 plus), this trend has been dubbed ‘the silver tsunami’. At present in Poland this group consists of about 5.5 million people, however in 2025 it will have risen to over 9 million. Its members have dynamically changed their lifestyle and the nature of their everyday life. More and more often, they consciously depart from the stereotypical retiree, whose day was limited solely to visits paid to the shop, cemetery or pharmacy accompanied by a consuming loneliness, and are developing a willingness to lead active lives in their later years. The rapid development of Universities of the Third Age proves this best.
- Social trends - the example of new social trends may be exemplified by Screen Culture, Social TV. or the role

of women as purchasers. The phenomenon of Screen Culture involves the idea of our usage of an increasingly higher number of devices equipped with a screen. According to P. Góralowski, just from Microsoft there are presently twelve billion working screens and Morgan Stanley predicts that there will be eighteen billion in three years' time [Góralowski, 2012]. As an effect of this, we are sitting in the evening in front of the TV screen and have our mobile phone (sometimes two), a tablet or a laptop screen at hand. Screens surround us, and have become a window on the World. Screen Culture has contributed to and intensified another trend, called by N. Hatałską – Social TV [Hatałska, 2012]. The trend is our constant commenting in the social media on what is happening currently on TV. The example of the farcical football match between Poland and England and the reaction of Polish people on Facebook (for example, 'our national swimming pool', etc.) exemplify that trend. A further trend is the growing role of female purchasing. It has been proven that as many as eight out of ten consumer decisions are taken by women. Even products until now traditionally male purchases (cars, financial products) are more and more the acquisition of women. These phenomena indicate the market's appearance in the future.

- Change in profitability cycles in the economy – In just the first decade of the 21st century we have witnessed at least three periods of economic recession. The views of economists are dominated by two theories on the shape of profitability cycles in the coming years. The first proposes the occurrence of recession, punctuated by brief periods of growth, which will be of shorter spans, thereby meaning they will occur more often and more intensively. However, the cycles will also be briefer and the growth phases will come around more often. The second suggests that in the coming years, the Polish economy in particular will develop at a very low level, bordering on stagnation. Regardless of which of these theories will be implemented in a company's operations, management of resources and the manner of undertaking market decisions should be altered.
- The role of modern technologies – when forecasting the future, one cannot ignore the impact of new technologies. This refers both to the revolution taking place in the field of screens (laptops, smart TV, tablets, smart phones) and the scale of their business application but also the integration of technologies into many

other areas (nanotechnologies, RFID, QR codes, quantum engineering, mechatronics, etc.). All of these mean that over the coming years we shall remain under the overwhelming influence of modern technologies and they will determine change dynamics, not only in business. An example of this is NFC technology and its application in smartphones, which may lead to the elimination of payment cards from the market. Why carry troublesome plastic cards when you can make purchases with your phone which works like a payment card or connects to your bank account allowing transfer of funds? Reaction to this from Mastercard and Visa was swift. Towards the latter part of 2012 we saw a Getin Bank project which as a world first would commercially introduce Display Card Mastercard – a bank card equipped with a microdisplay and a keyboard. This functions as a token, generating passwords for internet banking. This card also has a display which shows your account balance and facilitates communication with the bank. In addition, it can display currency rates and the due date of loans and, as with most cards issued today, it can make contactless payments¹. It is not certain that this will ensure the security of Mastercard and Visa and their market standing but it does however show the consequences of technological changes on business activities.

There is much evidence of the forthcoming changes. Their scale will probably equal the number of casualties. Products disappear from the market (e.g. newspapers, typewriters, landline phones), companies face problems, all business sectors and categories are affected. For example the sector of music publishing changed its business model (stopped profiting from record sales and began earning from concert organisation) and banks are forced to modify their business borders (this is often business sector, tax advice and cost analysis). It all contributes to the fact that the world in several years will be different from today.

Can we imagine a world without newspapers (Newsweek announced that in November 2012 it issued the last printed version of its magazine)? How will our lives be like in a world of devices that understand us (smart TV, self-ordering smart fridges, Google cars)? A world without printed newspapers, personal computers, language schools, DVD hire and many other of today's common products may become our reality. What

¹ <http://banki.wp.pl/kat,6599,title,Getin-Up-szybszy-od-mBanku-lepszy-od-Synca,wid,15089604,wiadomosc.html?ticaid=1f953>. [accessed, May 2014]

should Agora or Presspublica do when faced with changes in the newspaper market? What should the reaction of Dell, Acer or HP be to the shrinking PC market? What survival methods should be applied by the language schools of Helen Doron or Empik or Beverly Hills video hire when new technologies set new competition rules or eliminate old sectors from the market?

It seems that mere survival is the worst strategy. Hewlett Packard, aware of the need for change, has been undertaking surprising and painful decisions. It discontinued sales of PCs, smartphones and tablets despite the fact that the latter returned their initial outlay in a relatively short period of time. According to HP, it gave up the sale of tablets a month after its debut and smartphones after a year and a half following the takeover of Palm. These tough decisions stemmed from HP's willingness to return to its core business – specialist devices, consulting and software [Gazeta Wyborcza, 22.08.2011]. Meanwhile, Sony departs from TV sets in favour of smartphones, technologies for the medical sector as well as batteries for electric cars. All this is caused by trends and a changing market, claims the Sony board [Gazeta Wyborcza, 13.04.2012].

The scale, intensity and complexity of change affects the evolution and modification of concepts, methods and business operating tools. It also refers to an organisation's internal (lean management, project management, process management, etc.) as well as external processes. Marketing, which from the moment of its creation evolved in a search for its identity and forms of expression, is particularly affected.

Marketing as a management field – continuous evolution

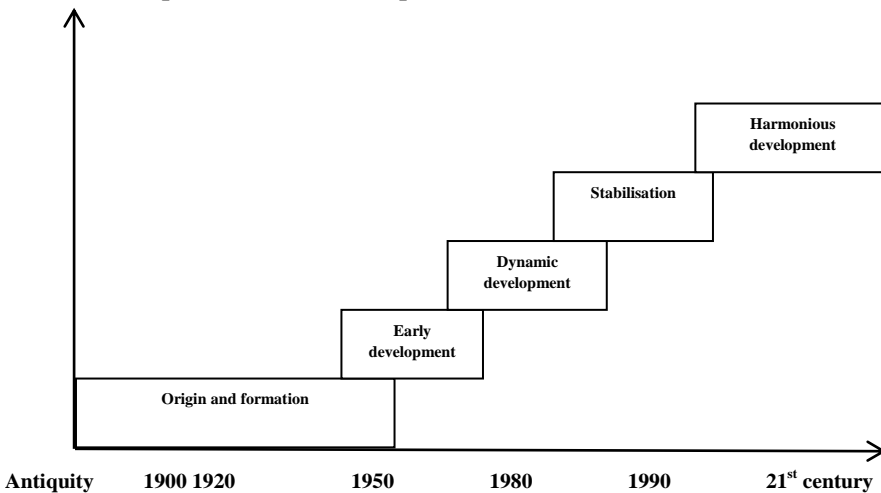
It is unclear at what date marketing began its development. R. Fullerton claims that the origins of marketing have their roots in the commencement of the industrial revolution in Great Britain in the 1870s and in the middle of the 19th century in both Britain and Germany [Fullerton, 1988]. A. Sagan, relying on sources from R. Bartels, points to the beginning of the 20th century as the date of the creation of marketing ideas and thoughts [Sagan, 1988]. Analysing academic programmes and the literature on the subject, J. Haggerty claims that the subject read at university under the title of marketing first appeared at Harvard School of Business Administration in 1909, and in 1915 the book that contained the word “marketing” in its title [Weld, Haggerty, 1936]. There is also the belief that the origin of marketing development should be dated to the period after World War Two [Webster, 2002; Celuch, et. al, 2002; Brownlie, Saren, 1991]. Its multi-level nature, drawing from not only sociology [Jonassen,

1959], economy and psychology [Bartels, 1988], but also anthropology, demography, political sciences and history [Bartels, et. al, 1965], means that its scope of interests, activities and development significantly exceed the traditional understanding of a company's marketing activities [Bartels, 1974; Ambler, et.al, 2001].

Analysing the information available, the published material and introduced changes, particularly relying on publications by R. Bartels [1988], W. Wilkie and E. Moore [2003], and S. Vargo and R. Lusch [2004], one can divide the whole of marketing theory development into five periods. Certainly the dates are only suggestions, as the transition process from one period to the next was very fluid:

1. Origin and formation (up to 1920)
2. Early development (1920-1950)
3. Dynamic development and redefinition (1950-1980)
4. Stabilisation (1980-1990)
5. Harmonious development (1990- till today)

The above is presented in the Graph 1 below.



Graph 1. Stages of marketing development

Source: Own work.

The first period, 'Origin and formation' commenced with the exchange of goods, the forming of a market and the development of theory of value [Shaw, 1912; Marshall, 1890; Say, 1821; Smith, 1776, Reprint: Strahan, Cadell, 1904]. The practice of marketing is linked to the industrial revolution and the period of the mid18th century in England and Germany

and the 1930s in the USA. Marketing developed as an academic discipline, based on sciences which already boasted particular achievements – economy, sociology, psychology along with anthropology. Marketing focussed at that time on the analysis of markets and their actors – consumers and governments [Wikie, Moore, 2003]. The initial development was mainly focussed on agricultural markets and the problem of distribution, and to a lesser degree, advertising and trade. This period saw the first publications devoted not only to trade and distribution but also marketing, which became the theoretical foundation of marketing and its differentiation from other fields of knowledge [Bussiere, 2000; Savitt, 1990]. That period also witnessed work which was the basis for the theoretical development for the institutional², functional³ and commodity⁴ schools. Therefore, this period gave birth to marketing as a subject taught at universities, as a topic of publication and as a subject of market institutions' activities. This is the period of thought formation and theoretical assumptions.

The early stages of development covers the years from 1920 to 1950. In its initial stage, R. Bartels quotes publications that attempted to determine the principles and basis for market and company operation in that field and integration of the current thoughts into one coherent manner⁵. The main emphasis is put on transactions and their effects and the reply to the question of how an organisation implements marketing functions and to what degree they add value to products. It was believed that the main value added to products through marketing was the usefulness of space and time (meaning the benefits linked to distribution), which was one of the main theoretical and practical streams of marketing origin. Apart from the profitability of space and time, possession and ownership [Vargo, Lusch, 2004] was also emphasised. For example, F. Clark defined marketing as efforts, the aim of which is the transfer of ownership of goods [Bartels,

² The institutional school dealt with the problem of marketing as an area of a particular institution's activities – wholesaler and brokers: P. Nystrom: *The Economics of Retailing*, vol. 1/2, Ronald Press, New York 1915.

³ The functional school dealt with functions performed by the marketer and their aims – P. T. Cherington: *The Elements of Marketing*; Macmillan, New York 1920.

⁴ The commodity school focussed on marketing operations implemented in reference to particular products or their categories as well as product features – M. T. Copeland: *Marketing Problems*; A. W. Shaw; New York, 1923

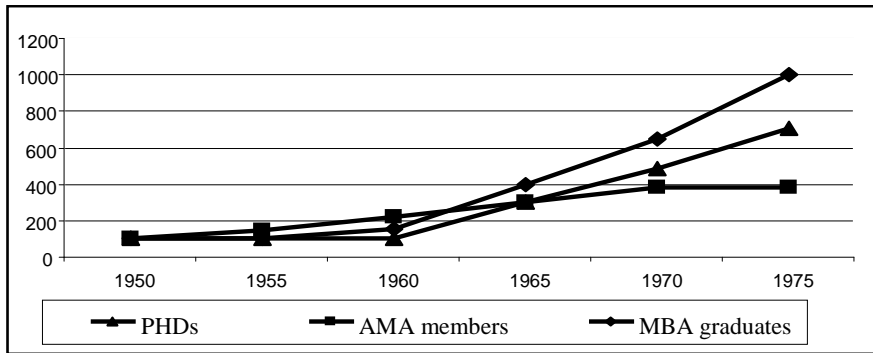
⁵ After Bartels (R. Bartels: *The History of Marketing Thought*; published 3, Gorsuch Scarisbrick Pub, New York, January 1988) these include amongst others: F. E. Clark: *Principles of Marketing*; Macmillan; New York, 1922; H. H. Maynard, W. C. Weidler, T. N. Beckman: *Principles of Marketing*; Ronald Press Company, New York, 1927; P. D. Converse: *The Elements of Marketing*; Prentice Hall, New York, 1935.

1988]. This period is concluded by a commonly asked question about the future of marketing and its scientific status [Converse, 1945; Alderson, Cox, 1948; Bartels, 1951].

Being geared towards decision making processes and the perception of marketing as a managerial activity, clearly triggered the need to adopt scientific achievements, in particular mathematics and statistics for the field of marketing. This resulted on one hand in the growing applicability of scientific research methods, on the other with a more commonplace usage of analytical methods in practice. Apart from the above, one should be aware of an important element of marketing thought of this period. It is not marketing functions and operations or the consequences of these actions for society, but the client who was put at the centre of a company's attention. Consequently, it was widely acknowledged that value is determined by the market not the company [Drucker, 1954; McKitterick, 1957; Levitt, 1960]. It is worth pointing out that placing customers at the focal point attracted the attention of scientists to the client, their behaviour and the factors influencing their choice. W. Wilkie and E. Moore claim that the important concepts, models or techniques that appeared in this period were linked to the above trends. They included amongst others – marketing mix concepts, product lifecycles, the process of new product development, marketing information systems, DAGMAR methods, segmentation strategy, marketing audit, rating, perception maps and others.

The dynamic development of marketing in this period was also combined with a rapid spread of marketing infrastructure – the number of members of associations, the number of articles published in marketing journals, the number of graduates from marketing studies and doctoral theses from the field of management. This dynamics is presented in Graph 2. For example, at the beginning of the 1950s, the American Marketing Association had almost 4,000 members, while towards the end of this period the numbers had shot up fourfold. The overall number of published articles on marketing in the USA in five main journals⁶ up to 1950 stood at over 1,400 whereas towards the end of the 1980s it had reached the level of almost 6,000 articles [Wikie, Moore, 2003]. In that period the Marketing Science Institute was established, which in the first ten years increased its membership to 1,000 in twenty countries across the World [Wikie, Moore, 2003] and still today remains a key World scientific and research institute.

⁶ Journal of Retailing (appeared after 1925), Journal of Marketing (1936), Journal of Advertising Research (1960), Journal of Marketing Research (1964), Journal of Consumer Research (1974).



Graph 2. Dynamics of the growth of PhDs, American Marketing Association members and MBA graduates

Source: W. L. Wikie, E. S. Moore: Scholarly Research in Marketing - Exploring the “4 Eras” of Thought Development; Journal of Public Policy & Marketing, vol. 22, Fall 2003.

The 1950-1980 period should be regarded as the one that witnessed the rapid development of marketing knowledge as well as adapting new methods and techniques from other scientific fields. Marketing in this period was clearly geared towards assisting marketers with marketing management. In contrast to the initial years of this period, which had a limited social focus, the late 1970s saw an increased interest in this field, giving rise to the seeds of consumerism. Moreover, the second half of this period of marketing thought development was under the influence of the new technological revolution – computers and the internet – which would later radically transform the market.

The late 1970s and the 1980s is called the period of stabilisation. It is characterised on one hand by the strong emphasis on the social aspect of marketing activities, on the other by a fragmentation of marketing activities [Wikie, Moore, 2003], focused on selected methods without a wider context. The concept of micromarketing developed in this time brought side effects such as a loss of market identity and a lack of clarity in its definition, as A. Sagan rightly points out [Sagan, 1988]. This period however had two important benefits, first of all it pinpointed and commenced the era of services marketing development and relationship marketing which today is evolving towards the wider application of technology and utilisation of this knowledge in the areas of company operation on the internet. Secondly, the period of stabilisation of the 1980s gave a clear stimulus to the search for identity and marketing sources in the

1990s. As for infrastructure, the 1980s saw the arrival of numerous new journals on the subject of marketing. However, like science, they tended to be quite specialised. For example, *Journal of Personal Selling & Sales Management* (1980), *Journal of Consumer Marketing* (1983), *Journal of Product Innovation and Management* (1984), *Journal of Interactive Marketing* (1987) [Wikie, Moore, 2003] appeared on the market. The period happening at the time commenced with the continuation of thoughts on the future and role of marketing. The extensively quoted “Marketing on the Crossroads” and “Marketing’s Mid-life Crisis” clearly questioned current marketing activities and pointed to the need for redefinition [Brady, Davis, 1994]. This period results, in the authors view, in three main trends. Firstly, an extensive search for identity, possibilities of determining and, more importantly, research into the market orientation of an organisation. The objective of the research is to establishing the intellectual foundations of marketing cementing its position and role in an organisation. This trend was initiations by such authors as, B. Shapiro [1988], A. Kohli and B. Jaworski [1990] along with J. Narver and S. Slater [1990]. On the one hand it is focussed on describing marketing and its role in an organisation, on the other researchers attempt to determine to what degree marketing contributes to building value and how it is connected with a company’s success. These deliberations concentrate on placing marketing neither as a social process nor exclusively a managerial process. They point to the cultural role of marketing in an organisation and also implementation activities. As a result, marketing is viewed as a foundation for learning companies and refers to the integral role of marketing in management [Slater, Narver, 1995]. Marketing becomes on one hand a link between a company and the market, on the other an adhesive for all processes occurring in an organisation. Practically, it leads to the changes that occur in modern organisations. Marketing departments are being replaced by such units as Key Account Management, Category Management, CRM, Customer Service Department, Business Development Department, etc..

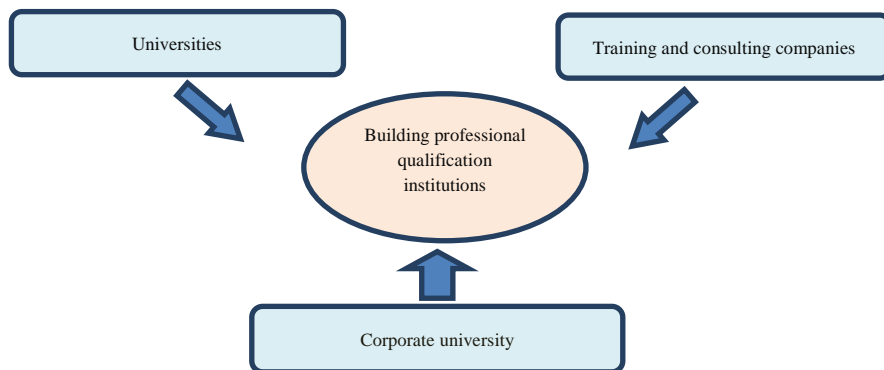
The second distinct trend determines the possibility of measuring marketing activities, both its processes and effects. This is a continuation of the work on the assessment of value which marketing adds to products. R. Shaw [1998], T. Amblera [2003] and J. Lenskolda [2003] exemplify this trend. Marketing is no longer perceived as a function or a set of marketing operations, it is more of a strategic nature and represents a holistic approach with the focus on managerial skills and the financial aspects of marketing activities. Researchers attempt to integrate all the current directions of thought. In many publications the client is seen as no longer an element

of the company's interest but has become its partner. Managers and researchers look for an answer to the question of the value offered by companies with which they can compete. They highlight the necessity of the process approach and they view a business and its processes in a holistic manner.

Marketing tends to harmoniously integrate the soft fields, such as social, creative, conceptual and strategic as well as hard ones, such as managerial, quantitative, operational and applicational. Marketing has begun to return to its roots and is benefiting from the achievements of its predecessors. Complaints against modern marketing are of a similar nature to 10 years ago [Brady, Davis, 1994], or even a 100 years ago [Jones, 1911], as at the beginning of the notion of marketing such elements like client [Drucker, 1954; McKitterick, 1957; Levitt, 1960], process [Alderson, Cox, 1948] and measurements [Feder, 1965] were emphasised. Therefore, we may say that in searching for marketing identity it is worth drawing from its roots and origins, as, apart from the many trends, one can find the determinants of marketing's identity here. More and more often, marketing is being defined as a process with a need to determine the value which it brings and depends on, as well as the possibilities of measurement of effect and market activities. This leads to more in-depth understanding of the client and greater respect for him. Marketing performs the role of a not all knowing supplier, but a link between client and an organisation.

Personal qualifications

Changes in business as well as the evolution of concepts, methods and management tools, marketing in particular, create a kind of pressure to introduce changes in the area of managerial education and, in a wider scope, the ability to transfer knowledge and adopt new solutions from theory to marketing practice. This need is intensified by the fact of the increasing inadequacy of the current education system in the managerial field for market conditions. Consequently, one can suggest changing the boundaries of the established threefold division of the managerial education market. It seems that in the changes, institutions will play the key role that combines theory with management practice. The winners will be able to integrate knowledge and practical skills with theoretical models and solutions. There is now the natural growth of a fourth player on the market of managerial education, institutions promoting professional qualifications (CFA, CIM, ACCA, IPR, MRS, etc.). They have started to play an increasingly important role (Graph 3).



Graph 3. Elements of the managerial education market

Source: Own work.

The most important institution in the field of professional qualifications is probably The Chartered Institute of Marketing (CIM), with its seat in Cookham near London, established in 1911. The origins and aims that guided the creation of this non-profit organisation stemmed precisely from the diagnosis that was conducted in the earlier part of this article. The main objectives of CIM include:

- Determining professional standards in the area of marketing
- Combining theory with business and best practice
- Raising employee performance quality and the standing of personnel in the area of marketing

These objectives are implemented through activities in several key areas, combining traditional academic ones (e.g. research, publication) and para-academic education (training, workshops, planning the development of career paths, etc.). The key area is however certification of marketers across the World according to strict procedures and standards.

These make the Chartered Institute of Marketing the largest current training and consulting institution in the World, integrating the theory and practice of management and it ensures a consistent transfer of knowledge from business to education and vice versa. At present, CIM consists of 60,000 members operating in 110 countries around the world and over 150,000 people across the World can boast CIM qualifications.

Here it is worthwhile posing a question about the forms and methods of combining the theory and practice of management, about the manner and tools of knowledge transfer from the academic world to business and vice versa. Trying to point out good practices in this area, one

can differentiate two levels: organisational and formal, and content and empirical. Firstly, CIM is neither an academic centre, with its infrastructure and bureaucratic burden, nor strictly a training institution. Thanks to this, CIM can licence universities and academic centres to conduct programmes according to CIM standards, which is its second significant good practice and at the same time its advantage. Should these regulations and standards be breached, it would result in the removal of the right to implement CIM programmes. Thirdly, the key CIM bodies (programme committee, board of managers, etc.) are a 'think tank' the most renowned and experienced academics and professionals. Such a mixture of personalities ensures adherence of programmes and standards of managerial education to the evolving market. Finally, it is worth mentioning that examination procedures still remain an example of good practice for numerous institutions, especially universities.

As for the content and empirical aspect, a number of important principles should be emphasised which determine the quality of CIM programmes and the effective transfer of knowledge between theory and practice of marketing. Firstly, the very fact of having experienced professionals and learned scientists in the CIM structure ensures up-to-date and appropriate standard of knowledge. This knowledge, thanks to the participation of professionals, it has a utilitarian aspect, whereas via academics it adheres to the standards of managerial education. Secondly, regular, three to four year, extensive research is conducted, whose aim is to identify and map the key competences indispensable for marketers to implement at a strategic and operational level. The effects of this research prove useful during programme modification, when the foundation of management is combined with new theories and operational methods. Thirdly, examination procedures are based on combining the theory and practice of marketing. These exams are based on case studies, however the assessment criteria reflects theoretical knowledge as well as the ability to adapt it.

The good practices presented here, in a nut shell, which refer to the organisation and formal aspect as well as content and empirical ones should be complimented by another key factor which makes CIM a good example of the direction of the evolution towards which the institutions of the managerial education market will head. Although the Chartered Institute of Marketing, is a non-profit institution, it competes in the market, with all its associated benefits and risks, and must constantly face the pressures of competition. Due to that pressure, the feeling of self-satisfaction

and strategic and organisation inertia, which are the classic symptoms of regulated markets or sectors reserved for state organisations, are limited.

Summary

The Chartered Institution of Marketing serves as an example of an organisation whose establishment and development is linked to the evolution of the business world and, in consequence, its transformation in the theory and practice of management, marketing in particular. CIM programmes focus on three main areas:

- Building of knowledge and improvement of marketing managerial skills at the strategic and operational level through comprehensive programmes;
- Boosting the participants' and their companies' ability to compete on international markets through implementation of international professional standards in the programme;
- Developing individual and team competences in development and marketing areas through the practical and interactive nature of the programme.

Such directions in the area of managerial education naturally induce the combination of theory and practice of its application. Therefore, transfer of knowledge from business to a training organisation, or even further to a development institution, remains a vital condition. Comprehension of these problems, challenges and expectation of the business sector, facilitates the creation of such managerial education programmes that would enable the flow of theoretical knowledge (responding to challenges and defining problems) from the academic or para-academic area of business.

The example of CIM is not alone, this type of process also occurs in other fields of management. In the area of accountancy and finances they refer to CFA or ACCA qualifications. In the area of process or project management Six Sigma, TQM, etc.. Certification of projects according to PRINCE methodology or KAIZEN activities optimisation are only a few selected examples. Therefore, it seems that the presented direction of changes in the area of managerial education and transfer of knowledge between theory and practice of management based on professional qualifications is currently not only clear but is becoming a leading force for change.

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COMPETENCIES OF POLISH SCIENTISTS AS A CONTRIBUTION TO THE SUCCESS OF INNOVATION RESEARCH AND DEVELOPMENT PROJECTS

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Abstract

The states which top the list of the number of conducted research and development activities put substantial emphasis on a scientist's competencies. Today, experts are able to determine the competencies that will decide on the success of projects in the next decade. They include, among others, leadership skills, team work, entrepreneurship as well as international and cross-sector mobility. What is the place of Polish scientists in relation to these competencies? What are their strongest and weakest points? How do the competencies of Polish scientists translate into the success of projects conducted in our country? These questions were to find their answers thanks to the research conducted in 2011 commissioned by the National Information Processing Institute. This article presents some of the results. It includes, amongst others, the differences between scientists from science departments and companies as well as between project managers and members of research teams.

Key words: Innovation, scientists competences and innovation projects

Introduction

Pondering the reasons for the wealth of nations, John Stewart Mill wrote in *On Liberty* [2003]: '...all good things which exist are the fruit of originality'. Innovation (lat. *nova*) is a process that leads to a particular change. In this respect innovation should not be confused with ingenuity which is only the first stage of marketing a new solution. Chris Freeman and Luc Soete [1997] wrote (based on the classic Schumpeter's definition): 'An innovation is an idea, a sketch or model of a new or improved device, product, process or system. An innovation in the economic sense is accomplished only with the first commercial transaction involving the new product, process, system or device, although the word is used to describe the whole process'. Such a process is expected to involve not only inventors, most frequently scientists, but also specialists from other disciplines e.g. marketing. Their goal is the successful implementation of an innovative project, which should be understood as, 'a novel venture involving resources and within time, cost and quality limits'

[Kerzner, 2005], in order to achieve the set target which is the implementation of an innovation on the market. The success of such a project is not simply its implementation (operational success), but also achieving results that increase a company's competitiveness in the long term along with financial benefits (henceforth called strategic success).

Krzysztof B. Matusiak [2010] writes that within innovation one can spot three overlapping features: combining knowledge and its intellectual element with a marketing vision, pioneering and uncertainty over the final result. These types of activities are mainly conducted by employees of the R&D sector. It is this sector that requires highly specialised above average knowledge and technical skills as well as a readiness to accept risk that involves the investment of time and money in the project, the results of which are impossible to predict. The R&D sector involves the commercialisation of ideas, here however indicators in the national innovation index⁷, governmental and private R&D expenditure⁸, patent activities⁹, etc. show a clear discrepancy between assumptions and practice. Polish issues with marketing solutions are of a systemic character, therefore overcoming these problems requires comprehensive action. A number of expert appraisals, including the analysis of best practice in R&D management conducted by the National Information Processing Institute (OPI)¹⁰, point out that Poland still lacks systemic support for the complex work of scientific researchers, meaning: a) it lacks effective

⁷ For example in issued by The European Commission Innovation Scoreboard, Poland is the fourth from the bottom, before Bulgaria, Rumania and Latvia. Among others attractiveness of a research system, innovation and economic results of conducted research got the lowest scores, see *Innovation Union Scoreboard*, http://ec.europa.eu/enterprise/policies/innovation/files/ius-2013_en.pdf, accessed 12.09.2013; compare information in *OECD Science, Technology and Industry Scoreboard 2011*, OECD Publishing, 2011; accessed 12.09.2013.

⁸ The total expenditure on R&D in Poland in 2012 stood at 0.9% of GDP. To compare, in the most R&D advanced countries total expenditure on R&D is about 5% of GDP. Compare Eurostat, *Research and Development Expenditure by Sector of Performance*, <http://epp.eurostat.ec.europa.eu>

⁹ The number of granted European patents may serve as an example of a low patent activity: in 2012 Poland was granted 80 patents, whereas Germany received over 13 000 and in Great Britain, Holland or Italy about 2 000 each. See: <http://www.epo.org/about-us/annual-reports-statistics/annual-report/2012/statistics-trends/granted-patents.html>, access; 16.10.2013.

¹⁰ The results of the research were published in two monographs: Gryzik A., Knapieńska A., *Zarządzanie projektami badawczo-rozwojowymi w sektorze nauki*, OPI, Warszawa, 2012; Gryzik A. et al., *Zarządzanie projektami badawczo-rozwojowymi w sektorze przemysłu*, OPI, Warszawa, 2012. Compare also: Geodecki T. et al., *Kurs na innowacje. Jak wyprowadzić Polskę z rozwojowego dryfu?*, Fundacja GAP, Kraków, 2012.

and stimulating methods for the development of the market of financing scientific ventures, b) the level of effectiveness of cooperation mechanisms for science and industry sectors is inefficient¹¹, c) commercialisation of scientific results remains, for many scientific centres, a huge organisational burden and a legal challenge¹². The problems of science financing refer not only to the manner in which public resources are distributed (including too low requirements from the public sponsor), but also their evaluation and accountability.

Poland is not the only state struggling with the problem of systemic management of R&D. The Lisbon Treaty, which was to contribute to 'building economies based on knowledge', was not implemented in the majority of EU countries, and we can already say that the strategy Europe 2020 diagnoses insufficiently the problem of decreased competitiveness, offering no remedy, therefore it may follow the fate of its predecessor. In order to overcome the difficulties in planning policy geared towards boosting innovation, the Polish legislator should receive the description of as many elements of the R&D sector as possible. Such health analyses of R&D sectors in Poland are frequently conducted by governmental and independent agencies [e.g. Orłowski, 2013]. The area which is overlooked is the scientists themselves [Audretsch, et al., 2010]. This gap is filled by the research conducted by OPI in 2011 on the psychological and competence profiles of scientists from the science and business sectors. It shows which competencies have the strongest link to a project's success and measures the level of competencies among Polish scientists.

The article presents merely a part of the results of this extensive study, focussing on the problem stated above. The starting point for the analysis of the competence level amongst scientists must refer to the identification of those which, to the highest degree, affect the success of innovative projects. The presented results of the OPI research identify the competencies with the strongest link to a project's success. In order to confirm their validity and additionally to narrow the analysis to those competencies which are today regarded as progressive, the results of scientist competencies analysis conducted abroad will be quoted.

¹¹ The cooperation problems between these two distinct sectors are reflected in the mentioned OPI research and among others in the analysis of the knowledge transfer centres operations. See: Kijewska-Dąbrowska I., Lipiec K., *Rola akademickich ośrodków innowacji w transferze technologii*, OPI, Warszawa, 2012.

¹² Commercialization issues are discussed in e.g. Niewęglowski A., *Umowy wdrożeniowe jako instrument komercjalizacji osiągnięć naukowych*, w: Lipiec K., red., *Komercjalizacja wyników badań naukowych a ośrodki transferu technologii*, OPI, Warszawa, 2011.

Therefore the overall picture of external factors influencing the working conditions of scientists, taken from the analysis conducted, will be enriched by a description of the scientists themselves. This will be done by answering the following research questions:

- Which scientist competencies will build state innovation over the next decade?
- What is the level of these competencies among Polish scientists?
- What is the impact of a scientist's competencies on the success of innovative projects?

This article is a contribution to the discussion on a scientist's role in creating innovations both on a micro (operational and strategic success of an R&D project for a company or a science department), and macro (the success of national innovation policy) scale.

Scientists' and countries' innovation – A theoretical overview

Competencies can be defined as 'characteristics that individuals have and use in appropriate, consistent way in order to achieve desired performance. These characteristics include knowledge, skills, aspects of self-image, social motives, traits, thought patterns, mind-sets and ways of thinking, feeling and acting' [Dubois, Rothwell 2004]. In McLagan's [1989] view, positive results may be achieved through 'widely varying, sometimes extremely complex, patterns of professional behaviour'. The modern understanding of competencies is fully reflected in the definition by Richard E. Boyatzis [1982]: 'competence is the potential within a man leading to such behaviour which contributes to the fulfilment of requirements for a given position within the parameters of an organisation's boundaries which triggers the expected results'. Referring the theory of competence to the science sector, one must pay attention to the fact that each change taken in response to social challenge or market requirements should involve changes in competencies of the personnel involved, in other words, scientists. The research 'Skills and competences needed in the research field objectives 2020', conducted in 2010 by L'Association pour l'emploi des cadres (Apec) and Deloitte Consulting in 8 countries with well developed research infrastructure (Finland, France, Holland, Japan, Germany, The United States, Switzerland, The United Kingdom) ¹³, identified 3 basic phenomena which redefined the manner of research project management around the world [Lamblin, Etienne 2010]. These include:

¹³ The analysis covered the countries selected on the basis of two indices: expenditures on R&D as percentage of GDP and the number of researchers *per capita*.

- 1) structural changes: steering of state policy towards the development of science and technology followed by increasing funding for R&D projects;
- 2) increased focus on market needs;
- 3) new ideas and strategies for conducting research projects: regulation of intellectual property rights, promotion of interand multi-disciplinary ventures conducted in a multicultural environment¹⁴.

These phenomena cause the world's leading research centres to perceive differently the required features of their employees. According to experts commissioned by Apec and Deloitte¹⁵, the future will open to the scientists who, apart from their professional competences (knowledge, the ability to determine research problems and their analysis using advanced IT tools), also have managerial skills: they are entrepreneurs with well developed interpersonal and teamwork skills¹⁶. The analyses point to significant differences in valuing particular competences in public and private institutions. In its commercial aspect, intangible competences are valued- the highest valued are people professionally prepared, with excellent interpersonal skills in their relationships with fellow researchers and company representatives¹⁷.

As for the prioritising of scientists' competences, similar conclusions were included in *Science and Technology Industry Outlook 2012*, prepared by the OECD. It accentuates the fact that in recent years, countries emphasised the promotion of cross-sector mobility among

¹⁴ In recent years countries such as Australia, Finland, Ireland, Norway or Slovenia decided to open the most significant science funding programmes for foreign researchers. Moreover, Austria, Germany, Luxemburg and Switzerland encourage research of national and foreign scientists. This tendency is also reflected in educational programmes. See e.g. *Science and Technology Industry Outlook 2012*, OECD, p. 201.

¹⁵ The experts consisted of laboratories managers, HR managers of innovation companies, universities' management, governments' representatives of the countries covered by the research.

¹⁶ Apec & Deloitte research views the command of foreign language and awareness of research importance and their impact on external relations as beneficial for future. The identified, required personality traits of scientists include: creativity, openness, involvement, motivation and adaptive skills.

¹⁷ Apec i Deloitte research points to the dependency of researchers competences and the level of organization development in which they operate. Similar conclusions on the impact of organization culture are included in the OPI research report (Cichocki et al., *Zarządzanie pracami B+R – porównanie profili psychologicznych i kompetencyjnych naukowców zatrudnionych w sektorze nauki i w sektorze gospodarki*, Warszawa 2011, unpublished).

scientists (knowledge-business, business-knowledge) and foreign mobility¹⁸, they take actions to foster entrepreneurship among young researchers (business courses in Slovenia and Germany). There is growing awareness that innovation is better encouraged within the network of public organisations (research institutes, universities), companies and also suppliers and customers. For example, the level of national and international cooperation for innovation in Finland (the field's leader) stood at almost 60% [OECD 2010] between 2004 and 2006, and in Sweden, Holland and Austria at around 40%. Despite good practices in this field there are still a number of developed European countries which struggle with the problem of their policy for the development of scientific personnel who could face the challenges in the global economy. OPI research shows that this problem also includes Poland.

Research methodology

The starting point of the analysis of the competences of Polish scientists is the assessment of the importance of the development of the competences of scientists in countries with the most advanced R&D sectors.

Therefore this article takes into account only those competences identified in psychological and competence profile research conducted in 2011, which, according to desk research analysis, were considered to be fruitful in the coming years. They are:

- 1) **international and cross-sector mobility:** participation in foreign work experience and internships, willingness for workplace transfer and cross-sector movement;
- 2) **leadership:** engagement in target achievement, concern for motivational level, acceptance of responsibility for the results from teamwork;
- 3) **teamwork skills:** flexibility on role within a group, positive attitude towards cooperation, involvement in cooperation with other parties;
- 4) **entrepreneurship:** translation of research results into economic and practical benefits, potential income and costs mindset gearing.

The first feature- international and cross-sector mobility- was determined on the basis of answers gained exclusively from the demographic questions in the survey, originally not considered to be competences but as a characteristic of the whole of the research population.

¹⁸ The report mentions Australia, Canada, France, Germany and Great Britain as the countries traditionally increasing the attractiveness of their market to foreign scientists.

The respondents were asked whether in their professional career they had been on an internship in a foreign R&D institute and whether they had had experience within a company (question to scientists) or in research departments (question to business people). In future it will be worthwhile expanding this competence analysis by questions on the type of internship, its length, location, etc..

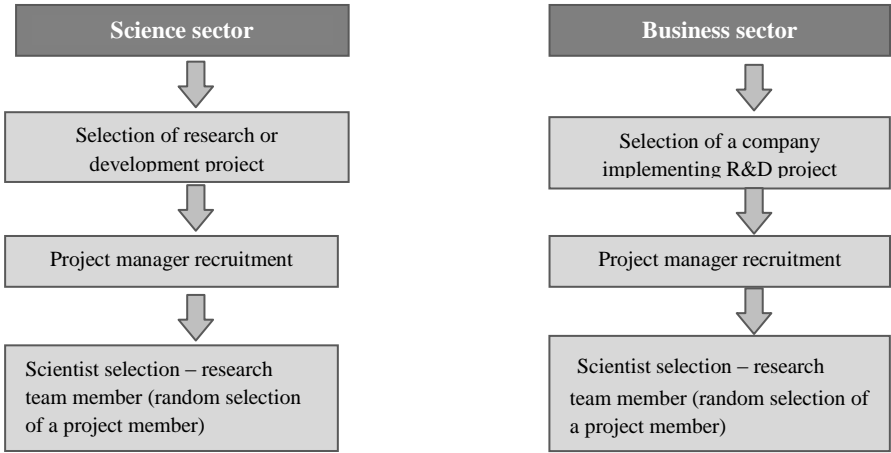
The next three features- leadership, teamwork and entrepreneurship- are typical intangible competences which affect the overall quality of tasks and cooperation effectiveness. The survey was presented in the form of a test which checked knowledge and skills.

Division into subjective and objective success has been created while looking into the impact of competences on overall project success. Particular criteria were given indices. **Subjective success** of an R&D project was based on individual answers to the question, 'To what degree did the project result in success?' (scale from 1 to 100%). The criteria of objective success were divided into:

1. Implementation of the planned tasks in the prescribed time and in accordance with the budget – **operational success**.
Achieving results which increase an organisation's long-term competitiveness – **strategic success**.
2. Due to a variety of funding principles, the strategic success of an R&D project has a different dimension in the sectors of science and business, the success index was therefore built on mutual core indices, which were complimented by indices determining a company's and research centre's competitiveness. Strategic success is a resultant of: a) accomplished practical applications, b) good financial results, c) significant scientific track record and d) commercial success (perceived as a combination of implementation success and business activity).

The index of the overall R&D project's success was constructed as a sum of weighted specific rate indices. The applied weight system includes the growing importance of strategic success, particularly in the area of implementation. Firstly, it stemmed from the above mentioned importance of success for the organisation's competitiveness and innovation in the economy. Secondly, it was triggered by a slight variability in the remaining success measurements. All the above variables were normalised, as a result of which they have values ranging 0-1. An index value closer to 1 means the greater success of a project.

The research covered scientists engaged in R&D projects in research institutions (science sector) and in companies (business sector). The term ‘scientist’ signifies a person who fulfils at least one of the following criteria: a) participates in R&D; b) has a doctoral degree or higher; c) is employed by a R&D institution. First, the selected R&D projects (science sector) and companies (business sector). Further stages are presented in Graph 1.



Graph 1. Sample selection diagram

Source: Own work.

The focus was only on fairly large projects from the years 2005-2011 which lasted for a minimum of one year, their minimum budget stood at 200,000 zloties and the team stood at a minimum of five people. The sampling frame of research institutions was the project base from the OPI resources (as it is the most complete collection of data available in Poland); contact details were obtained on 6167 scientists. To decide on the selection of companies, the prestigious ranking of the 500 most innovative companies in Poland was applied. It is compiled by the Institute of Economics of the Polish Academy of Sciences, based on the annual survey results; an extra source of selection is the group of companies implementing R&D projects part funded from the state budget and EU funds, as well as those companies taken from reports and publication on innovation, patenting companies and those investing in R&D. Based on internet resources, the companies chosen were compiled. Information about the implementation of their

projects fulfilling the criteria was verified by phone; 647 e-mail addresses of potential respondents were obtained. An invitation was sent to all contacts from both collected bases. In all, 735 surveys were collected. 345 of the respondents held managerial positions in R&D project teams, while 390 were members of research teams. This is presented in detail in Table 1.

Table 1. Sample structure according to the scientist's role in the project and sector

Role in the project	Science sector	Economy sector	Total
R&D project managers	n=259	n=86	n=345
Project team members	n=296	n=94	n=390
Total	n=555	n=180	n=735

Source: Own work.

The survey was conducted by the CAWI (*Computer-Assisted Web Interview*) method where an anonymous questionnaire on an internet site had to be completed. The pilot study covered 19 people; it gave the basis to the final verification of the research model as well as of the validation of the research tools and individual test entries. The respondents received an invitation e-mail to take part in the research along with a link to the on-line survey. The answers given were automatically registered on the server and the research was constantly monitored by a qualified supervisor. The interviewees could also avail of a help desk if required.

The level of competences of Polish scientists

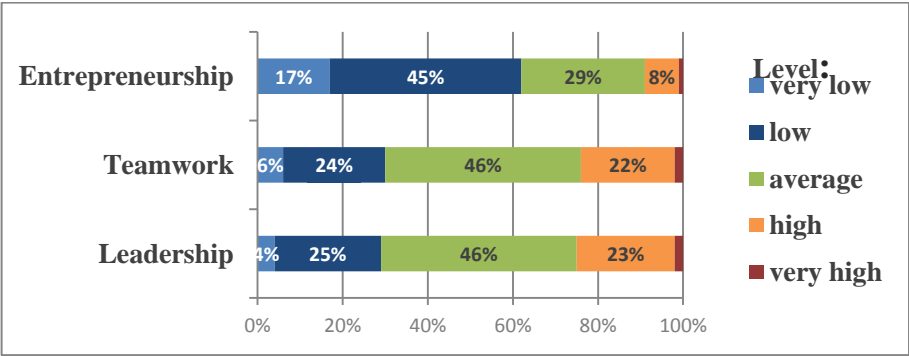
Although the research referred to both a scientist's personality traits and their competences, attention was focussed on the latter, normally secondary to personality traits, however, significant from the point of view of R&D projects. The scientific circles from research institutions and companies were compared in respect to the aforementioned competences. The discussion on the scientists' competences, divided into the commercial and public sector, was regarded as meaningful due to their specific nature. It is worth highlighting that, according to experts engaged in preparation of the quoted foreign research, the science sector (principally to a lesser degree focussed on economic results) should develop competences facilitating the putting of product solutions into practice.

Science sector

As for the range of experiences, 43.7% of R&D project managers and 29% of team members were somewhat involved with foreign

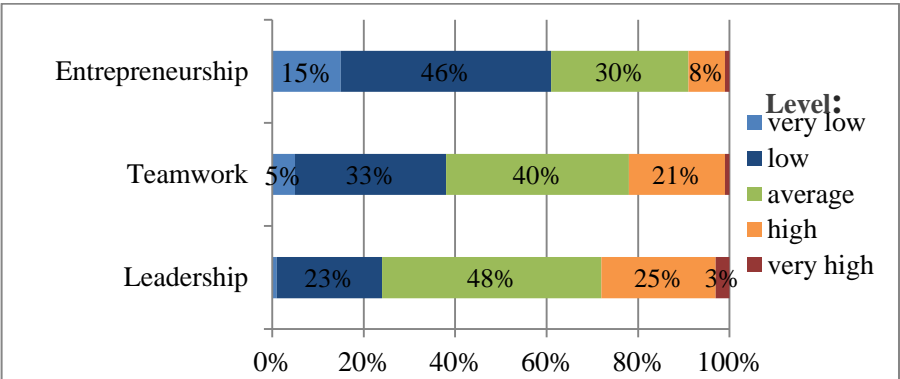
universities at certain stages of their careers. Every third scientist had, in the past, worked for a company.

