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THE ANALYSIS OF R&D INTERNATIONALIZATION – CASE STUDY OF COMARCH ENTERPRISE

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Abstract

The aim of this article is to present theoretical aspects to the R&D internationalization process and its reasons together with the R&D internationalization case study of a Polish enterprise Comarch.
The article consists of a theoretical part discussing the essence, forms and reasons of R&D internationalization; a methodical part presenting research methods and measures for determining the degree of R&D internationalization; and a practical one in which the R&D internationalization process in a Polish IT enterprise Comarch has been presented. This process is still going on – the company is setting up R&D branches abroad (in Germany, Austria, Switzerland and France), has started research cooperation with foreign science centres, taken over foreign companies or participates in research syndicates in order to implement projects from the EU's Framework Programmes. The analysis of the Comarch case was a part of the research conducted by the author of the present paper in 2011 on the R&D internationalization process implemented in Polish enterprises.

Keywords: R&D internationalization, R&D activity, enterprises in Poland.

JEL classification: O3.

Introduction

The process of internationalization (i.e. making economic activity international) results in taking up economic activity by an enterprise in different sectors outside a country. It is a process of broadening companies' economic activity (on a national level) to foreign markets. The internationalization of R&D activity, which is a part of the internationalization process and regards R&D, has evolved in recent years. The following factors have contributed to this phenomenon: growing specialization in a global value chain, globalization of markets (connected with technological progress enabling the division of a production process of a product into numerous, consecutive stages usually held in different countries), rapid development of ICT, internationalization of science, international activity of scientists or the integration of developed and developing economies (China, India).

The analysis of literature on the R&D internationalization indicates that as far as the implementation of the aforementioned process by Polish enterprises is concerned, hitherto published research findings relate to the process only partially. This stems from the novel character of issues referred to in the present paper as well as the lack of comprehensive methodology for the R&D internationalization.

The article sheds light on the essence of the R&D internationalization process, its reasons, and measures to be adopted for determining the degree of the R&D internationalization in enterprises. It presents the findings of research conducted by the author on the R&D internationalization in a Polish enterprise Comarch.

1. Research and Development activity – definition

R&D involves creative activity, taken systematically, in order to increase knowledge (on man, culture and society) and use this information to develop new products. The creative activity consists of three kinds of research: *basic research*, *applied research* and e*xperimental development*[1].

Basic research aims at revealing new regularities, truths, rules, laws of science. It is based on property, structure and dependence analysis. The research is experimental or theoretical and can be oriented or not (so called pure). Basic pure research contributes to science development and results from researcher's own interests. The research has no particular aims imposed and, consequently, is not a part of innovation activities. On the other hand, this research usually leads to the emergence of new laws and scientific theories. The outcome of the research has

normally no trade value and can be found in publications and lectures but it may lead to applied research.

Basic oriented research has one aim: creating wide knowledge basis which can help solve problems or take advantage of opportunities, both existing as well as the anticipated ones. The research is usually conducted in a higher education sector and – to some extent – on a government and self-government level.

Applied research often uses the outcome of basic research but the work is original and aims at getting new knowledge. This research, however, has particular practical aims, which distinguishes it from basic research. The outcome of applied research leads to the emergence of inventions which are often tested in laboratories or as prototypes. The outcome is often protected by a patent or kept secret.

Experimental development, which is based on constructing, making projects and experimenting, applies existing knowledge acquired from research activities or practical experience. The knowledge is exploited while making new or improving existing materials, appliances, products, processes, systems or services (including the preparation of experimental prototypes or pilot systems). This category does not exist in humanities. In social sciences experimental development can be referred to as a process of moving knowledge (acquired during research) to operational programmes, including "demonstration projects", initiated to carry out tests and evaluations[2].

An innovation element and the elimination of scientific and/or technological uncertainty distinguish R&D activity from other activities, i.e. the solution of a problem is not an obvious consequence of the previous state of knowledge.