The intangible competencies of this group were at a fairly low level. Despite the lack of reference to the population norms, they can be assessed to be average, as the medium values are close to 4 on a scale from 0 to 8. Leadership presented itself quite favourably (25% of managers and 28% of project members scored very high or high) along with teamwork (respectively 24% and 22%). However, over 60% of the managers and members scored low in entrepreneurship. Managerial competences are presented in Graphs 2 and 3.



Graph 2. Distribution of competencies of R&D project managers in research institutions

Source: own work based on research among project managers in research institutes [n=259].



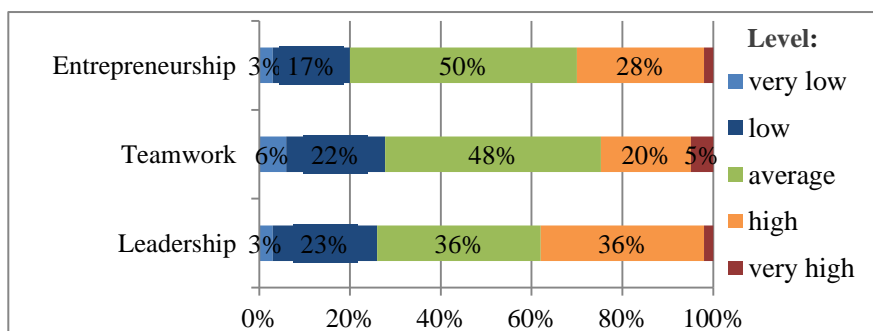
Graph 3. Distribution of competencies of R&D project team members in research institutions

Source: own work based on research among team members in research institutions [n=296].

Business sector

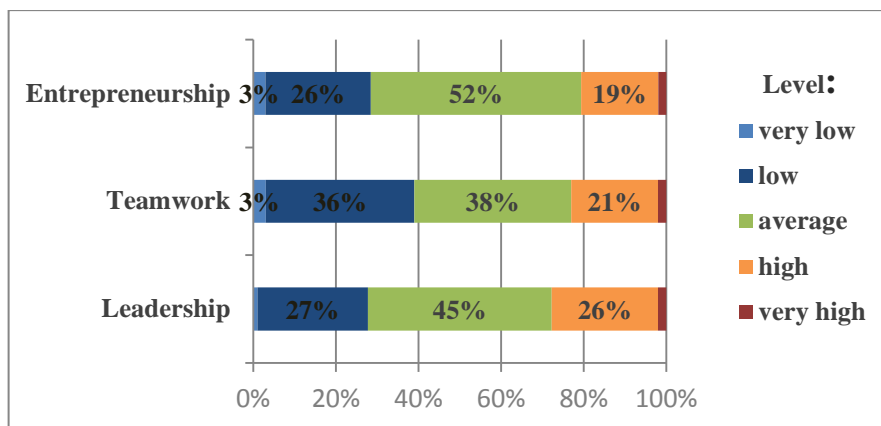
Managers and research team members gained professional experience abroad far more rarely than scientists from the state sector – only 10% of managers and 11.7% of members had such an internship. Half of the managers and 17% of team members had worked for a research institution in their lives.

As for managerial competences, as many as 80% of R&D project managers had at least average skill of translating research results into practice (in research institutions 38%). Distribution of the remaining competences looks similar, though it is worth noting that the percentage with competences above average was higher in the private sector than in research institutions (for example, in managers very high and high levels of leadership- 38%, whereas in the science sector- 25%). It is interesting that higher competences in the area of leadership were observed in managers who had previously worked for research institutions. The distribution of individual competences of research team members in comparison to the distribution of competences of their managers is similar. The detailed data is presented in Graphs 4 and 5.



Graph 4. Distribution of competences of R&D project managers in companies

Source: own work based on research among project managers in companies [n=86].



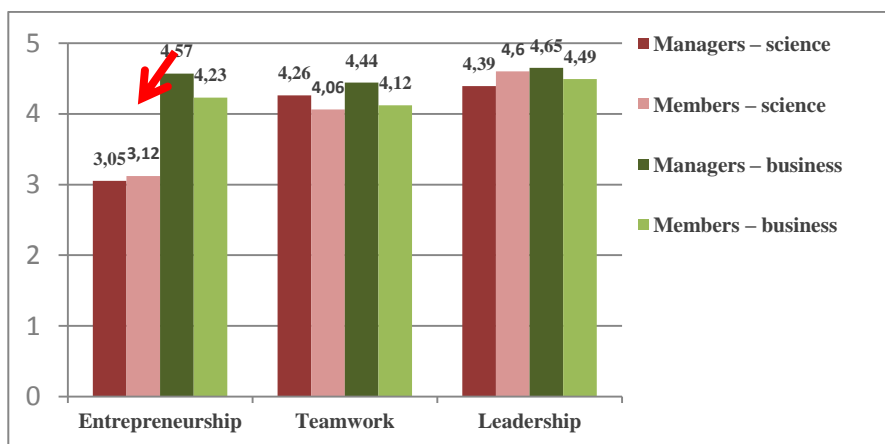
Graph 5. Distribution of competences of R&D project team members in companies

Source: own work based on research among members of research teams in companies [n=94].

The results of the competences test pointed to the fact that most interviewees had a higher level of social competences (e.g. teamwork) than personal ones (e.g. entrepreneurship). This is presented in Graph 6. Such a competence profile may contribute to the positive atmosphere in the work of research teams and good relationships between supervisors and subordinates. On the other hand there is a danger that the shortcomings in the area of personal competences will have a negative impact on the organisation of work, the quality of the solution generated and overall effectiveness, including economic.

The greatest discrepancies between employees of the state and private sectors are obviously noticed in reference to entrepreneurship. This competence was significantly higher in companies (managers- 4.57 in comparison to 3.05 in their counterparts in the science sector; team members- 4.23 in comparison to 3.12). This stems from the fact of operating in a market environment which induces improvement of the skills that turn research results into economic benefits. Their different environment and university operations means that the results achieved by researchers in the science sector should not be interpreted as wholly negative. It is worth bearing in mind that the main purpose is conducting research and educating students. The influence of research departments on economic and regional development is perceived as their 'third mission', giving priority to research and didactics. The discussion on 'entrepreneurial'

or ‘innovative’ universities (in Poland) is a recent phenomena [e.g. Clark 1998, Leja 2006]. Creating innovations by scientists may have direct implications through their activities, not only being simply ‘entrepreneurial’ though, as is suggested in the literature¹⁹ on the subject, but also shaping academic entrepreneurship in the face of the presented results has obvious merit.



Graph 6. Competences R&D managers and R&D project team members implemented in research institutes compared with companies

Source: Own work based on research.

Competences and the success of innovation projects

What is overall assessment of a project’s success seen through the eyes of the management and participants in innovation ventures, including in the context of the differences between the science and the business sector? Does the perception of success depend on competences? In order to assess this, the respondents were requested to highlight a successfully completed project in which they participated. Among the respondents from the science institutions, about 40% of projects refer to basic research, about 30%- development work, and the remaining ventures combined these two activities. The business sector however was significantly dominated, obviously, by projects of a developmental nature; basic research stood at slightly less than 10%.

¹⁹ See e.g.: Cieřlik J., Guliński J., Matusiak K.B., A. Skala-Późniak, *Edukacja dla przedsiębiorczości akademickiej*, PARP, Poznań – Warszawa, 2011.

When it comes to research results, the highest score, close to value 1, (in the business sector) was achieved by the index of operational success. This is understandable as the projects selected, in the respondents' view, were accomplished successfully. The average score was slightly lower for the companies' sector, which can be explained by the fact that the projects conducted by R&D departments in companies bear a higher risk, which often leads to discrepancies in reference to the planned goal.

The index of subjective success scored lower than the operational success index. Bearing in mind the project's success, respondents mentioned adherence to budget or meeting deadlines in first place, and therefore in-depth analysis caused a lowering of the subjective assessment.

The value of the commercial success index (in both sectors) turned out to be very low. In science institutions the average stood at about 0.10 (for managers) and 0.11 (for team members). For practical applications it was only 0.05 (for managers, as well as for team members), whereas in private companies it stood at 0.09 (for managers) and 0.13 (for team members). This is presented in detail in Table 2.

As mentioned before, the managerial competences of project managers overall were not significantly higher than the team members. Following this idea, the assessment of the relationship between the competences of R&D project executors and the project's success was conducted both for management and research team members.

In the science sector, the analysis of overall project success revealed significant differences between project managers who had served an internship in a foreign R&D institute and those without such an experience. Such an effect was not noticed in companies, which stems, among others, from the fact that the scientists employed had rarely participated in foreign internships. A similar relationship was observed in the area of knowledge transfer between science and business (through the professional experience of employees of research institutions employed in companies and vice versa). However, it must be pointed out that the business experience of managers of the science institutions foster project success more than the experience of the scientific work of managers in companies.

Table 2. Selected features of success indices distribution

Particulars			Overall success index	Operational success index	Strategic success				Subjective success index
					Financial success index	Practical applications index	Track record index	Commercial success index	
Managers	Science	Average	0.41	0.98	0.15	0.05	0.66	0.10	0.62
		Median	0.41	1.00	0.00	0.00	0.86	0.01	0.61
	Business	Average	0.38	0.88	0.43	0.09	0.18	0.28	0.51
		Median	0.37	1.00	0.50	0.03	0.00	0.28	0.47
Members	Science	Average	0.40	0.97	0.17	0.05	0.66	0.11	0.59
		Median	0.40	1.00	0.00	0.00	0.86	0.01	0.59
	Business	Average	0.38	0.87	0.45	0.13	0.18	0.31	0.49
		Median	0.36	1.00	0.50	0.03	0.07	0.28	0.48

Source: Own work based on research

Table 3 shows, among others, that the success subjectively assessed by the project managers of the science institutions was determined by their leadership competence- people with a higher level of this competence perceived their achievements more favourably. Positive and clear, though statistically insignificant, is also the impact of team work and entrepreneurship. In this sector, commercial success was accompanied by a leader's entrepreneurship (particularly in ventures involving simultaneous basic and developmental research). The positive impact of entrepreneurship is observed among the R&D project team members in science institutions. Interesting is the fact that in the business sector (team members group), entrepreneurship shows a negative correlation with project success. Project success remains therefore under the beneficial influence of a research team manager's competences, not the members of these teams and refers mostly to science institutions rather than companies.

Table 3. Interdependencies between competences and project success in science institutions and companies

		Success indices	Leadership	Team work	Entrepreneurship			Leadership	Team work	Entrepreneurship
Managers	Science	Overall success index	0.01	0.01	0.04	Team members	Science	-0.04	-0.04	0.09
		Subjective success index	0.20	0.08	0.06			-0.13	0.04	0.08
		Operational success index	0.06	-0.02	0.04			-0.08	-0.04	0.04
		Financial success index	0.02	-0.09	0.07			0.04	-0.01	0.06
		Practical applications index	-0.02	-0.04	0.14			0.01	0.00	0.08
		Track record index	0.12	0.08	-0.01			0.07	0.07	0.14
		Commercial success index	0.01	-0.08	0.12			0.04	-0.01	0.07
	Business	Overall success index	0.12	-0.04	0.10		Business	0.07	0.06	-0.07
		Subjective success index	0.09	0.00	-0.01			-0.01	0.02	-0.19
		Operational success index	-0.05	0.01	0.09			-0.18	0.01	-0.02
		Financial success index	-0.07	0.11	0.04			0.13	-0.02	-0.08
		Practical applications index	0.10	0.02	0.17			0.07	-0.07	-0.06
		Track record index	-0.16	0.13	-0.05			-0.11	0.06	-0.08
		Commercial success index	0.00	0.10	0.14			0.15	-0.02	-0.07

Spearman's rank correlation and dependence; significant dependencies with $\alpha=0.10$ were put in bold. Negative correlation marked in black.

Source: Own work based on research.

Summary

In this era of interdisciplinary research conducted by international teams, the managerial competences of scientists, such as leadership, ability to work as part of a team, entrepreneurship and- when treated as an introduction to competence acquisition – international and cross-sector mobility - have become increasingly significant. The presented foreign research referring to competences that build the innovation of countries for the forthcoming decades have shown this perfectly. Based on foreign prognosis, the level of these competences for Polish scientists: managers

and research team members was analysed. Worryingly, the research sample shows an average level, both in the science and business sectors. This average score, calculated on the basis of a questionnaire completed by members of the science and economy sectors, is roughly value 4 on a scale of 8. Despite the lack of references to population average, it is curious there is no difference in the level of competences between managers and project members. Such a situation would be explained by more in-depth analysis of the recruitment of project management personnel conducted in companies and universities. The research on the influence of competences on project success did not reveal clear and expected results. Analysis shows that a project's success is facilitated by entrepreneurship and foreign mobility, which corresponds well with the opinions expressed by foreign experts. In reference to Poland, it calls for systemic support of scientist exchange (Top 500 Innovators- internship-training programme of science departments serves as a good example). Such programmes should be expanded by activities which make scientific advancement dependent on working in various institutions, and by internships and work experiences. Especially that cross-sector experiences of scientists had a positive impact on project success.

The OPI research shows that scientists from the business sector were generally more industrious than research institution staff, which clearly stems from their daily operations in the challenging market environment. The poor results scored by the representatives of the state sector prove the call for entrepreneurial attitudes which can contribute to- still difficult in Poland- breaking the barriers in cooperation between science and business. Scientists are still focussed on 'pure' scientific work putting aside the issues of commercialisation and implementation. It is important to balance appropriately the mission of Polish research centres so they includes the implementation of the whole innovation process, meaning from idea to implementation, taking into account a company's engagement in the final stage. Without the overlapping of these two worlds it is hard to count on any significant economic success of a company or scientific organisation, and, as a consequence, on a national scale. Innovation scoreboards highlight the weaknesses in innovation implementation in Poland confirming this unequivocally.

An important question which should give rise to further research is the surprising lack of influence of experience in scientific work of company management on project success. Unfortunately, it may prove the fact that our science sector is an enclave of good work atmosphere which does not translate into effectiveness and quality. It may also confirm

the thesis of another OPI research (referring to research project management) that projects implemented in science sectors were not created in response to real problems but were merely a way to build professional careers through implementation of risk free research, easier for financial accountability to the sponsor and, in fact, unprofitable. It must be mentioned that such an attitude amongst scientists is forced by the existing research financing system and the general unwillingness of sponsors (both public and private) towards truly innovative and consequently high-risk research.

There is a call for systemic solutions to all the results presented above. Although they show that personal competences such as entrepreneurship and the international mobility of the research sample of scientists translate into project success, they are only the introduction to the description to very complex scientists' circles and do not show the full range of problems faced by this group.

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COMMERCIALISATION OF RESEARCH RESULTS – COOPERATION BETWEEN SCIENCE AND BUSINESS

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Abstract

When analysing the term commercialisation one should answer the crucial question: what mechanisms govern commercialisation of knowledge and technology as well as which resources and sources determine it. The article presents a theoretical deliberation concerning the development of issues related to the commercialisation of research results in the last century. A review of literature precedes the section on sources for the commercialisation of knowledge and technologies when considering research results and technology providers. The author claims that analysis of technological resources also determines the possibilities for the cooperation between science and business. It is important for the selection of the commercialisation strategy to describe technological resources and their complementarity. Strong technological resources and their market availability ensures independent technological development. However, a lack of technological resources or the chance to acquire them encourages an innovative organisation to pass know-how or technologies to another, capable organisation which is willing to commercialise this knowledge on the market. Frequently however when commercialising research results, organisations establish cooperation on the market in order to build resources to implement research results. This article, ‘Commercialisation of research results – cooperation between science and business’, is concluded with an example depicting the cooperation between scientists and business people in a new spin-off company set up in order to build technological resources and the market implementation of a device for measuring the structure of soft material surfaces.

Key words: commercialisation of research results, spin-offs

Commercialisation of research results at universities – theoretical deliberations

Rothwell [1992] points out that in the 1950s and 60s one could clearly determine technology, its innovativeness (the level of knowledge) as an important factor shaping commercialisation. In the 1970s marketing played the main role. As a result of the marketing approach, commercialisation was identified with the launch of a new product on the

market. The following decade saw attempts to integrate all the operations concerning research and technological development with marketing. Later years witnessed the influence of networking on the commercialisation of technologies. Knowledge gathering and links with commercialisation stakeholders had a strong influence on the management of research results and technology from the moment of concept to market launch. At the beginning of the 21st century, commercialising processes, market links, accumulation of knowledge and cooperation between companies generating innovations was key to achieving the highest implementation results. Open innovations also started to play a major role in commercialising processes. Open innovations is connected to utilising work and research projects previously developed elsewhere but abandoned as being unviable, too niche or difficult to continue with [Pomykalski, 2001].

Commercialisation of research results and technology in Polish literature is viewed more often as launching a new product or technology on the market [Sojkin, 2010; Matusiak, 2010; Stawasz, 2008]. Operations included in the commercialisation process before and after patenting are highlighted by Klineciewicz [2010]. Additionally, he stresses the importance of identifying the actors in each stage of commercialisation. Commercialisation of research results and technology should consider the key and indispensable operations shaping the value-added of an idea, research results and products before and at the launch stage of a technology or product on the market. The actors in the commercialisation process and the factors shaping it determine the construction of an organisation's business model when launching new technologies and products on the market.

The process of commercialisation is linked with the transfer of knowledge and/or technologies which can lead to the creation of spin-off or start-up companies [Lendner, 2007], granting licences [Jackson, Robinson, Whitfield, 2008] or sale of *know-how* or *know-why*. Markman et al. [2005] provide four categories which assist in understanding commercialisation: innovative organisations, experiences, the learning process and the spread of knowledge. According to these four categories, the determinants of the commercialisation process include creators of technologies and research, specialisation and unique competencies of an organisation, *venture capital* investment as well as cooperation networking for the internationalisation of technologies. From a practical point of view, the first step towards commercialisation should be recognising the sources for the development of new technologies, and not the stages in the commercialisation process. Then the process

of commercialisation will be based on two main sources of knowledge: the possibilities of new technologies and the knowledge of target market requirements. Identifying the dominant source for the process of commercialisation will enable one to answer the question of whether the process of commercialisation is subordinate to the development of technologies or new products as well. Global Commercialization Group²⁰ set up at the University of Texas in Austin in order to search for commercial projects at the university, bases commercialisation on four competitiveness factors, international competitiveness, access to capital, access to markets and market potential. International competitiveness encourages the identification of the most competitive technologies, determines optimal competitiveness strategies and better motivates international cooperation. Access to capital facilitates the development of technologies, boosts the attractiveness of research, allows a variety of forms of support: from business angels, venture capital to own or public funding. Access to the market determines mainly the technology's standing and its technical and marketing nature. Access to the market and market potential stimulates the many stages of the commercialisation process and removes investment risk. The example shown below of the technology of measuring temperature to a 100th of a degree can be applied in various fields. The measurement of temperature to a 100th of a degree allows for the detection of some types of cancer and, in rescue services and the armed forces, is applied to measure the temperature at night in the difficult and dangerous conditions of finding hidden or buried people. Depending on market accessibility, there are different routes for the creation of a prototype, the analysis of patent clearance, market assessment, market testing, market launch (medical or military devices) and, as a consequence, the stages of the commercialisation process follow. Balanced technological development can be interpreted in the context of networking building and the building of an innovative organisation's culture which supports all creators, entrepreneurs and investors. The lack of the right climate for commercialisation means that public funds for example are spent on research results in research centres which will not be allocated for cooperation with industry, thereby resulting in the absorption of the funds (together with other laboratories) and the necessity for further funding for future research development from the public purse. Analysing the results of the research by Rudolfa et al. [2003], one can assert that innovativeness

²⁰ Materiały wewnętrzne Global Commercialization Group, IC2, University of Texas at Austin, 2009.

and the objective of implementing research results, technologies and products should be the basis for well-functioning innovative organisations. However, the generation and development of research results and technology is facilitated by a favourable climate for commercialisation, which allows researchers to look into the future application of research results.

Cadenhead [2002] calls the analysis of a consistent monitoring (in order to implement a technology or a product) *a snapshot of the future*. At a certain stage of the commercialisation process, one should abandon creativity and begin cooperation with business, otherwise commercialisation is ineffective both economically and technically: economically as there is no return of capital for reinvestment in research, technically due to a lack of industrial application. This hampers changes to technical technology parameters so that it may be applied in practise²¹. Markman et al. [2005] pay particular attention to the acceleration of the development of technology or a new product through the commercialisation process. In the global economy, in which new technologies spread rapidly, effectiveness and most of all the effectiveness of the commercialisation process depends on the speed of new technology absorption in new sectors, the speed of generated parameters and product characteristics. The acceleration of the development of technologies and new products through technology or product adaptation to new sectors, or the same market sectors but within new segments of product purchasers and technology users, spreads the costs of technology development. It allows an increase in the likelihood of success for a new technology or product²². Large et al. [2000] emphasise the impact of the human factor, mostly research teams, on the shape of the commercialisation process. In their theory on cascade commitment they draw attention to the fact that the success of technology and science transfer requires a unique approach for each stage of the commercialisation process. The commercialisation team have a significant impact on the building of the success of technology commercialisation. The team members working in the area of research, gather knowledge which can be a value added for the

²¹ The Plasma monitor, invented at the University of Illinois would not have come about without research into gas ionisation. The search for a practical application led to this alternative to the traditional kinescope television.

²² Nanosilver for example is a common material utilised in new products. If we consider its anti-bacterial and anti-fungal qualities we can apply it in a variety of new products such as: dishwasher tablets for more effective cleaning (household chemicals), in anti-allergy ointment for horses (cosmetics for animals), ant-bacterial self levelling floors (electronic industry clean rooms) and fibre for anti-allergy materials (textile industry).

market. They shape the quality of technology and the research processes. People working for the transfer of knowledge and technology evaluate market analysis more efficiently as well as financial and human resource structures crucial for further commercialisation (e.g. engage patent spokespeople, prepare the strategy for the intellectual property protection, search for support from industry and within their own organisation, prepare to change technological features into market features, as well as consider the project market needs necessary to boost their economic value). Specialists responsible for the implementation of technologies or licence sales, know how to construct a proper business model for the commercialisation of technologies.

Moreover, every organisation which undertakes the commercialisation of knowledge or technology (e.g. a company, science and research institute or centre for technology transfer) has their own specific market features. These features impact on the company's standing in its field. This difference is so vast that a uniform identifying of tendencies and capabilities for the effective development of research results and technologies in different stages of the market commercialisation process is very difficult. Research results and an idea for a technology are worthless up to the moment of their application and value added for stakeholders is indicated who participate in the commercialisation process and during the market development of the life cycle of a technology and a product. Commercialisation process determinants, an organisation's unique market features and sources of commercialisation all impact the existence and shape of the individual stages of the commercialisation process and, as a result, condition the effective implementation of research results and technologies on the market [Trzmielak, 2013].

The sources of research result commercialisation

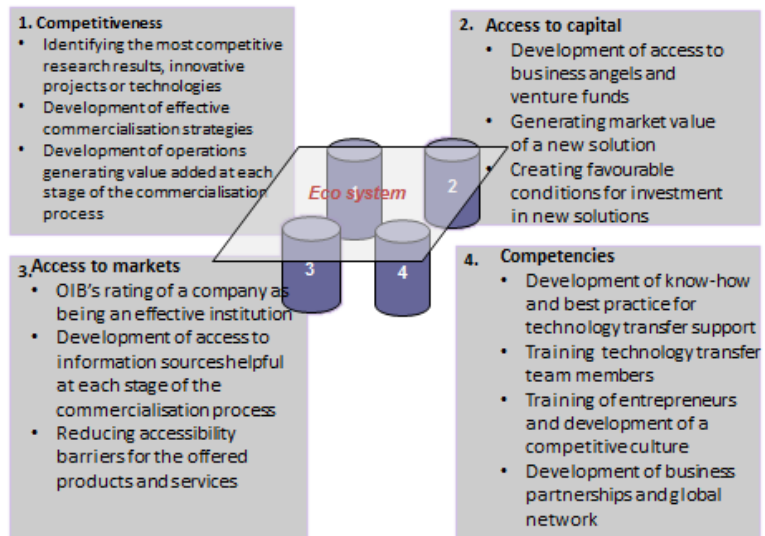
When analysing the above theories, one can enumerate the following sources of knowledge and technology commercialisation from the point of view of the provider of research results and technology.

- Supply and demand for the academic research results;
- Commercial demand (for a technology or new product);
- Material resources;
- Human resources;
- *Know-how* and *know-why*;
- Supply of financial resources.

Universities educate and support the development of renown scientists who wish to gain scientific achievements and patents, are

ambitious and undertake new scientific or research and development challenges. They create new solutions for the market. Scientific achievements and competition among scientists foster demand for new research. Other sources of implementation are commercial demand stimulated by the need for the introduction of a new technology to the market, entrepreneurship or the need for a new product's success. These condition growth in the target market, determine the company's competitive advantage, boost the quality of life and reduce the risk and uncertainty of a company's operations [Barańska-Fischer, 2008]. Commercial application of an invention stems from a company's efforts in the field of technological innovations [Peaucelle, 1999]. Simon and Fassnacht [2009] point out that commercial demand may lead to price control (a company's operations and policy which implement their aims through adequate management tools) and affect whether the technology is applied or not. Tangible and intangible resources have a huge impact in the initial stages of the commercialisation process. Tangible resources influence, among others, the acceleration of technologies that conditions which new features a prototype will receive or which new target market demands will be identified. They determine idea generation, prototype building and testing stages. The supply of financial resources is significant at every stage and becomes key at the stage of nearing the market. A lack of accessible financial resources in equity may stop even the most ground-breaking solutions, whereas a glut may lead to the commercialisation of technologies of lesser importance from the point of view of sector or company development.

All these factors create a sort of ecosystem for commercialisation. This ecosystem means (Graph 1) that we may, but are not forced to, commercialise ideas and research results to a greater or lesser effect. Lichtenthaler [2008] however, highlights that an organisation preparing new technological solutions might not take into account all applications for new technologies as it searches for new solutions exclusively for its own needs and other sectors where the technologies could be potential implemented are frequently overlooked. As a consequence, the new technology may never reach the market or arrive after a delay.



Graph 1. Ecosystem for research results commercialisation

Source: Own work: based on P. Zukowski, *Eco-system*, Global Commercialization Group, presentation material CTT UL, October, 2009.

Cooperation between science and business – analysis of technological resources and their complementarity

When analysing various commercialisation strategies, one can assume that the main principle for technology commercialisation is foremost capital: accumulating research funds, raising capital for an organisation's growth, return of investment expenditure and profit. Commercialisation strategies must indicate the path for knowledge capitalization [Thukral, et. al., 2008]. The choice of niche or larger scale market does not only depend on the readiness of a technology entering a small or larger market but also on the resources of a company (e.g. capital and human). Megantz [1996] links the dependency between the path of commercialisation and a company's technological resources as well as resources available from the market. One can differentiate four scenarios which determine the success of a commercialisation strategy (Graph 2):

- Strong technological resources and excellent complimentary resource accessibility – the preferred *strategy for independent technology implementation and product sale*;

- Strong technological resources but low access to complementary resources – *powerful cooperation and resource supplementing strategy*;
- Weak technological resources but high access to complimentary resources – *defensive cooperation strategy*;
- Weak technological resources and low access to complimentary resources – *selling resource strategy*;

The first analysed scenario points to the benefits of independent implementation of a technology on the market, production and product sales. In the area of academic companies, the market launch of new technologies may be implemented through spin offs. Spin offs receive the rights to intellectual property in exchange for a share of the company. Setting up a new spin off company also entails the granting or purchase of licenses. Companies may also attempt to buy technologies (with adequate financial resources), release them independently on the market and profit from product sales.

		Complimentary resources	
		Weak accessibility	Excellent accessibility
An organisation's technological resources	Strong	<ul style="list-style-type: none"> • Complimentary resource acquisition • Strategic alliance • Joint venture • Licence sales <i>Powerful strategies of cooperation and resources complementation</i>	<i>Strategy of independent implementation of technology and product sales</i>
	Weak	<i>Strategy of selling company resources</i>	<ul style="list-style-type: none"> • Technology purchase • Strategic alliance • Joint venture <i>Defensive cooperation strategy</i>

Graph 2. Commercialisation strategies depending on the competitiveness of own and complementary resources

Source: Own work based on: R. C. Megantz, *How to license technology*, Wiley, New York 1996, p. 4, D. M. Trzmielak, *Komercjalizacja wiedzy i technologii. Stymulanty i strategie*. Wydawnictwo Uniwersytetu Łódzkiego, Łódź 2013, p. 97.

Strong technological resources and weak accessibility to complementary resources lead to the need for cooperation with other companies in order to supplement, unite and strengthen resources. A high level of own technological resources gives a strong tender position when negotiating with other companies. Figueiredo et al. [2007] emphasised the importance of the will to cooperate and the division of risk due to the development and implementation of technology. Combining a company's resources brings a synergy effect which particularly strengthens the operations of the cooperating parties and may accelerate the implementation of a technology providing it is possible to transfer knowledge and access valuable resources of partners. Commercialisation of technology and its market launch may occur through joint ventures and licence sales.

Accessibility to complementary resources, when having weak technological resources, which manifest themselves through, for example, the lack of protection for intellectual property and the lack of competitiveness of the technology once on the market, calls for technology purchase, search for cooperation and setting up mutual ventures. Transfer of technologies mainly flows 'towards' companies.

A weakness of technological resources and significant barriers in resource acquisition when establishing cooperation with other companies will force an organisation to reconsider the validity of technology development and technology resource maintenance.

Following Hughes and Morgan [2007] and their proposal of strategy development planning and effective resource application, based on *Resource – Advantage Theory* (R-A: *theory, Resource-Advantage Theory*) we can define technological resources as ones which enable the extraction of key resources while building a commercialisation strategy, as well as resources that facilitate imitation and resources building the value of technology. According to this theory, technological resources that build a commercialising strategy include six areas:

1. Access to capital – for the development of new technologies;
2. Rapport with target market - communication with technological stakeholders, knowledge of alternative technologies and competition market;
3. Elements of structural resources, such as laboratories, equipment, intellectual property protection systems and implemented processes;

4. Human resources facilitating commercialisation, such as employee experience of commercialisation, skills in the development of technology, mobility, acceptance of routine and change;
5. Intellectual resources: knowledge, patents, utility models, trademarks, product marks and licenses;
6. Social resources: networking, culture of innovation and prestige.

The construction and selection of a commercialising strategy should be based on the heterogeneous nature of resources. High versatility facilitates the introduction of powerful strategies, low versatility however leads to defensive operations or abandoning the development of a technology [Trzmielak, 2013].

Commercialisation of research results based on the creation of spin offs

The commercial nature of research results and the process of setting up spin offs. The subject of one commercialisation, which was created at a Polish university, is based on many years of research on conducting substances, semi-conductors and insulators²³. Research into as low as nanometre and atomic magnification precision is a challenge for many scientists, both in Poland and across the World. Research concerning the achievement of atomic magnification led to the creation of software and electronic components facilitating the complete processing of recorded images. Commercialisation of research results, and measurement software systems were mainly focused on the implementation of devices for soft substance research, such as proteins, DNA, polymers, etc. without affecting their integrity. The target sectors of these research results are, for example, nanotechnology, electronics, material and biomedical engineering, along with medicine. All of these sectors have enjoyed dynamic growth over recent years which brings promising commercial potential for the research results, created software and devices. Market potential is created by the many parties requiring specialist measurements and image processing. The main buyers include: industrial laboratories, companies which are technologically advanced in scientific research in the biotechnological and medical sectors, universities, science institutes, testing stations for material resistance, biomaterial producers, laboratories of medical diagnostics which monitor biological processes at the monoparticle level

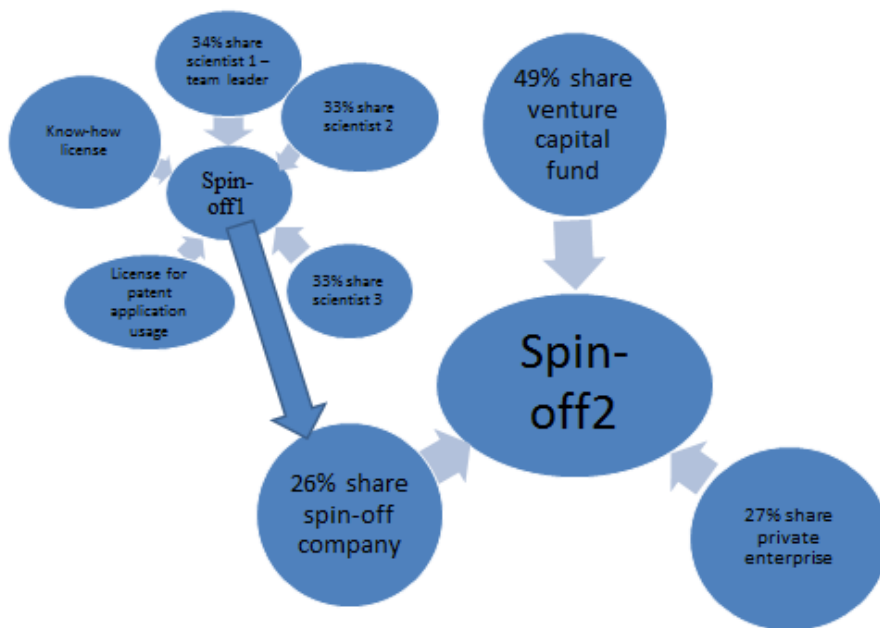
²³ Due to the fact that the companies have yet to be set up data on them, equity and scientist affiliation could not be provided. The reange of know-how and patent application have been altered in the case study in order to protect confidential information.

and pharmaceutical companies carrying out research on the impact of antibiotics, interactions of medication and bacteria, and DNA damage.

The research results produced at the university do not guarantee their immediate launch on the market, which stems from one crucial reason. The created prototype of the device was a laboratory prototype and it was necessary to prepare a market prototype which would be exhibited at fairs or presented directly to potential buyers. The timeline for the creation of a market prototype was estimated at one year. During this time it was necessary to improve the software, prepare electronic modules for serial production and militarisation of the laboratory equipment.

The scientists working on the prototype managed to attract the interest of an entrepreneur from the precision mechanics sector who possessed knowledge and devices indispensable for the production of a miniature version for researching soft substances without damaging their structure. The main problem in the implementation of this venture was its funding, from creation of the market prototype to its presentation to the final buyers and the opportunity to collect orders from institutions which carry out research into soft substances. Conversations between scientists and entrepreneurs were concluded with the idea of setting up a shareholding spin off company, which, along with the entrepreneur, will look for sources of capital until the moment of completion of the prototype and the market introduction of soft substance research devices. The intended spin off (limited liability) company is intended to be set up based on set up capital, know-how from the designing of the analogue and digital electronic system by three scientists as well as two university know-how licences on digital signal processing and the patent application for the Friction Force Microscope systems.

After a few weeks of searching and talks with the representatives of venture capital funds, there arose an interest from one wishing to join a mutual project which would set up a shareholder company for prototype preparation, distribution development, raising initial orders and sales of the devices for testing soft substances in the nanotechnology segment, material engineering, biomedicine and medicine. The structure of capital for the new spin off (spin-off 2) is presented in Graph 3. The new company is intended to consist of a venture capital share, precision mechanics company share and the whole share from spin-off 1. This new company had its targets set for two years, including: completion of market prototype within one year of the company's launch and production and sales in the second year of the device in an amount that would cover operational costs of the company for that year.



Graph 3. Constituents and shares of parties in planned or intended companies

Source: Own work.

Summary

Market commercialisation of research results produced by science and research centres requires foremost such resources as: results which catch the interest of the final receiver, research results which can be the basis for a technology or product, the demand for academic research results initiated by innovative companies, material resources, human resources, *know-how*, *patents or patent application* and the supply of financial resources. A company undertaking the task of commercialisation of research results should possess the above resources however they should be available via the market. Otherwise science and research organisations should change their field of research. The carrying out by a science and research organisation of research which does not enjoy market interest hampers further research funding and retaining personnel. Strong resources and excellent access to them allows the creation of spin-off companies and the introduction by these companies of a strategy of independent

implementation of a technology. Strong resources and low accessibility to complimentary resources or low technological resources and excellent access to resources, encourages cooperation and resource complementation strategy which is presented in the case study above.

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REGIONAL SPECIALISED OBSERVATORIES NETWORKS IN TECHNOLOGICAL DEVELOPMENT AND INNOVATION EXEMPLIFIED BY THE SILESIA VOIVODSHIP

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Abstract

The Regional Specialised Observatories Network is a systemic tool to encourage interdisciplinary cooperation between the key participants of the regional innovation system in order to build the competitive advantage of the region. The network responds to the region's requirements by creating a modern tool to monitor the effects of the pro-technological development of the region in particular areas of technology, established in the Technological Development Strategy (TDS) for the Silesian Voivodship for the years 2010-2020, which is a constituent of the Regional Innovation Strategy. The observatory network will concentrate on collecting and processing specialised knowledge in the areas of technology in accord with TDS, monitoring technological and economic trends and assessment of the endogenous technological potential of the Silesian Voivodship. The network's operation, through the link to the regional observatory as well as to national initiatives, will stimulate many forms of cooperation and contribute to the bonding of economic circles, innovators, science and research centres, the regional government and authorities responsible for drawing up and implementing development policy. The Regional Specialised Observatories Network is an open structure geared towards collecting, processing and publicising specialised knowledge, being a trustworthy source of data and information on technological areas in the region. The article presents the Network's impact on identifying challenges and technological trends in reference to the region's potential.

Key words: technological development and innovation, networking

Introduction

The growing interest in innovations and their impact on company and economy competitiveness, both on a regional and national level, has resulted in the necessity to create strategies favourable for the innovation

development of various areas, particularly in technology [Kosiedowski, 2001]. Such activities have resulted in attempts to define innovation policy not only in its general sense but also defining technological areas which may, with appropriate back up or selection, become crucial to the region's development. The shaping of such a policy demands up-to-date knowledge on the condition and developments in technological areas. Analysis of EU state's economies in the 1990s highlighted that innovations result from complex interdependencies and interactions between different actors and institutions [Wojnicka et al., 2006]. Technological changes do not follow a linear pattern but through feedback mechanisms within a particular integrated system with companies at its centre. The success and effectiveness of these processes are determined by the way they organise production and the innovations through which they gain external sources of knowledge and undertake multifaceted cooperation with R&D institutions through their research potential and knowledge resources [Klepka, 2005]. The instrument of shaping these benefit chains and knowledge building are the specialised observatories set up in Europe whose aim is to constantly monitor and assess activities in areas to identify technological trends that lead to competitive advantage.

The idea of creating this Regional Specialised Observatories Network is multipurpose for the development of both the region and the state. One can regard as most significant the identification and assessment of the endogenous potential of the region in the area of its technological advancement and innovation, which is created based on directly collected data from the companies and institutions engaged in the construction of this potential. The observatories' activity, as a constituent of the regional development strategy, concentrates on the search for and reinforcement of areas of advancement and development niches within 'smart specialisation' [OECD, 2012].

The importance of information resources in technological development and innovation

Within the last few years, information management systems (including collection and storage) has undergone constant evolution and change. This process depends on the operation of the global economic system which affects the development of management sciences and the manner in which competition is conducted. At present, information for a particular user is of far greater importance than information based on the full database. The development of technologies, particularly in IT, also plays a significant role thanks to which information is easily generated,

processed and spread. This context highlights the importance of gaining a competitive advantage by such sciences and activities as knowledge management, the intangible economy, innovation management and intellectual capital management. Gaining a competitive advantage based on information resources stems from a change in the way of thinking and the expectations of business people, clients as well as in scientific circles. Skilful management of information has become a challenge. The release of appropriate information and the collecting and processing of data has become the basis for strategic operations, not only within a particular organisation but also at local and regional levels [Mazur-Lukomska, 2006]. Specialised observatories are a response to contemporary expectations as well as a tool supporting the decision-making system at the level of voivodship, borough, institution and company management where the observatories' importance increases in relation to the size of the network. In the long run, it will be necessary to include the observatories into the region's strategic management system and to prove their impact on the authorities decisions on development policy in order to achieve consensus and build coalitions for ideas and solutions. This derives from the specific mission of the observatory as a scientific and analytical centre which, acting for the benefit of and through the funds of the voivodship board, should reinforce the region's competencies within the area of development policy and create a regional think-tank²⁴ [Woźniak, 2013]. The article presents the idea of building a specialised observatory network in order to monitor and assess the endogenous potential of the region. The work is the result of the experiences collected while creating and implementing this solution in the Silesian Voivodship.

Review of the existing specialised observatories

A review of solutions within selected specialised observatories, both within the country and abroad, has been conducted in order to identify the scope of activities, accessible information and data useful while running a specialised observatory. It has confirmed that the regional and sectoral observatories in Poland mainly utilise secondary statistical data, obtained by the Central Statistical Office (GUS) and relevant statistical offices and data collected on unemployment statistics taken from the district (PUP) and voivodship job centres (WUP). Only a few observatories conduct their own analysis based on the above mentioned data and research

²⁴ THINK-TANK a platform for exchanging experiences and opinion on effective management of a region , in this case regional innovation system management.

commissioned through specialised research institutions as well as data obtained from surveys and interviews. Wielkopolska Economic Observatory²⁵, run by SENCE Consulting Ltd. and TNS Pentor Poznan, serves as an example. The observatory conducts surveys with companies and CATI interviews with the inhabitants of the region. The observatory analysis the economic climate and its changes in a comprehensive manner. The scale of the research conducted enables the accurate presentation of results according to the level of each of the five Wielkopolska sub-regions: Poznański, Kaliski, Koniński, Pilski and Leszczyński.

Another observatory, Pomerania Economic Observatory²⁶, run by the Pomerania Development Agency in cooperation with a panel of scientists headed by Prof. Piotr Dominiak, conducts periodic surveys aimed at business people in small and small-medium sized companies in Pomerania. The scope of the observatory's activities covers the development dynamics and the competitiveness of companies as well as directing economic changes in the region.

While analysing the sources of information for the observatories, one must highlight the wide spectrum of institutions and data. They come from, among others, the IT System of Monitoring and Financial Control over Structural Funds and the Cohesion Fund (Lublin Economic Observatory), the National Polish Bank, (Wielkopolska Economic Observatory), SZPON database, presenting comprehensive information on culture (Culture Observatory). For environmental information, the data can be obtained from the Central or Voivodship Inspectorates for Environmental Protection, which operate in the monitoring and reporting of environmental quality.

The observatories also avail of data provided by research centres and a number of governmental institutions with which sub-regions (in the case of regional observatories) or international organisations (in the case of the Culture Observatory- ENCATC, TILLT, Creative Clash) cooperate, and from conferences, workshops and seminars, which are information exchange platforms. In the case of foreign widely accessible observatories, the source of data depends on the subject matter of the specialisation [Ekeland, Tomlinson, 2001]. JISC Technology Observatory²⁷ aims to classify reactions to expected trends and draws up future scenarios for using technologies in higher and further education in Great Britain. The

²⁵ www.obserwatorium.pl

²⁶ www.arp.gda.pl, www.ris-pomorskie.pg.gda.pl

²⁷ JISC ITT: JISC Technology Observatory www.jisc.ac.uk

observatory utilises data provided by, Deloitte, PA Consulting Group, Technology Review, FP7 Future Internet Projects. It analysis horizontal sides of technological changes and passes information on existing knowledge and experiences to interested parties. Significant emphasis is put on research in the area of accessible technologies and solutions in the IT sector in order to identify trends (technologies, standards and common practices). The users are research institutions or public companies and departments which follow the advancement of technology in the IT sector.

The European Commission's Joint Research Centre²⁸ observatory, run in cooperation with the European Commission Research Centre, the Institute for Prospective Technological Studies (JRC-IPTS), Directorate-General for Research and Innovation (DG-RTD) as well as in close cooperation with Directorate-General Enterprise and Industry (DG-ENTR), relies on data available on cordis.europa.eu covering European science, research and implementation projects such as FP7 or CIP-Innovation. The observatory's activities cover the collection and processing of information on the degree of research and innovation implementation, national, regional and European analysis of the state of the R&D sector, education and technological advancement as well as the implementation of research and development policy, coordination of scientific and technological operations including promotion of development and transfer of technologies. The Economic Complexity Observatory²⁹, run by a consortium of five organisations led by Technopolis Group, acquires trade data from the Robert Feenstra Centre for International Data and UN Comtrade, focussing on the analysis of the development and implementation of eco-innovative technologies.

Data sources in Europe may also be derived, apart from widely available databases comparing EU member states (EUROSTAT or OECD) or UN member states (The Database of International Statistical Activities-DISA), from specialised databases which are trustworthy sources of information on, amongst others, the international petroleum market and other energy sectors (International Energy Database), industry (UNIDO), environment (European Environment Agency) and health (WHO).

Analysis of the specialised observatories' functionality has led to the forming of the first guidelines for the Regional Specialised

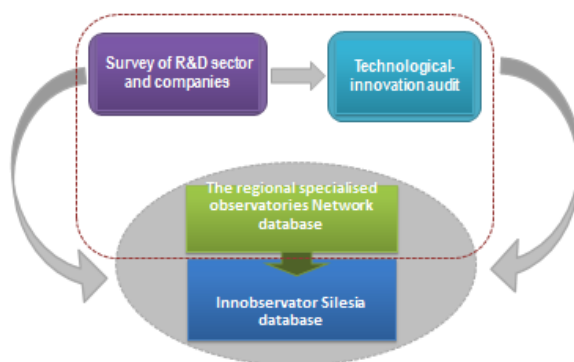
²⁸ European Commission's Joint Research Centre (JRC) ipts.jrc.ec.europa.eu

²⁹ Eco-Innovation Observatory www.eco-innovation.eu

Observatories Network in the Silesia Voivodship, which, as a result, will set up an effective and transparently constructed observatory, handling information on the level of implementation and advancement of technologies in the Silesia voivodship.

Regional Specialised Observatories Network exemplified by Silesia

The Regional Specialised Observatories Network in Silesia is implemented through Innobservator Silesia Platform and 'Management, implementation and monitoring of the Regional Innovation Strategy in the Silesia Voivodship' (3rd edition). The aim of the network is the development of the region's economic potential through improvements in the paths to competitive advantage based on cooperation and result exchange of the implemented Regional Innovation Strategy in Silesia Voivodship and Programme for Technological Development for the years 2010-2020 among the actors of the Regional Innovation System. The establishment and operations of observatories network are an integral part of the Network which is the answer to the region's needs as far as the creation of a modern tool to monitor the effects of the region's technological advancement in certain technological areas, especially those defined as smart specialisations. It is also possible to assess the validity of expenditure in the coming programming for 2014-2020. In the wider scope, observatories network will become a key element in the verifying and assessment of development policy implementation within the regional specialisations. The operations of observatories network will entail collecting and processing specialised knowledge on technological areas, monitoring technological and industrial trends and assessment of the endogenous technological potential of the Silesia Voivodship. Information collected and made accessible in the network will come from the extensive public statistics, questionnaires and technological audits of R&D sectors and companies run in order to contribute to the development of the Regional Specialised Observatories Network (Graph 1).

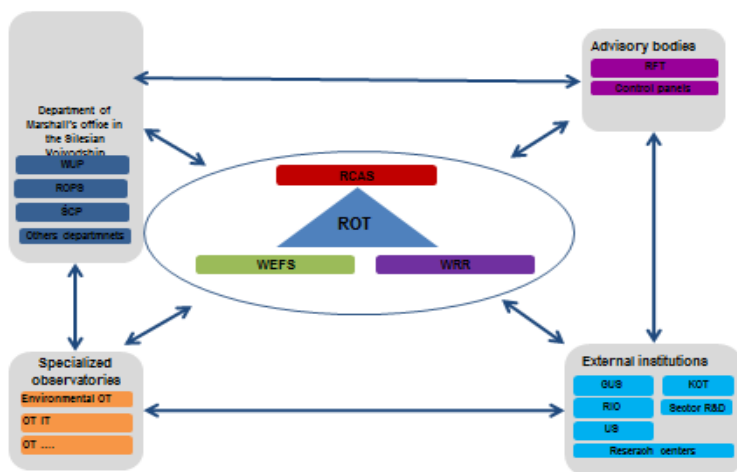


Graph. 1 Tools of technological development strategy for Silesia Voivodship for 2010-2020

Source: Own work.

Observatories, apart from their potential for commercial activity, will perform an important public function. This will entail the consolidation of strategic and reporting data, providing a number of services for the regional government, doing analysis which will flag up developmental opportunities and identify so called ‘weak signals’ which may lead to reorienting of support policy in a given area. The network’s operation, due to its link to the regional observatories as well as other national initiatives, will facilitate communication between economic circles, innovators, science and research centres, the regional government and authorities responsible for drawing up and implementing the development policy of the region, which at the same time will contribute to the development of a modern and competitive economy of the region. In Silesia Voivodship, the Regional Territorial Observatory, performs along with specialised observatories and other institutions supervised by the Silesian Voivodship Marshall’s Office, serving as a network of information exchange.

The Regional Centre for Strategic Analyses (RCSA) implementing The Development Strategy of the Silesia Voivodship ‘Śląskie 2020’ and being a coordinator of the Regional Territorial Observatory, along with the Marshall’s Office, sets the framework for the Regional Territorial Observatory, presented in Graph 2.



Graph 2 interconnections within the structure of the Regional Network of Information Exchange

Source: Handbook on regional specialised observatories network operations within Innobsvator Silesia platform.

The regional network of information exchange will include the Regional Specialised Observatories Network, which will contribute to the competitive advantage of the region, based on cooperation, and multiply the effects of The Regional Innovation System through:

- support and facilitation of the development management of the region in the areas of: regional scientific and technological potential, prioritising of key technological areas and assessment of the effectiveness of the Silesia Voivodship's regional pro-technological development policy and reinforcement of regional specialisation,
- reinforcement of the adaptation potential of the region, regional research service market and regional staff through building relations between the R&D sector, companies, institutions of business relations and the region's authorities,
- partnership in creating a regional network of knowledge and competencies verifying the selections of smart specialisations,
- greater transfer and commercialisation of knowledge.

In its final shape, the Regional Specialised Observatories Network will act as specialised observatories responding to the needs of the particular technological areas established in the Technological Development Strategy for 2010-2020. The suggested solution will include the stipulations for creating observatories for subject matters not covered by the Technological Development Strategy in order to ensure the source of information in the areas of regional specialisation. In Silesia Voivodship there are a number of institutions supervised by the Marshall's office such as: Voivodship Job Centre (WUP) and Regional Social Policy Observatory (ROPS), Silesian Entrepreneurial Centre (ŚCP) participating in The Regional Network of Information Exchange. The operations of the Regional Territorial Observatory also receives back up from the data resources of the National Territorial Observatory (KOT), Central Statistical Office (GUS), regional accounting chambers (RIO), State Treasury offices (US) and other institutions, including research centres. In its final shape, the regional network of information exchange, as a system of collecting and processing information for Silesia Voivodship, including the Regional Territorial Forum and Control Panels, will initiate key projects for the Silesia Voivodship such as the so called 'flag projects' and the Regional Specialised Observatories Network will become a tool for monitoring indexes comparing and assessing the effectiveness of the innovation support policy at a regional level.

Summary

The extension of the Regional Specialised Observatories Network through new, specialised observatories will contribute to the creation of an information system which will serve as a comprehensive source of data and information on technological information in the region and contribute to the development of the regional network of information exchange of the Silesia Voivodship, which is a strong support tool for the development of the economic potential of the region and its competitive advantage through cooperation. The collected specialised data, which are frequently more comprehensive than the data offered by the main statistical institutions (e.g. Central Statistical Office), facilitate a better and more comprehensive description of the endogenous potential of the region. The Regional Specialised Observatories Network adheres to evidence-based policy, providing conditions for in-depth diagnosis of the operation's effectiveness, including the effectiveness of instruments of grant support for the research, development and innovation sector, which is further verified by the assessment of quantified results. Evidence based

policy guides not only the development of the public administration but also affects the economy and science, building interdependencies in these areas. The implementation of a regional specialised observatories network will mainly affect the direction of public intervention aimed at translating its results into the growth of innovation and competitiveness of the regions, and, as a consequence, the whole of the country. Further development of the Regional Specialised Observatories Network, including the Regional Network of Information Exchange, will contribute to the initiation of key projects for the Silesia Voivodship and will also become a valuable source of knowledge for similar initiatives implemented nationally. Moreover, it will allow the region to assess the best direction and validity of expenditure in any new strategy.

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INNOVATION AND NEW TECHNOLOGIES

INNOVATION THROUGH INTERACTION

- THE CONCEPT OF OPEN INNOVATION IN THEORY AND IN PRACTICE

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Abstract

Open innovation is one of the most discussed topics connected to innovation, based not only on the search for new ideas and solutions but also on the emphasis for cooperation and the benefit of the diffusion of knowledge and dialogue. An innovative company should not construct an iron curtain separating it from the influence of the market and competition but participate in the exchange of ideas whether internal or external.

The concept of open innovation is the foundation of the above idea, meaning an innovation management strategy which benefits from both internal and external sources, the constant monitoring of the latest scientific achievements, investment in patents, competitor's licences and making unutilised research projects available to others.

This paper will show the characteristics and examples of the above strategy application, which prove that innovation processes, appropriately applied to market needs, may generate concrete benefits, both for worldwide corporations and small and medium-sized companies, as it is the consumer that significantly builds the market of innovations and therefore can be considered its co-constructor.

Key words: Open innovations

Introduction

"He who rejects change is the architect of decay." These words of Harold Wilson pinpoint the essence of innovation and its inevitability in the development process. Since the beginning of humanity innovation has been an inseparable factor of development, perceived as the drive for demand, stimulating economic growth and increasing a company's competitive advantage [Fagerberg, 2006; Wojnicka, 2003]. Innovative methods of production and supply were the basis of survival for social groups in a competitive environment, giving rise to social and industrial revolutions [Bruland & Mowery, 2006].

The World's economy is changing as we speak. Marketing strategies that were until recently perceived as beneficial, in the light of the crisis have become outdated. The change in our perception of innovation, as an interaction not only with other entrepreneurs but also among scientific

and consumer circles, is currently the challenge for entrepreneurs. Paradoxically, the crisis favours innovations, as entrepreneur's search for new solutions and cooperation methods. The aim of this paper is to present the model of innovation management- open innovations and their practical applications among not only the World players but also SMS's.

Innovation and innovation processes- theoretical background

I shall start the discussion on innovation by quoting a number of its definitions suggested by the classics on the subject. Joseph A. Schumpeter sees innovation as the introduction of new products or a new production method, the opening of a new market, accessing new sources of raw materials or, finally, the reorganisation of economic processes [Schumpeter, 1934]. However, P. F. Drucker determines innovation as a particular entrepreneurial tool by which a change is turned into an opportunity to commence new economic activity or provide a new service. He claims that innovation does not have to be technical, or even of a material nature [Drucker, 1992]. Following the definition suggested by the Main Statistical Office, an innovative activity is a sequence of activities of a scientific (research), organisational, technical, trade or financial nature, whose aim is to design and implement new or significantly improved products or processes. Moreover, the term innovation activity is inseparable from innovation which can be conducted by a company either internally or may involve the purchase of goods, services and knowledge from external sources [GUS, 2009].

Taking into account the above definitions, innovation should be regarded as a change conducted in order to obtain a new product, service or quality. What is more, we should not forget the fact that it is an integral part of a development and a drive by which we create, develop and introduce new products to the market and improve already existing solutions.

The literature on the subject of economics points to two main meanings of innovation- innovation as a product and innovation as a process [Cohen & Klepper 1996, Fagerberg 2006]. According to Schmookler's theory, the differentiation between these two terms is the key to understanding innovations. **Innovations perceived as a result** refer to the final selection of goods, services or ideas regarded by customers as new. However, **innovations treated as a process** refer to the creation and maturing of an idea, research and development and design activities, production, marketing and propagation and therefore innovation diffusion. The concluding element of the multi-faceted innovation process is product,

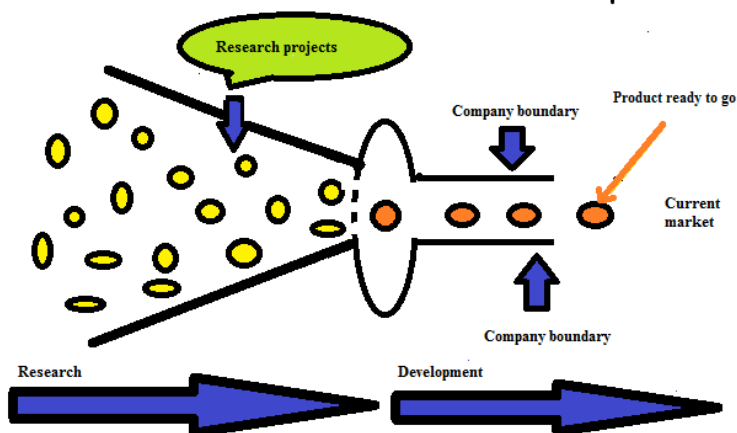
technological, organisational or social change [Inauen & Schenker-Wicki, 2011]. Andrzej H. Jasiński presents, in a visual manner, the essence of the innovative process as a two-legged body whose one foot stands in the research and development zone while the other stands in the production zone [Piekut, 2011].

Furthermore, the theory and literature on the subject includes two competing definitions of the innovation process: That of J. A. Schumpeter's supply definition and P. F. Drucker's demand definition. From the point of view of supply, the innovation process consists of a sequence of events: creation (idea), innovation (invention) and diffusion (propagation). The process occurs as if independent of the industrial process and it is necessary to find an entrepreneur to apply the innovation in the production process. However, from a demand point of view, the innovation process is a sequence of undertaken events guided by market processes which gives the foundation for innovation implementation, allowing an entrepreneur to gain a competitive advantage. Diffusion of innovation is a key element in the innovation process, without which innovation would make no economic sense. The Oslo Manual defines innovation as the propagation of innovations through market and non-market channels starting from its initial implementation anywhere in the World, as well as being the manner in which innovations are propagated through market and non-market channels, from the moment of product implementation to contact with the consumer. Knowledge of diffusion mechanisms and their effectiveness is a valuable tool in the hands of managers, as without it, it would be difficult to determine that a new product has been successfully introduced to the market. The main objective of diffusion is to make an innovation accepted by the highest number of purchasers, which is why the success of the innovation diffusion process, namely a positive acceptance by the market, determines the success of the whole venture [Klincewicz, 2011]. Thus, it shows that each link in the process of innovation implementation and the necessity to skilfully manage an innovation from the idea stage to implementation, play a crucial role in the innovation's success [Antoszkiewicz, 2008].

Evolution of an innovation process

The 20th century was dominated by the closed model of innovation strategy (Graph 1), in which the innovation process occurred within a company and was based on the conviction that innovations required monitoring which entailed a strict protection of intellectual property and the close guarding of trade secrets. By this we can understand that both R&D

activities and marketing were carried out within a company utilising their own resources only [Kozłowski, 2008].

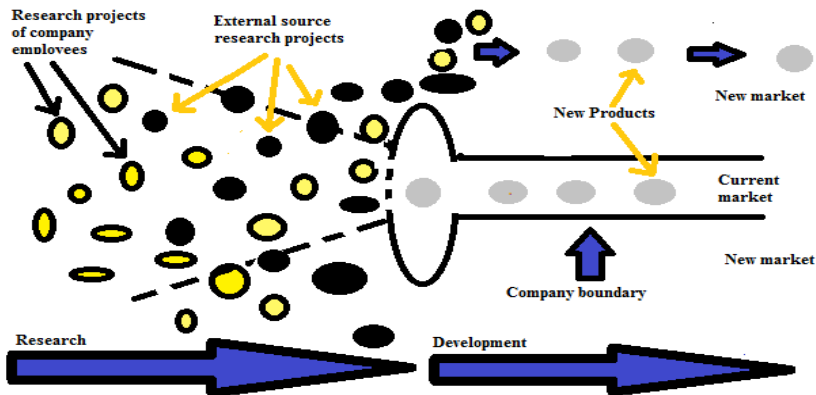


Graph 1. Model of the closed innovation process

Source: Own work based on: Henry W. Chesbrough, *Open Innovation. The New Imperative for Creating and Profiting from Technology*, Harvard Business School Press, Boston, 2003.

This traditional approach becomes less important when confronted with the growing mobility of employees, who transfer previously gained knowledge and experience to a new workplace. The research conducted by the consulting company Booz Allen Hamilton in companies across a variety of sectors points to the fact that there is no correlation between expenditure on R&D and successfully completed innovations [Mierzejewska, 2008].

Socio-economic changes and widespread access to information contributed to the change in the perception of innovations. The market was gradually saturated as the competition grew, therefore demand models of innovations appeared which focussed on consumer preference, determining the market success of a product. Slowly, innovation became the answer to the market expectations. Currently, innovation processes combine in one model both demand and supply factors, thanks to which, the demands of the market are compatible with the technological capabilities of a company [Rothwell, Zegvelt, 1982]. The most advanced model of innovation management is the concept of open innovation (Graph 2) presented in 2003 by Professor Henry Chesbrough, executive director of the Centre for Open Innovation at the University of Berkley.



Graph 2. Model of open innovation process

Source: Own work based on: Henry W. Chesbrough, *Open Innovation. The New Imperative for Creating and Profiting from Technology*, Harvard Business School Press, Boston, 2003.

The concept of open innovation

Open innovation is a paradigm which assumes that firms can and should use external ideas as well as internal ones starting from the research stage of the innovation process and finishing with the commercialisation of the product. It is necessary to constantly monitor the latest scientific achievements, invest in patents or licences from competitors and make a company's own unutilised solutions available, according to the concept- "not all specialists work for us" [Chesbrough, 2003]. The above business model utilises both internal ideas and external paths to acquire innovative solutions without the fear that taking the project outside a company's boundary will curtail profitability. In the closed business model, projects which were rejected by the company at their initial stage, frequently did not get a second chance to be implemented.

According to the comparison below, (Table 1), one of the basic difference between closed and open innovation models is the approach towards cooperation with specialists. The first model focuses on the employment of the most renowned specialists, whereas the latter accentuates the value of accessing knowledge from external sources. Thanks to the fact that projects can be utilised by various organisations, the opportunity for a higher number of ideas to be implemented is opened up. The concept of open innovation places emphasis on the advantage of business model effectiveness over the priority of product introduction to the market. Instead of strict monitoring and closing of an innovation

process, the above concept suggests benefitting from open access to ideas through solution acquisition from external sources and disposing of a company's own unutilised ideas [Andrejczuk, 2013].

Table 1. Comparison of closed and open innovation principles

PRINCIPLES OF CLOSED INNOVATION	PRINCIPLES OF OPEN INNOVATION
Employment of renowned specialists in their field.	Establishment of cooperation including with specialists in a given field from outside the company.
In order for R&D to be beneficial an innovative process has to be worked on from start to finish through our own means.	External ideas and solutions are utilised in a company, which, through research, contribute to added value.
In order to achieve success a product must be launched on the market before competitors.	Launching a product on the market before competitors does not necessarily guarantee success. A business model is of far greater importance than leading the way
Our aim is to introduce the highest number of best products.	If we use both internal and external research and ideas we will succeed.
We closely guard our intellectual property from competitors' access.	Intellectual property rights are a company's assets. We acquire new external ideas and sell our own unutilised ones.

Source: H. W. Chesbrough, *Open innovation*, Harvard Business School Press, Boston, Massachusetts 2001, p. XXVI.

The crucial element of open innovation is the previously mentioned commercialisation of intellectual property rights. The main aim of patent protection is protection of the idea against its illegal application, however, Professor Chesbrough gives it an added role recognising the subject of patent protection as a company asset. He does not perceive patents as a barrier but as a product of trade between entrepreneurs, particularly when they do not possess their own laboratories or scientific personnel [Chesbrough 2003].

Open innovation in practice

The above method was successfully implemented by one major international company, Procter and Gamble, which, in 1999, decided to shift

from a closed business strategy to open innovation [Sakkab, 2002]. Despite the fact that the P&G team consists of 8,600 researchers, there are still 1.5 million specialists beyond the company's boundaries who it would be worthwhile establishing cooperation with. A new post was created, external innovation manager, whose target was to produce 50% of the new products within 5 years drawing upon external ideas- by 2000 the rate stood at 10% [Kozłowski, 2008]. Thanks to the implemented changes, one of P&G's best sellers, an electrical toothbrush, was produced according to the design of four businessmen from Cleveland Ohio, based on the research results conducted by P&G. Moreover, following the firms open innovation policy, projects created within the company (but not implemented) are openly accessible even to its direct competitors [Sakkab, 2002]. Other successful examples of open innovation strategy are the activities of Boeing and IBM which set up departments responsible for the commercialisation of intellectual property, making it a source of income. Thanks to the above operations, IBM has become the biggest World patent owner in the biotechnology sector [Gassmann, 2006].

Following their own slogan advertising the InnoCentive platform, *'A breakthrough idea may come from anywhere in the World'*, this internet portal has become an innovation platform attracting entrepreneurs, non-governmental organisations and state institutions. Companies looking for innovations within their sector avail of this service by placing their offers there, which, apart from a detailed description of a problem, include information of the financial rewards which will be given for the most interesting solution. In this way, the Internet has become a platform for innovative solution exchange and a tool for the entrepreneur to establish cooperation with specialists from across the World. InnoCentive is an opportunity for smaller companies, as the advice of the registered specialists will help them to be not only a step ahead of their competitors but also to find ever better solutions [Garski, 2010].

The Philips Group Corporation is yet another successful example of open innovation strategy. Nowadays, when almost everyone owns a HDTV, very few people remember that the first HDTV device was created by Philips in the 1980s. However, the project was a success only after the establishment of cooperation with companies producing HD cameras and those that could ensure high resolution transmission. Therefore Phillips, concentrating on its own innovation, lost 2.5 billion dollars as it failed to create cooperation with companies which could facilitate a wide application of HD technology [Adner, 2012]. Having learnt their lesson, the Phillips Group Corporation built an R&D centre in Eindhoven which was

transformed into an innovation and business centre where 80 start-up companies, academic institutions, consultants and investors cooperate with a group of 8,000 employees on innovative technologies. While R&D expenditure remained unchanged, the number of patents registered doubled [Viskari, 2007]. The campus offers state-of-the-art infrastructure that facilitates the creation and exchange of ideas. The cooperation between Phillips' employees and industrial design architects has resulted in the creation of light installations based on the latest OLED technologies. This is how an original light illumination was created, commissioned by Aston Martin One-77, according to the project by Jason Bruge Studio utilising the light solutions of Philips Lumiblade OLED [Lombardi, Harris, 2012].

Consumer as a co-builder of innovation

According to the report *The Future of Innovation Management: The Next 10 Years* by the consulting company Arthur D. Little, understanding users' expectations is the most valuable capital nowadays. An in-depth understanding of customers' needs still remains the most crucial area for innovation investment. Innovation through customer interaction means not only spending huge sums on market research but also listening to clients' needs and adjusting products accordingly. Open innovation changes the entrepreneur's approach towards their customers, who become not only a recipient of a product or service but are also a significant element of the adaptation process. Entrepreneurs have a natural advantage in this as share capital is information coming from clients. Apple drew on this knowledge in a brilliant way combining new technologies and product aesthetics, which proves that success is measured not only through product launch but also customer enticement [Peppers, M. Rogers, 2006].

The example that shows the necessity of an open outlook on the innovation process with a special emphasis on the customer is Motorola, which faced a waning importance on the mobile phone market. Despite its great success in introducing the first slimline phone in 2004, Motorola's market share fell as it did not offer any new innovative products. According to the theory of Henry Chesbrough, Motorola's weakness lay in its focus on just the product in their outlook on the innovation process. Motorola, in their strive to offer new innovative products, overlooked customer experience with its current range and their desire for a greater range of services, which mobile phone users had come to expect [Wojnicka, 2011].

Chesbrough claims that cooperation with consumers can strengthen a business model, draw the attention of technology designers to

the practical application of a product and reinforce customer emotional product attachment. Making customers and users co-builders of innovations allows us to eliminate the weak points of a concept, which can be updated by ready solutions coming from customers.

Summary

Innovation through interaction is the basis of open innovation, focussed on a dialogue with entrepreneurs, consumers and even competitors. The methods of cooperation are multifarious, as it is the entrepreneur who decides which elements of the innovation process should be made available to others and which elements should be acquired from external sources. Skilful management of intellectual property protection rights becomes a crucial aspect when implementing projects. However, the benefits of open innovation include the rapid expansion of the new product market, lowering access costs to technologies while having the possibility of benefitting from frozen assets (e.g. patents).

Entrepreneurs face the challenge of creating and implementing a coherent business model based on communication which would entail a free exchange of ideas. It is impossible to establish competitive innovation without a creative business strategy. Opening a company up to cooperation and not drawing only from internal sources is key to building a company's competitive advantage. In the face of structural changes in the World economy, survival is ensured only for those companies geared towards operation in a state of permanent change. Innovation occurs where an idea occurs, however business and economic growth occurs where it can be successfully launched on the market. You cannot be competitive when lacking creativity and intelligent development cannot exist without a creative economy.

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INNOVATIVE ENVIRONMENT FOR BUSINESS DEVELOPMENT

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Abstract

Innovativeness is one of the main determinants for a company's development and when searching for the correlation between innovativeness and development one needs to apply quantitative measures. This work includes a model for a company's assessment in its technology and environment innovative aspects. The concept of quantitative assessment of environment is presented through determining innovation structure and coming up with a general innovation index. It is an important element in creating a diagnostic tool to be applied in the area of innovativeness and development interdependences.

Key words: Technological innovativeness, innovative environment

Introduction

European Union policy confirms the key role of innovativeness in developmental processes. *'The strategy for smart and balanced development ensuring social inclusion'* within *Europe 2020 Strategy*, among other targets, highlights intelligent development through economic growth based on knowledge and innovation. In order to implement this strategy, the European Commission put forward flagship initiatives which include:

'Innovation Union' – a project to improve framework conditions and access to research and innovation funds, in order to turn innovative ideas into new products and services, which, as a consequence, will contribute to economic growth and boosting employment. [Strategy, 2010]

The terms innovation, innovative company and innovativeness are therefore regarded as synonymous for development, hence the justification for operations which will result in the effective application of innovativeness in a company's development process.

Innovativeness and a company's development

Applying the rule that a company's innovativeness is a factor that ensures its development, allows one to conclude (applying Zeroth-order logic) and present the correlation between innovativeness and a company's development. Introducing the symbols (R, W, F) and ascribing them simple sentences:

- Rule (R) – A company’s innovativeness is a factor in ensuring its development,
- Condition (W) – Researched company is innovative,
- Facts (F) – Researched company is developing,

We can, using connectives of conjunction and implication create three complex sentences corresponding to three types of logic:

- Deductive logic (concluding):

$$(R \wedge W) \rightarrow F$$

“If a company’s innovativeness is a factor ensuring its development and the researched company is innovative then the researched company is developing.”

The truth function of premises (R and W) guarantees the truth function of conclusion (F).

- Inductive logic (concluding):

$$(W \wedge F) \rightarrow R$$

“If the researched company is innovative and is developing then the company’s innovativeness is the factor which determines its development.”

The truth function of premises (W and F) does not guarantee the truth function of conclusion (R). A company’s development is a fact possible to confirm unequivocally. Nevertheless, other innovative premises in a company’s development may also occur. Thanks to the observation and research of a large number of companies it is possible to prove the validity of the implication pointed out by the inductive reasoning and may also validate the hypothesis that a company’s innovativeness is a factor ensuring its development.

- Abductive logic (concluding) [Urbański, 2009]:

$$(F \wedge R) \rightarrow W$$

“If the researched company is developing and its innovativeness is a factor in ensuring its development then the observed company is innovative.”

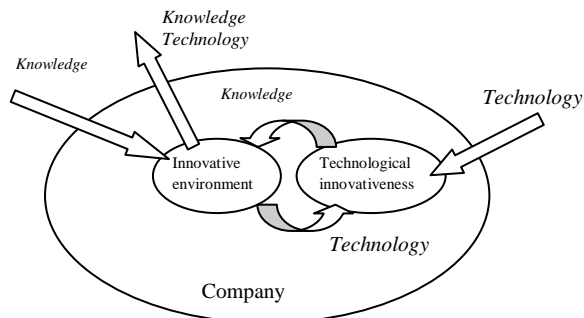
The truth function of premises (F and R) does not also guarantee the truth function of conclusion (W). Similarly to the above case, a company’s development is a fact that can be unequivocally confirmed. However, there can be other premises apart from innovativeness in a company’s development. Showing through observations and research conducted on a large number of companies the truth function of implications pointed out by the abductive logic, may validate the hypothesis that a company’s innovativeness is the main factor ensuring its development. Presenting the interpretation of the abductive conclusion

results in this different form, one may assert that it is difficult to find a company that is developing without being innovative.

The empirical research into the truth functions of indicated types of logic requires the application of a company's development and innovative measures. In the case of development, such measures are well known and commonplace, for example a wide range of growth measures [Motyka, 2011]. However, currently applied, mainly bi-state, innovation measures [for example, statistical research, research according to OSLO Handbook], while useful in other cases, here appear insufficient. Therefore, there are justified attempts to extend the range of a company's innovation assessment methods, applying multi-state or continuous measures which will contribute to the creation of a diagnostic tool applied in the area of innovativeness and development interdependencies.

Types of innovative activities in a company

The main aim of a company's operations is to sell its goods and services. This generates revenue, which is indicated as the main goal in the classic model or increasing a company's market value, which is its aim according to the modern theory of company development. In a company, one can perceive innovativeness as directly linked to products and their manufacturing techniques as well as manufacturing techniques in the process of service implementation [Jasiński, 2008; Matusiak 2008]. This is technological innovativeness which considers product features as well as the features of manufacturing techniques [Zehner, 2008]. The remaining company operations and features create the innovative environment [System..., 2011]. Graph 1 shows the position of technological innovativeness and the innovative environment within a company.



Graph 1. Division of innovative activities in a company

Source: Own work.

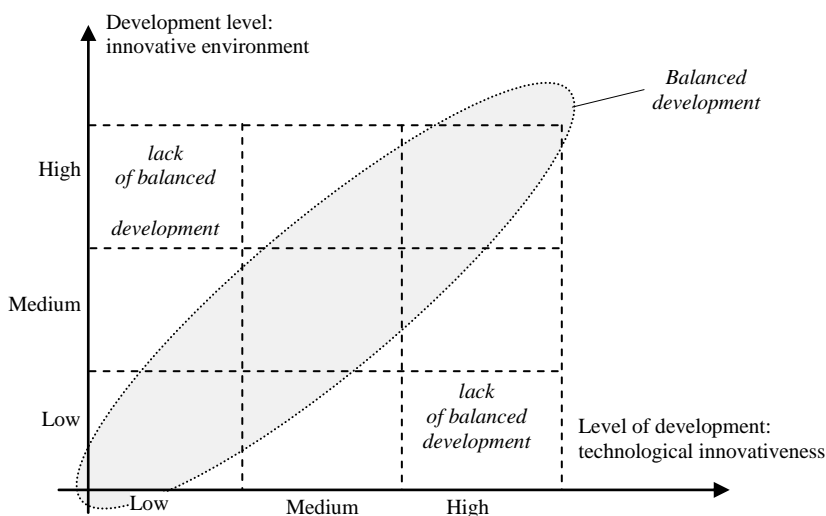
An innovative environment boosts technological innovativeness through the implementation of new technologies (products or manufacturing methods). At the same time, an innovative environment draws from technological innovation knowledge, which stimulates its development. Technological innovativeness is also empowered externally, through new technologies acquisition. An innovative environment draws from outside, ensuring its development but it can also transmit (sell) knowledge or technologies to the outside world [Frąckowiak, 2004].

For example, an innovation which is protected by a patent was created in an innovative environment as a result of research conducted. This is an element of innovative environment development; however it does not impact the revenue or increase a company's value [Mard, 2000; Hitchner, Mard, 2003]. The commercialisation of this innovation, namely boosting technological innovativeness or external sales will affect the revenue or increase a company's value [Trzmielak, 2013]. Another example is the purchase by a company of technologies (machinery, product manufacturing methods), which boosts technological innovativeness [Klincewicz, 2001]. Understanding of the purchased new technology empowers with knowledge the innovative environment, thereby stimulating its development. The cooperation between companies and the scientific personnel of universities may serve as an example of knowledge transfer from outside a company towards an innovative environment [Hsu, et al., 2008].

An innovative environment and a company's technological innovativeness occur at different developmental levels, which may be presented using a state-transition matrix (Graph 2) [Kaczmarska, 2009; Kaczmarska, 2010; Kaczmarska, Gierulski, 2012]. In the matrix, the company is represented by the coordinates of a point corresponding to the development level of technological innovativeness and the innovative environment. The location of the point on the matrix surface requires the establishment of continuous measures for both coordinates³⁰.

In the matrix of innovative states one can point to three areas in which development levels of technological innovativeness and the innovative environment are balanced, and the remaining parts of the matrix are the areas of domination or the lack of balanced development.

³⁰ In the case of technological innovativeness such measures were suggested in the works of: [Gierulski et al., 2013; Gierulski, Kaczmarska, 2013].



Graph 2. Company innovativeness states matrix

Source: Own work.

The above matrix may serve as a basis for the construction of a diagnostic tool of the current innovative state of a company along with an indication of the operation directions which foster beneficial changes.

Innovative environment structure

Innovative environment structure shows the layout of innovative activities arranged according to the degree of innovation. In place of the frequently applied bi-state assessment – innovative or non-innovative environment – a discrete multi-state scale has been applied. An operation division into two classes has been introduced: conservative operations and innovative operations. Each class is split into three areas, depending on the intensity of the assessed feature. This has given rise to the creation of six zones (as in [Gierulski et al., 2013; Gierulski, Kaczmarska, 2013]) connected to the ascribed level of their innovation (Table 1.).

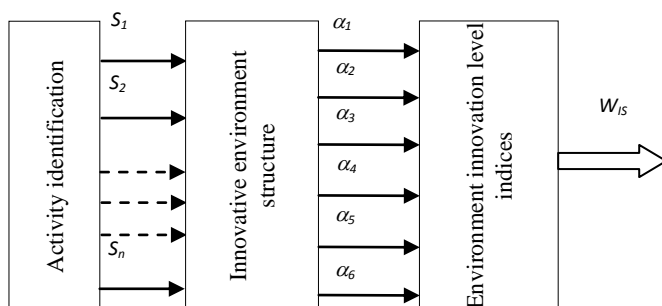
Table 1. Zone of innovative environment level

No. zone	Environment class	Innovative level zones	
		Operations	Measure
1	Conservative	Definite conservative	α_1
2		Medium conservative	α_2
3		Moderate conservative	α_3
4	Innovative	Moderate innovative	α_4
5		Medium innovative	α_5
6		Definite innovative	α_6

Source: Own work based on [Gierulski et al. 2013].

Innovation level assessment must be ascribed to one of the six zones. The first zone includes definite conservative operations within the innovative environment. Innovation features here are almost non-existent or invisible. The innovative features in further zones become ever more intense, up to the sixth zone where it is definitely dominant.

The research into innovative environment structure is conducted in two stages (Graph 3.). The first identifies activities ($S_1...S_n$) and ascribes them to the innovation level zones. The second determines the values of innovation structure coefficient α (Table 1.), which are the measure of participation of the zone activities in an innovative environment, expressed in percent.

**Graph 3. Research into innovative environment structure**

Source: Own work.

Based on the indicated values of structure coefficients, α is calculated as a value of the general index of environment innovativeness (W_{IS}), as a function of implemented operations in that environment.

$$W_{IS} = f(\alpha_1 \dots \alpha_6)$$

$$\alpha_k = f(S_1 \dots S_n)$$

where: $k = 1 \dots 6$, n – the number of identified activities within an innovative environment.

The index can be calculated applying the centre of gravity method with weighted coefficients

[Kaczmarska, Gierulski, 2012]. The role of the weighted coefficients is to strengthen the activities at the higher innovation levels in the overall environment assessment. In accordance with this method for the linear weighted coefficient, the general innovation index of the environment is calculated following the formula:

$$W_{IS} = \frac{\sum_{k=1}^6 k \cdot (k \cdot \alpha_k)}{\sum_{k=1}^6 (k \cdot \alpha_k)}$$

where: $k = 1 \dots 6$ – number of innovation level interval

α_k – coefficient values of innovative environment structure.

The lowest value of the general innovation index calculated in such a manner equals 1 and the highest stands at 6. It is a closed interval $\langle 1; 6 \rangle$ with the extension equalling 5. The location within the interval denotes the percentage index calculated according to the following correlation:

$$W_{IS}^{\%} = \frac{W_{IS} - 1}{5} \cdot 100\%$$

The general innovation index of the environment is a one-parameter overall assessment established based on the structure determined by coefficient α .

Measurement methodology

The information on the innovative environment is collected though the interview method using a special research form. The form includes each innovation zone to which five activities are attached, including one that is undetermined and is linked to the specifics of the researched company. The assessment employs Likert Scale (0, 1, 2, 3, 4, 5), which determines the intensity of activities. Data gained in such a manner is sufficient to determine the structure of the innovative environment and calculate the general innovation index.

Research form data for each innovation zone provide five number values that denote the intensity of individual activities. Expressing this data as coefficients:

$$\vartheta_{k,i} \quad k = 1 \dots 6, \quad i = 1 \dots 5$$

Where: k – numerator of innovation zones,

i – numerator of activities in zones

The received data can be presented in a matrix of innovation level coefficients:

$$[\vartheta]_{6,5} = \begin{bmatrix} \vartheta_{1,1} & \vartheta_{1,2} & \vartheta_{1,3} & \vartheta_{1,4} & \vartheta_{1,5} \\ \vartheta_{2,1} & \vartheta_{2,2} & \vartheta_{2,3} & \vartheta_{2,4} & \vartheta_{2,5} \\ \dots & \dots & \dots & \dots & \dots \\ \vartheta_{6,1} & \vartheta_{6,2} & \vartheta_{6,3} & \vartheta_{6,4} & \vartheta_{6,5} \end{bmatrix}$$

Two column matrixes have been introduced in order to perform calculations:

$$[V]_{5,1} = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix} \quad [J]_{6,1} = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

Innovation structure can be determined using absolute and relative measures. Company innovation structure is determined applying absolute measure by coefficients α^* which take the values from the interval $\langle 0;20 \rangle$. The matrix of coefficients denotes the following correlation:

$$[\alpha^*]_{6,1} = [\vartheta]_{6,5} \cdot [V]_{5,1}$$

Relative measure shows percentage of activities in individual innovation zones applying normalised correlation coefficients α .

$$[\alpha]_{6,1} = \frac{[\alpha^*]_{6,1}}{[\alpha^*]_{1,6}^T \cdot [J]_{6,1}} 100\%$$

Coefficients α allow the calculation of the value of the general innovation index of the environment in the above presented manner.

Examples of analysis results

Two companies were the subject of the analysis for which the values of structure coefficients were determined on the basis of available knowledge on the products, applied manufacturing methods, and other company operations.

Company P1 – a medium-sized iron foundry which specialises in sewage goods. It also offers non-standard mouldings utilised in the machinery building industry. Their products undergo a resistance test ($\alpha_6 = 0.2$). The company's own team of constructors cooperate with scientific centres which facilitates moulding processes computer simulations ($\alpha_5 = 0.2$). Modern automatic moulding flasks, castings, moulds, cleaning and painting lines are implemented. Moreover, they run training on production automation, drawing from the experiences of other iron foundries. The production relies on the process approach ($\alpha_4 = 0.3$). Cast iron stoves feature air intake systems with dedusting devices. The plant also produces basic goods using traditional methods. The foundry introduced a quality management system that adheres to ISO 9000 ($\alpha_3 = 0.1$) and runs basic health and safety training ($\alpha_1 = 0.1$). Traditional IT systems ($\alpha_2 = 0.1$) are applied in management.

Company P2 – from the chemical sector, produces flexographic paints (utilised in printing) and cardboard, paper and wood glues. A section of production focuses on traditional products. There is a possibility to modify products to meet customer requirements. The eco-aspect in paint production ($\alpha_3 = 0.3$) is taken into account. The company is attempting to launch cutting edge products in the area of flexographic paints through cooperation with external laboratories ($\alpha_5 = 0.1$). Transfer of technologies ($\alpha_4 = 0.1$) also takes place. The company runs basic health and safety training and applies a traditional quality control system ($\alpha_1 = 0.2$). Quality mismanagement occurs at the level of basic training. The structure of the company is functional and the IT management support systems traditional ($\alpha_2 = 0.3$).

Table 2. shows the data and the analysis results for the examples of P1 and P2. The results in graphic form are shown in Graph 4.

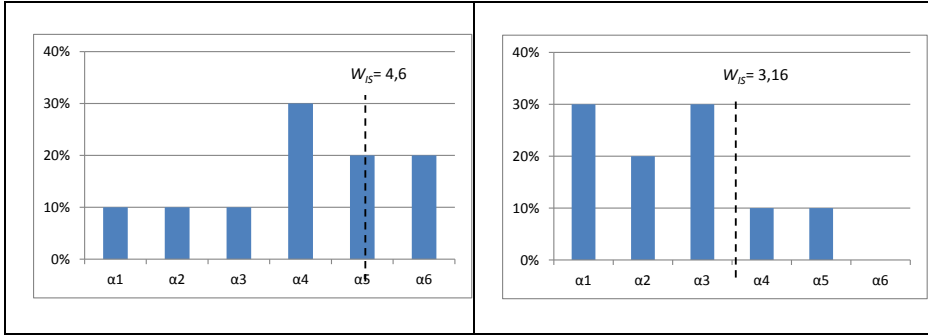
Most of company P1's activities are considered innovative ($\alpha_4, \alpha_5, \alpha_6$), the conservative operations occur to a lesser degree, which is reflected in the low values of coefficients $\alpha_1, \alpha_2, \alpha_3$. The general innovation index for the environment stands at 4,6, which gives the value of 72%. This is a significant index value, which proves the high level of environment innovativeness. Unlike in company P2, where the majority of actions are of a conservative nature. The general innovation index stands at 3,16 which

is 43,2%. Such results point to the medium level of innovative environment in this company.

Table 2. Examples of data and results

Company	Coefficients of structure						Indices	
	α_1	α_2	α_3	α_4	α_5	α_6	W_{IS}	$W_{IS}\%$
P1	0.1	0.1	0.1	0.3	0.2	0.2	4.6	72%
P2	0.3	0.2	0.3	0.1	0.1	0	3.16	43.2%

Source: Own work.



Graph 4. Companies P1 and P2 environment innovation structure.

Source: Own work

Conclusions

According to statistical data, the dynamics of E.U. development as a whole is in decline, which is linked to the drop in the pace of innovation growth. Therefore, it is necessary to investigate the reasons for this negative trend, which may provide tools facilitating development activities. Based on a quantative approach applied in quality management (Six Sigma), according to which, measurement is the basis for assessment, it seems valid to come up with a methodology for measuring a company’s innovativeness in the aspect of its development. The methodology presented in this work adheres to this view. The quantative continuous measures in two complimentary areas: technological innovativeness and the innovativeness of the environment, constitute a solid foundation for the creation of a diagnostic tool which will enable the indication of individualised actions for boosting development.

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NEW TECHNOLOGIES AND PROCUREMENT AND NEGOTIATION PROCESS SUPPORT

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Abstract

The aim of this work is to present innovative IT solutions which can be widely applied in the area of procurement processes and accompanying negotiations, thereby contributing to the assessment of their practical applicability. Particular attention has been placed on Ariba Networks, a platform for procurement management.

This work sources the latest literature in this field as well as research conducted in one of the largest worldwide companies operating in the Polish market of fast moving consumable goods.

Key words: New technologies, negotiation.

Introduction

Globalisation and the internet are the two factors which most affect a company's current environment. Opening up to the World, forced all participants of market processes to search for new tools to facilitate efficient operations on the international arena, boosting their flexibility and adaptability. The processes of the internationalisation of a company manifests itself in the expansion of operations in foreign markets, which means the far-flung branches of a company need to cooperate with each other and be constantly monitored, in 3 areas particularly: purchasing, sales and cost management. Unfortunately, some of the above mentioned areas are still not recognised as ones where using the internet and IT technologies could contribute to facilitating business processes.

This is particularly the case in the purchasing process, especially negotiation, which is IT innovation resistant. The main reason for this is the unwillingness to introduce change due to a lack of experience in the utilisation of new IT technology and an incapability to see the big picture of the negotiation process, which should consider, apart from sociological and psychological analyses, analysis of the effectiveness of a variety of solutions and the final selection of business partners. One obviously cannot exclude the influence here of deeply-rooted attitudes and a stereotypical perception of negotiations through direct communication – 'face-to-face'. It is generally believed that only this form allows the exchange of verbalised thoughts, ideas, knowledge and information as well

as enabling the message 'beyond words' in the form of non-verbal signals. Therefore, managers are reluctant to use tools unfamiliar to them and are not fully aware of their practicable applicability. One may here risk the statement that these are the main reasons for modern interactive communication models [Drzazga, 2006] or electronic transactional systems not being applied despite their value being indisputable, as these innovations ensure not only instant feedback and rapid information exchange between partners in real time, across geographical, political and social borders (which speeds up the decision making process) but also boost the effectiveness of the purchasing and negotiation process.

The internet as an indicator of new business conduct

Using the internet in order to search for market information on supply and sales sources, market gaps, identify the needs and expectations of a range of market segments, effective ways of influencing purchasing decisions, etc., are the sine qua non conditions in the current economic climate. The introduction of modern IT technologies actually broadens a company's operational borders and allows closer ties between companies in real time without middle men, which results in a significant reduction of costs and an increase in customer satisfaction [McKenna, 1997]. The continued blurring of the traditional hierarchal structure of operations (companies participate in various communities for the benefit of mutual ventures and initiatives), enables cooperation based on negotiation. The widening of negotiation options is accompanied by the simplification of transactions with clients. Furthermore, fast access to information and its exchange gives a new dimension to the relationship between companies, enhancing knowledge on distribution processes, needs and servicing of customers [Callation, Nemec, 1999]. It also adds a new aspect to standards of managerial conduct [Lewicki, et. al., 2012] in reference to clients, despite the belief from the early 1990s that the new IT technologies would not significantly impact the work of management [Gregor, Stawiszyński, 2002].