2. Internationalization of R&D – theoretical aspects and reasons

Broadly speaking, the process of the internationalization of R&D involves – apart from opening R&D centres abroad – international cooperation in a research network, technological alliances, research contracts and agreements, *open innovation* with a foreign partner, international mobility of scientists, international patents.

Four complementary areas shape the process:

- international R&D cooperation between at least two countries,
- creating CBR networks by transnational corporations in different parts of the world (setting up new centres and/or taking over foreign CBR),

– system of international grants, circulation of licences and patents (intellectual property protection),
– open innovation, open source.

Consequently, the R&D internationalization process can be analyzed in two categories: advanced R&D internationalization (active) and basic (passive). The passive R&D internationalization consists in establishing relations and making research contracts with foreign partners, participation in international research programmes, applying for international patents, but without doing research outside own country.

The active R&D internationalization, on the other hand, involves all forms of making R&D international, including the creation of research and development centres abroad. Therefore, the passive R&D internationalization may precede the active R&D internationalization. This passive way of internationalization shows that the company acquires knowledge, experience, new skills, develops its resources but does not cross its borders.

The phenomenon of R&D internationalization is not new[3], but its importance has increased significantly in recent years, especially in the context of *open innovation* strategy and globalization. Even the first works on the phenomenon referred to R&D internationalization[4] as the key to the growth of an enterprise. Doing research in enterprises was very centralized because companies wanted this activity to stay under direct control of the board.

Within the last two decades the R&D internationalization strategy of transnational corporations and the reasons for taking up such activity have changed. The change generally consists in a transition from an "exploitation" model, brain drain to cooperation in developing knowledge and skills. In the 1970s and 1980s of the previous century the main factor of the location of a R&D branch in a foreign developed country was adjusting products and services to conditions of that country. Since the 1990s internationalization has been a consequence of production and sale globalization, and its main aim is the access to new knowledge.

As far as markets (i.e. home market and external market abroad) are concerned, there are four kinds of processes of R&D internationalization. A traditional approach to the internationalization process refers to the relocation of R&D activity from one developed country to another developed country, which took place in the 20th century. A modern approach, in contrast, focuses on the relocation of R&D activity to developing countries. The patterns of internationalization are presented in a Table 1.

Table 1. Patterns of R&D internationalization

	Developing country	Developed country
Developed country	Modern process of internationalization (e.g. USA → China, EU → India)	Traditional process of internationalization (e.g. USA → EU, Japan → USA)
Developing country	Expansive process of internationalization (e.g. China → Brasil, India → China)	Catch-up process of internationalization (e.g. China → USA, India → EU)

Source: Zedtwitz, Gassmann (2002).

There are many reasons why R&D activity is located abroad. They depend on different factors, both in a home country as well as a host one, such as the country's development level, technological and education level, the height of barriers to enter and exit. The reasons are also connected to the type of enterprise activity, its financial and HR situation, as well as its strategy, vision and mission. There are also factors connected with the international environment (membership in international organizations, trade contracts etc.). Thus, the factors can be considered on an international, state (local) and organization's level.

There are the following factors of the R&D internationalization of multinational enterprises[5]:

– changing needs of multinational enterprises,
– growing resources of talents in fast developing countries,
– the government strategy of a host country,
– growing technological competence of enterprises from *emerging economies*.

The conducted research shows that when it comes to opening a research department abroad (R), the supply factors really matter, i.e. quality, quantity and the specialization of a science centre[6]. The most important factors are the proximity of local universities and science parks as well as innovation centres. On the other hand, the decisions on the location of development

Table 2. Reasons for the location of R&D activity abroad

Reasons for the location of research activity	Reasons for the location of development activity
Proximity to local universities and science parks	Local market needs
Developing networks of informal relations	Proximity to consumers and leading users
Limited own science centre	Cooperation with local partners
Access to local specialists	Access to a market
Sharing the risk of research works	Taking advantage of various time zones
Support for local projects	Cost advantages
Local patent law	Adaptation of innovation process to local production
Low acceptence of research works in a home country	Intellectual property protection

Source: Zedtwitz, Gassmann (2002), pp. 569–588.

projects (D) depend on demand factors. Table 2 shows the outcome of the research. It is often the case that the differences between a research and development work are slight.