New IT and communication technologies enable mass individualisation of offers, which can undoubtedly be regarded as another factor affecting managerial decision processes. The ease with which one may now ask a particular person for his/her preferences allows not only the adjustment of the offer but to a greater degree gain a partner's trust, and perhaps loyalty. The possibility of creating a new database which registers individual actions, becomes the foundation for customised offers. The ability to gain a wide range of information, particularly about business

partners, allows the creation of negotiation infrastructure [Ertel, 2005], defined as a kind of 'database' supporting managers while negotiating with clients. The internet is also particularly useful as a source of information which can be regarded as a significant advantage, particularly at the pre-negotiation stage. More and more often a company's internet site includes information on company operations, its missions, management and contracts, thereby becoming a tool for verifying a partner's trustworthiness. Moreover, sharing knowledge with other participants of the negotiation process shortens the time required for the pre-negotiation stage³¹ and final decision making.

The introduction of new IT and communication solutions allows the establishment of cooperation with a significantly higher number of partners than previously, however it also poses a number of risks. Foremost among these is the contribution to an increase in the uncertainty around transactions and a partner's behaviour. The ease of finding a new, preferable offer results in decreased stability between companies. New technologies create an opportunity to cooperate with a large number of partners and opens up new possibilities for those meeting the expectations of being a sound partner, though they do not eliminate the risk coming from having insufficient knowledge of a partner's behaviour while negotiating. The lack of personal contact between negotiating parties (excluding video conferencing) limits the opportunity to apply the full art of negotiation and eliminates the ability to 'hear' non-verbal messages coming from body language for instance. The possibility to affect the course of the conversation through the choice of negotiation time or venue is also curbed. The risk of the occurrence of false interpretation in complex and multi-faceted cases also increases. The significance of developing a personalised relationships also falls, which may lead to them being of a shorter nature.

Application areas for new IT technologies that support negotiation processes and purchasing decisions

The tools which facilitate the work of managers and marketers at the pre-negotiation stage, as well as further on at the final purchasing decision making stage, include computer models of negotiation support, NSS – Negotiation Support System, whose aim is to conduct negotiation analysis [Biesaga-Słomczewska, 2009]. These models have become the base for the

³¹ Extensive work by: G. Probst, S. Raub, K. Romhard, *Zarządzanie wiedzą w organizacji*, Oficyna Ekonomiczna, Kraków 2002; J. Pfeffer, R.I. Sutton, *Wiedza a działanie*, Oficyna Ekonomiczna, Kraków, 2002.

creation of electronic negotiation systems, ENS – e-Negotiation System, among which the most common include:³²

- *GroupSystems supporting traditional ‘face-to-face’ negotiation.* This system most frequently plays the role of a so called ‘analytic drive’ and is applied in order to process information referring to the very process itself and its participating parties. It supports construction of offers, their comparison and, should the need arrive, a search for a compromise as a solution.
- *The Additive Scoring System (ASS)* supports structuring of a negotiation, determining its main aims, the criteria of offer assessment and options for offer selection through consideration of qualitative and quantitative results. The created description of a negotiation situation enables the drawing up of a negotiation scenario and the identification of a negotiator’s preferences, including the best alternative for negotiation consensus. Unfortunately, the system has a flaw, which is the arbitrary assigning of abstract values of assessment to situations occurring in real time, hampering the interpretation of results and stirring up doubt stemming from applying a points’ scale which gives unclear values for instance [Wachowicz, 2007].
- *Analytic Hierarchical Process (AHP)* is applied in a situation with multiple goals. The advantage of this system is the application of a verbal scale referring to the significance of the negotiation issues without ascribing to them any abstract marking scale. The drawback is the application of the principle of ‘pair comparison’ while assessing the issues and, on this basis, coming up with the hierarchy of best solutions.
- *System INSPIRE*, aims to make the information on negotiation processes, analytical methods and graphic techniques of data visualisation widely available, as well as ensuring communication between negotiators within a computer system group. INSPIRE

³² An in-depth description of the procedure of the computer modelling system for negotiations support can be found in: T. Wachowicz, *Negotiation and Arbitration Support with Analytic Hierarchical Process* [w:] T. Trzaskalik (red.), *Multiple Criteria Decision Making*, AE, Katowice 2007; T. Wachowicz, *E-negocjacje. Modelowanie, analiza i wspomaganie*, AE, Katowice 2006; T. Wachowicz, *Model wspomagania mediatora w negocjacjach dwustronnych, cz. I, Badania operacyjne i decyzyjne*, no 3-4, 2004

is the first training system. The negotiations are conducted in three stages using the system.

At the first, pre-negotiation, stage the assessment of the negotiation topic is conducted, the possible packets are analysed, a maximum

and minimum aim is determined, own BATNA and supposed partners BATNA are set and conduct strategy is determined.

The second, negotiation, stage includes the exchange of offers and communication between parties according to (Graph 1) a simplified chain of events. The example³³ below depicts merely the initial fragment of the commencement of negotiations.

Let us assume that company 'C' (Cypress) reports the need to buy parts for their machinery product. Without formulating an offer, it just sends a message inviting potential suppliers for negotiations. Company 'I' (Itex), interested in cooperating, sends the offer most beneficial for itself, in the form of a packet which includes the negotiable constituents (e.g. price, payment terms, delivery dates and return of faulty components). Obviously, the company starts with a high though realistic offer, which is accompanied by a message (a note including justification, requests for clarification or suggested options). In the reply to the proposal, company 'I' receives a follow up response from company 'C' along with an appropriate message, a further option and its rating.

³³ The example of Inspire application in negotiating process between two companies along with the description and the analysis was included in <http://invite.concordia.ca/inspire/demo.html>, accessed on: 30.12.2013.

Proposed offer

Rating of offer

Message

Your counterpart's offer 1: Tue. 17 Mar 1998 19:37:19 GMT

Price	3.47 \$	Thanks for your offer. I agree with you in the time of delivery, 20 days benefits we both. The other conditions are really high for my company and we can not accept them.
Delivery	20 days	
Payment	60 days after delivery	
Returns	Full price	
		<div> <div>Your</div> <div>rating 15</div> </div>

(3)

Cypress' reply

Your offer 1: Tue. 17 Mar 1998 02:19:58 GMT

Price	4.37 \$	Hope you think it's reasonably . It definitely benefits my company !!
Delivery	20 days	
Payment	Upon delivery	
Returns	75% refund with 10% spoilage	Bettina
Your rating : 100		

(2)

First Intex offer

Your counterpart's message 1: Tue. 10 Mar 1998 22:12:20 GMT

Dear Bettina: My company is interested in receiving offer from suppliers for our new product. I would be grateful you to send me an offers to provide real wheel gear assemblies to my company. I look forward hearing from you.
--

(1)

Cypress'
message inviting
negotiation

Graph 1. Record of exchange of offers conducted using Inspire system

Source: T.Wachowicz, *E-negocjacje. Modelowanie, analiza i wspomaganie*. [w] *Informatyka w badaniach operacyjnych* (ed.) T.Trzaskalik, Wydawnictwo Akademii Ekonomicznej w Katowicach, Katowice 2006, p.88.

At the stage of describing a negotiation issue, the system's users have already received overall guidance regarding the most attractive options

for them (namely an 'offer rating' indicated by the system, based on the previously assumed weights for the 'players' for each option), this 'rating' is verified each time negotiating packets change. The system allows the opportunity to follow any movement (viewing a process graph), thanks to which, one can constantly assess the scale of both parties' concessions [Wachowicz, 2007].

The third, post- negotiation, stage includes analysis of whether the settlement achieved by both parties was optimal. The Inspire system compares the packages, presents its critical assessment, highlighting both parties' best options (Graph 2.).

E-Sourcing is currently one of the most popular and innovative systems supporting the pre-negotiation process and its effective conduct. Constructed on an electronic platform, it enables global communication with suppliers of goods and services that have been invited to bid for potential cooperation projects. Each seller, having received their code and access password, may send an offer, participate in a tender, update their offer data, add attachments or pull out of a tender at any stage. The system facilitates offer correction, instantly visible to the purchaser, which is its main benefit. The purchaser draws up the criteria which determine his offer request, he has the option to conceal or reveal certain information important for the supplier, however, the fact that the system secures distribution, via the internet, of identical documents and information to each supplier simultaneously (unlike their distribution via traditional means) makes it innovative with regard to the tools utilised previously, due to the offer's homogeneity and clarity for all interested parties. This ensures fair competition according to the principles of purchasing ethics³⁴. The system is valued for its data archives and tracking a particular request as well as analysing the replies received from suppliers, which facilitate the selection of the best supplier in its class who is able to meet a client's expectations and ensure comprehensive cooperation with them. Apart from the above, other benefits of the system include the collection of a number of diverse offers, grouped according to criteria, which allows the selection of the most optimal solution concerning both a product's standard and price.

³⁴ Por. E.J.Biesaga-Słomczewska, K.Iwińska-Knop, *Internet jako narzędzie doskonalenia jakości procesu negocjacyjnego*, *Zeszyty Naukowe Ekonomiczne problemy Usług*, no 703, Szczecin, 2012, pp. 24–33.

<div>Post – settlement analysis</div> <div>Improve the achieved compromise</div> <div>You and your counterpart have jointly accepted the following package</div> <table><tr><td>Price</td><td>3.98 \$</td><td rowspan="5"></td></tr><tr><td>Delivery</td><td>30 days</td></tr><tr><td>Payment</td><td>30 days after delivery</td></tr><tr><td>Returns</td><td>Full price</td></tr><tr><td>Your rating</td><td>50</td></tr></table>					Price	3.98 \$		Delivery	30 days	Payment	30 days after delivery	Returns	Full price	Your rating	50	The Compro mise achiev ed
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Your rating	50															
<div>As mentioned earlier, this compromise is binding in the sense that it will continue to apply regardless of any future actions you and your counterpart may take, unless both of you <i>jointly</i> reach another compromise.</div> <div>INSPIRE has reviewed the preferences information provided by you (and your counterpart) and determined that each of the following packages is better than your current compromise for at least one of you, while leaving neither of you worse off (There may be more such packages, only the maximum of five, covering the whole range, are shown). The value of each package to you is also printed as a score under the package:</div>																
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Your rating	90															
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Graph 2. Post- negotiation analysis conducted using the Inspire system

Source: T.Wachowicz, *E-negocjacje. Modelowanie, analiza i wspomaganie*. [w] *Informatyka w badaniach operacyjnych* (ed.) T.Trzaskalik, Wydawnictwo Akademii Ekonomicznej, Katowice 2006, p. 90.

The presented systems of negotiation support cover just a fraction of a manager's and marketer's purchasing process activity. Among a number of solutions, the most valuable are those which are constructed on an electronic platform, as it is those that make the business processes global. Such a system is E-Sourcing.

Ariba Networks – an innovative platform for networking business partners

Ariba Networks is one of the World's biggest such networks, supporting all stages of a company's business: from searching for and networking with partners³⁵, through e-supply and e-invoicing assistance to even working capital management. Due to its universality, it has attracted half a million large companies, including General Motors, Pfizer, MacDonald's, Siemens, BP and Unilever.

Ariba, established in 1996 in California [Jakovljevic, 2011], came up with the idea to create a platform that would enable companies to improve the effectiveness of procurement process management. The initial stage of platform operations was mostly focused on employee effectiveness through simplification of their daily tasks, thanks to the application of supporting software (spreadsheets, text documents and electronic presentations). The following stage of innovation development concentrated on boosting productivity in the area of cooperation between particular company departments, which initiated Electronic Resource Planning (ERP), namely advanced resource management [Fertsch, 2006]. In other words, ERP is an IT system class which facilitates company management or cooperation of a group of companies which collaborate in order to store data and through them conduct operations [Fertsch, 2006].

This company's first product innovation was Ariba Buyer system, released in 1997, followed 2 years later by a complete business-to-business system on the specifics of the marketplace with a supplier network³⁶. In its first version, the system operated under the name Ariba Supplier Network which was later changed to Ariba Network. In the same year, the company made its appearance on the stock market and resources gained through this were devoted to software development and the establishment of strategic

³⁵ Source: <http://www.ariba.com/solutions/sell/supplier-membership-program/faq/pl>, [accessed on: 29.09.2013].

³⁶ <http://www.siliconvalleyhistorical.org/#!ariba-company-history/c1q8b>, [accessed on: 29.09.2013].

alliances with on-line payment and logistic support services, which, as a consequence, contributed to the creation of the largest community of buyers and sellers on the internet. In light of the fact that there was a constant rise in proposals for large scale purchases, a new product innovation arose – Ariba Sourcing system, which enabled the use of purchasing strategies in all categories of production expenditure as well as the previously mentioned facilitation of negotiation and in practice meant comprehensive support of a company's purchasing processes.

To meet customer expectations, in 2006 Ariba³⁷ launched a further product and organisational innovation, changing their model of service provision into Software as a Service, which provided software for storing applications on their own servers without the necessity for clients to install it. This function significantly boosted the company's competitiveness on the market, however it also entailed a new cost for the company stemming from the necessity of ensuring constant access to the service.

Overall, Ariba Networks supports business processes in the following three areas: ³⁸

Purchasing – systems that look into a company's expenditure and their sources, monitoring transactions with external parties (e.g. through creating a list of potential suppliers, thereby reducing costs and trading risks). At the stage of supplier selection, a buyer can use Ariba Sourcing Solutions, which is particularly useful when creating purchasing strategies, especially during negotiations. It also enables selection and monitoring of suppliers [Jakovljevic, 2011]. Another advantage is the constant monitoring of cooperation with suppliers and its comparison according to the key indices selected, which could optimise future partner selection. The most extensive system of purchase support is Ariba Procurement and Expense Solution [Jakovljevic, 2011]. This allows the monitoring of the purchasing process from the moment of requirement through order placement to chosen supplier, delivery monitoring, up to invoicing and payment. Ariba Supplier Management Solution [Jakovljevic, 2011] is a particularly useful supporting system in the management of the purchasing process. Its unique applicability comes from the possibility to identify new supply sources and evaluation and assessment of cooperation risk with individual suppliers.

The presented purchasing support systems available on electronic platforms obviously do not exhaust the list of all possible solutions in this

³⁷ In 2012 Ariba was sold to a German company SAP compare. http://dealbook.nytimes.com/2012/05/22/sap-agrees-to-acquire-ariba-for-4-5-billion/?_r=0, accessed on: 01.10.2013.

³⁸ Source: <http://www.ariba.com/solutions>, accessed on: 03.10.2013.

area, which is particularly noticeable in the large, multinational corporations that compete in launching innovations in the field of electronic transactional solutions. They enable companies to ensure not only the cohesiveness of the reporting and monitoring system but also effective purchasing process management in all branches, independent of their location, as well as the application of one homogeneous procurement strategy, which ensures maximisation of effect through careful selection of supplier base and the ensuring of full control over transactions conducted. Moreover, the users of Ariba Network's purchasing systems may avail of e-auctions, an electronic form of product price negotiation. This utilises reverse auctions, namely when a buyer expresses his or her willingness to purchase a product and during the auction the sellers outbid each other offering increasingly lower prices for its supply.

Sales – software supporting internet sales (e.g. through facilitating the search for a particular supplier and simplification of the purchase process in their virtual shop).

Payment management – the possibility of replacing traditional payment systems with electronic ones. Ariba Spend Analysis Solution [Jakovljevic, 2011] is software which supports expenditure analysis. It enables users to follow the costs generated by particular types of purchases, thus facilitating cost monitoring within a company. Extra software modification (Ariba Data Enrichment) enables the forecasting of expenditure, which, as a consequence, facilitates financial management within a company.

Ariba Contract Management Solution is the system supporting the above three areas and the monitoring of the total contract cycle from contract requirement and its acceptance, through the whole preparatory process, negotiations of terms and conditions, up to the moment of signing with authorised electronic signatures. Apart from its overseeing process aspect, the system additionally controls contract continuity, thanks to reminding users of upcoming contract end dates and the necessity for renegotiation.

Implementation of electronic technologies in the area of procurement – benefits and drawbacks

The benefits of electronic procurement implementation are indisputable, which is proven by the research conducted in ten multinational organisations including Hewlett Packard, Rolls-Royce,

GlaxoSmithKline and Skanska in the report of the consulting company AberdeenGroup [2005]³⁹.

The greatest advantage highlighted by these Boston specialists is the reduction of company operational costs, which stems from a reduction in transactional costs and the possibility to negotiate improved contractual terms thanks to access to a wider range of suppliers. Controlling administrative expenses is also significant through the increase in process effectiveness as a result of the reduction in traditional communication via telephone or fax to a partly automated electronic one as well as giving up paper documents and their storage in archives. Thanks to procurement process standardisation, employee productivity rises when it comes to cooperation between a company's departments (finance, logistics, storage and quality control) engaged in procurement. Paradoxically however, introduction of e-procurement⁴⁰ may contribute to an increase in expenditure on procurement process management. The rise in efficiency of individual employees (servicing a higher number of transactions) may cause an increase in the cost of their management. Despite this, the benefits are regarded as significant. In companies applying virtual procurement support systems every extra dollar spent in this area generated from 5-20% return on procurement expenditure.

Apart from the advantages achieved there are also reported cases of dissatisfied system users but they are mainly the result of incorrect application which unfortunately triggers losses and poses risks. The usage of software requires adequate employee training, true for both buyer and seller. In order to make the implementation of the system effective one should observe the suppliers already on the virtual market in a chosen sector as well as determining the possibilities for new companies to enter this market. Small companies find it extremely difficult to stay on the internet transactional platforms due to their limited scale of operation. Therefore, large companies must consider the risk of dead markets (of little activity) when establishing cooperation with smaller suppliers and the possible loss of forecasted benefits of innovative procurement solution implementation.

Companies willing to implement procurement management systems must also take into account the fact that their current suppliers may not have the required technology at their disposal or show resistance

³⁹ *Best Practices In E-Procurement, Reducing Costs and Increasing Value through Online Buying*, AberdeenGroup, Boston 2005, pp. 4–8.

⁴⁰ e-procurement refers to e-business [e-biznesu](#) that deals with electronic integration and management of all electronic ordering and supply departments in both public [sektorze publicznym](#) and private sectors [sektorze prywatnym](#).

towards its introduction due to the necessity of incurring extra expense (cost, service training, etc.). There are two solutions to this problem: supporting of the supplier during the transition to the new system, which is seen as a burden, or two fold running of the procurement process, meaning maintaining the traditional means of cooperation with current partners while searching for new ones that operate on the virtual network. Each scenario entails further costs and delays planned benefits from the implementation of the new system. As the quoted report says, over a half of the companies implementing electronic systems faced the problem of approval of the budget and support from higher management who have the tools to mitigate the resistance of various employee groups anxious about the consequences of changes to the procurement process.

The introduction of Ariba solutions in Hewlett-Packard (HP)⁴¹ may serve as an example of the extensive implementation of an electronic procurement system. HP is one of the World leaders of modern technologies, including production of electronic devices, software and outsourcing service provision. It has a work force of over 330,000 and has an annual turnover exceeding 110 billion dollars. The main principle guiding the introduction of the procurement system was the finding of significant savings thanks to the decrease in the number of non-production goods suppliers and an increase in expense monitoring. HP opted for the implementation of a comprehensive system when Ariba was at its initial stage in the e-procurement market. At present, Hewlett-Packard applies purchasing and invoicing modules for non-production procurement. 95% of this operation is conducted through these modules. All purchasing categories (production, non-production and purchasing of services) apply the tools which facilitate cost analysis and supplier management. Thanks to the implementation of expenditure management strategies, the creation of a strategic supplier base and the introduction of e-procurement platform standards the company's operational expenditure dropped in 2005 to the level of 0.75% of total company expenditure, compared to 0.95% in 2002. The scrapping of over 100 locally developed systems for just one generated an annual saving of over 7 million dollars. Additionally, the application of this system allowed the company to evaluate suppliers and continue cooperation only with the highest quality service providers. Ariba systems facilitated the automation of the processes, focussing employee attention on strategic aspects when making purchases.

⁴¹ *Best Practices In E-Procurement, Reducing Costs and Increasing Value through Online Buying*, AberdeenGroup, Boston 2005, pp. 18–20.

The success of the Ariba system application consists of a number of factors, including not only support provided by the management and its engagement in the introduction process but also ensuring the user-friendliness of the system. This fact contributed to the reduction of the occurrence of errors stemming from the application's users natural tendency towards software personalisation. The company does its best to structuralise the process, every improvement suggestion proposed by an employee must therefore be evaluated. Only the best solutions are adopted, which enables the avoidance of unnecessary change and saves the costs connected to platform development. Another constituent of HP's success in the implementation of the system is also the long term planning of its implementation, in particular, gradual integration with the existing software used in the company.

Summary

The presented innovative IT solutions which are currently commonly introduced in procurement processes and the accompanying negotiations clearly sets the direction of a new era in business conduct. The coming years will undoubtedly surprise us with new solutions in the area of automation and computerisation of most processes taking place within a company, independent of their sector or country of origin. The direction of the current procurement systems point to continual improvements in the process and its development. However, the human factor seems to be crucial in all cases. Without sufficient expenditure on training and awareness-raising it will be hard to implement even the best systems and accompanying solutions. Negotiations are more vulnerable in this respect as their conduct will always rely on the person. The existing negotiating process support models or their accompanying systems will not replace the human mind. It is impossible to work exclusively using e-auction and similar tools as one cannot describe some product features in such detail for them to become quantifiable. It will be hard to make smaller market players implement expensive systems. There will always be multi-level negotiations: e-negotiations regarding price and traditional negotiations which include the full qualitative aspect of product features as well as an emotional one which, in the final stages, translates into building better relationships between partners. Electronic procurement and negotiation systems will perform their supportive role. Companies implementing online solutions need to be aware of both their benefits and drawbacks and be able to justify the validity of such operations.

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INNOVATIONS IN THE AGRICULTURAL SECTOR

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Abstract

The aim of this paper is to show the impact and significance of innovation in agriculture. Its economic development takes place when innovation solutions based on knowledge and modern technologies are implemented and intensified. Innovations in agriculture encompass a number of operational fields: resource management, soil protection, cultivation processes, biodiversity protection, ecological cultivation and production of bioenergy. The demand for agricultural innovations in different localities may vary, therefore there is a need to bring together the local requirements through utilisation of a multitude of possibilities in a variety of ways, adjustment adaption capability and conditions of a particular rural environment. There is also a need to emphasise the strong integration of innovations in agriculture with other sectors of the economy, which is translated into the acquisition of new solutions and the introduction of innovations that encourage adjustment and the capability to cooperate as well as the application of modern technologies in the economy. Innovative activities that solve problems become the main stimulant to a dynamic economy in agriculture, allowing the most beneficial implementation of its potential.

This article has been divided into three parts, in the first, the author conducts a theoretical deliberation on the agricultural sector. The second part presents the conditions for innovation processes in this sector and the third, 'Innovative tendencies in the development of agriculture', includes the areas of innovative change in agriculture.

Key words: Innovations, new technologies, agriculture, local area

Introduction

The achievement of an adequate level of agricultural development requires implementation of resources and tools that allow constant advancement. Innovations are considered to be the main factor for this development. The introduction of innovations in agriculture gives the opportunity to improve the lives of rural communities. It allows more efficient production of competitive products and, as a consequence, improves farmers' income as well as that of other rural residents. It also sustains and, to a degree, creates new employment places, which is particularly important as unemployment is one of the most pressing issues

in rural areas. It is becoming a common belief that innovations ensure an effective impact on: the opportunity to catch up with this existing development lag of the local environment, companies, fulfilling peoples' needs and raising the competitive advantage of each farm holding. As a consequence, innovations are regarded as more and more significant constituents of the pro-development process and one of the main resources for achieving agricultural goals.

The importance of innovations in agriculture draws attention to the issue of development directions to put it into practice. Agricultural operations require, in order to achieve their objectives of both acquiring innovative solutions in the current areas of operations as well as introducing and developing new production trends, which are the basis for the required transformations resulting in improvement of innovative principles. Implementation of the set predevelopment objectives requires an adequate direction and effective implementation based on, for example, indispensable infrastructure. Thanks to this, it is possible to achieve effective economic structures and the development of entrepreneurship under the particular conditions of an individual local communities. Thus, the objective of this paper is the presentation of the impact and importance of innovations in agriculture, seen as the factor allowing solutions to existing problems. Innovations in the agricultural sector allow the adaptation of this sector to the development process and the structural changes occurring in the global economy.

Innovations in agriculture

The dynamic developments in the World economies is reflected in all types of activities. They stem from new scientific challenges and new technologies which facilitate transformations for achieving a business's goals. Facing these challenges requires modernisation of operations conducted by companies across all economic sectors. It is innovations that through the spread and adaptation of knowledge have been regarded as the main drive of economic development. It is becoming a widely held belief that companies able to activate their knowledge, technologies and unique experiences (products and services) or the innovative methods for their creation and attracting customers with their offers have found themselves in the most favourable position [Tidd, Bessant, 2013].

In agriculture, just like in other sectors of the economy, it is advisable to carry out modernisation with the introduction and spread of innovative ventures. Innovations in this sector include new knowledge, technology in agricultural production, processing and the introduction of

solutions for economic and social processes. Agriculture is not a homogeneous sector, consisting of a variety of production chains such as plant cultivation, rearing animal and market gardening. Here, innovations refer to new and improved seed types, tissues, vaccines, cultivation, rearing, equipment and techniques. They also encompass the application of quality standards, organisational restructuring, improvement of management and sales to new buyers and markets [Pomareda, Hartwich, 2005].

It is worth emphasising the territorial aspect of the innovation process [Zajda 2013]. This emphasises the possibilities coming from a particular environment and its stimulating abilities for the implementation of innovations. It is particularly true in the area of agricultural activity, which displays strong territorial bonds and is organically linked to the features of the land where it is conducted. Innovations in local scale agriculture is understood as operations that have yet to be introduced in a particular locality. It means that what is regarded as the norm in one area in another is considered as innovation. Therefore innovations can be regarded as new methods, habits and devices used to perform new tasks or solution to problems that arise in a particular area [Sunding, Zilberman, 2000]. Innovativeness is defined as the ability to constantly transform knowledge and ideas into new products, processes and systems that serve the achievement of a company's goals [Lawson, Samson, 2001]. Some of these are in fact viable only for a particular sector, others are of a more universal nature, having sometimes a significant impact on the whole economy, such as electricity applications or modern IT and communication technologies [Tidd, Bessant, 2013]. Therefore, innovations in agriculture often stem from innovative sources in other sectors (among others, earlier and later links of the supply chain).

The market approach to innovativeness is a new way to solve a client's problems, and innovations are seen as goods or services which in an innovative way fulfil the needs highlighted by clients, regardless of the fact whether it takes place based on previously known methods or new scientific achievements or not. It is essential that the client receive a solution which in a new (previously unknown) manner meets their needs [Ražny, 2013]. It is also assumed [Rajalahti, et. al., 2008] that innovation is not a science or technique but the application of all types of knowledge in order to achieve the desired social and economic results. Innovations are usually not a complete novelty but rather a creative copying of, most frequently, a local nature. Indeed, innovations though perceived as referring to major changes are unusually focussed on many minor improvements and the constant process of modernisation. Innovative activity is effective when

it refers to pre-existing solutions. It is a kind of adaptive function whose aim is to stabilise reality. The success of innovative operations must be linked to the current technology available [Masarek, 2013].

Therefore, there are a few levels of innovativeness, usually regarded as three fold [Innovation, 2009]:

- First level – copying ideas from other regions;
- Second level – combining a few known elements in order to arrive at a new solution;
- Third and highest innovation level – creating a brand new idea.

The first two levels occur most frequently. In most successful cases they are not based on new inventions, but utilise pre-existing ones [Rajalahti, et. al., 2008]. They are mainly the answer to market demands or a need for a solution to a particular problem and are linked with a practical applicability in a particular reality.

It is assumed that innovations in agriculture should to a greater degree answer business needs rather than just be technological inventions [Ražny, 2013]. The key to creating and introducing a profitable innovation is a business model which considers predominantly the problems of interested parties as well as the cost and income accounting. The market will not accept a new type of fertiliser if it is too expensive or machinery if overcomplicated. The development of the agricultural sector is dependant to a significant degree on how effectively knowledge is generated and applied in various ways which facilitate innovations, this is knowledge that enables overcoming the complex, volatile and multi-faceted problems occurring in agriculture.

Innovations in agriculture are therefore perceived as new knowledge and widely understood technology, applied in management processes in agriculture, production, processing as well as sales. However, they signify different ideas in different contexts, which makes it difficult to discuss one definition. Innovation (particularly concerning development of agricultural areas) is seen not only as a technological process or a popularisation of research results, as innovation must generate tangible results and be practical [Innovation, 2013]. As a result of the application of innovations by farmers or processing and distribution personnel, agriculture is able to produce/sell desirable products of improved quality, generate higher income, boost competitive advantage and bring about social benefits.

Conditions for innovative processes in agriculture

Today's agriculture is determined by many aspects which direct demand for concrete innovative activities. Most of all one should highlight:

- Significant structural diversification of agriculture, which affects need diversification for both new knowledge and technologies. There are spatial conditions for agricultural innovations specific to a particular place or time, while many innovations of a more global nature are adjusted to the needs and local reality of the users.
- Changes occurring in the agriculture sector under the influence of the far-reaching transformations in the economy trigger the need for innovative solutions. These are particularly noticeable in the aspect of changes linked to supply chain creation. Within these chains, production, processing and sales of agricultural product processes are coordinated. The relationship between the links of the supply chain become increasingly formalised, and the arrangements cover a wider scope of ideas, space and time.
- The narrowing of production specialisation undergoes changes over time, following customers' requirements concerning quality, level of processing, changes in norms and health and safety as well as the introduction, processing and distribution of agricultural products which leads to a share increase of products of a fairly high and ever increasing unit value. Therefore, new solutions must keep up with the increasing client requirements and demands.

As a consequence, one can assume that innovation advancement in agriculture is determined by the following development trends [Rajalahti, et. al., 2008]:

- The development of agriculture is increasingly driven by markets not production
- Production, trade and consumption of agricultural products is ever more dynamic and evolves in an unpredictable manner
- The structure of agriculture is undergoing significant changes
- The development of agriculture is increasingly occurring in a globalised environment, having an impact on national and local interests
- The rapid growth of ICT transformed the opportunities to avail of knowledge gained in different places for other goals
- Knowledge, information and technologies are, to a greater degree, generated, channelled distributed and applied by more numerous, varied (multi-faceted and diversified) flow links.

Attention should be drawn to the tight bond between agriculture and other sectors of the economy. Agriculture gears itself to provide for these sectors, acquires their modern solutions and introduces innovations that facilitate adjustment to the needs coming from modernisation

introduced in these sectors. Innovations are frequently the result of problem solving based on personal experiences using available equipment, relying on technologies coming from other sectors. These are highly dependent on other sectors of the economy. As a result, they may come from institutions that are not connected with the agriculture sector, for example ICT or biotechnology.

The local context must also be emphasised. The innovation process is based on the convergence of factors and economic capability. The main factor for innovation induction is potential demand, which requires the support of technical capabilities and knowledge ensuring technical resources for new solutions. The factors behind the success of an innovative offer are not regarded as universal but specific and dependant on a wide range of technological and market features [Tidd, Bessant, 2013]. Drawn from experience is the fact that the main challenge in most cases of successful innovation is not the creation of the invention but the ability to adapt and apply it. This demands the search for new sources of inspiration for innovativeness. Expansion of access to knowledge through the development of the potential of communication channels and the scope for mutual contact, encourage the spread and adaption of information. Making modern media commonplace along with a tangible reduction of access costs, stemming from new network routes and modern electronic transfer lines, generate clear results. Obstacles created by distance decrease along with the spread of wireless transfer technology, which impacts the scope and speed of innovation processes.

Innovative directions in agricultural development

Innovations in agriculture focus on striving to achieve a range of benefits. This does not only concern increased yield and production, more efficient fruiting plants of greater flexibility but also a more selective application of plant protection chemicals, reduction of environmental impact, boosting plant resistance, reduction of the emission of greenhouse gases and improvement of the natural capital.

Most innovations in agriculture are linked to cultivation, fertilisers, plant protection substances, fodder, supplements, veterinary medicaments as well as agricultural machinery. The advancement in biological sciences and information technology is a vital source for innovation. The most talked about, yet controversial, are changes in biotechnology, in the production of genetically modified crops in particular. It is worth emphasising the characteristic signs of innovation which can be observed in individual aspects of their introduction to agriculture. They are

multifarious in regard to subject matter, level of innovativeness as well as expected results.

In reference to plant production, one can point to a wide range of stimuli facilitating the implementation of change in the cultivation of agricultural products. These include, seeds of a higher quality, more efficient fertilisers and the introduction of ecological products. This is not linked to impressive transformation and the conducted changes are considered minor improvements. Radical innovations concern the implementation of more significant change such as GMO seeds, the trend for ever greater plant attributes to utilise water and fertiliser more efficiently and be more pest resistant, which generates greater opportunities for producers. Other important innovations in agriculture include soil cultivation, in precision agriculture in particular. This cultivation technique, which precisely selects plants for particular conditions, focuses on the ultimate usage of resources in order to improve the quality and quantity of crops while reducing the cost of production. This limits the application of fertilisers and pesticide, prevents soil degradation and boosts efficiency, as the plants can avail of water and fertilisers more effectively and are more pest resistant. Modern systems of so called closed loop are applied here, which include environmentally friendly agricultural and technological practices, including satellite imaging and information technology. The development of computerisation and satellite technology generate a new huge potential for precision cultivation. It is undoubtedly the future of agriculture, especially as it impacts the improvement of the quality of the environment.

A similar goal is the introduction of new ideas based on so called ‘effective microorganisms’, namely a choice of bacteria cultures whose aim is to sustain or reinstate the natural balance in cultivation. Ecological processes are applied here to supplement soil fertility. This speeds up the biological regeneration of soil causing the humus layer to grow more quickly. This does not replace fertiliser but increases the process of restoring its optimal state [Miernik, 2013].

Introduction of GMO plants is a controversial area of innovations. Their aim is to boost profitability of production and be resistant to natural pests. The controversy regarding their application stems from the anxiety about the possible negative impact on consumer health and the dangers they pose to unmodified organisms (however, research generally refutes this). The fact remains that GMO cultivation generates clear economic benefits through significantly higher yields, time, fuel and machine savings, reduced chemical usage, energy consumption, water consumption, increased

nutritional value of plants, the possibility of producing new, cheaper bioproducts (especially industrial) as well as the improvement of some quality features. Increased profits follow, as well as the improvement of the profitability of agricultural production and, consequently, a more favourable competitive advantage for producers.

Other innovative impacts linked to modern crop protection products boost plant development through an increase in plant resistance to unfavourable conditions, especially soil pollution. They are primarily applied in intensive and monoculture farming.

One modern innovative direction is the practice aimed at the development and sustainability of biodiversity. Contemporary highly intensive agricultural practices negatively affect biological diversity of the cultivated environment. Specialisation (monocultures) and intensification of a number of production methods, fallow land growth and the marginalisation of traditional agricultural and environmental practices requires counteraction in the form of modern innovative solutions. These allow a compromise between maximisation of the current economic effects of agricultural businesses and the need for the sustainability of biodiversity which means adding value and strengthening the local natural heritage, giving a foundation for the continuity of ecosystems [Hermon, 2014]. Biodiversity ensures therefore a higher adaptability to changing conditions and risk resistance.

A partial set-aside solution may serve as an example of the introduction of new economic practices beneficial for biodiversity. For instance the cultivation of alfalfa enables lengthened blooming, thanks to which beneficial insect attraction is increased. Making alfalfa fields of seven metre rotation strips where harvesting is forbidden is a low cost alternative for the creation of a set-aside strip. Such conduct has led to an increase in insects, butterflies and birds [Rural, 2009]. Similar effects are generated through leaving soil to lie fallow, which serves as a habitat and food source for ground-nesting birds.

Sweden is the leader in its engagement in biodiversity protection. A group of farmers set aside on their fields so called 'nesting windows'-unsown areas allocated for nesting, limit pesticide use along the fields, adjust mowing patterns and introduce water sources [Rural 2009].

Biodiversity has a positive impact on innovative solutions in agricultural production. First of all, it is a major reason for undertaking diversified eco-cultivation. Ecological practices draw from a variety of local cultures, their ethical values and beliefs. On a global scale, they appear varied and multi-faceted as they are based on local adaption solutions.

Ecological agriculture is driven by consumer demand for natural food, free from chemical additives. Undoubtedly, this generates a positive developmental impetus and favours the biodiversity of plant species. It seems however that this direction of food production may only be of a niche nature, as it requires adherence to a number of rigorous environmental conditions of production and more importantly, is highly restricted by high production cost demand and, as a consequence, price, which is an extremely sensitive area for the modern consumer.

Another direction in the search for innovative solutions for agricultural production is working towards the utilisation of renewable resources of an organic origin for energy production in a more beneficial manner based on technical advancement. Many types of bio-refineries are being utilised in order to achieve this goal. They allow industrial use application of such resources for alternative fuel production, thanks to the processing infrastructure. Agriculture for energy may become an area which will witness a strong stimulus for the development of innovative agricultural energy and ecological technologies [Marks-Bielska, Bielski, 2013].

The foundation of this is the agricultural production of biomass applied in the production of biofuels and biogases. A big advantage of this type of agricultural production is the possibility to use fallow land for cultivation. Biomass may be transformed into liquid fuel through a technological process which requires the implementation of renewable energy production technology in small companies neighbouring agricultural businesses. A company producing bioethanol may produce from plant and agricultural waste a few thousand litres of bioethanol. In addition, it offers employment of a relatively high standard, which seems yet another innovation in the area of the improvement of the local labour forces' qualifications. What remains after bioethanol production is used to produce fodder for livestock [Supporting, 2009]. Groundbreaking methods of using plants which were previously not regarded as resources are being investigated. For instance *Jatropha* - an oily shrub with inedible berries which may be grown on soils unsuitable for edible crop cultivation. From its seeds a vegetable oil can be produced for use in the production of eco biofuel [Innowacje, 2007].

In order to produce biogas in modern biogas plants, not only are all sorts of biomass resources used based on energy plant cultivation such as wood, tree leaves, straw, hay, waste after vegetable cultivation (primary biomass resources) but also all kinds of organic waste and sewage (secondary biomass resources) from agricultural farms and the agrifood industry, which may be fermented into gas. This allows the utilisation

of many byproducts according to the above mentioned groundbreaking system of 'closed loop' whose aim is to minimise or even eliminate waste. It is believed that long term energy agriculture will transform the Polish countryside into one of the great innovation areas [Marks-Bielska, Bielski, 2013].

Innovations in agricultural areas may also be linked to local resources. An area may possess resources which could be utilised in an innovative manner [Zajda, 2013]. It usually goes along with their unique nature stemming from their origin, including manufacturing culture, coexistence with nature, uniqueness and rarity of materials as well as their ecological and health qualities. In agriculture this mainly concerns natural resources rather than economic ones. Unique resources are particularly valuable and their innovative aspect strengthens this feature. More common resources may be used in a nonstandard way reflecting the uniqueness of a particular territory. Their innovative dimension is gained by usage either according to a specific trajectory or a general one but with specific aspects [Zajda, 2013].

The former above mentioned group includes particularly high quality soil, especially beneficial hydro conditions or qualities of the climate coming from natural features of the environment facilitates the utilisation of these strongpoints. For example, for plant production whose cultivation requires unique conditions, e.g. certain flower types and herbs that are key ingredients in the production of cosmetic, perfumes or medicine, this gives them their uniqueness.

In the case of commonplace resources, innovativeness entails for example the cultivation of certain plants, and, in particular, their processing based on technologies specific for that region, thereby accentuating the good points of these products. Based on the region's image, the product gains its unique quality, making it distinctive through association with the said area. For instance „Ser Koryciński” (cheese), „Olej Kujawski” (oil), „Kropla Beskidu” (mineral water), and „Miód Wrzosowy z Borów Dolnośląskich” (heather honey). These products are associated with a particular place and its appeal, and serve as examples of an innovative approach using our image of a particular region.

Summary

Agriculture has at its disposal a wide range of possibilities for innovative activities. The uniqueness of a situation (own potential and external conditions) translates into a variety of development possibilities, directs local agriculture along separate, specific paths that

depend on economic conditions and economic potential as well as efficient management. Transformations occurring in the market economy demand an increasing level of agricultural production development based on crop quality and boosting value added, as well as greater adjustment to the overall level of economic development in the country and obtaining a more beneficial and comparable economic standing. The answer to these challenges is in developing innovations in agricultural production based on the utilisation of harmoniously linked areas of operations together with adequate support. Innovative activities are highlighted which rely mainly on the transfer of knowledge facilitating the solution to current problems, coming up with new, competitive, high quality products well adjusted to the local environmental conditions, agricultural tradition and customer preferences, including entrepreneurs. There are a number of innovative possibilities both within agriculture itself and agricultural services whose introduction may result in market success.

Innovations are the answer to the market changes occurring, offering better development possibilities for the future. The stronger and more advanced the economy, the more developed the partnership of the companies that create it, which in effect, generates a more solid foundation for strengthening development trends. It is advisable to create capable constellations of agricultural companies and service institutions, ways of cooperating and monitoring tools. These should be linked to the conditions of the environmental context. The impact of these conditions on the development possibilities of agricultural activities through separate companies requires particular attention. One should consider mainly the state and possibilities of technical infrastructure improvement. There is also a call for groundbreaking solutions, better adjusted to the reality of organisational practices and tools implemented in business. Only the utilisation of modern and innovative change ensures the sustaining of effective economic structures and the development of entrepreneurship in agriculture. This will strengthen the adjustment to market conditions and boost competitiveness of companies operating in that sector of the economy.

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ECO-INNOVATIONS FOR ECONOMIC GROWTH AND ENVIRONMENT PROTECTION

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Abstract

The aim of this work is the presentation of current EU issues on eco-innovations in the light of its role for economic growth and natural environment protection. Within the EU economic and environmental climate, eco-innovations can be the key to Europe's competitiveness in the future. However, in many EU countries, including Poland, the market of eco-innovations is developing too sluggishly and faces a number of obstacles. Moreover, there are many differences between the EU countries in the field of eco-innovations. Although at the European level numerous support tools are currently applied, there is a growing necessity to gear them towards making eco-innovations commonplace on the market.

This paper makes an attempt at answering a few questions crucial for finding optimal solutions for the development of an integrated support system for ecological innovations, in particular: what are the potential benefits of the implementation and development of innovations for the economy and natural environment, what are the current eco-innovation support tools and the main issues in their development, and what is the level of eco-innovation in the EU countries including Poland, seen through the available data.

Key words: Eco-innovations

Introduction

Eco-innovations are one of the elements of the current EU innovation policy, whose environmental aspect has been increasingly important in the EU economy in accordance with the principles of balanced development [EC, 2011a].

The literature on the subject offers many definitions of ecological innovations, also called eco-innovations, which encompass all innovation solutions utilised to protect the environment and human health. These include products, production processes, services, technologies as well as innovative methods of marketing and management whose main objective is to reduce the negative impact on the natural environment. Eco-innovations refer also to building pro-ecological consumer attitudes, support for environmental friendly products and expansion of markets for ecological

products. By eco-innovations one can also understand even slight improvements, but the most important is their contribution to the implementation of balanced solutions whose aim is more effective application of natural resources, reducing any harmful influence on the environment while maintaining a high level of innovation [Szpor, Śniegocki, 2012; Woźniak et al., 2010b].

The term ecological innovations is often linked to the term environmental technologies, so called eco-technologies and pro-environmental technologies of balanced development. However, the implementation of ecological solutions through process or product is also significant as eco-innovation products are mostly fully biodegradable, posing no harm to the environment and human health. Every type of eco-innovation contributes to the reduction or substantial elimination of the anthropogenic burden and curbing the usage of significant natural resources, especially non-renewable ones, e.g. energy resources. As it is put in the EU strategy on the natural environment [EC, 2012c], in the search for ecological innovation solutions it is worth copying nature, utilising natural solutions occurring in the natural environment.

The discussion on eco-innovation should also consider both economic and ecological aspects as the necessity to limit harmful impacts of industrial processes on the environment seems as crucial as the reasonable and balanced utilisation of natural resources [EIO, 2012]. One should also stress that both aspects of eco-innovations are equally important, as they perform an important role in mitigating the effects of harmful changes triggered by man in the natural environment and in economic systems [EC, 2012c].

Eco-innovations are strongly linked to the methods of using natural resources and the ways of production and consumption, therefore the expected benefits for the environment, society and trade stemming from extensive implementation of eco-innovations may bear significant results for the future [EC, 2011a]. Most importantly further development of eco-innovations may result in a lesser impact on the environment and better resilience of the whole economy, beneficial for companies and society in general [Woźniak et al., 2012a; 2012b].

The eco-innovation operations of companies value all initiatives, such as systematic ecological education of the workforce, limiting the use of natural resources by e.g. saving water and electric energy as well as segregating waste. The implementation of the ISO 14001 norm on environmental management may serve as a good example or even

purchase of office paper saving devices. Undoubtedly, such activities have an important impact on reducing company costs [Leszczyńska 2011].

According to the main EU strategic documents such as the strategy 'Europe 2020', the priority of 'smart development' or the initiative 'Innovation Union', eco-innovations remain one of the most vital factors in competitiveness growth and EU socio-economic development in the nearest future. This direction of EU development policy is clearly supported in the face of growing competition from developing countries and maintaining the competitiveness of European companies and regions should be based on the implementation of improved, innovative products, manufacturing and organisational processes. Unfortunately, the economic climate in the EU is currently unsatisfactory and, against previous prognoses, the chances of overcoming the crisis by the end of 2013 are minuscule⁴². Therefore, the analysis of EU economic growth shows that among the main priorities for the nearest future are promotion of competitiveness and eco-innovations as factors particularly effective in the stimulation of the economy and the key to the future competitiveness of Europe, according to the European Commission⁴³.

Support instruments for eco-innovations

For a number of years now many valuable initiatives have been undertaken supporting balanced eco-innovation development on the EU level. The European Commission provides effective backing to research and demonstration projects in the area of eco-innovations and market acceptance through several programmes [Lipińska 2013; Szpor, 2012]. Particular attention should be drawn to the *Competitiveness and Innovation Framework Programme 2007-2013 (CIP)*, which is the tool prepared by the European Commission to implement the Lisbon Strategy. The agenda of the programme is to support innovation (including eco-innovations), to improve access to funding and the facilitating of business support services in EU regions. For the 2008-2013 CIP the EU designated nearly 195 billion Euro for funding projects promoting ecological innovations in Europe⁴⁴.

⁴² O. Rehn, European Commission Vice-President and Commissioner for Economic and Monetary Affairs and the Euro, speech dated 22 Feb. 2013, <http://pl.euronews.com/2013/02/22/wzrost-gospodarczy-w-unii-nie-w-tym-roku/> [access: May 2014]

⁴³ *Ekoinnowacje, klucz do przyszłej konkurencyjności Europy* [online] <http://ec.europa.eu/environment/pubs/pdf/factsheets/ecoinnovation/pl.pdf> [access: 15 Nov. 2013]

⁴⁴ For details see: http://ec.europa.eu/cip/index_en.htm

One of the three specific CIP programmes, *Entrepreneurship and Innovation Programme (EIP)*, focussing on entrepreneurship, small and medium-size companies, competitiveness and innovation [EC, 2012a]. Eco-innovations are one of the main topics of *CIP EIP Non-financing Instruments*. The aim of this initiative is to support the implementation of innovative products, processes and services geared towards the reduction of harmful impacts on the environment, pollution prevention, and support of eco-innovations that promote more effective and responsible natural resource applications⁴⁵.

Through the *CIP Innovations* selection processes entrepreneurs can apply for funding for so called pilot projects or projects that commercialised eco-innovative techniques, products and processes which succeeded at the demonstration stage but due to the huge risk were not introduced the market. The support of such promising innovative eco-technologies contributes to erasing obstacles in the development and widespread application of eco-innovations, creates or expands markets for new products or improves EU companies' competitive advantages on the world's markets. Priority was given to the sectors which have significant innovation potential for limiting any impact on the environment. The areas which receive this funding change annually depending on the results of the previous selection processes and project results. So far the CIP EIP priorities include⁴⁶:

1. Material recycling – all activities geared towards the improvement of the waste sorting process, strengthening competitive advantage of recycling companies, creating new solutions in the fields of recycling and innovative products using recycled materials.
2. Buildings and constructions, namely innovative products for the construction sector, sustainable materials and techniques, better utilisation of recycled materials and renewable resources in construction as well as new technologies for purification and water saving.
3. Food and drink sector refers to creating 'greener' manufacturing and packaging processes, more efficient water management processes, innovations in limiting industrial waste, recycling and reclaiming materials, and methods of more effective utilisation of resources. Recently priority was given to sectors which have

⁴⁵ For details see: http://ec.europa.eu/cip/eip/index_en.htm

⁴⁶ For details see: http://ec.europa.eu/environment/eco-innovation/about/index_en.htm

a significant impact on the environment, such as the milk and meat processing industries

4. Greening business and purchasing are the areas ensuring that companies acquiring products are guided by environmental protection. This includes: effective utilisation of resources, aid provided for companies in process and product adjustment to the requirements of environmental protection and promotion of the widespread inclusion of ecological innovations in the supply chain.

So far there have been five rounds of applications in *CIP Eco-innovations* selection processes. The most important data on the selection processes, conducted between 2008 and 2012, is presented in Table 1.

Table 1. *CIP Eco-innovation* selection processes comparison between 2008 - 2012

	2008	2009	2010	2011	2012
Number of proposals	134	202	287	279	284
Number of participants	444	614	895	860	916
Requested funding (M€)	110	150	264	199	196
Average requested funding (k€)	830	770	921	712	690
Participation of SME (%)	74	70	66	67	67

Source: *First overview of the Call 2012 CIP Eco-Innovation, First application and market replication projects EACI, Unit 3: Eco-Innovation - Market Replication*, EC, Brussels, 2012.

The number of proposers increases annually with a comparable number of applications in the last three years. However, since 2010, the proposed sum has been on the decrease. One should pay attention to the fact that SME have a relatively high share of the process selection, which proves that they drive eco-innovation [EC, 2012b].

While discussing the support instruments for eco-innovations, we should also mention the European Innovation Partnerships (EIP) incorporated in the leading initiative of ‘Innovation Union’. The aim of the EIP is gathering companies and resources around the common objectives of acceleration of breakthrough innovations which will solve specific social problems where the market potential is high for EU companies. Effective resource management is the priority, particularly in the fields of raw materials, sustainable agriculture and water management. Due to the fact that eco-innovations are geared towards the economy effectively utilizing its resources, it remains an EIP support instrument (*EC Eco-innovation Action*

Plan (Eco-AP), based on the experiences of ETAP action plans since 2004, proposed that EU countries participate in non-compulsory national plans on eco-innovations, whose aim is to identify an effective policy to foster the EU countries' policy exchange and to work out favorable implementation conditions for eco-innovations to flourish. These action plans will use the existing initiatives of ecological technology support, but will focus to a greater degree on eco-innovations, both in the private and public sectors and adhere to the global objectives in the area of sustainable development. The initiative of identifying best practice in eco-innovations will also be strengthened⁴⁷ in order to propagate more successfully good practice among EU countries [EC, 2011a].

Among the Polish support instruments *GreenEvo-Green Technologies Accelerator* should be pointed to. It is the Ministry for Environment's own project supporting Polish eco-innovators, whose aim is to promote Polish green technologies in foreign markets and their export support. These companies can also participate in foreign trade missions and receive funding from the export support resources. This programme has turned out to be a success. In 2012, the fourth edition of *GreenEvo* took place and 14 companies⁴⁸ were selected for the programme.

Other significant Polish initiatives include:

1. Gekon programme – Generator of Ecological Concepts which focuses on various initiatives supported by Polish research institutions and provides backing in technology development for environmental friendly companies. Projects are evaluated according to five categories dedicated to environmental protection, among others, recycling, energy effectiveness and water protection⁴⁹.
2. The establishment of several eco-innovation orientated clusters.
3. Polish participation in Environmental Technology Verification (ETV) - a pilot programme of the European Union supporting propagation of eco-innovative technologies⁵⁰.

Since 2014, all demonstration projects and projects implementing technological and social innovations, including eco-innovation, will receive further support from the EU's 'Horizon 2020' programme. The main objective of this programme is to increase EU competitiveness through the

⁴⁷See the EU funded project: *Polityka w zakresie przyspieszania ekoinnowacji*, <http://www.ecopol-project.eu/>

⁴⁸For details see: www.mos.gov.pl

⁴⁹For details see: <http://program-gekon.pl/>

⁵⁰For details see: http://www.mos.gov.pl/artykul/4676_czym_jest_etv/17954_czym_jest_etv.html

implementation of a several specific objectives, among which it is worth paying attention to: the strengthening of EU standing in the areas of research, innovations and technologies, as well as an increase in all forms of innovation, including eco-innovations [EC, 2011b].

A valuable EU initiative supporting SME in the future is the *Programme for the Competitiveness of Enterprises and SMEs (COSME) 20014-2020*, which will continue the actions of CIP from 1st January 2014. The designated budget is 2.5 billion Euros and its main objective is to counteract the most serious market weaknesses hampering enterprise growth, in SMEs in particular⁵¹ [EC, 2011e].

EU innovation and Poland

There is no eco-innovation without innovation, therefore we should invest in eco-innovation along with laying foundations for overall innovation potential [Bukowski et al., 2012a; 2012b]. It is worth pondering what the shape of innovation in the EU member states is, in Poland particularly.

It is generally viewed that Europe is still insufficiently innovative and Poland is in last place both on the innovation and eco-innovations ranking. Based on the statistical data of the latest EU reports and primarily according to the Innovation Union Scoreboard published by the European Commission in March 2013 [IUS 2013], there is steady but slow progress in innovation performance in the EU, despite the continuing economic crisis [EC, 2013a].

The Scoreboard shows average innovation performance measured using composite indicators grouped into three categories and eight areas. The first index category includes so called 'basic conditions' that foster innovation implementation: human resources, open, ideal and attractive research systems, funding and support. The second category refers to company operations and reflects the efforts of European enterprises towards innovation, including investment, networking and entrepreneurship as well as intellectual assets. The third concentrates on indices of 'products' which show how innovations translate into benefits for the whole economy. Innovation leaders and economic results, including employment, are the specific indices in this category [EC, 2013a].

The IUS 2013 and a complementary report to the Scoreboard conclude that the majority of the EU member states improved their innovation performance. However, there are still countries, from Central

⁵¹ For details see: http://ec.europa.eu/cip/cosme/index_en.htm

and Eastern Europe in particular, which do not concentrate sufficient efforts in order to boost their performance to bridge the gap, which widens year on year, as is the case in Poland. The differences in the results between the states are substantial and the innovation gap between the member states is growing. The authors of the report claim that the negative innovation results were influenced by the continuing economic crisis in the EU, which contributed to the fall in business and venture capital investment over the years 2008-2012 [EC, 2013a; 2013b].

The most innovative countries, which have been the innovation leaders for a number of years, are still improving their performance. As in the 2012 Scoreboard, among the innovation leaders are Sweden (SII equals 0.747), Germany (0.72), Denmark (0.718) and Finland (0.61). These countries show performances above that of the EU average (0.544). In the second group there are innovation followers which show a performance close to that of the EU average: Holland, Luxemburg, Belgium, Great Britain, Austria, Ireland, France, Slovenia, Cyprus and Estonia. The third group consists of moderate innovators: Italy, Spain, Portugal, The Czech Republic, Greece, Slovakia, Hungary, Malta and Lithuania. These are the states that show performances below that of the EU average. The final group consists of modest innovators: Poland (0.27), Latvia (0.225), Rumania (0.221) and Bulgaria (0.188). Among the countries that boosted their innovation performance over the years 2008-2012, expressed by percentage change on the SII index value, are Estonia (7.1%), Lithuania (5.0%), Latvia (4.4%) and Slovenia (4.1%). Poland recorded the very slight growth of 0.4% (EC, 2013a).

Analysing the latest report from the European Commission, *The State of the Innovation Union* [EC, 2013a], it is worth considering the most significant factors stimulating innovations. Undoubtedly SMEs are the main drivers that turn ideas into products and commercial services. These commercialised innovations come through excellent research systems. All the innovation leaders rely on research and development and therefore allocate a very high level of expenditure in these areas and, in support of such national actions towards innovations, companies and universities play the most prominent roles. In addition, it is common for these innovation leaders that their business sectors show a higher level of investment in R&D than in other EU member states. These countries are the main patent applicants and have a highly developed link between universities and industry. For example, while the EU average patent application index stood at 3.9 in 2012, both Finland and Sweden's stood

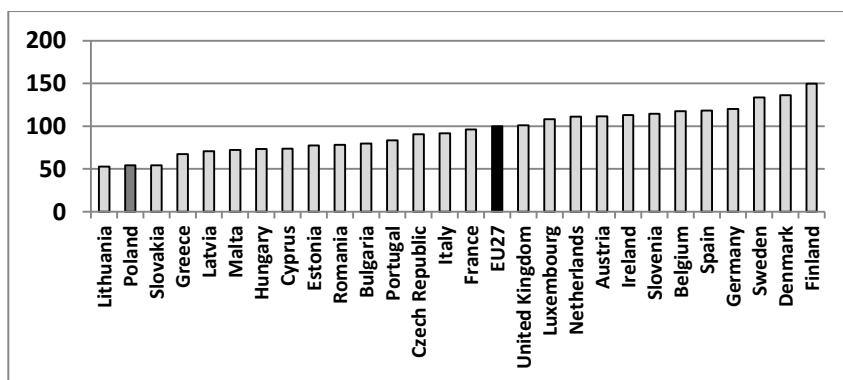
at 8.93, Germany-7.42 and Denmark-7.04. Poland scored as low as 0.45, Bulgaria-0.34, Lithuania-0.31 and Romania only 0.18 [EC, 2013a].

The Scoreboard therefore points to the fact that Poland is among the least innovative EU countries. Furthermore, 2012 saw regression in reference to 2011 (a fall from 23rd position to 24th) [EC, 2013a]. The lowest scores are recorded in the areas of cooperation between science and business, the number of innovators, quality, openness and excellence of research systems. The results of funding and support, namely public and private expenditure on R&D [Zadura-Lichota 2013] are still deeply unsatisfactory.

Analysis of the EU's and Poland's eco-innovation potential

The low scores in innovation potential of Poland translate into very poor results in the area of eco-innovation. According to the annual report of the *Eco-innovation Observatory* (EIO), Poland took the second last position in the eco-innovation ranking across EU member states for 2012, slightly improving its result from 2011 when it bottomed the list. [EIO 2012; EIO 2013].

In order to compare overall eco-innovations across EU member states, one composite index was constructed (SEI) comparing the results to the mean of 100 for EU27. The results for 2012 are presented in Graph 1.



Graph 1. Overall eco-innovation results for the EU states in 2012

Source: Own work based on EIO, 2013.

Lithuania, Poland, Slovakia, Greece, Latvia, Malta, Hungary, Cyprus, Estonia, Rumania, Bulgaria, Portugal, The Czech Republic, Italy,

France, the EU, Great Britain, Luxemburg, Holland, Austria, Ireland, Slovenia, Belgium, Spain, Germany, Sweden, Denmark, Finland

In 2012, 12 of the EU states scored above the EU average, however 15 countries performed below the average. Eco-innovation leaders include Finland (SEI index 149.8), Denmark and Sweden. It should be highlighted that these countries are innovation leaders in the field of overall innovation in the 2013 IUS ranking. The fourth position taken by Germany (overall index 120) fully confirms the rule that a high level of innovation boosts eco-innovations. Germany tops the list of the second group of six countries of innovation followers, performing well. There are also six other countries which score at a medium level, Holland being their leader reaching 111.2. However Poland finds itself second last among the countries trying to close the gap with an index of 54.4, nearly three times lower than Finland.

The EU Eco-innovation Scoreboard (EIS) is an important tool which assesses and compares comprehensively the eco-innovation results of the EU member states. The overall eco-innovation index was calculated on the basis of sixteen indicators from eight different databases grouped in five areas:

1. Eco-innovation input, focusing on financial backing for eco-innovations as a percentage of GDP, the value of 'green investment' and scientific personnel in eco-innovations.
2. Eco-innovation activities, firms having implemented eco-innovations and environmental management systems.
3. Eco-innovation output, e.g. patents.
4. Environmental outcomes, namely consumption of water, material, energy and gas emission.
5. Socio-economic outcomes, which include employment in eco-industries (% of total workforce), eco-innovation market size, exports of products from eco-industries (% of total exports).

The score of the EU-27 member states in the five areas of eco-innovations over the years 2010-2012 is presented in Tables 2 and 3. Based on the data included in the tables, we can conclude that on the evidence of eco-innovation activities, Poland came last in environmental and socio-economic outcomes, taking 23rd place and 22nd in eco-innovation input and output. It is worth noting that in 2012, in comparison to the previous years, there was a slight improvement in the areas of eco-innovation activities and output, however, at the same time a slight fall in input, environmental and socio-economic outcomes.

Analysing Poland's scores in the area of overall eco-innovation, the situation is critical and the gap between the country and the EU leaders is huge. One may ask the question whether there is any possibility to bridge this gap and improve the situation.

Table 2. Comparison of eco-innovation performance across the EU-27 Member States in the areas of eco-innovation activities and input over the years 2010-2012

Country	Eco-innovation activities			Eco-innovation input		
	2010	2011	2012	2010	2011	2012
EU27	100	100	100	100	100	100
Austria	183	101	104	81	80	79
Belgium	69	90	88	135	144	142
Bulgaria	12	41	50	36	21	20
Cyprus	20	62	63	22	22	14
Czech Republic	70	171	167	73	80	69
Denmark	223	107	98	176	184	191
Estonia	60	95	96	77	67	94
Finland	105	125	120	288	272	279
France	47	83	83	108	96	115
Greece	64	25	27	45	n/a	n/a
Spain	258	224	215	123	120	102
Holland	30	58	58	100	101	97
Ireland	62	109	108	219	211	210
Lithuania	29	75	80	42	34	25
Luxemburg	45	95	79	76	81	74
Latvia	38	39	45	37	50	30
Malta	44	53	53	22	29	20
Germany	194	125	123	115	129	125
Poland	23	41	41	33	32	25
Portugal	109	122	124	64	62	71
Romania	35	118	114	48	42	40

Slovakia	30	67	75	36	35	34
Slovenia	6	119	105	55	68	55
Sweden	92	156	152	196	213	204
Hungary	39	82	80	50	49	34
Great Britain	14	110	125	119	135	124
Italy	104	88	89	90	73	79

Source: Own work based on EIO, 2013.

Table 3. Comparison of eco-innovation performance across the EU-27 Member States in the areas of output, environmental and socio-economic outcomes over the years 2010-2012

Country	Eco-innovation output			Environmental outcomes			Socio-economic outcomes		
	2010	2011	2012	2010	2011	2012	2010	2011	2012
EU27	100	100	100	100	100	100	100	100	100
Austria	258	223	168	114	114	106	138	112	102
Belgium	153	101	117	96	95	91	131	153	159
Bulgaria	n/a	37	98	43	47	46	167	193	195
Cyprus	116	86	107	73	74	67	99	111	121
Czech Republic	51	17	23	67	68	65	77	129	135
Denmark	245	182	171	110	109	108	137	98	96
Estonia	n/a	63	69	48	52	49	59	92	90
Finland	205	186	196	78	77	76	119	106	103
France	89	119	89	114	111	110	112	83	79
Greece	10	69	92	89	88	88	34	43	51
Spain	18	144	120	98	101	103	77	127	120
Holland	252	112	124	146	139	131	92	123	142
Ireland	35	159	128	91	86	99	38	26	24
Lithuania	4	23	23	74	70	75	46	54	54
Luxemburg	142	240	143	148	145	138	73	89	98
Latvia	7	95	97	86	82	66	82	119	117
Malta	n/a	117	97	131	132	123	45	14	7

Germany	245	160	155	111	110	108	121	95	93
Poland	9	23	52	64	66	61	83	84	81
Portugal	14	63	72	87	86	86	59	72	64
Romania	1	41	101	56	59	60	98	78	81
Slovakia	n/a	12	30	81	85	74	43	61	53
Slovenia	n/a	58	103	73	74	76	143	233	241
Sweden	233	187	177	122	108	105	90	56	39
Hungary	58	58	52	99	99	75	77	120	125
Great Britain	70	73	71	137	136	131	83	63	60
Italy	72	63	71	110	113	110	96	106	104

Source: Own work based on EIO, 2013.

It seems that Polish innovation will be able to improve, but immediate action must be carried out, most of all in the attitude towards development policy at governmental level. Policy and public actions must facilitate eco-innovation in Poland starting from today [Bukowski et al., 2012b]. Poland's low score may stem from flaws in the eco-innovation development support system. On an optimistic note, Poland is capable of competing in eco-innovations immediately, at least through implementing pro-innovation reforms and ensuring adequate funding of eco-innovative initiatives, for SMEs in particular.

To sum up the analysis of eco-innovation performance in the EU member states, one will come to the conclusion that through its report the European Commission points to the directions and solutions for future sustainable eco-innovation development across all the UE states [EIO, 2013]. The authors of the report agree unanimously that a strategic partnership between decision-makers, companies, citizens and scientific personnel is necessary to identify the actions needed in order to boost the role of ecological innovations in the transfer towards an ecological economy, also called a 'green' economy.

Eco-innovation development barriers

The studies conducted in the EU countries in 2011 on the approach of European entrepreneurs towards eco-innovations [EC, 2011c] pointed to the fact that the majority of countries, including Poland, see a slow and hesitant development of the eco-innovation market. Despite some

positive indicators on eco-innovation initiative development, there are still a number of barriers. This situation mainly occurs in the new member states.

The two main barriers hampering eco-innovations are uncertain market demand and investment return. Other significant obstacles include: the lack of acceptable environmental benefits and their costs set against market prices, funding limitations, rigid economic structures, barriers linked to infrastructure and behaviour patterns, perverse incentives and subsidies. It is worth mentioning that entrepreneurs frequently do not possess sufficient knowledge on the benefits and effective ways of eco-innovation implementation. Awareness of the advantages of ecological innovative technology implementation among entrepreneurs and consumers in Poland is relatively low compared to the eco-innovation leading countries [EC, 2011a; EC, 2011c].

Ecological innovations are still perceived as mostly ‘end-of-pipe’ innovations or environment protection technologies. Entrepreneurs are very cautious about the low-emission economy concept, unwilling to implement rigorous environmental protection laws, often regarded as an extra cost. Investing in cheaper technologies and the unwillingness to establish cooperation with R&D institutes are also significant barriers in eco-innovation implementation in companies [EC, 2011c; Szpor, 2012].

Unfortunately, Poland lacks an integrated system of ecological innovation support and although recently there have been strategic declarations at the governmental level, many areas of public policy still suffer from a lack of decisive actions. Today Poland needs a long-term strategy on eco-innovations, based on partnership as well as more overall national interest and engagement as numerous issues and barriers significantly hamper eco-innovation performance. The creation of clusters brings hope for the future and the increasing support of some institutions, e.g. the National Research and Development Centre and the National Fund for Environmental Protection and Water Management, given through programmes promoting mainly innovative pro-ecological technologies (e.g. see the above mentioned Gekon). Therefore, it is justified to say that Poland is capable of accelerating eco-innovation development mainly through adequately geared policies and actions, allocating extra funds for investment in the area of eco-innovations as well as the implementation of the right risk reducing tools for entrepreneurs and investors.

Summary

The last decade has seen steady, consistent growth in interest on eco-innovations at the European level. The most significant reasons for

eco-innovation development undoubtedly include the occurrence of climate change, global competitiveness growth and exhaustion of natural resources.

Eco-innovations, which have huge potential, are definitely the answer to the challenges of today's EU economy, particularly in the area of competitiveness growth. Where business and environment go together, there is always a place for eco-innovations as they are beneficial both for the economy and the environment.

Ecological innovations top the EU innovation policy list of priorities in the 2020 framework, which is why the EU applies various types of eco-innovation support instruments. However, this backing is still not sufficient as apart from adequate financial incentives there is a call for a more coordinated approach of institutions engaged in the innovation sector development, scientific research and environmental protection. Eco-innovation applications run by The European Commission within the *COSME* programme should continue in the new financial framework as they successfully contributed to the implementation and propagation of eco-innovative projects across the EU.

Based on IUS and EIO statistics, one can conclude that there are significant divergences in the areas of innovation and eco-innovation performance among EU member states. The Polish economy, like the economies of other new member states, still shows a low interest in innovation thus eco-innovations. In order to catch up with innovation leaders Poland must put more emphasis on innovative economy promotion. Engagement on the national level seems vital. Policy and public action must foster eco-innovation and the implementation of such actions should be commenced immediately.

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***THE FACTORS STIMULATING SCIENCE AND
ENTERPRENERS COOPERATION, INNOVATION
PRECESSES EFFECTIVENESS***

FACTORS SHAPING INNOVATION COOPERATION BETWEEN COMPANIES AND RESEARCH AND DEVELOPMENT INSTITUTIONS EXEMPLIFIED BY THE CASE OF SOUTH-WESTERN POLAND

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Abstract

The aim of this paper is the presentation of the probit models analysis factors shaping innovation cooperation between companies and research. The practical issue is exemplified by the case of south – western Poland. The main aspect is the stimulation of innovation cooperation with the R&D sector. The article shows local influence of regional location of the participants of the supply chain on innovation cooperation between industrial companies of south-west Poland and universities, research institutes and Polish Academy of Science. The paper is divided into three significant parts focusing on: cooperation between business and universities and Polish Academy of Science, research institutes and foreign R&D centers. The author of chapter investigates the probability of innovation cooperation between R&D sector institutions and industrial companies of south-west Poland which operate locally or regionally, the probability of innovation cooperation between R&D sector institutions and industrial companies of south-west Poland which operate internationally or at least nationally and the probability of innovation cooperation between R&D sector institutions and large and medium-sized industrial companies of south-west Poland.

Key words: Innovation, companies and R&D cooperation

Introduction

The literature on the subject separates the sources of innovation into internal and external [Stawasz, 1999]. Internal ones are those which operate inside a company [Świadek, 2011]. External ones are divided into national and foreign [Jasiński, 2000]. Availing of a national or foreign source depends on the company's standing, type of activity, financial situation, type of market and product [Janasz, Koziół, 2007]. National sources include research and development institutions grouped into four pillars: a) Polish Academy of Sciences departments, b) research institutes, c) universities, d) research departments [www.stat.gov.pl/GUS/definicje].

Foreign sources of innovation come from foreign institutions with their own R&D resources. They are companies or institutions which transfer knowledge, licences and know-how.

Cooperation between R&D institutions and companies boils down to four aspects: a) education of employees or potential employees, b) provision of information on the sector's state and available technical solutions, c) provision of knowledge on new products and processes or improvement of existing products and processes, d) operations of normalisation, certification and calibration of devices (the act on research institutions, 2010; the act on the Polish Academy of Sciences, 2010).

Universities implement the first aspect of R&D sector cooperation with companies. They educate both employees and candidates for employment at three levels (baccalaureate, master and doctoral studies). In addition they offer MBA and post-graduate studies. The Polish Academy of Sciences also provides education (doctoral and post-graduate studies) for employees and candidates for employment.

Universities, research institutes and the Polish Academy of Sciences departments deal with the second aspect of R&D sector cooperation with companies. Within these operations the above mentioned institutions provide expertise, opinions, market research and various analyses for the companies they cooperate with. They can also run and develop databases as well as operate in the areas of scientific, technical, economic information, inventiveness as well as industrial and intellectual property. Additionally, they are occupied with publishing activities, such as releasing monographs and specialised journals.

Research institutes, development departments, the Polish Academy of Sciences departments and universities implement the third aspect of cooperation between the R&D sector and companies. They run scientific and development research, adjust their results to practical demands and put these results into production. They can also, on the basis of their research, start manufacturing devices, equipment, materials and other products which can be made available to companies. The implementation of the latter, in accordance with the acts of law, takes place exclusively in research institutes.

Set in this context, the main aim of the research was to provide an answer to the question of which factors have an impact on establishing cooperation between industrial companies of south-west Poland and R&D institutions. The research hypotheses are the following:

1. The probability of innovation cooperation between R&D sector institutions and industrial companies of south-west Poland which

operate locally or regionally is lower than the probability of innovation cooperation between R&D sector institutions and industrial companies of south-west Poland which operate internationally or at least nationally.

2. The probability of innovation cooperation between R&D sector institutions and large and medium-sized industrial companies of south-west Poland is higher than the probability of innovation cooperation between R&D sector institutions and micro and small industrial companies of south-west Poland.

Methodology of the research

The empirical data, which became the basis for the calculation and consequently interpretation of the results, was obtained from the survey sent to industrial companies of Dolnośląskie and Lubuskie Voivodships. The analysis has a statistical nature and refers to the period 2009-2011, which follows the methodology standards included in the Oslo Manual [2008].

In order to confirm or reject the research hypotheses, the following parameters defining a company and its relations were implemented as independent variables: a) company size (micro, small, medium-size and large), b) the source of capital (national, foreign and mixed), c) company income (growth, drop, stagnation), d) situation in the sector in which a company operates (growth, recession), e) employee qualifications (high, low), f) market features: location in reference to the researched company (local, regional, national, international), territory (major urban centres, minor urban centres, rural areas), PKD⁵² section (potential purchasers), g) location in reference to the researched company of other participants of the supply chain (suppliers, purchasers and competitors): local, regional, national, international, h) relations with other participants of the supply chain: only necessary contact, no contact, cooperative, hostile or amicable, i) technology level utilized by the company (technologies: high, medium-high, medium-low, low) . The dependent variable was the reason for establishing cooperation by the researched institution with: a) Polish Academy of Sciences departments, b) universities, c) research institutes and R&D departments, d) foreign R&D institutions .

⁵² PKD – Polska Klasyfikacja Działalności – Polish Statistical Classification of Economic Activities.

An index of companies available on the Internet was used as a starting point to establish the researched population. An overall presentation of the group is included in the table below.

Table 1. Features of the research population

No	Features	Dolnośląskie	Lubuskie
1	The number of surveys completed correctly	231	268
2	The number of industrial companies in the region in reference to the overall number of companies according to the applied index	14.2%	13.5%
3	The number of industrial companies in the region in reference to the overall number of companies according to the Central Statistical Office	8.2%	8.2%
4	The number of industrial companies of a voivodship in reference to the overall number of industrial companies from Dolnośląskie and Lubuskie voivodships according to the researched index.	76.6%	23.4%
5	The number of industrial companies of a voivodship in reference to the overall number of industrial companies from Dolnośląskie and Lubuskie voivodships according to the Central Statistical Office	75.8%	24.2%
6	The number of industrial companies from the applied index in reference to the number of industrial companies according to the Central Statistical Office	22.3%	21.4%
7	the number of companies which returned correctly completed questionnaires in reference to the overall number of industrial companies of a given voivodship	1.9%	6.4%

Source: Own work based on data taken from an Internet database and the Central Statistical Office.

As presented in Table 1, the applied index included 21-22% of the overall number of industrial companies from the researched voivodships. Questionnaires were sent to all the institutions in the above index. As for the population number, the data is comparable to the Central Statistical Office information on innovation activities in industry [GUS, 2009].

The return rate of the survey varied from 8.45% in Dolnośląskie to 30.6% in Lubuskie Voivodships. The very high level of returns in the

Lubuskie Voivodship stemmed from the method of questionnaire retrieval. Research personnel personally attended the companies after prior arrangements and, based on the interview with the authorised personnel, filled in the questionnaires. Due to technical reasons such conduct was feasible only in this voivodship. The surveys in the Dolnośląskie Voivodship were sent by post after a prior telephone conversation.

The dependent and independent variables were dichotomous, meaning they acquired values equal to 0 or 1. Dependent variables signify that cooperation with a competitor occurred (then the variable stood at 1), or it did not occur (then the variable stood at 0). The fact of dependent and independent variables being dichotomous results in the impossibility of applying the most popular modelling methods which include multiple regression.

For the purposes of this paper calculations were conducted using Statistica software. In total 228 probit models were created for four dependant variables out of 33 statistically significant and will be presented and discussed below.

Due to the application of models taking into consideration only one factor to interpret the research dependencies, structural models will be presented below. Key importance is attached to the symbol at the parameter. A positive one shows that the probability of establishing cooperation between an institution and an industrial company of a particular size is higher than in the remaining groups. A negative one signifies that the probability of innovation cooperation with an institution is lower than in the remaining groups.

Cooperation between business people and universities and the Polish Academy of Sciences departments

Cooperation between the industrial companies of south-west Poland and universities occurred much more often than cooperation with the Polish Academy of Sciences departments. It resulted in a fewer number of models describing the cooperation between the Polish Academy of Sciences departments and business people of the regions (only 2) in comparison to the number of models describing cooperation between universities and industrial business people (18). The statistically significant models obtained referring to cooperation between universities and the Polish Academy of Sciences departments and industrial companies were grouped according to the factors influencing this type of cooperation and presented in the table below.

Table 2. Probit models describing the influence of selected factors on establishing innovation cooperation between the industrial companies of south-west Poland and universities and the Polish Academy of Sciences departments over the period of 2009-2011

Independent variable	Parameter	S	T	$P > z $	P_1	P_2	χ^2	P
Part 1. The impact of other participants of the supply chain on the occurrence of innovation cooperation between business people and universities								
competitor's location abroad	+1.05	0.23	4.57	0.00	0.36	0.08	19.84	0.00
supplier's location abroad	+0.47	0.19	2.51	0.01	0.18	0.09	6.02	0.01
Purchaser's location national	+0.40	0.16	2.52	0.01	0.15	0.08	6.28	0.01
Supplier's location regional	-0.39	0.18	-2.10	0.04	0.06	0.12	4.71	0.03
Purchaser's location regional	-0.47	0.21	-2.23	0.03	0.05	0.12	5.49	0.02
competitor's location local	-0.50	0.18	-2.87	0.00	0.05	0.13	8.89	0.00
Part 1a. The impact of the location of other participants of the supply chain on the occurrence of innovation cooperation between business people and the Polish Academy of Sciences departments								
competitor's location abroad	+0.91	0.34	2.65	0.01	0.08	0.01	6.12	0.01
Part 2. The impact of sales range on the occurrence of innovation cooperation between business people and universities.								
local sales range	-0.74	0.31	-2.40	0.02	0.03	0.11	7.50	0.01
national sales range	+0.33	0.16	2.13	0.03	0.13	0.07	4.60	0.03
international sales range	+0.39	0.15	2.52	0.01	0.14	0.07	6.41	0.01

Part 3. The impact of Polish Classification of Activities (PKD) purchasers on the occurrence of innovation cooperation between business people and universities								
purchasers from B section of PKD	+0.49	0.22	2.25	0.02	0.20	0.09	4.80	0.03
purchasers from C section of PKD	+0.43	0.16	2.76	0.01	0.15	0.07	7.56	0.01
purchasers from D section of PKD	+0.59	0.21	2.74	0.01	0.22	0.09	7.08	0.01
purchasers from P section of PKD	+1.01	0.26	3.93	0.00	0.36	0.08	14.59	0.00
Part 3a. The impact of Polish Classification of Activities (PKD) purchasers on the occurrence of innovation cooperation between business people and the Polish Academy of Sciences departments								
purchasers from B section of PKD	+0.72	0.33	2.20	0.03	0.06	0.01	4.28	0.04
Part 4. The impact of the type of ownership on innovation cooperation between business people and universities								
Polish ownership of company	-0.46	0.17	-2.76	0.01	0.08	0.17	7.40	0.01
foreign ownership of company	+0.42	0.20	2.14	0.03	0.18	0.09	4.38	0.04
Part 5. The impact of other factors on innovation cooperation between business people and universities								
Large company size	+0.56	0.21	2.61	0.01	0.21	0.09	6.47	0.01
Sector growth	+0.62	0.22	2.84	0.00	0.12	0.04	9.44	0.00
Market located in major urban centre	+0.57	0.16	3.58	0.00	0.15	0.06	13.39	0.00

Source: Own work based on own research.

where:

S – standard error,

T – students's t-distribution for a parameter,

P>|z| – probability of a parameter's insignificance

P1 - probability of the occurrence of a particular phenomenon in the research group of companies

P2 - probability of the occurrence of a particular phenomenon in the other group of companies

χ^2 – Chi – squared test

P - probability of a model's insignificance

The influence of the location of the other participants of the supply chain on innovation cooperation between universities and the Polish Academy of Sciences departments and business people of south-west Poland

The most numerous group of factors that influence innovation cooperation between business people of south-west Poland and universities and the Polish Academy of Sciences departments are those linked to the location of the other participants of the supply chain. Within this group the influence of the location of a supplier, competitor and purchaser on the probability of innovation cooperation with universities and the Polish Academy of Sciences departments was considered.

In the researched group model the highest probability of innovation cooperation between universities and industrial companies occurs in the group whose competitors are located abroad. Foreign competitors stimulate cooperation between companies and the Polish Academy of Sciences departments. In the first case the probability of innovation cooperation with universities stood at 0.36 and it was 4.5 times higher than the probability of cooperation between universities and industrial companies whose competitors were located somewhere in Poland. In the other case the probability of innovation cooperation between industrial companies and the Polish Academy of Sciences departments stood at 0.08 and was 8 times higher than the probability of cooperation between the Polish Academy of Sciences departments and companies whose competitors were located in Poland.

Having a foreign supplier encouraged innovation cooperation between universities and industrial companies. Having a purchaser located in Poland, though outside the boundaries of the Lubuskie and Dolnośląskie Voivodships, also stimulates innovation cooperation between industrial companies and universities. On the other hand, industrial companies having suppliers and recipients located in the region hampers innovation cooperation with universities. The fact of having local competitors also discourages innovation cooperation between universities and industrial companies.

The influence of sales range and PKD section purchasers on innovation cooperation between universities and business people of south-west Poland

According to the models presented in part two of Table 2, the highest probability of innovation cooperation between universities and industrial companies occurred in the group whose sales range crossed the Polish borders. The probability of cooperation in this group of companies stood at 0.14 and was twice as high as the probability of cooperation between universities and companies whose sales range was limited to Poland.

A slightly lower probability of innovation cooperation between universities and industrial companies occurred in the group of companies whose sales range was national. However, having a local sales range had a decisively negative impact on the probability of innovation cooperation.

Following the data presented in the next part of Table 2 the highest probability of innovation cooperation occurred in the group of companies whose purchasers were ascribed to section PKD P (educational activities). The probability of innovation cooperation in this group of companies stood at 0.36 and was 4.5 times higher than the probability of innovation cooperation between universities and business people whose purchasers were located in other sections of PDB than section P.

Innovation cooperation between universities and industrial companies was also stimulated by having purchasers which fell into; D section of PKD (production and supplying of electric energy, gas, steam, hot water and air for air-conditioning systems), C section of PKD (industrial processing) and B section of PKD (mining and excavation). Having a purchaser belonging to section B of PKD stimulated innovation cooperation between the Polish Academy of Sciences departments and industrial companies.

The influence of the type of ownership and other factors on innovation cooperation between universities and business people of south-west Poland

The models from the fourth part of Table 2 lead to the conclusion that innovation cooperation between universities and industrial companies is stimulated by having the ownership rights to a company by institutions whose headquarters are located abroad. The probability of innovation cooperation in this case stood at 0.18 and was twice as high as the probability of innovation cooperation between universities and companies which belonged to people residing in Poland or were in part-ownership with a person living in Poland.

Similar conclusions can be drawn from the second model presented in part four of Table 2. The probability of innovation cooperation between universities and companies belonging to Polish parties stood at 0.08 and was more than twice as low as the probability of innovation cooperation between universities and companies which belong fully or at least partly to people resident abroad.

The fifth part of Table 2 indicates that the highest probability of innovation cooperation between universities and industrial companies occurred in the case of large companies. The probability stood at 0.21 and was more than twice as high as the probability of innovation cooperation between universities and companies of other sizes.

Having a market located in an major urban centre also stimulates innovation cooperation between universities and business people in south-west Poland.

The final model presented in Table 2 shows the impact of economic stimulation on innovation cooperation between industrial companies of south-west Poland and universities.

Innovation cooperation of business people with research institutes and development departments

In the case of cooperation between industrial companies of south-west Poland and research institutes and development departments there were seven statistically significant models. They were divided into three groups. The first one presents the impact of company size on cooperation with R&D departments and research institutes. The second shows the impact of sales range on innovation cooperation. The third is determined by the influence of location of the other participants of the supply chain and the PKD section of purchasers on innovation cooperation with the R&D sector and research institutes. All significant models created statistically are presented in Table 3.

Table 3. The influence of selected factors on innovation cooperation between research institutes and development departments and business people of south-west Poland between 2009 and 2011

Independent variable	Parameter	S	T	$P > z $	P_1	P_2	χ^2	P
Part 1. The impact of company size on innovation cooperation with the R&D sector and research institutes								
Micro companies	-0.54	0.19	-2.80	0.01	0.06	0.16	8.70	0.00
Medium-sized companies	+0.45	0.15	2.94	0.00	0.22	0.11	8.47	0.00
Part 2. The impact of sales range on innovation cooperation with the R&D sector and research institutions.								
Local sales range	-0.48	0.23	-2.07	0.04	0.06	0.15	4.80	0.03
international sales range	+0.32	0.14	2.28	0.02	0.18	0.11	5.20	0.02
Part 3. The impact of the location of other participants of the supply chain and the PKD section of purchasers on innovation cooperation with the R&D sector and research institutes.								
competitor location local	-0.43	0.16	-2.78	0.01	0.08	0.17	8.09	0.00
Purchaser located within the country	+0.35	0.14	2.39	0.02	0.19	0.11	5.63	0.02
Purchaser falling into section B of PKD	+0.43	0.21	2.07	0.04	0.24	0.13	4.11	0.04

Source: Own work based on own research.

The influence of company size and sales range on innovation cooperation between the R&D sector and research institutes and business people of south-west Poland

The data presented in the first part of Table 3 leads to the conclusion that the highest probability of innovation cooperation between R&D centres and research institutes and industrial companies occurred in the group of medium-size companies. The probability of cooperation between the institutions stood at 0.22 and was twice as high as the probability of innovation cooperation between R&D centres and research institutes and companies of a different size.

However, micro company size has a discouraging impact on innovation cooperation between R&D centres and research institutes. The probability of innovation cooperation stood at 0.06 and was over 2.5 times lower than the probability of innovation cooperation between R&D centres and research institutes and small medium-size or even large companies.

The second part of Table 3 presents the highest probability of innovation cooperation between the institutions, which occurred in the group of companies whose sales range was international. This stood at 0.18 and was 64% higher than the probability of innovation cooperation between R&D centres and research institutes and industrial companies of south-west Poland whose sales range was not international.

A clearly discouraging impact on innovation cooperation between R&D centres and research institutes and business people of south-west Poland came from having a local sales range. The probability of innovation cooperation in this group stood at 0.06 and was 2.5 times lower than the probability of innovation cooperation between R&D centres and research institutes and business people of south-west Poland whose sales range exceeded this.

The influence of other participants of the supply chain and PKD sections of purchasers on innovation cooperation between R&D centres and research institutes and business people of south-west Poland

The last part of Table 3 concludes that having a local competitor has a negative impact on innovation cooperation between business people and R&D centres and research institutes. The probability of innovation cooperation in this group stood at 0.08 and was twice as low as the probability of innovation cooperation between R&D centres and research institutes and business people whose competitors were located further afield.

Innovation cooperation between R&D centres and research institutes and business people of the Lubuskie and Dolnośląskie Voivodships is stimulated by having purchasers located nationally but beyond the borders of south-west Poland. The probability stood at 0.19 and was 73% higher than the probability of innovation cooperation between R&D centres and research institutes and business people whose purchasers were local, regional or even international.

The last statistically significant model presented in the third part of Table 3 depicts the stimulating effect of a purchaser that falls into section B of PKD (mining and excavation) on innovation cooperation between R&D centres and research institutes and business people of south-west

Poland. The probability of innovation cooperation between then stood at 0.24 and was 85% higher than the probability of innovation cooperation between R&D centres and research institutes and business people of south-west Poland whose purchasers were located in sections other than B of PKD.

Cooperation between business people and foreign R&D centres

In the case of innovation cooperation between business people of south-west Poland and foreign R&D centres, six statistically significant models were created which describe the factors influencing innovation cooperation between these institutions. The factors varied greatly therefore are impossible to divide, which is why they were put together. The obtained calculated models are presented in the table below.

Table 4. The influence of selected factors on innovation cooperation with foreign R&D centres and business people of south-west Poland between 2009 and 2011

Independent variable	Parameter	S	T	P> z 	P₁	P₂	χ^2	P
Large companies	+0.81	0.26	3.07	0.00	0.12	0.02	8.59	0.00
Polish ownership of a company	-0.66	0.23	-2.88	0.00	0.02	0.08	8.12	0.00
Income growth	+0.81	0.37	2.18	0.03	0.04	0.01	6.95	0.01
International sales range	+0.47	0.23	2.06	0.04	0.05	0.02	4.43	0.04
market located in major urban centres	+0.56	0.24	2.32	0.02	0.05	0.01	5.87	0.02
high technologies applied in a company	+0.49	0.24	2.04	0.04	0.05	0.02	4.49	0.03

Source: Own work based on own research.

The above table shows that the probability of innovation cooperation with foreign R&D centres and industrial companies of south-west Poland occurred in the group of large companies. The probabilities of innovation cooperation in this group stood at 0.12 and was six times

higher than the probability of innovation cooperation between foreign R&D centres and industrial companies other than large ones.

Having a market located in a major urban centre encourages innovation cooperation between foreign R&D centres and industrial companies of south-west Poland. In this case the probability of innovation cooperation stood at 0.05 and was five times higher than the probability of innovation cooperation between foreign R&D centres and companies whose markets were located in minor urban centres and rural areas.

Another factor which stimulates innovation cooperation between foreign R&D centres and industrial companies of south-west Poland was the income growth achieved by companies. In the case of an improvement in income generated by the companies of south-west Poland the probability of innovation cooperation between foreign R&D centres and the companies stood at 0.04 and was four times higher than the probability of innovation cooperation between foreign R&D centres and companies whose income stayed at the same level or decreased.