3. Methods and measures for determining the degree of R&D internationalization

Dynamic development of R&D internationalization is hardly reflected in the methodology for dealing with the phenomenon. International organizations such as OECD, UNCTAD and UE have already noticed the importance of the process. Nevertheless, the existing principles and system of statistics, science, technology and innovation do not enable one to measure the phenomenon with precision. Development of methodology for the R&D internationalization is one of major challenges.

The analysis of the literature on the R&D internationalization indicates that, as far as the implementation of the aforementioned process by Polish enterprises is concerned, hitherto published research findings relate to the process only partially. This stems from the novel character of issues referred to in the present paper as well as the lack of comprehensive methodology for the R&D internationalization. The following 15 measures may be adopted for determining the degree of the internationalization under discussion:

a) total R&D expenditure incurred by enterprise;
b) total number of research staff members in enterprise;
c) R&D expenditure incurred by enterprise's R&D centre located abroad;
d) number of research staff members in enterprise's R&D centre located abroad;
e) share of R&D expenditure incurred by enterprise's R&D centre located abroad in total R&D expenditure financed by enterprise;
f) share of research staff members in enterprise's R&D center located abroad in total number of research staff members in enterprise;
g) ratio between the number of enterprise's R&D centers located abroad and total number of enterprise's R&D centers;
h) total number of enterprise's partners in R&D activity;
i) number of enterprise's foreign partners in R&D activity;
j) ratio between the number of enterprise's foreign partners in R&D activity and total number of enterprise's partners in R&D activity;
k) number of patents obtained by enterprise in cooperation with foreign inventor;
l) total number of patents obtained by enterprise;
m) number of patents obtained by enterprise abroad;

n) ratio between the number of patents obtained by enterprise abroad and total number of patents obtained by enterprise;
o) in order to determine the degree of R&D internationalization of a given enterprise, one may use R&D internationalization index which is an arithmetic average of the following three measures:
   – share of R&D expenditure incurred by enterprise's R&D centre located abroad in total R&D expenditure financed by enterprise,
   – share of research staff members in enterprise's R&D center located abroad in total number of research staff members employed in enterprise,
   – ratio between the number of enterprise's R&D centers located abroad and total number of enterprise's R&D centers.

The idea of developing measures for determining the R&D internationalization in Polish enterprises has been put forward by the author of the present paper. To be more specific, two forms of the R&D internationalization are to be determined (both at a basic level and advanced level), namely active R&D internationalization (refers to measuring FDI in R&D) as well as passive R&D internationalization (refers to international cooperation as part of R&D activity).

Niosi and Bellon carried out theoretical analysis and empirical research on the internationalization of national innovation systems (USA, Canada and countries of Western Europe)[7]. Measures they have suggested are still adopted by researchers and international institutions. OECD also recommends measures to be implemented for determining the degree of internationalization of R&D activity (see: Handbook on Economic Globalisation Indicators)[8].

It should be noticed that a number of aspects to the internationalization of R&D activity do not have directly measurable characteristics (e.g. reasons behind internationalization, barriers to internationalization), which hinders statistical analysis of these aspects. Therefore, research on the process of internationalization is based on qualitative methods such as questionnaire survey, face-to-face interview and case study.

4. Internationalization of R&D activity exemplified by Comarch – research findings

The analysis covered two groups of enterprises. Source of capital was a distinguishing criterion. The survey examined companies with 100% Polish capital and enterprises with 100% foreign capital (transnational corporations).

The analysis involved two stages. The first one was aimed at identifying transnational corporations that have opened their R&D centres in Poland (X–XII 2010). Fifty-seven entities

have chosen Poland as a location. The second stage was a questionnaire survey examining two groups of companies (the second half of 2011). Questionnaires were sent via e-mail to 94 transnational corporations and 102 Polish enterprises[9]. All in all, 33 transnational corporations sent back the filled-in questionnaires (i.e. 35% of selected firms). As for the Polish enterprises, 40 responded to the author's request (i.e. 39% of selected firms).

In order to supplement questionnaire data and provide a complete image of the R&D internationalization in enterprises, face-to-face interviews were held in some cases to shed some light on the aforementioned process. Information collected in such a way laid a foundation for a number of case studies[10].

The article is aimed at presenting one case study, namely the process of the R&D internationalization implemented in Comarch enterprise.

An example of a Polish enterprise which successfully implements the strategy of R&D internationalization is Comarch from Cracow. The company was set up by prof. J.Filipiak at AGH University of Science and Technology in 1993 (spin-off). Comarch creates specialist IT software and solutions for key lines of business. This is one of few Polish technological companies which managed to enter a global market selling the software under its own brand name in western Europe, the USA and South America. Comarch is a company based on knowledge, therefore its most precious resource is their workers. Students and graduates of universities – mainly AGH University – are the source of employees for the enterprise (21.4% of the Polish staff come from AGH University). In 2011 the Comarch group business employed more than 3500 people in Poland and abroad. The majority work in Cracow centre – 59.5% (25% with higher education, 15.7% university students). The average age in the Comarch group business is 30 (based on Comarch annual report, 2010).

Comarch is a global producer of IT solutions. Its activity is mainly based on: customer service systems, enterprise management systems ERP, IT security, CRM systems and sale support, electronic communication as well as business intelligence. The company's R&D policy is grounded on the experience and skills of the workers (1100 experts in several R&D centres in the world) and on financial investment in R&D which comes to a dozen or so per cent of income. Their R&D expenditure in 2011 was 102 mln zl (both own funds and actively gained European funds)[11].

The policy of Comarch involves the R&D works connected with the implementation of new products and standardization of their preparation for a client from the very beginning. Thanks to such a procedure, even if a product is tailored to the needs of a particular client, a part or the whole software/code can be used to the preparation of a standard program. Consequently,

the profitability of individual contracts is higher and there are more clients. The R&D strategy is thus based on investing in repetitive products. There are also 'turnkey solutions', in which, however, a repetitive product (e.g. ERP system) it very often their basic part.

The way of conducting research is as follows: R&D units for particular research purposes are created and their only aim is to implement R&D projects. The units are divided into responsibility centres/subcentres, in which individual projects are developed. Such approach enables the experts to follow the progress quickly, monitor both the outcome as well as the incurred R&D costs.

Since 2005 Comarch has been intensively developing its R&D activity on a corporation level. New structures have been created, which made it possible to effectively gain resources for development from the EU. The enterprise has also entered an advanced stage of R&D internationalization through opening its research centres outside Poland. At the moment Comarch has 15 R&D centres (CBR) in Europe, the biggest of which operates in Cracow.

Table 3. Comarch's R&D centres

Country	City
Poland	Krajów, Warszawa, Katowice, Wrocław, Poznań, Łódź, Gdańsk
Germany	Hanover, Munich, Brema, Dresden
Austria	Kirchbichl
Switzerland	Buchs
France	Grenoble, Lille

Source: Annual Report by Comarch (2010).

German, Austrian and Swiss markets are of key importance for the company since almost 30 per cent of its turnover comes from these countries. Opening a R&D centre here aims at adapting the company's solutions to the market needs.

In order to increase a synergy effect in the research network, Comarch's R&D centres carry out innovation projects together: in 2010 there were 45 projects both in Poland and abroad. The most important are:

- semiramis project (a key product of a German company SoftM Software und Beratung AG which was taken over in December 2008); the project is implemented simultaneously in R&D centres in Hanover, Munich, Kirchbichl and Warsaw,
- Document Management System (DMS) in Buchs w Switzerland, in Cracow, w Łódź and in Warsaw,
- Financial-book-keeping system (ISAR) in Brema, Munich and Warsaw,
- IT infrastructure management system of enterprise (ITM) in Grenoble and Cracow,

– projects: ECOD 2.0, loyalty platforms, Altum and CDAR Business Intelligence Comarch Workflow – cooperation of the Polish R&D centres.