Having an international sales range and the application of high technologies stimulated innovation cooperation between foreign R&D centres and industrial companies of south-west Poland. In both cases the probability of innovation cooperation stood at 0.05 and was 2.5 times higher than the probability of innovation cooperation between foreign R&D centres and companies whose range is not international or apply other technologies than high ones.

The only discouraging factor affecting innovation cooperation between foreign R&D centres and industrial companies was Polish ownership of these companies. In this case the probability of innovation cooperation stood at 0.02 and was four times lower than innovation cooperation between foreign R&D centres and companies which were fully or at least partly owned by foreign parties.

Summary

While analysing the probit models attention should be drawn to several patterns. The most frequently occurring regularity is the stimulation of innovation cooperation with the R&D sector by the fact that industrial companies have other participants of the supply chain (competitors, suppliers or purchasers) located abroad or at least beyond the region. This location of the other participants of the supply chain encourages innovation cooperation between industrial companies of south-west Poland and universities, Polish Academy of Sciences departments, research institutes and development departments. On the other hand a local

or regional location of the other participants of the supply chain discourages innovation cooperation between industrial companies of south-west Poland and universities, research institutes and development departments.

A similar dependency occurs in reference to the independent variable 'sales range'. The fact of industrial companies having a market located internationally (or at least beyond the region) encouraged innovation cooperation between industrial companies of south-west Poland and universities, foreign R&D centres, research institutes and development departments. However, a local sales range discouraged innovation cooperation between industrial companies and universities, research institutes and development departments.

The impact of the independent variable 'type of company ownership' follows the above regularity. The probability of innovation cooperation between industrial companies owned by foreign parties and universities is higher than the probability of innovation cooperation between universities and foreign R&D centres and industrial companies owned fully or partly by Polish parties.

The reasons for the above regularities can be found in the demanding nature of innovation activities of companies located not only in Poland, but also within the so called 'Visegrad Group'. The lack of pressure from clients and competitors on the implementation of new products has a negative impact on innovation activities of industrial companies. Due to the low level of economic advancement of the researched regions there is an absence of pressure from customers and local and regional competitors to implement new products into production. In such an environment there is a shortage of innovation cooperation between industrial companies and R&D departments, as companies do not feel compelled to do so. The appearance of a participant of the supply chain located abroad causes pressure on companies to implement a new product and consequently establish cooperation with R&D departments.

While interpreting the research results it is worth paying attention to the stimulating effect of having section B of PKD purchasers (mining and extraction) on innovation cooperation between these companies and R&D institutions such as: universities, Polish Academy of Sciences departments, research institutes and development departments. The reasons for this regularity can be found in the location of KGHM Polska Miedź SA. (an industrial conglomerate) in the Dolnośląskie Voivodshp. Due to its size, wealth and international competition challenges the company demands a lot from its subsidiaries and suppliers, which induce cooperation with the R&D sector.

Company size can also encourage innovation cooperation between universities and foreign R&D centres and industrial companies of south-west Poland. This stems from the fact that large companies have access to more substantial resources (capital, human resources and others) which can be allocated towards cooperation with the R&D sector. Whereas, the smaller the size of a company the less resources it has, which translates into the lower likelihood of cooperation with the R&D sector. It seems crucial as departments of the R&D sector have very humble resources at their disposal and without an external funding source they are not able to initiate cooperation with industrial companies beyond the stage of informing of their willingness to do so. Moreover, departments of the R&D sector favour cooperation with large companies due to the range of cooperation and the possibility of receiving funding.

By and large, one can claim that the smaller the size of a company, the less probability of innovation cooperation between industrial companies and science institutions. Innovation cooperation between industrial companies and departments of the R&D sector is encouraged when medium-size companies cooperate with research institutes and development department. On the other hand, micro size definitely discourages innovation cooperation.

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DETERMINANTS OF COOPERATION WITH INSTITUTIONAL PARTNERS AND INNOVATION -PERFORMANCE OF POLISH MANUFACTURING ENTERPRISES. RESEARCH OUTCOMES.

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Abstract

The aim of this paper is to assess of the influence of institutional cooperation (with research institutes and universities) on the innovation performance of companies as well as determinants of such cooperation. The analysis was based on data from the Polish version of the *Community Innovation Survey* (CIS) for 2008-2010. The sample consists of 7783 medium-sized and large manufacturing enterprises from sections C to E. Based on the results of a structural equation model it has been concluded that there is a statistically significant relation between institutional cooperation and innovation performance of the researched companies, as well as (in the case of cooperation with Polish companies) in the introduction of product innovations new for the country, Europe or the world. The analysis of critical values between parameters enables the establishment of a hierarchy of company features which determines such cooperation. These include the system of employee incentives for the creation of intellectual property, company size and own R&D -department. The application of the employee incentive system better explains the decision to establish cooperation with Polish companies than with foreign ones. However a feature which is not institutional cooperation friendly is belonging to a larger group of companies. Key words: institutional cooperation, innovation -performance, Polish CIS, Poland

Key words: science and industry cooperation, innovation performance of enterprises

Introduction

At present, due to the rate of change, rising costs and risk of failure, the implementation of complex innovation projects without cooperation is practically impossible. A company requires specialised knowledge which may be gained from partners in the supply chain, competitors or institutional partners [Kessler et al., 2000]. Between 2008 and 2010, every third company cooperated in innovation ventures (the EU average is 25.5%). A slightly higher percentage was registered in medium-

sized companies and even higher among large companies, where six out of ten declared such a cooperation [Eurostat Statistics Database]. Polish - manufacturing companies value most highly cooperation with their suppliers, then customers followed by research institutes, universities, consulting companies, competitors, Polish Academy of Sciences departments and foreign research institutes [Central Statistical Office] Cooperation with institutional partners is classed as least valuable, which may be surprising taking into consideration that the success of cooperation depends not only on the innovativeness of partners, a willingness to participate in projects together but also on the reduction of opportunistic behaviour, which is a more common among institutional partners [Möller, P. Törrönen, 2003].

This type of cooperation, analysed in the context of the innovation performance of a company, is the subject of this paper. The first section includes a review of the literature and the research hypotheses. The second presents the sample, the research methods and variables operationalisation. The third provides the results and the fourth the conclusions.

Institutional cooperation and company innovation performance - theoretical background and research hypotheses

Recent years have seen the growing popularity of the concept of *open innovation*, meaning ‘systematic creation, finding, maintaining and application of knowledge inside and outside an organisation as a result of innovation processes’ [Lichtenthaler, 2011] and implemented in cooperation with various external institutions [Chesbrough, 2003; H. Chesbrough, et al. 2006; E. Von Hippel, 2005]. The selection of partners for cooperation depends on, among others, the nature of the innovation project, competencies of the parties and their behaviour in mutual relations. This cooperation can be vertical - within the value chain or horizontal (at a particular stage of value creation), among others, with competitors and institutions (research institutions and universities). Literature offers many examples of the positive impact of institutional partner cooperation on company innovation performance. Based on the results of CIS for France and Germany, Robin and Schubert [2013] proved that while institutional cooperation is product innovation friendly, it does not influence process innovation. On the other hand, Monjon and Walbroeck [2003] claim that companies which introduce more radical innovations are more likely to cooperate with universities, whereas less innovative companies avail of ready available solutions to a greater degree. Lööf and Brostrom [2008] proved the existence of a positive link between institutional cooperation

and innovation performance in the case of large companies and Miozzo and Dewick [2004] analysed this relationship amongst companies in the - construction industry. Based on the above, the first research hypothesis is-proposed as:

H1. Innovation cooperation with institutional partners impacts positively on company innovation performance.

Usually the introduction of innovation 'new to the market' is not accidental but reflects strategic operations geared towards the improvement of a company's market position [Hamel and Prahalad, 1989]. Implementation of new solution creation processes (e.g. a new product or technology development) and their commercialisation requires huge financial resources (in particular, in the case of radical breakthrough innovations), and is also linked with the high technical, market and economic risk of such a project's failure [Rutkowski, 2007]. On the other hand, only such projects are potentially able to ensure the company's stronger, more difficult to imitate, effect of differentiation. Institutional partners possess knowledge which encourages the creation of brand new products [Belderbos et al. 2004a, Nieto and Santamaria, 2007]. At the same time they are not directly affected by market changes in the case of innovation project implementation, which lead to the creation of new market segments [Tether, 2002; Monjon and Waelbroeck, 2003], therefore their behaviour is, by nature, less opportunistic than other cooperation partners [Kim and Lui, 2010]. The above deliberations lead to the next research hypothesis:

H2a. Innovation cooperation with institutional partners encourages the introduction of new market innovations or the creation of new market segments.

Institutional cooperation determinants in the area of innovation activity

Research proves that success in introducing innovation that stems from cooperation, largely depends on a company's absorptive capacity, which is the result of company resources and competences [Cohen, Levinthal, 1989 and 1990]. The more a company invests in R&D the better it is prepared to absorb knowledge from outside, including that from cooperation. Literature stresses the growing importance of intangible resources for the creation of a company's competitive potential [Grant, 1991; Sulikowska-Formanowicz, 2002], in particular knowledge, regarded by many researchers as a strategic resource [Kogut, Zander, 1992]. The development of employee competences and the stimulation of the ability to undertake particular tasks as well as attitudes towards external institutions increase the importance and value of intangible resources [de Wit, Meyer,

2007]. Taking the above into consideration, the following research hypotheses is-proposed as:

H3. The internal resources of an innovative company encourage innovation cooperation with institutional partners.

H4. The employee incentive system to create intellectual property in an innovative company encourages innovation cooperation with institutional partners.

Many previous researches highlights the importance of company size on innovation cooperation. This stems from the fact that large companies, by their very nature, have greater resources, a greater absorptive capability of knowledge from outside and therefore can draw greater benefits from cooperation. The majority of research points to the positive relationship between company size and a willingness to cooperate [Leiponen, 2002] including this with institutional partners [Laursen and Salter, 2004; Fontana et al., 2006; Serrano-Bedia et al., 2010,], therefore the next research hypothesis is placed as:

H5. The size of an innovative company influences positively cooperation in innovations with institutional partners.

Being a part of a capital group gives access to the resources of other group members which affects a company's standing and transaction security thereby making it easier to gain new cooperation partners. However, the resources within the group of companies may fulfil the individual company's needs, decreasing its incentive to look for external cooperation partners. Taking into consideration the fact that literature on the subject points mainly to the positive relationship between belonging to a capital group and establishing cooperation in innovation with institutional partners [Tether, 2002; Mohnen and Hoareau, 2003; Belderbos et al., 2004b], though the opposite view is also expressed in certain papers [Veugelers and Cassiman, 2005], the final hypothesis is proposed as:

H6. Being a innovative member of a capital group encourages cooperation in innovations with institutional partners.

Research sample, methods, variables applied in the structural model

Analysis was conducted on a representative sample of 7783 medium-sized and large Polish companies from the research GUS PNT-02

for the years 2008-2010, belonging to the sections from C to E (according to PKD 2007) ⁵³, Table 1.

Table 1. The features of research analysis

Features of sample *		Sample in the model N=745		Non-Innovators N=4988		-Innovators N=2795		Complete sample N=7783	
		N	%	N	%	N	%	N	%
Product innovation		745	100	0	0a	2055	73.5b	2055	26.4
Process innovation		619	83.1	0	0a	2169	77.6b	2169	27.9
Organisational innovation		530	71.1	458	9.2a	1349	48.3b	1807	23.2
Marketing innovation		45.1	60.5	402	8.1a	1107	39.6b	1509	19.4
Company size	Medium-	397	53.3	4356	87.3a	1885	67.4b	6241	80.2
	Large	348	46.7	632	12.7a	910	32.6b	1542	19.8
Technology level	Not classified	0	0	655	13.1a	272	9.7b	927	11.9
	Low	170	22.8	2232	44.7a	843	30.2b	3075	39.5
	Medium	525	70.5	2026	40.6a	1558	55.7b	3584	46
	High	50	6.7	75	1.5a	122	4.4b	197	2.5
Capital group	Polish	165	22.1	406	8.1a	478	17.1b	884	11.4
	Foreign	179	24.0	527	10.6a	615	22.0b	1142	14.7
	Independent firm	401	53.8	4055	81.3a	1702	60.9b	5757	74
Target market	Local	201	27.0	1667	33.4a	661	23.6b	2328	29.9
	National	344	46.2	1981	39.7a	1359	48.6b	3340	42.9
	EU	173	23.2	1165	23.4a	654	23.4a	1819	23.4
	Other markets	27	3.6	175	3.5a	121	4.3a	296	3.8

* Based on estimated boundary average. The difference in variables is significant at .05 level. Index a/b – Benferroni correction for multiple comparisons. Each letter in the lower index indicates a cluster which features differ significantly at .05 level.

Source: Own research based on the PNT-02 questionnaire. *Report on innovations in industry for 2008-2010*, www.stat.gov.pl/formularze.

⁵³ The selection for the research was done using Polish Classification of Business Activities (PKD) 2007 adhering to the EU Statistical Classification of Business Activity (NACE Rev. 2). In 2011 research on innovation in industry (sections B to E) and in services sector (sections H to M) were conducted on the complete sample. For more details see : *Działalność innowacyjna przedsiębiorstw w latach 2008-2010*, GUS, Urząd Statystyczny w Szczecinie, Warszawa 2012, p. 15. Stand alone basis was obtained thanks to the R 082-06/12 contract dated 19.02.2012 on the access of individual, non-identifiable data gained from the PNT-02 research on innovation in industry for 2008-2010 for Poland.

In order to indicate statistically significant differences between innovative and non-innovative companies, Chi-square with column proportions (Bonferroni method) was used. In the research sample, the majority are *Non-Innovators*, N=4988, meaning those which, between 2008 and 2010, did not introduce neither process nor product innovation. and Innovators, N=2795, which mainly introduced process innovation (77.6%), followed by product innovation (73.5%), organisational (48.3%) and marketing innovation (39.6%). The analysed sample is dominated by medium-sized companies (67.4%) from medium -technology sectors (55.7%)(according to EUROSTAT, 2008), mainly independent (not part of any capital group) (60.9%) and for which Poland is the most significant target market (48.6%). Based on institutional partner cooperation indication, from the *-Innovators* cluster for the structural model, N=745 companies were qualified (see details in Table 1).

Research method

In order to assess the cause relationship between variables, an analysis of structural equations was applied. It analysed the structure and strength of linear –relationship between at least one independent variable and one or more dependent variables [Bedyńska, Książek, 2012]. The aim of this modelling is to find a model which will, reflect reality in the best way [Perek-Białas, Pleśniak, 2013]. The analysis refers not only to the direct relationships between variables but also those that are indirect and combined [Gaul, Machowski, 1987]. Using a structural model we can differentiate *observable variables (visible)*, measured during the research and marked with rectangles, and *unobservable variables (hidden, latent)*, marked with ellipses, which are not directly measured during the research but are introduced theoretically and may have an impact on the expected cause and effect relationships depicted by path coefficients ascribed to the particular arrows [Książek, 2012]. Residue variables are introduced to the model to represent the influence of variables not covered by the analysis, these are –marked with a circle. In order to determine the hierarchy of the influence of particular variables an analysis of the critical values between parameters was also conducted.

Variables applied in the structural model

Like other researchers [Veugelers and Cassiman 2004, Mothe et al, 2010], we assume as a filter variable, the question whether a company between 2008-2010 introduced new or significantly improved products or processes. On this basis, 2795 companies were classified as *Innovative*. The level of a company's innovation -performance (*SprInno*) will be

measured by such variables as: the introduction of product innovation new for the market (*InnoProdNR*), the introduction of product innovation first in the country, and/or Europe, and /or the world (*InnoProdNKEŚ*) and the introduction of process innovation new for the market (*InnoProcNR*).

Institutional cooperation (*WspInst*) will be operationalised with observable variables such as indication of the cooperation partner: Polish Academy of Sciences, a research institute, a public foreign R&D institution, a university from Poland and/or abroad. The variables will create 2 subcategories: institutional cooperation with Polish partners (*WspInstKr*) and institutional cooperation with foreign partners (*WspInstZ*).

The remaining variables signify the importance of a company's own resources, including R&D department (*WIZasPrz*), the existence of an employee incentive system for the creation of intellectual property (*SystZachPrac*), company size (*WielPrz*) and belonging to a capital group (*GrupKap*). The details of the construction of variables are included in Table 2.

Table 2. Variable applied in the structural model of institutional cooperation of Polish manufacturing companies.

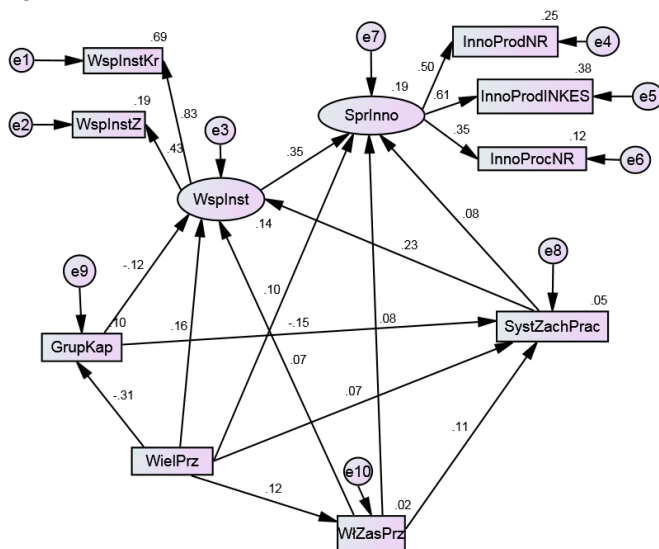
Variable	Variable construction
<i>PIA</i>	Filter variable – "Innovation active company"
<i>PIAProd</i>	„1” if a company introduced a product innovation; „0” if it did not
<i>PIAProc</i>	„1” if a company introduced a process innovation; „0” if it did not
<i>SproInno</i>	Latent dependent variable – "Company innovation -performance"
<i>InnoProdNR</i>	„1” if a company introduced a product innovation new for the market; „0” if it did not
<i>InnoProdNKEŚ</i>	A count, if a company introduced a product innovation first in the country, Europe, the world
<i>InnoProcNR</i>	„1” if a company introduced a process innovation new for the market; „0” if it did not
<i>WspInst</i>	Latent dependent variable – "Cooperation with institutional partners"
<i>WspInstKr</i>	A count, if a company declares cooperation with the Polish Academy of Sciences, Polish research institutes, Polish universities.
<i>WspInstZ</i>	A count, if a company declares cooperation with foreign research institutes and universities
<i>WIZasPrz</i>	Independent variable – "Company's own resources"
	If indicated "3" ("very important") for the importance of own R&D resources, management, marketing services
<i>SystZachPrac</i>	Independent variable – "Employee incentive system"
	„1” if a company declares having an employee incentive system to create intellectual property; „0” if it did not

<i>WielPrz</i>	Independent variable – “Company size” „1” if a company employs over 250 people; “0” if less
<i>GrupKap</i>	Independent variable – “Belonging to a capital group” „1” if a company does not belong to a capital group; „0” if it does

Source: Own work based on PNT-02 questionnaire Report on innovation in industry for 2008-2010, www.stat.gov.pl/formularze.

The results of the research- the analysis of structural model paths of institutional cooperation in innovation activity and the hierarchy of variable

The structural model was done by the Asymptotically Distribution-Free method (ADF) and turned out to fit well to the data ($\chi^2(10) = 29,02$; $p = 0,048$; CFI = 0,96; RMSEA = 0,029). The graph below presents the generated model.



Graph 1. Visual presentation of the structural model of Polish manufacturing companies institutional cooperation and cooperation determinants

Source: Own research based on the data from PNT-02 questionnaire. Model generated by AMOS 19. In the upper-right corner of variables there is information on the percentage of explained variation of a particular variable. The remaining values are a standardised - estimates of a particular relationship.

Table 3 presents the values of standardised -estimates for the interdependence paths shown in Graph 1 and the hierarchy of variable interdependencies in particular groups.

The majority of analysed paths are statistically significant, being at least at the level $p < 0,05$; in the case of two relationships (*WielPrz* -> *SystZachPrac*; *WielPrz* -> *SprInno*) the results of the statistical tendency stood at ($p < 0,09$). Two paths (*SystZachPrac* -> *SprInno* and *WIZasPrz* -> *SprInno*) turned out to be statistically insignificant ($p > 0,05$).

Table 3. Standardised -estimates for the structural model of institutional cooperation and the hierarchy of variables in particular dependence groups

Variables			Standardised estimates	Statistical significance (p)
The hierarchy of variables that determine company innovation =performance*				
<i>SprInno</i>	<---	<i>WspInst</i> (H1)	0.351a	0.001
<i>SprInno</i>	<---	<i>WielPrz</i>	0.097b	0.067
<i>SprInno</i>	<---	<i>SystZachPrac</i>	0.082b	0.124
<i>SprInno</i>	<---	<i>WIZasPrz</i>	0.079b	0.127
The hierarchy of variables that determine institutional cooperation				
<i>WspInst</i>	<---	<i>SystZachPrac</i> (H4)	0.229a	0.001
<i>WspInst</i>	<---	<i>WielPrze</i> (H5)	0.164a	0.003
<i>WspInst</i>	<---	<i>GrupKap</i> (H6)	-0.119b	0.011
<i>WspInst</i>	<---	<i>WIZasPrz</i> (H3)	0.069c	0.046
The hierarchy of variables that determine an employee incentive system				
<i>SystZachPrac</i>	<---	<i>GrupKap</i>	-0.154a	0.001
<i>SystZachPrac</i>	<---	<i>WIZasPrz</i>	0.109b	0.001
<i>SystZachPrac</i>	<---	<i>WielPrz</i>	0.065b	0.081

Innovation performance and types of innovations				
<i>InnoProdNKEŚ</i>	<---	<i>SprInno</i>	0.613	0.001
<i>InnoProdNR</i>	<---	<i>SprInno</i>	0.500	0.001
<i>InnoProcNR</i>	<---	<i>SprInno</i>	0.346	0.001
Institutional cooperation and types of cooperation				
<i>WspInstKr</i>	<---	<i>WspInst</i>	0.831	0.001
<i>WspInstZ</i>	<---	<i>WspInst</i>	0.432	0.001
Other dependencies				
<i>WIZasPrz</i>	<---	<i>WielPrz</i>	0.125	0.001
<i>GrupKap</i>	<---	<i>WielPrz</i>	-0.311	0.001

* Note: the averages with other ascribed indices (in the column) (in dependency groups) vary significantly statistically at at least $p < 0.05$ level.

Source: Own research, based on the structural model of institutional cooperation of Polish industrial companies <--- (dependency direction).

When analysing the hierarchy of variables which explain **the innovation performance of a company** it has been proven that the best indicator is the establishment of institutional cooperation (*WspInst*), which provides the best explanation of the variants of this variable, followed by the size of the company (*WielPrz*). **Thus the first hypothesis (H1) has been verified positively.**

The analysis of the hierarchy of variables that **-explain institution cooperation** shows that employee incentive system (*SystZachPrac*) and company size (*WielPrz*) better explain the likelihood of establishing institutional cooperation than being a member of a capital group (*GrupKap*), having their own R&D department or other innovation friendly resources (*WIZasPrz*). It has been proven that belonging to a capital group of companies (*GrupKap*) has more impact on the establishment of institutional cooperation than having own R&D resources (*WIZasPrz*), however belonging to a group of companies has a negative influence on institutional cooperation. Moreover, it has been proven that the analysed indicators explain more clearly the variants of establishing a national

cooperation (69.0%) than a foreign one (18.6%). **Thus hypotheses H3, H4 and H5 have been verified positively. Hypothesis H6 has not been confirmed.** Furthermore, it has been indicated that belonging to a group of companies has a negative effect on institutional cooperation.

It was observed that belonging to a capital group (*GrupKap*) is the best indicator, yet having a negative effect, of employee incentive system implementation (*SystZachPrac*) and enables a clear explanation of the variability of *SystZachPrac* depending on the possession of innovation friendly resources (*WlZasPrz*) and company size (*WielPrz*).

Having divided introduced innovation into three types (see Table 4), it was observed that important indicators for implementing product innovation new for the market (*InnoProdNR*) are company size (*WielPrz*) and employee incentive system (*SystZachPrac*) (they explain more clearly the variability of the dependant variable than other indicators). In addition, company size (*WielPrz*) and establishing cooperation within domestic partners (*WspInstKr*) are significantly better indicators than the other variables included in the model, explaining the introduction of product innovation first in Poland, Europe and the world (*InnoProdNKEŚ*). **Thus, the hypothesis H2 has been confirmed, however only in the case of institutional cooperation with Polish partners (*WspInstKr*).**

Table 4 The values of standardised estimates for variables explaining the introduction of particular types of innovations and variable hierarchy

	Innovation performance(standardised estimates) for innovations:					
	<i>InnoProdNR</i>		<i>InnoProdKEŚ</i>		<i>InnoProcNR</i>	
	Beta	p	Beta	p	Beta	p
<i>WielPrz</i>	0.106a	0.009	0.185a	0.000	0.099a	0.014
<i>WspInstKr</i>	0.008b	0.841	0.108a,b (H2)	0.003	0.023a	0.542
<i>WspInstZ</i>	0.015b	0.703	0.052b	0.166	0.065a	0.098
<i>SystZachPrac</i>	0.085a,b	0.025	0.018b	0.616	0.034a	0.364
<i>WlZasPrz</i>	-0.012b	0.739	0.087b	0.016	-0.021a	0.563

Source: Own research, based on the structural model of institutional cooperation of Polish manufacturing companies.

Note: the averages with other ascribed indices (in the column) vary significantly statistically at at least $p < 0.05$ level.

The size of a company (*WielPrz*) is a stronger indicator of product innovation introduction new for the country, Europe or the world (*InnoProdNKEŚ*) than process innovation new to the market (*InnoProcNR*) ($p < 0,05$); whereas company size has no impact on product innovation new for the market (*InnoProdNR*). The overall model using the variability of institutional cooperation (*WspInst*), company size (*WielPrz*), incentive system (*SystZachPrac*) and their resources (*WIZasPrz*) explains 37.6% of –the variants of product innovation introduction first for the country, Europe or the world (*InnoProdNKEŚ*); 25% of the variants of product innovation introduction new for the market (*InnoProdNR*) and 11.9% of the variants of process innovation new for the market (*InnoProcNR*).

Table 5 The values of standardised estimates for variables, explaining the establishment of institutional cooperation in general and institutional cooperation divided into national and foreign

Variable	The values of standardised -estimates for cooperation:			
	With Polish partners		With foreign partners	
	<i>WspInstKr</i>		<i>WspInstZ</i>	
	Beta	p	Beta	p
<i>SystZachPrac</i>	0.202a	0.000	0.084a,b	0.024
<i>WielPrz</i>	0.141a,b	0.000	0.131a	0.001
<i>GrupKap</i>	-0.106b	0.004	-0.026b	0.500
<i>WIZasPrz</i>	0.063b	0.076	0.017b	0.651

Note: the averages with other ascribed indices vary significantly statistically at at least $p < 0.05$ level.

Source: Own research based on the structural model of institutional cooperation of Polish manufacturing companies.

When dividing institutional cooperation into national and foreign, it has been proven that, regardless of the type of institutional cooperation, employee incentive system (*SystZachPrac*) and company size (*WielPrz*), have the highest impact, while *SystZachPrac* explains more clearly establishing national cooperation (*WspInstKr*) rather than foreign

(*WspInstZ*). Belonging to a capital group (*GrupKap*) has, in the case of national cooperation, a negative impact. See details in Table 5.

Summary

The conducted analysis highlights the positive and statistically significant relationship between institutional cooperation and the general innovation performance of medium-sized and large Polish manufacturing - enterprises (measured by the introduction of a product and/or process innovation new for the market and product innovation new for the country, Europe or the world). As for the introduction of product innovations new for Poland, Europe or the world, it points to the significant impact of institutional cooperation with Polish institutional partners.

A number of determinants were established which significantly affect the start up of cooperation, such as employee incentive system for the creation of intellectual property, company size and resources, including R&D. An important feature, though negatively affecting cooperation, is belonging to a capital group. The rejection of hypothesis 6 may indicate that those analysed companies which belong to a larger group do not require the introduction of such cooperation, perhaps due to the possibility of using the knowledge resources possessed by other group members.

Therefore H1, H3, H4 and H5 have been confirmed. The hypothesis H2 was confirmed only in the case of cooperation with a Polish partner, while H6 has been rejected (see details in Table 6).

An important conclusion is the indication of the influence of the incentive system for the creation of intellectual property on institutional cooperation. This may be a meaningful indicator for companies willing to stimulate their employees and influence directly effective innovation cooperation with institutional parties.

It is worth noting that the empirical part of the research is based on the representative sample from the Central Statistical Office of large and medium-sized industrial companies from sections C to E and, while the constructed model of structural equations shows a high convergence with the empirical data (CFI = 0,96, RMSEA= 0,029), the presented results reflect to a higher degree the actual interdependencies occurring in business practices.

The volume of the work does not allow us to conduct more in-depth analysis or answer whether and to what degree the presented relationships depend on such company features as the technology level or the intensity and geographic range of their operations. An interesting topic that requires more profound analysis is whether and to what degree similar

dependencies occur in cooperation with supply chain partners, competitors or other institutions with which innovation companies establish cooperation.

Table 6. Research hypotheses verification

Research hypothesis	Hypotheses verification	
H1. <i>Innovation cooperation with institutional partners impacts positively the company innovation -performance.</i>	(+)**	Confirmation
H2 <i>Innovation cooperation with institutional partners encourages the introduction of new market innovations or the creation of new market segments.</i>	(+)**	Confirmation for WspInstKr
H3. <i>The internal resources of an innovative company encourage innovation cooperation with institutional partners.</i>	(+)*	Confirmation
H4. <i>The employee incentive system to create intellectual property in an innovation company encourages cooperation in innovations with institutional partners.</i> H4. <i>The employee incentive system to create intellectual property in an innovative company encourages innovation cooperation with institutional partners.</i>	(+)**	Confirmation
H5. <i>The size of an innovative company influences positively cooperation in innovations with institutional partners.</i>	(+)**	Confirmation
H6. <i>Being a innovative member of a group of companies encourages cooperation in innovations with institutional partners.</i> H6. <i>Being a innovative member of a capital group encourages cooperation in innovations with institutional partners.</i>	(-)*	Rejection

Significance at: *** $p < 0,001$, ** $p < 0,01$, * $p < 0,05$; (+) positive relationship between variables; (-) negative relationship between variables.

Source: Own research.

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THE EFFECTIVENESS OF THE INNOVATIVE PROCESS IMPLEMENTED BY SMEs.

THE RESULTS OF THE EMPIRICAL RESEARCH

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Abstract

The essence and the importance of innovation in the process of building the competitiveness of enterprises is widely described in the economic literature. But analysis of innovative activity of companies very often indicates that the innovations introduced to the market do not bring the expected benefits. This leads to the conclusion that very often the innovation activities of enterprises are inefficient and detailed analysis of such cases may identify the key barriers to implementing effective innovation.

The modern model for innovative activity indicates that one of the key factors for the success of the innovative activity of enterprises is the proper implementation of introducing new solutions to the market. The problem of the diffusion of innovation involves a number of issues related to the process of spreading and promoting innovation in the market. It is widely recognized that competencies in the area of innovation diffusion are a key determinant of the innovative potential of a company.

The author put forward the following research hypotheses:

Innovative activities carried out by the surveyed companies are inefficient.

The purpose of this paper is to present the problems associated with the effective diffusion of innovation in the SME sector in Poland, with particular emphasis on the barriers in this area. Commonly available statistical data, the author's empirical research results on innovation potential and results of other studies conducted by the University of Szczecin were used to prepare this publication.

Key words: Innovative process, SMEs innovative effectiveness

Introduction

The drivers of competitiveness growth in developed countries are innovations based on three pillars: R&D, knowledge and education. The effectiveness of innovative processes is becoming one

of the key measures of competitiveness. Innovations generate a significant added value for both industry and services and strengthen the competitive advantage of a national economy in the international market. Innovation is the key element to boosting efficiency and economic growth, particularly in the times of turbulent technological transformations. Development trends in highly developed countries point out that stable development is only ensured by building competitive advantage based on knowledge and successfully implemented innovations.

Poland is currently at a particular moment in its economic and social development. The existing competitive advantages, based mostly on lower labour costs, are fading. Therefore, it seems crucial to build competitiveness based on knowledge and innovation, with both being long-term constituents of economic growth.

Unfortunately, the innovativeness of the Polish economy still underperforms. The report, Innovation Union Scoreboard, published in 2012 by InnoMetrics research institute commissioned by the European Commission, shows that the Polish economy, as far as its Summary Innovation Index⁵⁴ is concerned, finds itself in 23rd place out of the EU-27 member states (the value of aggregated SII for Poland stands at 0.296, while the EU-27 average stands at 0.539)⁵⁵.

InnoMetrics scored companies from the SME sector's self-created innovation activity (Poland 13.76, while the EU-27 average is 30.31), cooperation between the SME sector in the area of innovations with other companies in the market (Poland 6.4 while the EU-27 average is 11.16) and the sale of innovative (new to the market or company) products and services (Poland 9.84 while the EU-27 average is 13.26) lowest.

Among positive factors fostering the innovativeness of the Polish economy one may find high potential in the area of innovation absorption – acquisition and implementation by Polish companies of foreign licences and patents (Poland 0.18 while the EU-27 average is 0.51), human resources (Poland 35.3 while the EU-27 average 33.6), opportunities for innovation funding and functioning of the innovation activity support system.

It is worth noting however that Polish innovation performance measured by SII in 2011 witnessed a fall compared with 2010 (SII stood at 0.304).

⁵⁴ The method for SII is described in detail in Innovation Union Scoreboard 2011, ISBN 978-92-79-23174-2

⁵⁵ http://www.proinno-europe.eu/page/summary-innovation-index-0#_ftn2

The 2012 World Bank ranking based on KEI (Knowledge Economy Index) also confirms the negative assessment of Polish innovation underperformance placing it in 38th position⁵⁶. The low assessment of Polish economy innovativeness is also seen in the Eurostat data collected in the Community Innovation Survey (CIS) that evaluates companies on the aspect of their innovation performance⁵⁷.

Polish innovation underperformance is particularly present in SMEs, which can have negative consequences linked to hampering the competitive advantage of the economy and causing the country's international marginalisation. Much research and many reports on Polish innovation performance touch on this aspect e.g. E. Horodyńska-Okoń, K. Piecha, W. Świtalski, M. Zastępowski, M. Pichlak.

Much national research (and some statistics published by e.g. Central Statistical Office) point to the fact that Polish companies frequently report a reasonably high level of innovation – especially in the area of the introduction of innovative products or services to the market as well as innovative solution absorption - *A. Żołnierski, Innowacyjność polskich przedsiębiorstw 2005, Raport PARP.*

Cognitive dichotomy highlights the existence of probable differences between the methodological definition and comprehension of innovation and the assessment failing to consider innovation performance aspects linked to expected results. Although the researched companies more often report implementation of innovation ventures, the effectiveness of these actions does not translate into a companies' results (measured by the main financial indices, e.g. product and service sales growth, profitability growth, operational costs reduction).

In the light of the above information, Polish innovation performance calls for the conducting of in-depth research and analyses in order to explain the present state of affairs.

The essence of innovation activity effectiveness implemented by companies

The notion of performance effectiveness is often applied in reference to economics, where it becomes particularly important in the areas of activity rationalisation and decision-making processes. The literature on the subject defines effectiveness as the capacity to produce

⁵⁶ Knowledge Economy Index Rankings <http://siteresources.worldbank.org/INTUNIKAM/Resources/2012.pdf>

⁵⁷ <http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/>

a desired effect, determined by the ratio of effect and expenditure [Stoner 1994]. The literature on the subject points out that innovation effectiveness is relatively rarely described (among others: Arundell, Bloch, Rosebusch, Sawang), however Polish literature lacks a full presentation of the influence of a company's resources on innovation effectiveness (among others: Karaganov, Karasek, Zastępowski). In the context of Polish economy innovation underperformance, the issue seems crucial, which triggers the need for research whose aim will be the calculation of precise methods of measuring and assessing innovation process performance and determining the effectiveness mechanisms of these processes.

The measure of effectiveness (both ex-post and ex-ante) is conducted using index methods based on individual and synthetic indices of resource utilisation productivity (e.g. labour, capital). Ex-ante effectiveness is calculated by assessing the expected effects engaging resources and time. Ex-post effectiveness considers the determination of the results of the implementation of a particular action.

The authors, focusing on the effective assessment of innovation activities, attempt to define the effectiveness of innovation performance (mainly in reference to defining the effectiveness of other company operations) and use the classic measures of effectiveness, based most frequently on the measurable features of innovation.

According to the literature on the subject [e.g. Brzeziński, 2001], in order to assess innovation performance, the same methods are applied as while assessing investment projects. Therefore, a wide range of innovation aspects are categorised as either technological, product or process forms, whose effects can be measures by financial tools. However, there is an issue with value and organisation innovations where it is hard to assess the expected returns and market success due to their complexity and the multifaceted nature of the possible effects and costs. It is suggested that there should be a differentiation between typical capital investment from the assessment of innovation implementation, as these ventures vary in; their objectives and manner of implementation, effects, methodology of expenditure and effect determination, result assessment conditions and the influence of other activity indices on change [Karganov, 2008].

Similar distinctions can be found in the list of types of company effectiveness proposed by A. Jaki [Jaki, 2008], who makes a clear division between effective investment and effective innovations. The author claims that such an approach is correct and validates the search for measurement methods and assessment of the effectiveness of innovation processes.

The above observations call for in-depth research on the essence of innovation process effectiveness and the attempt to determine measurement methods of innovation activity effectiveness which would consider their full picture and the complexity of innovation processes.

The starting point for the creation of a methodology of innovation activity effectiveness assessment may be a detailed analysis of innovation processes which occur in companies.

The measure of innovation activity effectiveness based on innovation diffusion process analysis.

The implementation of innovation ventures, regardless of company size and the type of implemented innovation, follows a pattern which is called by the literature on the subject the innovation process model [Drucker 1994]. The first models describing the implementation of innovation processes were proposed as early as the 1950s and 60s, push model and pull model are the traditional line models described in detail by the literature [Jasiński 1998; Stawasz 1999] which may serve as examples. The extremity of the first models of innovation process implementation, their passivity towards the external world and, highlighted by many authors, the necessity to include non-linear innovation processes [Janasz 1999; Kline 1985], led to the construction of further models of innovation process implementation. The most popular examples of innovation process implementation models include: *a chain-linked model* by S.J Kline and N. Rosenberg [Kline, Rosenberg 1986], *a coupling model* by R. Rothwell and W. Zegveld [Rothwel, Zegveld, 1985] and *a parallel model* by P. McGowan [McGowan 1996].

Later research on the essence of innovation process implementation was taken to further the evolution of the models by the development of innovation theory and practice in the area of innovation activities. The authors of the new proposals integrated innovation processes with practically every aspect of company operations, pointing to the fact that the existing company resources determine its innovation potential, namely the ability to successfully and effectively implement innovation ventures [Norek 2012]. In addition, the authors of the new models indicated the role and significance of the company learning process and knowledge management in reference to its innovation potential. The contemporary models of innovation processes implementation include: Fifth-generation innovation process [Rothwell 1995], systemic approach towards innovation process, spiral innovation process [Oslo Manual 2005], effective innovation management [Tidda, Bessant, Pavitt 2001].

Analysing contemporary models, one can clearly claim that the authors of each new proposal emphasised the importance of the diffusion stage and propagation of implemented innovations.

Diffusion of innovations as defined by the Oslo Manual is 'widely adopted through market and non-market channels starting at any place in the world' and refers to 'the manner in which innovations are propagated through market and non-market channels, from the first implementation to the contact with various consumers'[Oslo Manual 2005].

Diffusion of innovations can refer mainly to two groups of market participants:

1. Supplier diffusion - companies offering products and services. Diffusion of innovations in this group refers to making products commonplace (imitation) or the application of similar processes, organisational or marketing solutions. Diffusion can result from formalised transfer of technologies through buying licences and rights to use innovations implemented by other companies [Jasiński 2006].
2. Buyer diffusion – refers to the participants of the consumer markets. Diffusion refers to the principles of new product and service introduction to the markets, promotion of ingenious techniques and operations, publicising of state of the art ideas and concepts. The main objective of diffusion process operations is the maximum adoption of innovations by the highest number of buyers or adopters (as innovations is not always purchasable).

In conclusion we can claim that diffusion of innovations determines the principles of innovative product and service market commercialisation and is the element of the innovation process which is directly responsible for the market success of new products and services. Therefore, one can assert that without diffusion of innovations, innovation would not hold any economic significance [Kilnciewicz 2011], which causes many scientists to regard the issue of diffusion as key to effective implementation of innovation processes [Klein, Sorra 1996; Angle, Van de Ven 2000].

Moreover, stressing the importance of the diffusion of innovations, knowledge on this topic is indispensable in creating product and marketing strategies in companies that implement innovative products and services.

Research on the diffusion of innovations may prove vital in explaining company problems in the area of effective implementation of innovation processes. The significance of the diffusion of innovations

in the process of effective innovation performance is confirmed by a number of researchers: e.g. E.M. Rogers, K. Klincewicz.

The effectiveness of innovation processes can be analysed on two levels:

1. Diffusion of innovations – refers to the effectiveness of a company's innovative product and service implementation on the market
2. Absorption of innovations – a company's ability to absorb innovative solutions generated by other companies

Accepting the above understanding of innovation activity effectiveness in the process of effectiveness assessment at both diffusion and absorption levels, a number of indices can be applied, e.g.:

1. Innovation sales level
2. Innovation sales success index
3. Innovation advancement in researched companies
4. Level of customer acceptance of new products and services
5. Level of effectiveness of the diffusion processes of new products and services

The above presented indices clearly and directly assess the effectiveness of innovation activities based on quantified financial values enables the precise assessment of the effectiveness and comparison of innovation activity results. In order to conduct a more in-depth analysis of innovation process effectiveness one can construct other indices: e.g. profitability of innovation activities or their cost.

Assessing the effects of innovation activities we can attempt to prepare indices assessing diffusion and absorption of innovations in their financial, product, organisational and marketing aspects.

In the following part of this paper the author conducts a basic analysis of innovation diffusion process effectiveness in Polish companies of the SME sector.

Analysis and assessment of the effectiveness of innovation activities of the Polish SME sector. Research method.

Looking into the reasons for the low innovation performance of the SME sector [Norek 2013] the author paid particular attention to the barriers linked to the effectiveness of innovation process implementation. He conducted in-depth analysis on the dependencies between the level of company innovation, innovative products and services sales, the index of success achieved; and the dependency of new product or service adoption by customers and the real possibility of their commercialisation.

The research objective is conducted based on the inductive logic method which focuses on the analysis of the diffusion of innovation processes in SMEs. The research assessed all key determinants influencing the effectiveness of innovation activities. It was carried out through a questionnaire containing 43 questions divided into eight categories – innovation process stages implemented in a company. The detailed methodology is described in the author's other publications [Norek 2011].

Analysing the above features and the effects of diffusion processes, the author formed the following research thesis: *Innovation activities implemented by the researched companies is ineffective.*

Within the assessment of individual categories, the companies conducted the assessment of selected aspects of their operations in a given area. The internet questionnaire was carried out over the period of April 2012-August 2012.

200 companies from three regions of Poland were selected for the analysis:

1. Zachodniopomorskie - medium innovation performance voivodship
2. Podkarpackie - low innovation performance voivodship
3. Mazowieckie - high innovation performance voivodship

The selection of companies focused on ensuring an adequate research structure: 45% (90 enterprises) manufacturing companies, 55% (110 enterprises) services. The division into company size was the following: 39% (79 enterprises) micro companies, 47% (94 enterprises) small companies, 13.5% (27 enterprises) medium-sized companies.

The research sample was standardised by statistical methods considering the economy structure of these individual voivodships, company size and the prevailing type of conducted activities (Table 1.). The author is fully aware of the fact that the analysed sample is not representative, however it is a sufficient number to carry out the analysis and draw conclusions.

Due to the nature and volume constraints of this paper, the author presents only a number of selected results which enable the assessment of the effectiveness of innovation activities of the companies. The author carried out in-depth analysis of, among others, the following features describing the diffusion of the innovation process:

1. Innovation sales level;
2. Innovation sales success index;
3. Innovation advancement of researched companies;
4. Level of customer acceptance of new products and services.

Table 1. The structure of the research sample

Size	Voivodship	Type of activity		Total
		Manufacturing	Services	
Small	Mazowieckie	17	22	39
	Podkarpackie	16	15	31
	Zachodniopomorskie	8	16	24
Small total		41	53	94
Micro	Mazowieckie	17	16	33
	Podkarpackie	9	11	20
	Zachodniopomorskie	10	16	26
Micro total		36	43	79
Medium-sized	Mazowieckie	4	5	9
	Podkarpackie	5	4	9
	Zachodniopomorskie	4	5	9
Medium-sized Total		13	14	27
Total		90	110	200

Source: Own work.

The level of company innovation is determined through the placement of new products or services in its offer over the last three years, regardless of market success. The term ‘success index’ signifies the number of new products or services offered by a company over the last five years which were accepted by the market after their implementation. The assessment is complemented by the indices referring to the relationship between new product/service sales income and profits, and a company’s turnover over the last three years. The stand out companies in this respect are the companies for which the values of the above indices exceeded 30%, if the values are at about 1% the companies are regarded as the weakest. Such a range description is widely accepted in company innovation research and innovation audits. Aggregated results are presented in Table 2.

Table 2. Key indices of the effectiveness of the diffusion of innovation process implementation in the researched companies

Type of activity	Category	< 1%	2% - 10%	11% - 20%	21%-30%	> 30%
Services	Innovation sales	27%	27%	22%	18%	6%
	Success index	31%	29%	19%	17%	5%
	Innovation level	29%	24%	23%	19%	5%
Manufacturing	Innovation sales	25%	30%	22%	14%	9%
	Success index	15%	23%	27%	25%	10%
	Innovation level	24%	22%	26%	20%	8%
All	Innovation sales	26%	28%	22%	16%	8%
	Success index	23%	26%	23%	21%	7%
	Innovation level	27%	23%	25%	19%	6%

Source: Own work.

The results highlight that half of the researched companies (50%) are innovation underperformers (innovation level <10%) which puts them in the non-innovation category. As little as 6% of the companies can be regarded as innovative, namely those which over the last three years implemented new products or services (innovation level >10%). The results show that the companies do not possess sufficient innovation potential, which conditions the implementation of innovative ventures. The author's earlier research proves this thesis and points to the fact that the companies' lowest innovation potential occurs in the areas of innovation activity estimation and planning, communication, organisation and innovation activity funding [Norek 2012]. Detailed results of the percentage of innovative product sales in total company profits are presented in Table 3.

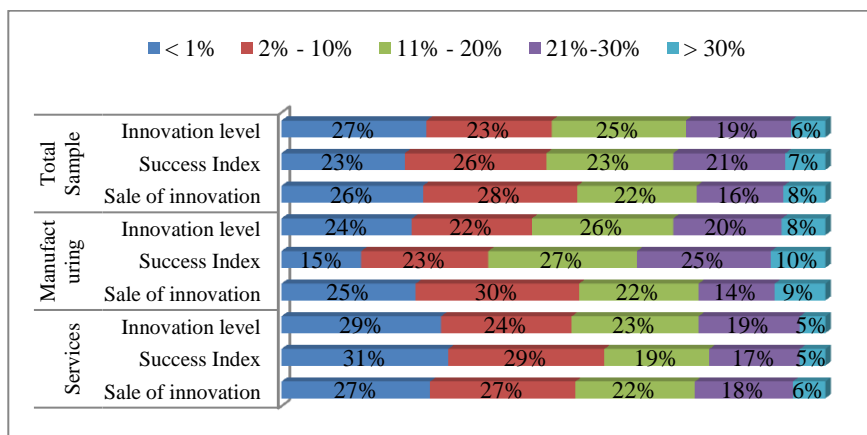
Table 3. Average percentage of profits from innovation sales

Company size	Type of activity		Final average
	Manufacturing	Services	
Small	9.8%	8.9%	9.35%
Micro	8.24%	6.49%	7.37%
Medium-sized	13.34%	12.78%	13.06%
Final average	10.5%	9.39%	9.93%

Source: Own work.

Medium-sized companies (13.06%) show a decisively high effectiveness determined as a percentage of the profits from innovations sales while micro companies scored the lowest (7.37%). Manufacturing companies reached a slightly higher percentage of profits from innovations sales – this score may come as a surprise as it is commonly believed that manufacturing companies are more innovative than services. The author's research does not confirm this state of affairs in reference to the effectiveness of innovation activity implementation.

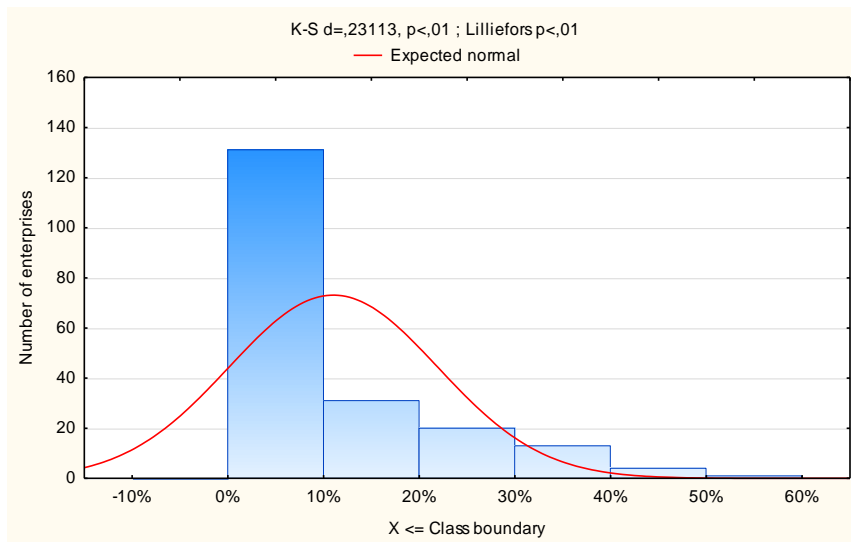
The index of market acceptance of innovations, which describes the effectiveness of diffusion, may complement the research results. The index is very unfavourable for the companies since as many as 49% score below 10% on the success index. As few as 7% of the implemented innovations were accepted by the market – with the success index above 30%. The achieved values should be regarded as unequivocal proof of the low effectiveness of the diffusion of innovations, which stems from the companies' insufficient potential in this area (Graph 1).



Graph 1. Key indices of the effectiveness of the diffusion of innovation process implementation in the researched companies referring to type of company activity

Source: Own work.

The innovation sales index determines the financial aspect of poor diffusion of innovation process implementation. As many as 54% of the companies report that profits from innovation sales are below 10% of the total profits, while 8% of the firms report that over 30% of profits are from innovation sales (Graph 2).



Graph 2. Histogram of percentage of profits from innovation sales in researched companies and expected value of normal distribution

Source: Own work.

The presented results show that slightly lower scores are registered by manufacturing companies than services, however the difference is not significant. The results, presented in graphic form, are shown in Graph 1. Graph 2 shows a histogram of the percentage of profits from innovation sales in researched companies and expected value of normal distribution – the histogram also confirms the poor effectiveness of innovation process implementation, determined by the profits generated by innovative product sales. The distribution of the percentage of net profits from innovation sales lies to the left, which indicates the profitability from innovation sales is lower than expected.

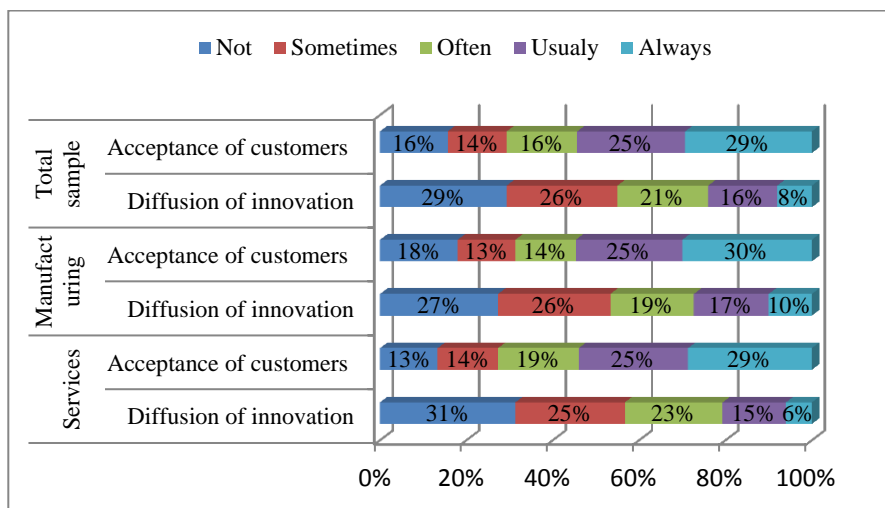
The next in-depth analysed category was on the dependence between customer acceptance of new products or services and the effectiveness of their diffusion. The results led to an unequivocal assessment of the diffusion of innovation process implementation in the companies of the SME sector and are presented in Table 4.

Table 4. Dependence between customer acceptance for the implemented innovations and diffusion effectiveness

Type of activity	Category	No	Sometimes	Often	Regularly	Always
Services	Innovation diffusion	31%	25%	23%	15%	6%
	Customer acceptance	13%	14%	19%	25%	29%
Manufacturing	Innovation diffusion	27%	26%	19%	17%	10%
	Customer acceptance	18%	13%	14%	25%	30%
Total sample	Innovation diffusion	29%	26%	21%	16%	8%
	Customer acceptance	16%	14%	16%	25%	29%

Source: Own work.

The results show that despite the fact that 29% of implemented innovations were always accepted by customers, the diffusion of a mere 8% resulted in full market success. The results prove that the companies, despite having valuable new products and services that earned customer appreciation, are unable to conduct an effective process of their market diffusion. This is yet another confirmation of the thesis of ineffective innovation activity of the researched companies of the SME sector. The results are presented in Graph 3.



Graph 3. Dependencies between customers acceptance and diffusion effectiveness of implemented innovations

Source: Own work.

Summary

The author proposed the thesis: *Innovation activities implemented by the researched companies are ineffective*. Such low potential in the area of effective implementation of diffusion processes is one (not the only one as other author's research show) of the determinants of low innovation performance of the Polish SME sector.

As the paper proves, a precise assessment of the effectiveness of innovation processes implemented by SMEs is methodologically challenging, which is reflected in the literature quoted by the author. Nevertheless, this issue, particularly in the light of Polish economic underperformance, is significant and requires in-depth studies.

In order to confirm his thesis, the author conducted empirical studies whose results have been presented in this paper. They clearly confirm the low effectiveness of innovation activities of the companies of SME that formed this research. The results enabled the formulation of reasons for such a state. It seems that the low effectiveness of the innovation activities of the SME sector is influenced by the low innovation potential of these companies – stemming from companies own resources utilised in innovation processes.

Despite the fact that 29% of implemented innovations always received customer acceptance, diffusion of only 8% was considered to have gained full market success. As many as 54% of the companies reported that the profits from innovation sales scored below 10% of the total profits, whereas only 8% reported that over 30% of profits come from innovation sales.

Another confirmation of the author's thesis of the low effectiveness of innovation activities of the companies are the results of the index describing the market acceptance of implemented innovations. The companies tested, scored especially poorly as 49% of them regarded their success index below 10%, only 7% of the implemented innovations met market acceptance – the success index is over 30%. The collected values can be regarded as undeniable proof of the low effectiveness of innovation diffusion implementation.

The quoted results juxtaposed with the reported level of innovation (expressed as the ratio of the offered innovative products and services) of the companies additionally reinforce the negative assessment of the effectiveness of innovation diffusion implementation.

The results should lead to in-depth studies in this area. A detailed 'case study' type of research seems advisable to assess the effectiveness of innovation processes during which diffusion processes of individual

innovations would undergo a specific and comprehensive analysis. Such research – thanks to an accurate description of the innovative process – would help to point out the mistakes committed by companies during the implementation of diffusion processes.

Equally valuable information would be provided by studies of change dynamics in the effectiveness of diffusion process implementation over an extended period – this would lead to conclusions and evaluations about whether SMEs are increasing their competences in this area. The author has at his disposal, data on innovation process implementation in companies over the period 2009-2012. Such a range of data will enable in-depth research into the dynamics of this phenomenon.

Comparison of the effectiveness of the innovation activities of Polish companies against those from other countries, especially innovation leaders such as Denmark, Finland or Sweden, would be another complementary study and would help to identify the innovation gap between the compared countries. Such a study may be based on the author's research and the widely available statistics, e.g. published by Eurostat.

Another direction of research into the effectiveness of innovation process implementation may be the idea proposed by N. Rosebusch, J. Brinckmann and A. Bausch which combines the effectiveness of innovation processes with company size, length of operating on the market or organisation culture – one of the resources constituting company innovation potential [Rosebusch, Brinckmann, Bausch 2009].

The author advocates the idea of the creation of a comprehensive model for the assessment of the effectiveness of innovation processes implemented by SMEs, which would describe in the most precise manner the nature and complexity of innovation processes.

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***THE ROLE OF EUROPEAN INTEGRATION AND
DEVELOPMENT OF BUSINESS DEVELOPMENT AND
SUPPORT ORGANIZATIONS IN COMMERCIALIZATION
OF KNOWLEDGE AND TECHNOLOGY***

COMPANY DEVELOPMENT AND POLISH INTEGRATION WITHIN THE EU –EXAMPLIFIED BY ANALYSIS OF THE AGRI-FOOD INDUSTRY IN THE VOIVODSHIP OF ŁÓDŹ

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Abstract

This paper attempts to assess the effort to develop agri-food sector companies in the Voivodship of Lodz between 1998 and 2012. It was based on data of production dynamics and scale of investment, financed mainly through EU pre-accession and structural funds. Initially, during this period, the agri-food industry in Lodz, after its systemic transformation, found itself in a state of recession. Despite this, the financing of investment through EU funds (from the SAPARD Programme and the structural funds, 'Improvement of Processing and Marketing of the Agri-food Sector' within SPO 2004-2006 and the activities 'Increasing Basic Value Added of Agri and Forestry Production') had a positive impact on the adjustment of the agro-food sector to the homogenous market of the EU within adherence to sanitary, hygienic and quality standards. The implemented investments in this sector boosted the level of company advancement, even though it was innovation based on imitation, through which companies implemented modern solutions and technologies previously applied by companies from the EU-15, it still enabled the achievement of technical advancement close to the EU leaders.

Key words: Company development, EU integration

Introduction

The aim of this paper is to attempt to assess EU structural fund utilisation for agri-food companies. The analysis focuses on companies located within the Voivodship of Lodz, which, between 2003 and 2012, received financial aid within the Common Agricultural Policy. Analysis is of the structure of the utilisation of the pre-accession funds within the SAPARD Operation Programme, Sectoral Operational Programme 'Restructuring and Modernisation of the Food Sector and Rural Development' (SPO 2004-2006) and the Rural Development Programme (2007-2013).

The work consist of five parts, the first being a theoretical overview of the issue of company development while the second presents the description of company circumstances during the pre-accession period.

The later parts provide information on the pre-accession resources allocated for companies of the agri-food sector, from which the companies benefitted from the 30th April 2004 as well as through EU structural funds. These parts describe the overall investment trends of companies from the Voivodship of Lodz and compare them to companies throughout Poland. The fifth part refers to the state of companies after the first few years of accession and the effects of the implemented investments. The article is summed up including conclusions on the last decade of the obtained financial aid.

Company development and investment financing

A company's development, along with other factors, affects survival over the long term. One can assume that apart from maximising profit this is the ultimate goal of companies. Development falls into qualitative and interdisciplinary categories which escape direct quantification and operationalisation. Despite the fact that company development is affected by a variety of factors, it is profit that is the basic source of financing development. In parallel, development is one of the conditions that determine a company's profits [Duraj, 2000].

Z. Piersionek claims that company development is foremostly qualitative and entails the introduction of product, process and structural innovations as well as organisational and management innovation [Piersionek, 1996]. A similar standpoint is maintained by A. Stabryła who perceives development as quality changes viewed positively from the perspective of the aim they refer to [Stabryła, 2006]. J. Penc presents a wider definition of company development and also accentuates the necessity of quality change. He believes that the quantitative growth of a company requires the introduction of quality changes, for example of an organisational or technical nature [Penc, 1997]. The need for development is closely connected with changes in a company's environment, which constantly affects it [Piersionek, 1996]. In their operations, companies may utilise various factors to boost development. These factors, highlighted in the range of phenomena as tangible constituents, are perceived as a cause or condition of the development process [Matejun, 2008]. External factors include, among others, regulations of the financial and tax system which impact on the capability for capital accumulation indispensable to finance current operations and development, as well as stimulation by the state, accumulation of resources for investment, development and export promotion purposes [Matejun, 2008]. Other significant factors for company development include financial and non-financial state support as well as access to banking and insurance

services, thanks to which companies can obtain financial resources indispensable for investment for change.

The development of small and medium-sized companies depends to a large extent on a company's development capital. The need for a high proportion from a company's own resources in investment financing stems from having limited access to foreign capital. A company operating on the market should develop its operational strategy to facilitate long term development. An indispensable element of such a strategy is the ability to implement investment, which raises the problem of financing [Bagieńska, 2008]. The development of Polish companies is currently determined mainly by the socio-economic principles of Poland, which, as an EU member state, is obliged to implement the community's development targets. This originates from the advancing globalisation of the World's economy and the rapid acceleration of its growth [Bagieńska, 2008].

The condition of agri-food sector companies before Poland's entry to the EU

Agri-food companies, after the transformation of the Polish system, found themselves in dire circumstances. Between 1999 and 2002 the consumption rate of food, beverages and tobacco products decreased from 3.20% to 1.18%, which is more than half. "The expenditure on capital assets in 2001 were reduced by 10.2%. The share of investment expenditure of GDP was reduced from 20.5% in 1998 to 17% in 2001. The real value of investment expenditure fell by 10%. Such a situation was clearly evident in the food industry, as its share of total investment expenditure fell by 1 percentage point" (Knap-Stefaniuk, 2010). The transformation in the structure of ownership which occurred in the second half of the 1990s led to the sale of the assets of a number of state companies and the appearance of private firms which started to develop their future production potential. This was also the time when previously successful state companies ceased to exist, unable to withstand the competition in the harsh market reality [Tarajkowski, 2008]. This transformation gave rise to companies which were underinvested and equipped with obsolete production machinery. With such resources, they had to face competition from the West in the fields of quality, price and production economics. This battle was frequently lost owing to the lack of financial resources indispensable to carry out production investment [Bagieńska, 2008].

Poor product quality, especially in comparison to the competition from the West, the lack of adequate logistics and modern marketing tools resulted in a reduction in product demand [Sapijaszka, 1997]. This reduced

utilisation of production resources and a lack of prospects for an improvement in this trend led to the closure of a significant number of companies. Boards of directors attempted to change such states of affairs but they failed in this matter due to a lack of funding and the inefficient investment credit system. From 1994, the possibility existed to obtain interest subsidies for both investment and working capital granted by the banks cooperating with the Agency for Restructuring and Modernisation of Agriculture, nevertheless this type of aid turned out to be insufficient as the banks which companies turned to for loans demanded guarantees which the companies could not provide and the high cost of loans meant investment through these funds ceased to be profitable [Bagieńska, 2008]. This in turn triggered stagnation among Polish producers and contributed to many spectacular downfalls.

Pre-accession resources for agri-food sector companies - SAPARD

Investment saw some positive trends at the beginning of 2000 thanks to the SAPARD Operational Programme, which is an EU funding programme supporting agricultural adjustment to the market economy among affiliated countries before their entry to the EU. Its aim is to boost the competitiveness of the agriculture and agri-food processing industries on both national and international markets. The objective of the programme is also to adjust the agri-food programme to the requirements of the homogenous EU market as far as sanitary, hygienic and qualitative aspects are concerned. SAPARD facilitated the modernisation of agri-food processing companies in order for Polish companies to compete with the highly developed and well-funded companies of Western Europe.

In the case of processing companies in Lodz Voivodship, as in the whole country, paramount importance before Poland's EU entry was geared to the improvement of safety, food quality and increasing the number of companies meeting EU sanitary and veterinary requirements. The aim of the programme was to support rationalisation, restructuring and advancement in the sector to boost its competitiveness and facilitate adjustment to operate in the homogenous market. This always entails the necessity to modernise the production base. The implementation of the EU Hazard Analysis and Critical Control Points System (HACCP) led to the necessity to improve control systems and indispensable employee training. The investment also covered environmental protection within companies, rationalisation of the water and energy usage based on costs, as well as strengthening of agricultural producer groups and their associations.

The above would not have been possible without SAPARD. Although the market of financial services offered other sources indispensable for daily operations and investment, subsidies for the interest on investment loans and working capital facilities granted by the banks, credit, a company's own share in financing as well as guarantees were not highly popular due to the high cost of these services. In its first stage, SAPARD also did not enjoy great interest due to the complexity of procedures for obtaining such assistance. Gradually however, more and more companies availed of this method of investment financing as a more beneficial alternative.

From the point of view of the quality of modernisation of the whole agri-food sector, the value of SAPARD was only in subsidising investment for purchasing new machinery and devices. Thanks to this, the production base of Polish companies underwent a huge improvement, which frequently contributed to a level of technological advancement higher than in many Western companies. On the other hand, this approach made it impossible for some Polish companies to avail of this programme due to the excessive cost of investments and lack of sufficient credit worthiness.

Till the end of the programme, The Agency for Restructuring and Modernisation of Agriculture – which deals with the implementation of EU support programmes for agriculture - paid out 1,068 billion Euro (4,512 billion zloty), exceeding the amount originally allocated for SAPARD. Within Measure 1, aimed at agri-food processing companies, 70 beneficiaries from Lodz Voivodship availed of this aid. A total number of 99 contracts were signed, which translated into a total aid sum of almost 150.4 billion zloty, which was 9.04% of all contracted projects within SAPARD⁵⁸. This amount was the greatest segment of public funding of all the programme's operations within Lodz Voivodship. The contracts referred to ventures following the framework 'Support for Food Processing and Marketing Improvement of Articles of Animal Origin' whereas fruit and vegetable processing support enjoyed much lower popularity. The average amount of aid granted for signed contracts stood at 1.52 million PLN and was higher than the national average, which stood at 1.24 million PLN. Lodz Voivodship was ranked fourth in the country as far as the number of signed contracts for project co-financing after Wielkopolskie (226), Mazowieckie (147) and Śląskie (109) and third when it came to the engagement of public resources, after Wielkopolskie (278.2 million PLN)

⁵⁸ Information on SAPARD implementation, www.arimr.gov.pl.

and Mazowieckie (205.7 million PLN). Out of 99 contracted projects 93 were implemented, for a total amount of 131.8 million PLN.

Investment within SOP 2004-2006 and PROW 2007-2013 – general trends

The EU aid programme which replaced SAPARD after Poland's accession to the EU was the Sectoral Operational Programme (SOP) 'Restructuring and Modernisation of the Food Industry and Development of Rural Areas for 2004-2006'. This programme continued both previously commenced and new investments for co-funding within the Common Agricultural Policy of the EU. Similarly to the pre-accession SAPARD, the programme was designed to support ventures of the rural population and companies of the agri-food sector. Measure 1.5., Co-funding of 'Improvement of Food Processing and Marketing of Agricultural Products' of priority 1 of SOP 'Support for Change and Adjustment within the Agri-food Sector' were offered to companies whose operations were in food processing and the marketing of agricultural products included in the amendments to the treaty establishing the European Union, excluding fish and forestry products and companies from countries outside the EU.

The principles of accessing this programme differed significantly from those of SAPARD, as in this case investment co-funding is conducted through the refunding of the costs met by entrepreneurs. In this case however there is a positive trend which can be observed in the market of financial services, which is the increase in attractive credit opportunities aimed at entrepreneurs from the agri-food sector. This was due to the previous positive experiences of the banks, which received the return of, on average, half of the value of the granted loans straight after the company's implementation of the investment and final calculation of costs with ARMA. Within SPO 2004-2006, the maximum amount of co-funding offered to entrepreneurs also increased and stood at 20 million PLN which was significant aid, as with SAPARD, facilitating modernisation of technological lines, a company's adjustment to sanitary and veterinary requirements and the introduction of HACCP systems across the whole country including Lodz Voivodship.

In Lodz Voivodship, 165 companies from the agri-food sector applied for financial aid for investment to the value of 331.3 million PLN. The most applications were filed in the district of Skierniewice (15), Pajęczno (14) and Eastern Lodz (13), the least from Opoczno (1) and Zduńska Wola (2). Almost a half of the implemented projects, which is to say 48%, concerned meat processing projects. The second and third

largest groups included milk processing projects – 18.7% and fruit and vegetable processing – 17.3%. The total value of implemented investment within operation 1.5. ‘Improvement of processing and marketing of agricultural products’ stood at 298.04 million PLN and the average value of projects was 3.97 million, which is slightly higher than the nation average of 3.82 million PLN. It is worth highlighting the fact that only 6 beneficiaries decided to implement more than 1 investment project, which puts Lodz Voivodship bottom nationally. Such a state of affairs may have been caused by the fact that 84% of companies that received investment support are micro, small or medium sized companies⁵⁹.

Since 2007, the aid for the agro-food sector companies has been paid out within the Programme for the Development of Rural Areas (PROW). The operation ‘Increasing the value-added of primary agricultural and forestry production’ is a continuation of the previous operation ‘Improvement of processing and marketing of agricultural products’ and is dedicated to Polish agri-food processing. Around 1,100 million Euro have been allocated in order to support investment through this programme. The aid is geared mainly towards small and medium sized companies, which can receive up to 50% eligible investment costs. Such operations, as in the previous support programmes, underpin the projects, whose aim is to improve a company’s competitive advantage, production quality, cost reduction, development of new products, processes and production technology. Support is also granted for activities which will improve production conditions in reference to current or recently introduced standards. Companies operating in the meat, milk, fruit and vegetable sectors dominate among the beneficiaries of this aid. Investment co-funding is aimed at purchasing new machinery and equipment as well as specialised means of transportation. The average aid paid out per project stands at about 450,000PLN.

Within the Lodz Voivodship, 221 companies applied. Most applications were filed in the regions of Sieradz (24), Radomsko (19) and Zgierz (18) the least from Poddębice (1) and Brzeziny (2). The total amount of the planned investment stands at 1,162 billion PLN, and an average investment cost for a single company is 5.25 million PLN. Almost a half of the companies applying for financial support express as their main target an increase in value-added, 24% of companies point

⁵⁹ Sectoral Report Operational Programme “Restrukturyzacja i modernizacja sektora żywnościowego oraz rozwój obszarów wiejskich, 2004-2006”, Działanie 1.5 “Poprawa przetwórstwa i marketingu artykułów rolnych”, MRiRW, Warszawa 2010, p. 26.

to the improvement of production quality, while 20% refer to the introduction of new products, processes and production technology⁶⁰.

Apart from the above mentioned SPO and PROW co-financing, entrepreneurs of this sector who benefitted from the resources of the European Agricultural Fund in order to develop rural areas between 2004-2006 'received the opportunity to benefit from EU funds within the so-called regional help. It is granted for investment and R&D activities within, among others, Operational Programme Innovative Economy (POIG) and for entrepreneurs operating in the Special Economic Zones' [Cieśliewicz, 2011].

Analysis of the condition of agri-food companies after Poland's accession to the EU

Despite investment, the number of companies in the Lodz Voivodship has been on the decline since 2002, which is similar in the majority of Voivodships (Table1).

Lodz Voivodship witnessed the highest drop in registered companies in 2003, before Poland's accession to the EU, but also in 2009, which seems to have been caused by the financial crisis, resulting in the decrease in exports due to the lesser demand for Polish products. In addition, the significant depreciation in the zloty caused the cost of loans taken out in foreign currencies to rise and – in the case of several companies – it led to substantial losses due to previously conducted option transactions⁶¹. Despite this trend for falling numbers of companies lasting since 2002, thanks to the investment, the dynamics of the sold production remains in the same range (Table 2, Graph 1).

⁶⁰ Own calculations based on ARiMR data.

⁶¹ Polska wobec światowego kryzysu gospodarczego, Polish Central Bank, Warsaw 2009, www.nbp.pl.

Table 1. Data on the number of companies accorded to sector and parts according to the Polish Classification of Enterprises

Territorial Unit	Local units								
	Sector D part 15						Sector C part 10+11		
	2002	2003	2004	2005	2006	2007	2008	2009	2010
ŁÓDZKIE	2808	2524	2524	2519	2499	2306	2108	1603	1556
MAZOWIECKIE	4011	3404	3404	3119	3153	2886	2851	2564	2511
MAŁOPOLSKIE	2026	1936	1936	1808	1764	1628	1638	1568	1502
ŚLĄSKIE	3016	2656	2656	2528	2430	2376	2278	2064	2082
LUBELSKIE	2356	2032	2032	1797	1728	1583	1418	1270	1215
PODKARPACKIE	1370	1120	1120	1032	1035	959	977	890	866
PODLASKIE	1063	907	907	735	721	654	700	579	575
ŚWIĘTOKRZYSKIE	943	791	791	717	697	643	659	604	565
LUBUSKIE	6117	559	559	539	520	479	459	429	2030
WIELKOPOLSKIE	3341	2632	2632	2576	2566	2447	2460	2056	775
ZACHODNIOPOMORSKIE	1198	1052	1052	999	995	914	906	793	436
DOLNOŚLĄSKIE	1654	1522	1522	1429	1424	1315	1169	1040	1056
OPOLSKIE	694	697	697	650	659	612	594	502	496
KUJAWSKO-POMORSKIE	1848	1453	1453	1292	1233	1110	1180	909	855
POMORSKIE	1424	1257	1257	1197	1173	1040	1046	908	633
WARMIŃSKO-MAZURSKIE	1027	994	994	888	821	773	749	668	900

Sector D part 15 – production of food and beverages (according to PKD 2004); Sector C parts 10 +11 – production of food and beverages (according to PKD 2007)

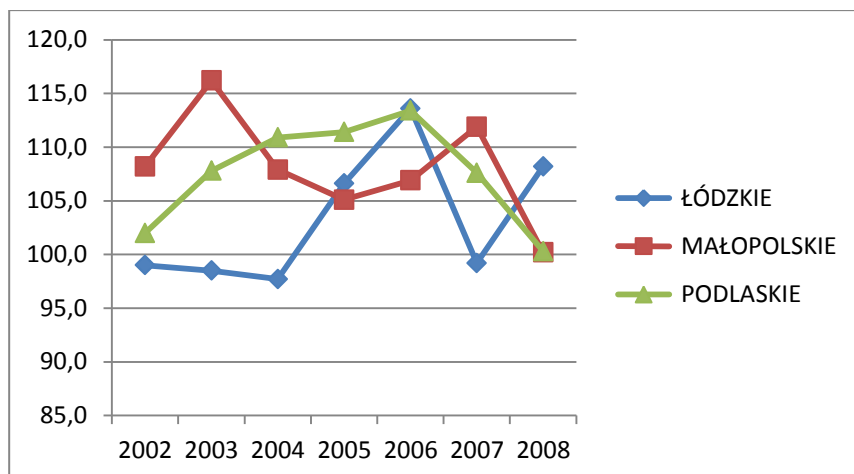
Source: Own work based on Bank of Regional Data, Main Statistical Office www.stat.gov.pl.

Table 2. Dynamics of sold production of industry according to sector and part PKD 2004 *

Voivodship	Food processing						
	2002	2003	2004	2005	2006	2007	2008
	%	%	%	%	%	%	%
ŁÓDZKIE	99.0	98.5	97.7	106.6	113.6	99.2	108.2
MAZOWIECKIE	96.9	108.0	111.9	108.3	110.8	118.7	96.3
MAŁOPOLSKIE	108.2	116.2	107.9	105.1	106.9	111.9	100.2
ŚLĄSKIE	111.3	117.8	112.4	115.6	112.8	111.8	119.7
LUBELSKIE	102.7	101.7	102.9	114.6	103.2	108.1	114.5
PODKARPACKIE	94.8	116.3	79.7	120.2	105.6	97.1	106.4
PODLASKIE	102.0	107.8	110.9	111.4	113.4	107.6	100.3
ŚWIĘTOKRZYSKIE	102.9	109.5	112.4	111.8	93.4	89.4	102.3
LUBUSKIE	103.1	99.8	92.7	89.7	100.1	107.5	109.5
WIELKOPOLSKIE	96.9	103.1	108.5	110.5	106.6	103.3	105.6
ZACHODNIOPOMORSKIE	90.1	109.7	110.9	103.5	95.0	100.5	115.2
DOLNOŚLĄSKIE	95.6	107.8	96.7	111.6	91.0	95.6	136.8
OPOLSKIE	118.2	105.4	111.5	109.3	91.7	97.2	99.7
KUJAWSKO-POMORSKIE	95.0	120.9	104.2	92.0	103.7	110.3	98.8
POMORSKIE	97.0	125.1	110.9	104.2	104.3	105.4	112.2
WARMIŃSKO-MAZURSKIE	91.4	106.7	90.3	99.2	115.6	136.6	100.4

** Fixed prices; previous year = 100; data refers to the whole group

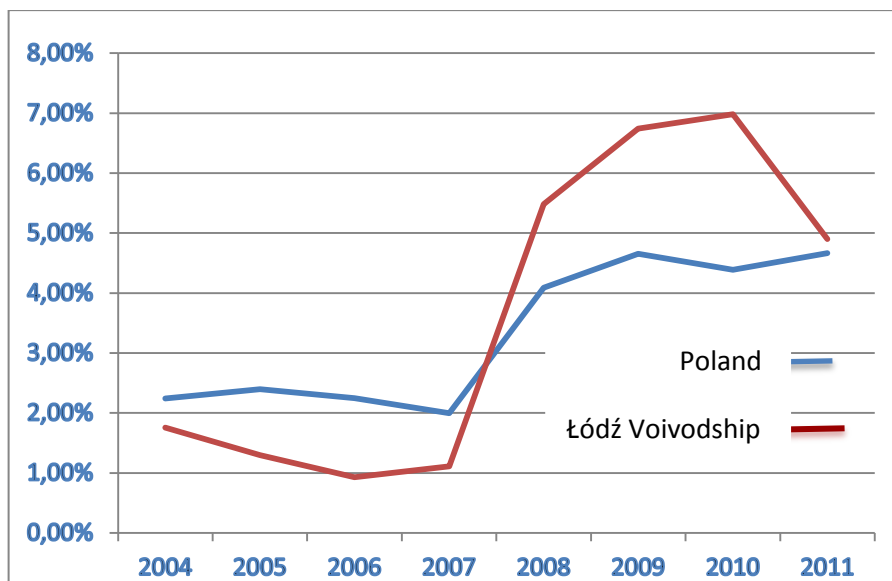
Source: Bank of Regional Data, GUS.



Graph 1. Dynamics of sold production of the food industry in selected Voivodships

Source: Own work.

This situation was possible thanks to the adjustment of the agri-food sector to the homogenous EU market in the aspects of fulfilling sanitary, hygiene and quality requirements. Such an expensive adjustment would not have been possible without additional sources of investment funding like EU aid. This assistance, combined with the financial aid from the national budget, supported the development of many food processing companies in Lodz Voivodship. However, the investment undertaken did not contribute directly to improvement under the HACCP system as, despite the implemented investments, the level of incompliance with the system in companies between 2006 and 2010 was constantly on the increase (Graph 2).



Graph 2. Incompliance with the HACCP system in inspected places which produce animal products

Source: Own work based on „Sprawozdań z działalności i stanu sanitarnego obiektów, w których produkowane są produkty pochodzenia zwierzęcego” General Veterinary Inspectorate, www.wetgiw.gov.pl.

The reason for such a state of affairs stems from the fact that most investment was linked to value added increase and not to the introduction of new processes or technologies. The negative result could also be a resultant of the restructuring of companies, which frequently interfered with current production processes based on HACCP requirements.

Since 2008, the Lodz Voivodship has seen a consistent improvement in company conditions connected to the adherence to the bill 853/2004 of the European Parliament and Council, which introduced laws connected to the hygiene of animal food⁶². Since that year, the number of incompliances registered by the veterinary supervision bodies has halved, meaning an increase of food production safety⁶³.

⁶² Regulation (EC) No. 853/2004, 29 April 2004 laying down specific hygiene rules for food of animal origin, Dziennik Urzędowy UE L139/55, 30.04.2004.

⁶³ Own calculations based on „Sprawozdań z działalności i stanu sanitarnego obiektów, w których produkowane są produkty pochodzenia zwierzęcego” General Veterinary Inspectorate, www.wetgiw.gov.pl.

Summary

To sum up, one can assert that Poland's accession to the EU has had a positive impact on the companies of the agri-food sector in the Lodz Voivodship. On the one hand it was a significant investment stimulus, boosting development and competitiveness, on the other it was an important factor in their continued market operations. However, not all companies of Lodz Voivodship passed this adjustment measure successfully. Many ceased to exist, others merged or were absorbed by a stronger competitor. The significant popularity of these funds led to the implementation of investment which facilitated company modernisation and, as a consequence, the achievement of a technological level similar to that of EU leaders. The process took several years and was very expensive, however its effects are visible today. Meat processing plants were co-financed to the largest extent as they were the biggest beneficiaries of assistance programmes. Milk and fruit and vegetable processing plants also benefitted significantly, becoming, as a result, highly developed and specialised enterprises.

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THE ROLE OF FRAMEWORK PROGRAMMES IN COMMERCIALISATION AND INNOVATION GROWTH SHOWN THROUGH RESEARCH RESULTS – EVALUATION RESEARCH OF THE POLISH EFFECTS

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Abstract

The article presents the results of evaluation research whose aim was the assessment of the effects of completed projects implemented by Polish research departments within the European Union Framework Programmes. This evaluation is the first attempt at a comprehensive analysis of the effects of Polish projects backed by this type of financial support. The research was conducted on the basis of three evaluation structuring criteria: effectiveness, utility and sustainability. The analysis considers three consecutive Framework Programmes which enable the assessment of participation effects and evolution of experiences of Polish beneficiaries over time. The results of the research was juxtaposed with the results of similar evaluation research in other countries, which increased the objectivity of the conclusions. The research pointed to the high effectiveness of achieving strategic goals at institutional level and the career development of individual scientists, as well as low effectiveness in economic output, meaning the impact on innovation is low. Such results are not only a features of Polish participation in framework programmes, but they also correspond to international research which highlights the implementation of other non-innovation geared research objectives.

Key words: European Framework Programmes, commercialisation, innovation growth

Introduction

The EU Framework Programmes is the largest venture of financing scientific development in Europe, including the creation of new knowledge, new technologies, new products and processes and the implementation of innovations for existing solutions. The aim of the

Framework Programmes is to encourage competitiveness and innovation⁶⁴ in European economies and their effects should improve on the existing knowledge in the strategic areas of development.

Framework Programmes are an important tool to implement scientific and innovation⁶⁵ policy geared towards the creation of a smart and balanced economy which encourages social inclusion [the European Commission, 2010]. The growth of European innovation is intended to create a knowledge base and innovation product support through facilitating access to funding for innovation companies as well as creating a common innovations market, promotion of cooperation and utilisation of European creative potential⁶⁶. Amongst others, this instrument targets the creation of favourable conditions for scientists, ensuring access to modern research infrastructure and, most of all, support and strengthening of the cooperation network between science and business sectors. The objective of these activities is to support and accumulate human resources in Europe as well as to stimulate private investment in innovation research, particularly in strategic areas for economic development. The assumptions of the innovation growth policy of European economies correspond with the Union's ambition to bridge the technological gap which separates it from the most technologically advanced countries (such as: USA, Japan, South Korea). Moreover, scientific knowledge and innovations produced within the programmes are to contribute to solutions for the most crucial social challenges.

The effective management of such a large research programme requires in-depth knowledge of the results and the scale of impact, as well as continual adjustment of this mechanism to the dynamic socio-economic climate. One of the tools of such an intervention's impact is evaluation research which offers wide ranging subject analysis of the policy instruments e.g. evaluation assessing the funding mechanisms, implementation process, procedures and the assessment of the true effects of intervention [Olejniczak et al., 2008].

An investment as large as the Framework Programmes - such as the forthcoming Horizon 2020 strategy – relies on the valuable conclusive information from beneficiaries' experiences. The European Commission

⁶⁴ Understood by the European Commission as the ability to implement innovations (new or improved products – goods and services; new processes, organisational and marketing changes) (OECD, 2005).

⁶⁵ Determined by, among others, the objectives of the Europe 2020 strategy.

⁶⁶ Contained in the leading initiative of the Europe 2020 strategy – Innovation Union (the European Commission, 2010).

runs systematic operations whose objective is the assessment of this instrument's effectiveness. The countries which take part in the programmes (e.g. Great Britain, Norway, Denmark, Ireland) undertake independent assessment of the effects of this venture through analysis of project results and their impact on the objectives and thematic areas, implemented both within European and national scientific and innovation policies.

In Poland however, there is a shortage of research devoted to project results, in particular on the utilisation of the effects produced by the Polish research teams. Reports and databases on the Framework projects provide knowledge on technical parameters and project task records. There is a shortfall on information on the project results and their impact on the beneficiary's environment and potential as well as economic advantages achieved. Access to the information seems vital from the point of view of Polish participants and the impact on the socio-economic climate in Poland.

There is a cognitive gap on the subjective experiences of the programme's beneficiaries and the possibility to assess the project's results was the main reason the research was conducted among the Polish project's participants. The research was of an evaluation nature⁶⁷. The aim of the research whose results are presented in this paper was the assessment of the true effects of the project, with the Polish research teams' participation filtered through three evaluation criteria: effectiveness, utility and sustainability. These criteria enabled multifaceted analysis of the Polish research teams' participation impact on the creation of a knowledge base and the growth of the innovation of economy (from the viewpoint of the science sector).

Framework Programmes and innovation – empirical research

The research was conducted by applying various research methods based on triangulation rule [Babbie, 2008]⁶⁸. The research used computer-assisted telephone interviewing (CATI) through a questionnaire and also in-depth interviews with beneficiaries and public institution representatives. In addition, the research was extended by the conclusions from the three cases analysed which involved public institution representatives who were actively engaged in the implementation of Framework projects. The final

⁶⁷ Evaluation is defined as a systematic socio-economic research method providing information on the quality and value of public service activities (Patton, 2008; Rossi et al., 1999; Weiss, 1998)

⁶⁸ The triangulation method recommends application of varied research methods.

stage of the research saw a panel of experts whose aim was the analysis of the evaluation conclusions.

The empirical research (statistical analysis, evaluation research, case study analyses) accentuates the role Framework Programmes play in the development of the knowledge base in Europe and value added generated in the area of science. This is further justified by the expanding budgets of consecutive programmes⁶⁹. Despite the magnitude of this research tool for the development of science, its impact on innovation is still regarded as insufficient. This phenomenon is linked to the *European Paradox* which claims substantial scientific advancement in Europe, however accompanied by low innovation growth. In practice, it signifies that European research programmes contribute to the success of scientific research departments but do not contribute significantly to innovation advancement. The European Paradox⁷⁰ stems from the fact that despite R&D being a drive for innovation, the interdependence between these two is not always direct. The commercialisation of R&D research is a complex process which depends on many factors on the micro level (project management) and on the macro level (market conditions, demand for a particular innovation).

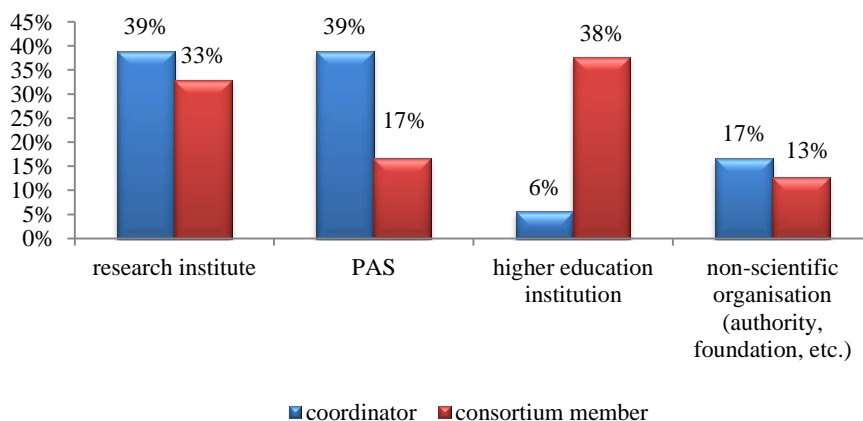
Looking into the reasons for the lower than expected innovation effects of Framework Programmes, it is worth paying attention to the fact that Framework Programmes are dominated by the ‘*technology-push*’ model based approach. This means that beneficiaries focus mainly on the research aspect rather than the practical applications of the research results. The projects are geared towards the creation of technological solutions at an early stage of development for which it is hard to determine a potential market application. The model geared towards market demands (‘*market-pull*’) is applied less frequently. However, the consecutive Framework Programmes are adjusted to the dynamic changes in the innovation creation process and more often consider so called demand models (7th Framework Programme, Horizon 2020) [Arnold, 2011].

⁶⁹ In the 5th Framework Programme 14.89 billion Euros was designated for the implementation of the projects, the 6th received 17.88 billion and the 7th 52.5 billion. The budget of the forthcoming Eighth programme (Horizon 2020) stands at 80 billion Euros.

⁷⁰ A critical approach towards Framework Programmes is expressed by Dosi, Llerena and Labini (Dosi et al., 2006). They deny the existence of the European Paradox pointing to the flaws of European knowledge at the level of scientific research and their commercial application. The validity of precompetitive research is questioned as being a mere excuse for gaining funding from the public purse for marginal areas rather than through self-financing sources, stressing the fact that it does not solve the problem of European innovation.

Moreover, the research conducted within Framework Programmes are defined as *precompetitive*, which means that such research focuses on the development of science and its applicable nature, however its aim is not the implementation of the development of particular products or processes [Fischer et al., 2009].

The survey encompassed 300 Polish beneficiaries including coordinators (6%) and participants (94%) of multinational consortiums. These individuals implemented research projects (development research, scientific research), infrastructure projects (laboratory supplies, equipment purchase, etc) and the projects supporting science institutions in their research. Among the coordinators, the most numerous group was constituted by research institutes and the Polish Academy of Sciences (PAS) institutes (39% each), these consortium members represented mainly higher education institutions and research institutes (Graph 1).