The R&D internationalization strategy in Comarch is also based on taking advantage of the EU Framework Programmes and the EU funds. Comarch is implementing three projects within the Seventh Framework Programme, completed four projects in the previous programme and was a project consortium leader in the Fifth Framework Programme.

Table 4. Comarch's participation in the EU Framework Programmes

Kind of project (name)	Framework Programme	Project amount
ADMIRE – Advanced Data Mining and Integration Research for Europe	Seventh Framework Programme (contract nr 215024)	4,066,380 EUR (the whole project)
MOST – Marrying Ontology and Software Technology	Seventh Framework Programme (contract nr 216691) Coordinator	5,344,959 EUR (the whole project)
NI2S3 – Net-centric Information & Integration Services for Security Systems	Seventh Framework Programme (contract nr 225488)	4,325,728 EUR (the whole project)
ECOLEAD – European Collaborative networked Organizations LEADership Initiative FP6	Sixth Framework Programme	6,994,579 EUR (the whole project) 176,000 EUR (for Comarch)
MDS – Misuse Detection System in Telecommunication Infrastructure	Sixth Framework Programme	1,729,530 EUR (the whole project) 168,360 EUR (for Comarch)
ASK-IT – Ambient Intelligence System of Agents for Knowledge-based and Integrated Services for Mobility Impaired Users	Sixth Framework Programme	1 4,926,123.38 EUR (the whole project) 124,966 EUR (for Comarch)
WearIT@work – Empowering the Mobile Worker by Wearable Computing	Sixth Framework Programme	23,473,354.27 EUR (the whole project) 246,600 EUR (for Comarch)

Source: own study.

The enterprise has also been implementing 13 projects financed partially from the Operational Programme Innovative Economy (operation 1.4 4.1) and 1 project as a part of IniTech Enterprise (the project implemented on the basis of a funding contract with the National Centre for Research and Development).

The cooperation with science centres from both Poland and abroad is another example of the R&D internationalization. Comarch develops such cooperation very rapidly. Together with AGH University of Science and Technology, Warsaw University and Poznan University of Economics, Comarch opened the Centre of Advanced Information and Communication Technologies. Moreover, Comarch implements novel projects and applies for European development funds in cooperation with foreign universities. In 2010 Comarch set up the

Innovation Lab at Innsbruck University. When implementing the ADMIRE project the company has the following key partners:

- Univerity of Edinburgh,
- University of Vienna,
- Technical University of Madrid,
- Slovak Academy of Science in Bratislava,
- Fujitsu Labs of Europe.

There is also a project NI2S3 consortium with Comarch and its other founders: Italian Vitrociset, british HW Communications, University of Florence and University of Aalborg as well as AGH University of Science and Technology in Cracow.

Table 5 presents measures for determining the degree of R&D internationalization in Comarch. Measures are based on generally available data. However, some have not been included in this analysis due to the lack of data.

Table 5. Degree of R&D internationalization in Comarch in 2010 based on selected measures

Measure	Value/number/%
R&D internationalization measure – total R&D expenditure financed by enterprise (in thousand zlotys)	92 900.0
R&D internationalization measure – total number of R&D staff members in enterprise	1106
R&D internationalization measure – ratio between the number of the enterprise's R&D centres located abroad and total number of the enterprise's R&D centres	53%

Source: own elaboration.

The annual R&D expenditure financed by Comarch amounts to 92 million. In the ranking published by a Polish daily *Rzeczpospolita*[12] Comarch came first and was awarded a title of the most innovative company on "The List of 2000" Polish enterprises compiled by the aforementioned newspaper.

Two sources of financing used by Comarch include their own resources and the EU programmes. The enterprise has been involved in 13 projects co-financed as part of the Operational Programme "Innovative Economy", in one project under the IniTech programme and, last but not least, in three projects as part of the 7th Framework Programme.