Graph 1. Distribution of the research sample according to the type of institution and its role in the project

Source: Own work based on OPI (Information Processing Institute) research results.

The research covered the majority of the beneficiaries of the 6th Framework Programme (62%), but due to the smaller data, the beneficiaries of the 5th and 7th Framework Programmes complemented the sample (19%

each)⁷¹. The data utilised in the research came from E-CORDA⁷² database, which collects the main information on Framework Programme funding and the beneficiaries⁷³.

Motivation to undertake project operations

The main motivation to participate in the framework programmes for Polish beneficiaries is the opportunity to obtain funding for research. The motivation of scientific development was also considered, stressing the importance of scientific networks for access to state of the art knowledge. The research results point to the fact that these institutions are frequently recommended as members for new consortiums through their track record of cooperation. Access to scientific networks was mentioned as the main non-monetary motivation for programme participation (every second coordinator and as many as 78% of consortium members stressed the importance of this factor). The research also confirmed the lack of a strategy of Polish institutions in the area of activity in Framework Programmes, though the high prestige of participation was appreciated throughout. Polish research confirms a number of European studies, which, similar to the main objective of international teams participation in Framework Programmes, point to the access to complementary knowledge and international qualifications through the network of scientific and business contacts⁷⁴, searching for technological solutions in new fields and the possibility of development in the area of the beneficiaries' specialisations, through implementation of research gained knowledge in these fields [Fischer et al., 2009]. The international participants also considered as a motivator research funding.

Commercialization of the research results implemented by Polish teams was rarely mentioned as the motivation drive in project participation. The demands of private investors for project results was only expressed by 20% of beneficiaries as the reason for undertaking research within the project. This also follows international studies [Astrom et al., 2012]

⁷¹ The evaluation research dealt with the three projects implemented within the 5th, 6th and 7th Framework Programmes (projects completed by 30th June 2012).

⁷² Access to the data courtesy of the National Contact Point NCP EU.

⁷³ E-CORDA database collects data on the technical parameters of the project, they do not include information on their effects. SEZAM is an attempt to create a database on the projects' results. However, it includes only the data on the projects of the 7th Framework Programmes in the area of ICT technology.

⁷⁴ This effect was also regarded as significant by the beneficiaries of the countries which, as a results of many years' experience with Framework Programmes, built extensive international networking (Danish Agency for Science, Technology and Innovation, 2010; Godo et al., 2009; Simmonds P. et al, 2010).

confirming that the motivation of scientific institutions (and surprisingly also companies⁷⁵) does not stem from the need to generate results of practical application. Similarly rare is the intention of the teams to implement project results (the significance of this varied greatly among the respondents). However, in the case of beneficiaries whose motivation was the commercial application of the project results, this objective was often achieved. Moreover, the research conclusions point out that despite the fact that the commercial implementation of the results was not the main objective of the conducted research, still the influence of the programmes on innovation was recorded. This conclusion stemmed from the fact that the majority of the teams indicated the achievement of at least one result linked to technology commercialisation [Fischer et al., 2009].

In the case of Polish beneficiaries whose participation in Framework Programmes resulted from the need of private recipients for the project's results, 23% of the beneficiaries confirmed the lack of results in the area of practical applications. 54% of the beneficiaries pointed to partial results, whereas significant results in this area were confirmed by 23%⁷⁶.

Assessment of Framework Programme effectiveness

The application of the criterion of effectiveness of Framework Programmes allowed to assess the level of the implementation of the project's objectives, the effectiveness of utilised methods in order to achieve the desired results, the effectiveness of institutions and the impact of external factors on the final achievements of all the operations. The evaluation research [ETAN Expert Working Group, 1999] divides the results of Framework projects into three groups:

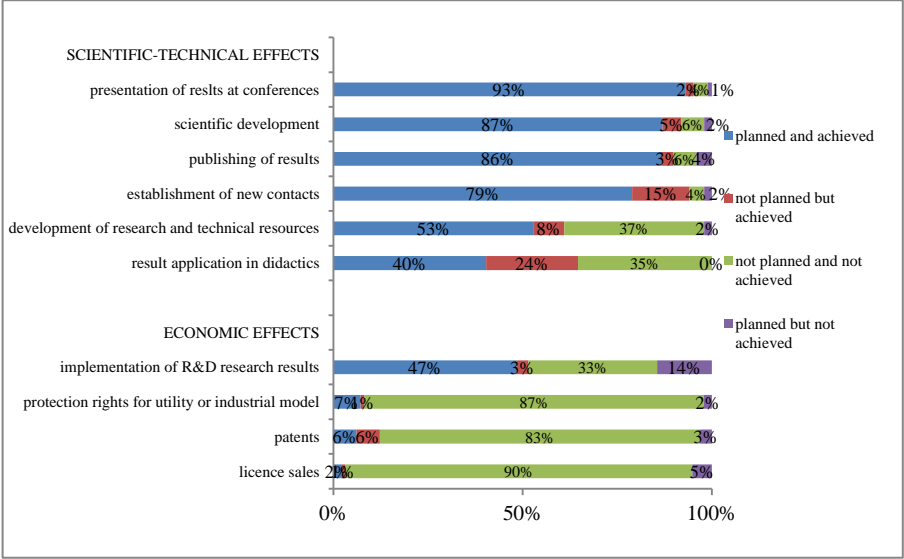
- scientific-technological effects
- economic effects
- social effects

Such a division allows to place the effects achieved by the Polish beneficiaries in the group of scientific-technological effects (which

⁷⁵ On the basis of the research results, companies do not treat Framework Programmes as a result development tool which can be immediately commercialised. Among the main reasons for participation in Framework Programmes they point to the access to scientific knowledge, skill developments, the opportunity to sustain operations at the current level of knowledge on created technologies and access to knowledge on new technologies (Fischer et al., 2009).

⁷⁶ The results in the area of practical applications in the research include: patents, protection rights both industrial and utility model, licence sales and project effect implementation. Partial occurrence of the results means that one effect from the group was achieved; significant occurrence signifies that at least two effects from the group were achieved.

is proved by not only the index of effect achievement, but also by the level of their planning). Low effectiveness characterises the projects with Polish participations in the area of an economic effects (Graph 2). The social effects were not looked into by the research (though the application of the results in didactics may be regarded as a social effect).



Graph 2. The assessment of project result effectiveness (frequency)
Source: Own work based on OPI research results.

Analysis of the data obtained pointed to the particular significance, in the beneficiaries’ view, of two factors of Framework project participation. Firstly, networking was regarded as the key and most desired effect. New contacts established within the consortiums are mainly foreign contacts, the majority being scientific ones (97% of institutions which gained new contacts labelled them so), more rarely business contact (29%). Secondly, the development of individual scientific careers can be regarded as a complementary effect of Framework project implementation. These effects contributed to the rise of an institution’s standing in the national evaluation system of scientific entities. Within the research that received Framework Programme funding, a number of scientific publications appeared, the participants often presented the results of their research at scientific conferences. The research also pointed out that the factor of career development possibility in its international aspect within Framework

projects increased the attractiveness of an institution as a workplace. Participation in Framework Programmes was also used to stimulate an institution's standing in the scientific world.

The frequency of results of a scientific nature (institution's scientific development and the scientists involved in the project) proves that Polish beneficiaries are focused on a project's objective achievement not linked directly with innovation growth. The effectiveness of Polish participation in the programmes was not recorded in the area of project result implementation. In comparison to other results, implementation was most frequently indicated as planned but not achieved (14% indications). If the implementations were applied, then in research institutes they finalised a project twice as often as in PAS institutes and higher education institutions, which stems from the main areas of activities of these institutions, a result of the law requiring research institutes to gear the results towards practical applications⁷⁷. The lower effectiveness of projects in the area of obtaining and managing intellectual copyrights was confirmed. In comparison to other results, acquisition of a patent and protection rights as well as licence sales were mentioned less often among the achieved results. Moreover, these results were not planned. Protection tools created a friendly environment for investment in R&D and for the commercial application of scientific research results. Therefore, the protection of research results is vital for innovation growth, and the low result achievements points to the low effectiveness of Framework projects in this area.

The presented results correspond to international assessment research. Assessment research among Framework beneficiaries in other countries confirms the low effectiveness of beneficiaries in areas directly linked to commercialisation of results or protection of intellectual property of achieved solutions. The respondents were in unison in confirming the lesser significance of these results and more frequently achieved a level below the expected rate, in comparison to the scientific and technological effects [Danish Agency for Science, Technology and Innovation, 2010; Godo et al., 2009; Simmonds et al., 2010; Technopolis Group, 2009].

The international data indicates the highest effectiveness of the Framework projects in a range of areas, though these referred mainly to scientific institutions and their employees' development. Scientific and technological results, such as participation in scientific conferences, determining of new research methods and techniques, or scientific

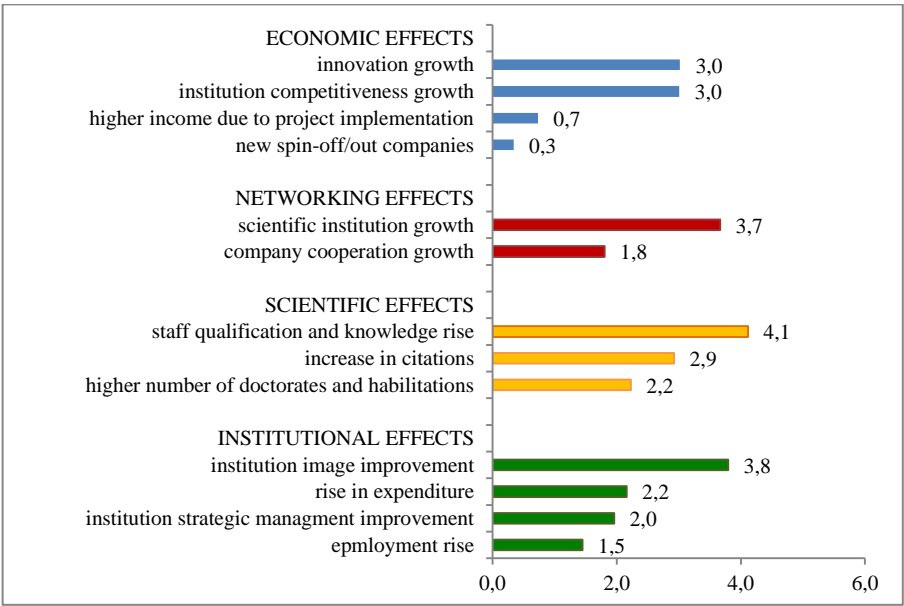
⁷⁷ The Law of 30th April 2010 on Research Institutes Dz. U. Nr. 96 Poz. 618.

publications were implemented beyond project participant expectations [Danish Agency for Science, Technology and Innovation, 2010; Simmonds et al., 2010; Technopolis Group, 2009].

Assessment of Framework project utility

The criterion of utility allowed to assess the true effects of the projects, both planned and unplanned (called side effects), referring to the current, observable situation. The criterion enables the measurement of the effects on, among others, innovation.

Graph 3 presents the classification of the Polish participation in Framework projects used in other evaluation studies [State Secretariat for Education and Research, 2009]. The project’s impact was measured in four aspects: economic effects (influence on the economy and employment level), networking effects (influence on scientific cooperation within a network), scientific effects (influence on the creation of new knowledge and improvement in qualifications) and institutional effects (influence on creating support conditions for scientific and development activities).



Graph 3. Assessment of the utility of project effects (average respondent score)

scale: 0=lack of impact, 5= very high impact

Source: Own work based on OPI research results.

The highest utility effect of the Framework projects was recorded in the area of rising qualifications and knowledge of personnel, scientific effects also scored above average. The beneficiaries admitted that participation in the project improved institution image, rarely though contributing to a rise in employment.

The high assessment of project utility in the area of networking effect corresponded to project effectiveness in the area of networking. Consequently, the projects contributed to an increase in beneficiaries' cooperation with other scientific institutions. The networking effects also play an important role in the institution's standing in the international arena. Participants of the in-depth research pointed to the significance of such scientific contacts (achieved thanks to Framework projects) for further international scientific ventures. Cooperation with companies was mainly established by those institutions whose operations and research included research geared towards commercial recipients (research institutes). The value of utility measurements of the economic effects varied. The beneficiaries confirmed the project's impact on institution innovation and competitiveness growth, however there was a lack of impact stemming from commercialisation of the research results (implementations and new spin-off/out companies). Moreover, the respondents admitted that the profitability of implementations was low. Among the beneficiaries who implemented new solutions, as many as 72% confirmed a lack of extra income from the effect⁷⁸. The opportunity to implement results was regarded by 39% of the beneficiaries as a significant project effect, so contributing to the development of the economy's innovation was not considered significant.

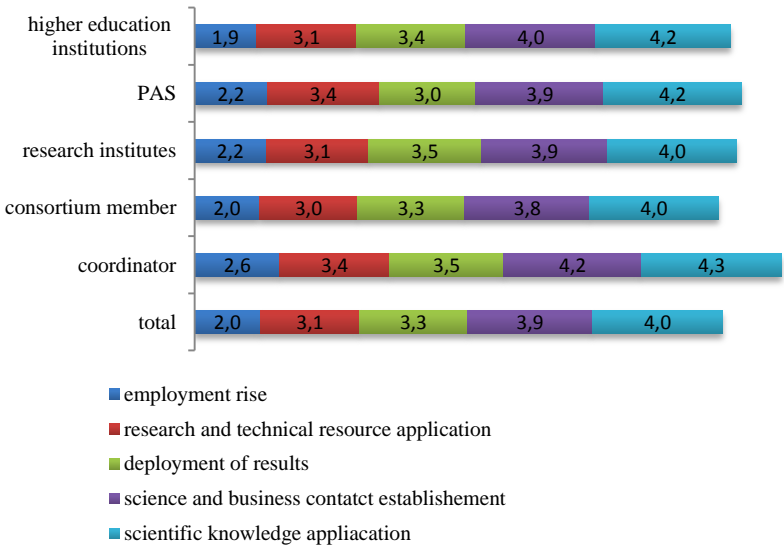
It is worth noting that the utility index values describing the assessment of the project's impact in the given areas increased along with consecutive programmes. Such dependency was recorded for all the analysed effect groups. It signifies the accelerating tendency of Framework project impact, not only in the field of scientific development, but also in the area of innovations.

In order to complement the analysis on the effectiveness and utility of the Framework projects, one must also evaluate their sustainability. The key element of this criterion is the assessment of the

⁷⁸ The research participants also pointed to the rare opportunity of consultations on the implementation of project effects with potential recipients.

continuity of the effects determined by, among others, the time span of the results impact and the aim of their further applications.

Among the most sustainable results the respondents pointed most frequently to the application of scientific knowledge and establishment of new scientific and business contacts (see Graph 4). Although the impact of these effects on innovation is perceived as less significant, still they remain the most quoted reason for project participation and are treated as achieved as expected. On the other hand, the results from the group with a higher impact on innovation (practical application of the effects) were assessed in the evaluation study as less sustainable.



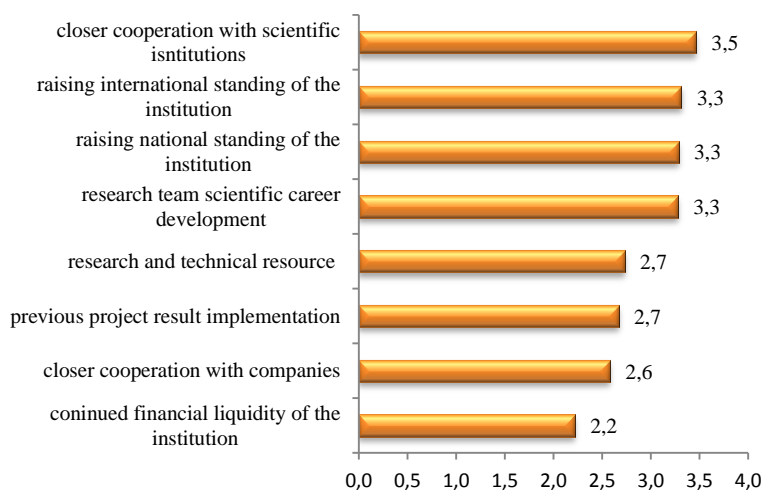
Graph 4. Assessment of sustainability of project results

Assessment measure: average of long-term project effects score. Scale: 1=dominance of short-term effects, 5=dominance of long-term effects.

Source: Own work based on OPI research results.

Analysis of the evaluation research results indicates that the higher the research institution's standing in the consortium, the more frequent the long-term application of the effects after the completion of the project. The research also shows that along with the consecutive Framework Programmes, the assessment of effect sustainability increases.

The effects of Framework projects are applied in other (consecutive) scientific institution operations. Most of all, such applications were recorded during further scientific and development work having the potential to be implemented or commercialised, and also in the form of publications or scientific conference participation (focus on scientific development and scientific career among research institution employees). It is pointed out most frequently that the main objective is close cooperation with other research institutions, raising of national and international standing and research team scientific career development (Graph 5). Closer cooperation with companies and commercialisation (having a direct impact on innovation growth) were rarely indicated as the objective of the continued activities.



Graph 5. Objective of continued activities

Assessment measure: average score of operations stemming from continuation of project activities. Scale: 1=definitely not; 2= probably not; 3= probably yes; 4=definitely yes.

Source: Own work based on OPI research results.

The above results confirm the fact that within the continuity of the Framework project results, practical application was more rarely indicated than the scientific effects, however the objective of continued activities did not refer to factors which impact innovation directly. It also confirms the fact that Framework Programmes raise the level of conducted research, enabling the search for innovation solutions and the possibilities

of technological development, however, the assessment of the impact of these effects on innovation requires a more long term time span.

Summary

The presented research is the first attempt to assess the effects of Polish participants in Framework projects and corresponds to evaluation research conducted among beneficiaries in other countries. What is more, the convergence of the results confirms the significance of this tool for participation in scientific networking and achievement of scientific and technological effects, however it points to the low application of the effects in the economic area, in Poland as well as other countries participating in the programmes. The assumptions of Framework Programmes refer to the objectives included in the EU innovation strategies which advocate a raising of conducted research levels, integration of the European scientific field, searching for innovative solutions and new ways of technological developments⁷⁹. Commercialisation of the innovations achieved as a result of a project has never been the major objective of Framework Programmes and is proven by the evaluation studies which confirm that the effects which may impact innovation growth directly are not common according to the research. Such an outcome determines not only participation of the Polish research institutions, but also corresponds to international research, indicating the achievement effects below respondent expectations and the low importance for the consortiums. However assessment of the direct impact of the effects of innovation on the economy requires a more long term time span. The conducted assessment research leads to the following conclusions:

1. The consecutive programmes brought continually better effects. The index of effectiveness, utility and sustainability increased and a clear positive correlation of these measurements with an institution's standing in a consortium (expressed by its role and financial participation in a project) were recorded.
2. The research accentuated the predominance of effects which translate directly into a research team's scientific career development and the rise of an institution's standing, through implementing an institution's objectives. On the other hand, effects that are beneficial for the economy rarely occurred, thus the low assessment of the project's influence on innovations.

⁷⁹ The main objectives for the European Research Area (the European Commission, 2007) is the integration of the scientific world and raising the level of scientific research.

3.The effects directly translating into the innovation of the economy were more frequently achieved by research institutes (the utility and sustainability of the effects were also assessed higher by these institutions). The higher effectiveness of these institutions is linked to their scientific profile (focused mainly on implementation of ventures of a practical nature). The research results indicate however, that even in the case of these institutions, the applications did not generate financial benefits, moreover their significance, among others, was assessed as low.

4.The continuation of the research commenced within Framework Programmes is a common practice among the beneficiaries. Such practices are in accordance with the European policy on initiative funding, which give long term development prospects and constitute value added on an international scale.

The evaluation research is one of the research methods applied to assess the effects of Framework Programmes. The in-depth understanding of the Framework Programme's impact on the macro economy (including innovation) requires the analysis of this instruments' impact from the viewpoint of individual beneficiaries.

Comprehensive innovation research definitely requires an extension of the analysis to the sector interested in research effect application. This aspect may give rise to later research geared towards assessment of the effects in the business sector. Such knowledge seems to be particularly important in the light of Horizon 2020, which obliges beneficiaries to conduct applicable research and to prepare to implement their results.

Despite the fact that the inclusion of Polish institutions in international research consortia often seems a huge challenge (which is indicated by the consistently low participation statistics), the evaluation research confirmed that the effects achieved by teams correspond to the effects of other European countries participating in these programmes. This justifies the significance of raising Polish participation in this instrument of research funding. Therefore, the understanding of participation mechanisms is significant for the improvement of the existing forms of support and increasing Polish institutions' participation in the forthcoming programmes. The importance of the application effects of the projects in the coming Horizon 2020 strategy demands state intervention to support the cooperation between the science sector and companies. Easier access to scientific research funding for the business sector increases its activity in financing science thus boosting innovation in the Polish economy.

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BUSINESS SUPPORT INSTITUTIONS AND INNOVATION ACTIVITIES OF THE COMPANIES IN SELECTED REGIONS OF POLAND

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Abstract

The current innovation of companies is regarded as a complex process, due to this, it is necessary for local governments to stimulate company innovation potential so purpose orientated plans have been implemented to create institutions for business support. The aim of this article is to analyse the direction and strength of these institution's impact on company innovation in peripheral regions of Poland. In order to verify this research objective, econometric probit modelling was utilised which relies on probability calculus. The examples shown below were based on a sample of 573 industrial companies from the selected peripheral voivodships of Opolskie, Warminsko-Mazurskie and Lubelskie. The results were then compared with the data from one of the most advanced regions in Poland- Wielkopolska. The main conclusions drawn apply for the following statements: 1) Support institutions achieved critical mass in a systemic stimulation of company innovation in the researched areas though the degree varies according to the institution, 2) The directions of the impact of the support organisation, while mostly positive and uniform, include unexpected divergences in the case of financial institutions, 3) more advanced voivodships receive stronger and more widespread help from support institutions.

Key words: Business support institution, innovation, innovative companies

Introduction

The current level of development in Poland means that innovations must now play a crucial role as competition through low production costs is no longer an option. In addition, over the last 20 years we have observed that the traditional factors of competitive advantage have lost their significance to the advancing globalisation processes as well as revolutions in computers and telecommunication [Audretsch, 1998]. The most economically developed countries perceive innovation as a driving force as well as a stabilisation of their advancement [Bukowski et al., 2012].

In Poland however, innovations are the only option available to catch up with the more developed nations.

Companies find it hard to implement innovations single-handedly and, from international experience, we can conclude that the most effective innovation systems are based on cooperation within the so called ‘triple helix’, between the areas of economy, science and public administration [Etzkowitz, 2002; Świadek, 2012]. Regional governments should act with clear goals in order to initiate the transfer of knowledge from scientific circles to businesses. As a result of which, the creation of institutions whose aim is to stimulate innovations in companies and support already innovative businesses have been set up. They are called by the general term, ‘business support institutions’ or ‘institutions of the modern economy’. Literature also includes such terms as, ‘business related institutions’, ‘entrepreneur support groups’ and ‘business support groups’.

Due to their specific nature and the social aspect of their creation, support institutions are an important development which fill the gap between market mechanisms and the activities of the public administration. In the market they offer services that create a specific institutional infrastructure network which enables business people to invigorate the development processes and implement planned strategies [Bąkowski, Mażewska, 2012]. In the subject literature one can find a number of vague definitions of support institutions. For the purpose of this article, the most accurate way of their presentation is enumerating the objectives of the centre’s role in economic development. Taking this into account we can divide them into [Matusiak, 2011]:

- Entrepreneurial centres – widespread promotion and incubation of entrepreneurship (often for groups discriminated against), provision of support services for small businesses and development stimulus for peripheral regions or those disadvantaged structurally;
- Innovation centres – widespread promotion and incubation of innovation entrepreneurship, technology transfer, provision of pro-innovative services, stimulation of academic entrepreneurship and cooperation between science and business;
- Para-banking financial institutions – relaxation of financial discrimination against newly set up businesses or small ones without credit history, provision of financial services adjusted to the new specific economic ventures.

The market of support institutions changes dynamically and business circles frequently witness new institutional bodies whose aim

it is to stimulate entrepreneurship and innovation. Table 1 shows the main types of business related institutions according to the categories above.

Table 1. Innovation and entrepreneurial centres in Poland

Entrepreneurial Centres	Financial Institutions	Innovation Centres
Training and Consulting Centres, Entrepreneurial Centres, Business Centres, Entrepreneurial Clubs, Consulting Points, Consulting and Advisory Centres, Pre-Incubators, Entrepreneurship Incubators	Regional and Local loan Funds, Loan Guarantee Funds, Seed Capital, Business Angels Networks	Technology Transfer Centres, Academic Entrepreneurship Incubators, Technology Incubators, e-Incubators, Technology Parks, R&D Parks, Industrial Parks, Technopoles

Source: A. Bąkowski, M. Mażewska, *Uwarunkowania rozwoju infrastruktury wsparcia w Polsce* [in:] *Ośrodki przedsiębiorczości i innowacyjności w Polsce. Raport 2012*, ed. A. Bąkowski, M. Mażewska, PARP, Warszawa, 2012.

At present it is believed that business support institutions are one of the key instruments in the systems that stimulate economic growth, which is why their presence is required in every industrial and innovation system. One may wonder how effective the influence of business related institutions on a company's innovativeness is. This refers mainly to those regions whose innovative activities in industry remains at a low level (e.g. peripheral regions) in comparison to highly developed ones. Such territories demand substantial attention connected to building a strong regional industrial system. Therefore, the aim of this article is to research the direction and strength of their impact on the innovation activities of industrial companies in peripheral regions of Poland, among others, Opolskie, Warmińsko-Mazurskie and Lubelskie Voivodships and, In order to get a clear picture of the state of innovativeness in the said regions, the results obtained from the research were compared with the data from one of the most developed regions of Poland – Wielkopolskie Voivodship. The research hypothesis of this work is the assertion that the impact strength of individual support institutions is spread unevenly on stimulation of innovation activities, meaning that some institutions are more effective than others, despite which, their impact remains positive.

Methodological foundations of the conducted research

In order to conduct a comparative inter-regional and international analysis of the research results, it was based on the innovation attributes established according to international standards in the Oslo methodology. These standards were drawn up at the turn of the 1980s and 1990s by experts from OECD member states headed by NESTI Group (Working Party of National Experts on Science and Technology Indicators) and published in an international manual called, *Oslo Manual*.

The Oslo methodology defines innovation as the implementation of a significantly improved product (goods or services) or a process, a new marketing method or a new organisational method in industrial practice in a new workplace or business relations [OECD 2005]. The innovation does not have to be totally new it is enough for it to be new for a given company, according to the above stipulations.

The conditions for the research of innovation activities included in the *Oslo Manual* are based on the so-called 'subject method' which assumes as a starting point innovation activities and other company operations as a whole. It considers the factors which support development and hamper innovation. Such an approach comes from the fact that, at present, the factor that shapes economic results and is significant for public policy is the success of individual companies.

Up until now there have been 3 editions of the manual, each one including changes that stem from more in-depth knowledge on the innovation processes which occur in companies and their impact on the economy. The 3rd edition of the *Oslo manual* establishes the standards regarding collection and interpretation of data on innovation in the industry and services sectors.

The above measurements of innovation activity, which can be determined as setting up cooperation between industrial companies and business support institutions, can be divided into 3 groups [OECD, 2005]:

1. Expenditure on research and development investment in the so far under invested fixed assets (buildings, offices, land, machinery and technical devices) and software.
2. Implementation of new products and processes (within the activities indirectly and directly linked to production as well as the administrative activity of a company).
3. Cooperation in the area of new products and technologies with suppliers, customers and competitors as well as representatives of national and foreign research centres.

Through the survey conducted and through probit modelling it has been discovered what influence entrepreneurship support institutions have on the above mentioned attributes of innovativeness. These include technological parks, technological incubators, academic entrepreneurship incubators, technology transfer centres, business angels networks, local or regional loan funds, loan guarantee funds as well as training and consulting centres.

The research material, consisting of 573 surveys, was analysed through probability calculus. This fact comes from the limited interpretation possibilities of multiple regression. With dichotomous variables (having values 0 as no, 1 as yes), parameters of the functions may have a negative value, which makes the interpretation more difficult. Such a situation calls for a better option, which is logistic regression whose analysis and interpretation is similar to the classic regression method. However there are a number of differences which include more complex and time consuming calculations and the fact that calculating values and drawing rest-graphs often does not bring anything new to the model [Stanisz, 1997].

In its wider aspect, logistic regression is a mathematical model which can be applied in order to describe the impact of a few variables X_1, X_2, \dots, X_k on the dichotomous variable Y . While all independent variables are qualitative, the model of logistic regression is the same as a log-linear model. To describe it one can also apply probit regression [Świadek, 2011].

In models using dichotomous variables, parameter estimation is done by the method of greatest plausibility. According to this method, one looks for a parametric vector which guarantees the highest probability of obtaining the values observed in a sample [Welfe, 1998]. In order to estimate the parameters, the probability function is established and then its extremum. Operations in this case are quite complex, however the method enables us to use it to calculate many models, for example those of various parameters or those with a complex structure of delays.

The models presented in this article are of a structural nature. A + sign next to the directional coefficient of a given model signifies that in a given group of companies the probability of the occurrence of innovation activity is greater than in other groups. At this stage it must be pointed out that the fact that the lack of a model does not mean the lack of an impact of a variable on the analysed attribute of innovation. Such a situation signifies that the research companies react to the analysed factor in a variety of ways and it is hard to determine specific tendencies in their activities. The models were generated through the programme Statistica.

Prior to that, the surveys for calculation were prepared in Excel spreadsheets.

Opolskie, Warminsko-Mazurskie and Lubelskie are voivodships of poorly developed industry. Taking into consideration the expenditure on innovation, it can be observed that the aforementioned regions achieved levels below the national average. In Opolskie Voivodship they stood at 191 249 PLN in 2011 (ranked 16th in Poland), in Warminsko-Mazurskie Voivodship, 256 074 PLN (14th) and in Lubelskie Voivodship 478 768 PLN (11th). A similar situation is reflected in expenditure on R&D. Industrial companies in the Opolskie region spent, in 2011, 84.2 million PLN (ranked 15th in Poland), those in Warminsko-Mazurskie region 201.1 million PLN (10th) and Lubelskie 378 million PLN (9th).

573 industrial companies took part in the survey on the innovation activities of businesses initiated by the support institutions. Below you will find their structure presented according to company size, type of ownership, level of applied technology and frequency of establishing cooperation with entrepreneurship support institutions (Table 2).

Micro and small businesses (Table 2) dominated in the 3 regions with a peripheral industrial system and altogether comprise over 70% of the researched companies. Medium sized companies stand at 22.5% with large ones at 6%.

Table 2. Structure of industrial companies in peripheral regions of Poland in 2011 according to size

No.	Company Size	Number of companies	Percentage
1.	Micro	207	36.13%
2.	Small	202	35.25%
3.	Medium-sized	129	22.51%
4.	Large	35	6.11%

Source: Own research based on conducted survey.

Polish owned companies (Table 3) dominated in the researched regions standing at 90% of companies. The number of companies with either foreign or mixed capital was similar- at about 5% each.

Table 3. The structure of industrial companies in peripheral regions of Poland according to their ownership structure (in 2011)

No.	Origins of capital	Number of companies	Percentage
1.	National	519	90.58%
2.	Foreign	29	5.06%
3.	Mixed	25	4.36%

Source: Own research based on conducted survey.

Industry in the researched regions is mainly based on traditional branches (Table 4) which is proven by the fact that nearly 60% of companies conduct their business on a low technological level. $\frac{1}{4}$ of the researched companies belong to the medium or low technologically advanced sector, whereas only 10% are medium-high and less than 5% of companies are highly technologically advanced.

Table 4. The structure of industrial companies in peripheral regions of Poland (in 2011) according to applied technologies

No.	Level of Technology	Number of Companies	Percentage
1.	High	28	4.89%
2.	Medium-High	61	10.65%
3.	Medium-Low	144	25.13%
4.	Low	340	59.33%

Source: Own research based on conducted survey.

As for cooperation with business support institutions (Table 5), the total percentage does not equal 100 as not all companies surveyed availed of such institution's services. Moreover, it is also possible to begin cooperation with a few institutions simultaneously.

The highest number of companies in peripheral regions avail of the services of various types of training and consulting centres and their share of the research sample stood at almost 30%. One can also observe a substantial interest in financing institutions with local and regional loan funds making it possible to obtain capital for almost 20% of researched companies and the loan guarantee funds granted guarantees for 14% of companies. In the voivodships covered, there is also noticeable interest in cooperation with technology parks (10% of companies) and technology

transfer centres (5%) while the participation of the remaining business support institutions is marginal.

Table 5. The structure of industrial companies in peripheral regions of Poland according to their cooperation with business support institutions (in 2011)

No.	Support Institution	Number of Companies	Percentage
1.	Technology Parks	54	9.42%
2.	Technology Incubators	15	2.62%
3.	Academic Entrepreneurship Incubators	14	2.44%
4.	Technology Transfer Centres	29	5.06%
5.	Business Angels Networks	10	1.75%
6.	Local and Regional Loan Funds	112	19.55%
7.	Loan Guarantee Funds	78	13.61%
8.	Training and Consulting Centres	166	28.97%

Source: Own research based on conducted survey.

Analysis of the impact of business support institutions on the implementation of new solutions in industrial companies in the peripheral regions of Poland

Analysing the activities of business support institutions in the peripheral regions (Table 6) one may notice the strong positive impact of technology parks and training and consulting centres on initiating innovation in industry. Technology parks contributed to the search for new solutions as shown by the growing expenditure on R&D. Moreover, such companies also invested in fixed assets and software as well as introducing new products and technological processes. These were linked not only to direct manufacturing but were also of a production related and administrative nature. A similar situation occurred in the case of training and consulting centres, the only exception being investment in machinery, offices and land, which did not show any patterns.

Technology transfer centres contribute to a lesser extent to the improvement of innovativeness in peripheral regions. For this support centre, 4 statistically significant models (out of 10 possible) have been

generated. The centres also contribute to the running of R&D operations, increasing the range of companies through the introduction of new products and the application of new technological processes, in general and directly linked to production (e.g. logistics).

It is worth pointing out that in the companies surveyed, technological incubators enhance the likelihood of conducting R&D operations and the implementation of new production related technologies, whereas academic entrepreneurship incubators encourage the purchase of new computer software.

While technology parks, technology transfer centres and training and consulting centres reinforce the potential of peripheral regions in the area of initiating innovations and entrepreneurship, in the case of financial institutions, the regions face a shortfall related to the difficulties in obtaining capital to implement new solutions. Out of three financing institutions: business angel networks, local and regional loan funds and loan guarantee funds, only the latter generally encourages the implementation of new technological processes in general and manufacturing methods. In the case of new software, for loan funds and loan guarantee funds, models of a negative directional coefficient were generated, therefore the probability of purchasing new software is greater in companies not cooperating with these two institutions. In addition, no model was generated for the business angels networks, which highlights the problem of securing high risk capital for highly innovative projects.

When observing the impact of support institutions in regions such as Wielkopolskie Voivodship (Table 7), one notices the greater influence on stimulating innovation than in peripheral regions. The impact of technology parks and training and consulting centres is similar regardless of industrial advancement. Significant divergences can be observed in the case of technology transfer centres as in Wielkopolskie Voivodship they are much more effective - out of ten possible statistically significant models eight were generated. Apart from initiating more innovations than in peripheral regions, there is a greater probability of investment in new fixed assets (general as well as machinery), software and support systems.

Table 6. Probit modelling with independent variable ‘business support institutions’ in statistically significant models describing innovation in industry and innovation cooperation in the peripheral regions

Support Institutions Innovation Attributes	Technology Parks	Technology Incubators	Academic Entrepreneurship Incubators	Technology Transfer Centres	Business Angels Networks	Local and Regional Loan Guarantee Funds	Loan Guarantee Funds	Training and Consulting Centres
Expenditure on R&D	+0.7x-0.5	+0.7x-0.4		+0.8x-0.4				+0.3x+0.5
Investment in the so far under invested fixed assets including:	+0.7x+0.7							+0.4x+0.6
a) buildings, offices and land	+0.4x-0.8							
b) machinery and technical devices	+0.7x+0.4							+0.4x+0.3
Software	+0.5x+0.1		+0.9x+0.2			-0.4x+0.2	-0.4x+0.2	+0.3x+0.1
Implementation of new products	+0.7x+0.6			+0.9x+0.6				+0.5x+0.5
Implementation of new technological processes, including	+1.0+0.6			+0.9x+0.6			+0.4x+0.6	+0.6x+0.5
a) manufacturing methods	+0.4x-0.1						+0.5x-0.1	+0.3x-0.1
b) production-related systems	+0.7x-0.5	+1.1x-0.5		+0.7x-0.5				+0.3x-0.5
c) support systems	+0.5x-0.9							+0.6x-1.0
Cooperation with suppliers	+0.7x-0.7		+0.8x-0.6					
Cooperation with competitors							+0.6x-1.9	
Cooperation with Polish Academy of Sciences departments			+1.3x-2.4					
Cooperation with universities	+0.5x-1.6							
Cooperation with national R&D centres	+0.8x-1.3			+0.8x-1.3	+1.0x-1.3			+0.4x-1.4
Cooperation with foreign R&D centres								
Cooperation with clients								

Support Institutions Innovation Attributes	Technology Parks	Technology Incubators	Academic Entrepreneurship Incubators	Technology Transfer Centres	Business Angels Networks	Local and Regional Loan Guarantee Funds	Loan Guarantee Funds	Training and Consulting Centres
General innovation cooperation	+0.6x-0.1		+0.7x-0.1					+0.3x-0.2

Source: Own research based on conducted survey.

Table 7. Probit modeling with independent variable ‘business support institutions’ in statistically significant models describing innovation in industry and innovation cooperation in the Wielkopolska Voivodship.

Support Institutions Innovation Attributes	Technology Parks	Technology Incubators	Academic Entrepreneurship Incubators	Technology Transfer Centres	Business Angels Networks	Local and Regional Loan Guarantee Funds	Loan Guarantee Funds	Training and Consulting Centres
Expenditure on R&D	+0.9x-0.5		+0.6x-0.4	+0.9x-0.4		-0.3x-0.3		+0.5x-0.5
Investment in the so far under invested fixed assets including:	+0.8x+0.6			+0.4x+0.6			+0.3x+0.6	+0.5x+0.5
a) buildings, offices, land	+0.4x-0.8							
b) machinery and technical devices	+0.5x+0.3	+0.6x+0.3		+0.6x+0.4			+0.3x+0.3	+0.5x+0.3
Software	+0.4x+0.1			+0.4x+0.1				+0.5x+0.0
Implementation of new products	+0.6x+0.3			+0.4x+0.4				+0.3x+0.3
Implementation of new technological processes, including:	+0.8x+0.6	+0.9x+0.6		+0.7x+0.3			+0.6x+0.6	+0.6x+0.5
a) manufacturing methods	+0.5x-0.1							+0.4x-0.2
b) production-related systems	+0.5x-0.5	+0.6x-0.5		+0.6x-0.5			+0.3x-0.5	+0.3x-0.5
c) support systems	+0.4x-0.8		+1.1x-0.8	+0.4x-0.8				+0.3x-0.9
Cooperation with suppliers				+0.4x-0.8				+0.2x-0.8

Support Institutions Innovation Attributes	Technology Parks	Technology Incubators	Academic Entrepreneurship Incubators	Technology Transfer Centres	Business Angels Networks	Local and Regional Loan Guarantee Funds	Loan Guarantee Funds	Training and Consulting Centres
Cooperation with competitors				+0.5x-1.8	+0.9x-1.7			
Cooperation with Polish Academy of Sciences departments		+1.9x-3.0		+1.1x-2.8				
Cooperation with universities	+0.9x-1.9		+1.5x-1.7	+0.5x-1.8		-0.7x-1.7	-0.8x-1.7	+0.6x-2.1
Cooperation with national R&D centres	+0.8x-1.5	+0.8x-1.4		+1.0-1.5				+0.5x-1.6
Cooperation with foreign R&D centres	+0.6x-2.1			+0.5x-2.1				
Cooperation with clients								+0,3x-1,0
General innovation cooperation	+0.6x-0,3		+0.8x-0.3	+0.8x-0.3		-0.3x-0.2		+0.4x-0.4

Source: Own research based on conducted survey.

Technology incubators encourage investment in machinery and implementation of new technologies, in general and in production related systems. Establishing cooperation between academic incubators of entrepreneurship boosts the probability of R&D operations and the introduction of new processes in support systems.

In the case of financing institutions, there is a similar shortfall in the peripheral regions though slightly smaller. Loan guarantee funds encourage investment in fixed assets (general and machinery) as well as new technological processes (general and production related). However securing capital from loan funds decreases the likelihood of expenditure on R&D which may be linked to a slowdown in the economy and to the fact that companies look to the fund for short term liquidity not for conducting research. In Wielkopolskie region there is a negative aspect connected to the lack of operations (or very limited) of business angel networks.

While analysing innovation cooperation in the peripheral regions, there is only a slight influence of support institutions (Table 6). The most

prolific cooperation, in the areas of new products and technologies, is established under the influence of technology parks and academic entrepreneurship incubators, however, for technology parks only 4 out of 8 possible statistically significant models were generated, for academic entrepreneurship incubators 3 out of a possible 8. Both parks and incubators encourage innovation cooperation in general and along with their suppliers. Transfer of knowledge from scientific circles, aided by parks, occurs as a result of cooperation with universities, national research departments and, in cooperation with incubators, with departments of the Polish Academy of Sciences.

Training and consulting centres encourage innovation cooperation in general and with the national departments of research and development. This cooperation is also stimulated by technology transfer centres and business angel networks. The probability of establishing cooperation with competitors increases under the influence of loan guarantee funds.

The frequency of establishing cooperation inspired by the support institution in both the peripheral regions and Wielkopolskie (Table 6 and 7), seems to show that these institutions are more effective in developed areas. In Wielkopolskie Voivodship, technology transfer centres are most effective at contributing to cooperation in all the researched institutions apart from with their clients. Training and consulting centres seem to also be quite effective at establishing general innovative cooperation and with national R&D centres (as is also the case in peripheral regions), universities and along the supply chain, meaning with suppliers and clients. Technology parks, apart from their contribution to the transfer of knowledge from universities to national research departments, as is also the case in peripheral regions, increase the possibility of establishing cooperation with foreign R&D centres. Academic entrepreneurship incubators encourage cooperation with universities in general, while technology incubators (for which in peripheral regions no model has been generated) encourage cooperation with the Polish Academy of Sciences and national R&D centres.

Among financing institutions only business angels encourage cooperation with competitors. In the case of local and regional loan funds and loan guarantee funds, models with a negative directional coefficient were generated, which means that, under the influence of these two institutions, there is little probability of establishing cooperation with universities, and in the case of loan funds, innovation cooperation in general.

Summary

The Opolskie, Warminsko-Mazurskie and Lubelskie regions have underdeveloped industrial systems. However while analysing the influence of support institutions on the innovation activities of industrial companies and, comparing it with the developed region of Wielkopolskie, one can see phenomena that may lead to the conclusion that industrial systems in these areas are growing stronger.

Technology parks and training and consulting centres achieved their critical mass in activating innovativeness in both the peripheral regions and Wielkopolskie. Moreover, the developed region can boast a high effectiveness in initiating innovation thanks to technology transfer centres. In peripheral regions it is lower, however one may assume that this is a delay resulting from the weaker development of these voivodships and that, in future, along with the development of the region the influence of technology transfer centres on a company's innovativeness will increase.

Support institutions have a mainly positive influence on stimulating innovation. There are however unexpected divergences linked to the financing of new solution implementation. In both the peripheral regions and Wielkopolska one can observe the positive impact of loan guarantee funds and local and regional loan funds on the activity and innovation cooperation as well as its lack of impact. In developed regions this refers to cooperation and R&D while in peripheral regions it refers to investment in new software. In the peripheral regions business angels networks hardly operate which most likely stems from weak demand as high-risk investments are strongly dependant on the state of the local economy.

In both the peripheral regions and the developed one, one can see a stimulating influence of support institutions on conducting R&D activities. This is undoubtedly positive as there is a high probability that the created innovations will not be mere copies of new solutions from abroad but will bring about the creation of their own new ideas.

Peripheral regions are characterised by a much lower tendency to cooperate than the developed region. In each of these regions knowledge is transferred from scientific circles, but in regions of underdeveloped industrial system it only comes from within Poland while in Wielkopolskie Voivodship also from abroad. In peripheral regions business people are very unwilling to cooperate with each other. Two cases registered a stimulation of cooperation with suppliers and one with competitors. The situation is slightly improved in Wielkopolska, however the level of cooperation stimulation is still not satisfactory. This tendency is worrying, as in order

to create a strong industrial system only transfer of knowledge from scientific circles to business is not enough. Cooperation between businesses themselves is also a vital element.

Business support institutions in Wielkopolska encourage innovation more vigorously and is more widespread than in the peripheral regions. This particularly relates to cooperation on new solutions. Therefore a request to the local government of the peripheral regions should be put forward to focus their policies on the encouragement of innovation cooperation. Taking the above conclusions into consideration, one can claim that the research hypothesis has been partly confirmed. There is however an uneven, though still mainly positive, impact of support institutions on innovation encouragement. Only financing institutions registered slight divergences.

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