There are 1106 persons employed in the Comarch R&D centres, which is an exceptionally high number.

The degree of R&D internationalization in Comarch, which has opened R&D centres both in Poland and abroad, is high (53%). In other words, the enterprise has located its R&D activity not only in the mother country but all over Europe. More than a half of the Comarch R&D centres are located outside Poland.

Table 6 presents conclusions drawn from the SWOT analysis based on the research.

Table 6. SWOT analysis in Comarch

The Strengths	The Weaknesses
1. Experience and workers' potential 2. Large R&D team in comparison to Polish competitors 3. Large R&D funds 4. Sale of software under own brand name all over the world 5. Good financial standing 6. Repetitive products	1. Small research potential in comparison with global concerns
The Opportunities	**The Threats**
1. 1. International expansion 2. Developing IT branch in Poland 3. Operating in a prospective sector 4. Development of new products 5. Permanent global digitization	1. Growing competition in IT sector both in Poland and abroad 2. Economic slowdown (i.e. limited IT expenditure) 3. Fast cycle of product ageing and constant necessity to finance R&D activities

Source: own elaboration.

Conclusions

The 21st century has intensified changes on the market, which made entrepreneurs introduce changes into innovation models. Due to global competition, a short cycle of product life and technological progress, the innovation process has become more expensive and riskier. This, consequently, forced the entrepreneurs to share their R&D risk and cooperate with other enterprises and organizations. In search of new sources of knowledge and innovations enterprises locate their R&D centres outside mother countries, all over the world.

There are many reasons why R&D activity is located abroad. It depends on different factors, both in a home country as well as in a host one, such as the country's development level, technological and education level or the height of barriers to enter and exit. The reasons are also connected with the type of the enterprise's activity, its financial and HR situation, as well as its strategy, vision and mission. There are also factors connected with the international environment (membership in international organizations, trade contracts etc.). Thus, the factors can be considered on an international, state (local) and organization's level.

Research on the R&D internationalization is complex. This article presents the author's original set of measures for determining the degree of the R&D internationalization. Certain aspects to the process do not have measurable characteristics, due to which the research is based not only on quantitative but also qualitative methods (a questionnaire survey, a case study).

The analysis of Comarch case indicates that since 2005 the company has been very intensively developing its R&D activity on a corporation level. The enterprise has also entered an advanced stage of the R&D internationalization through opening its research centres outside Poland. Comarch has 15 R&D centres in Europe, the biggest of which operates in Cracow.

To summarize, the process of the R&D internationalization in Comarch is ongoing and involves: opening the R&D branches abroad (Germany, Austria, Switzerland and France), research cooperation with foreign scientific centres; taking over foreign companies or participation in research syndicates in order to implement projects from the EU Framework Programmes.

We can assume that the R&D internationalization both in Poland and in the world will be growing. This is mainly because the innovation creation paradigm (from a closed to an open model) has changed. Consequently, the process of the R&D internationalization is a part of a worldwide trend of open innovation.

Notes

[1] OECD (2002), pp. 89–90.

[2] Ibidem.

[3] IBM has had a research laboratory in Switzerland since 1956.

[4] Ronstadt (1976), pp. 7–24; Lall (1979), pp. 313–331; Mansfield, Teece, Romero (1979), pp. 187–196.

[5] Li, Kozhikode (2009), pp. 328–339.

[6] Edler, Meyer-Krahmer, Reger (2002), pp. 149–164; Zedtwitz, O. Gassmann (2002), pp. 569–588.

[7] Niosi, Bellon (1994), pp. 173–197.

[8] OECD (2005).

[9] Questionnaires were sent, among others, to transnational corporations ranked among the biggest R&D investors in the world, Polish enterprises ranked among the biggest R&D investors in Poland in 2010, and Polish enterprises ranked among the most innovative entities in Poland in 2010.

[10] Research on the process of R&D internationalization in Polish enterprises has not been conducted in Poland so far. For research findings see: Kozioł-Nadolna (2013).

[11] www.comarch.pl.

[12] List of the most innovative... (2011).

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