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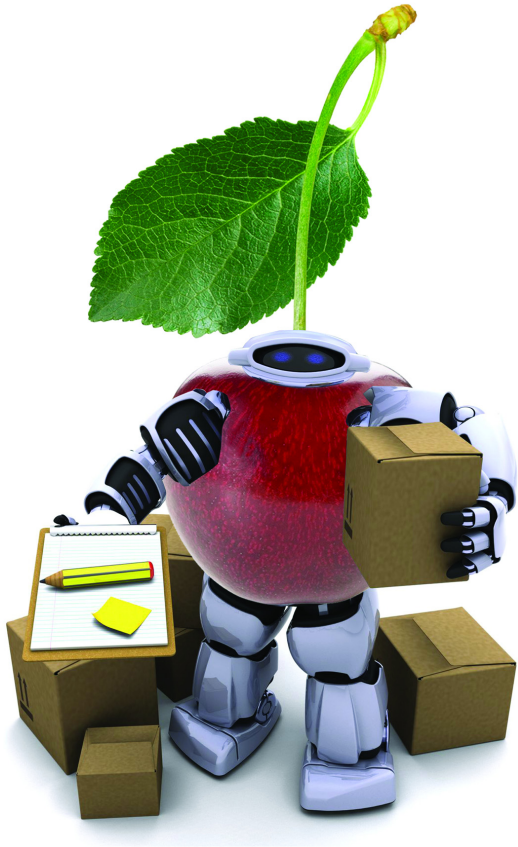

INNOVATIONS AS THE SUBJECT OF MARKET EXCHANGE

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Abstract

The article discusses the problem of the characteristics of innovation as products that the world increasingly also in Poland, are the object of market exchange. They differ substantially from the products offered by the production and service companies in the markets of consumer goods, also ready-made industrial goods. The key differences are due to the fact, that innovation can be a product — market traded object already as an idea and concept, or as a solution in different phases of development and growth. This will involve a high degree of uncertainty as to all aspects of the pro-innovation project in the development process. This applies above all intellectual property rights in the development process of innovation, functionality and technical parameters of solutions, manufacturability of solutions, affecting the ability of their production, marketing aspects, as well as the economic and financial aspects. In addition, the theoretical issues related to innovation as products — objects of the market exchange are discussed with examples from practice Gdansk University of Technology, who is the creator and provider of innovative solutions for the industrial market. There are characterized changes in knowledge, uncertainty and risk, resulting from the process of innovation. The article ends with conclusions.

Keywords: innovation, market exchange, product, marketing, risk

Introduction

Around the world, especially in the most economically developed countries, more and more often also in Poland, innovations at various stages of progress are becoming a subject of market exchange. They differ greatly from the products offered by producers and service providers on consumer goods markets and from ready industrial goods. The key differences stem from the fact that innovation can be a product — a subject of market exchange already as an idea, concept or also as an advanced solution at various stages of the process of creation and development. This is associated with a high level of uncertainty with regard to all aspects of the product and the results of implementation of an innovative venture at its particular stages. This concerns, among others, their functionality and parameters of technical solutions, opportunities for implementation of development processes, costs, interest on the market, or efficiency of the venture. This is also associated with the necessity to solve intellectual property issues associated with the results of research and development works. Other issues which have to be solved are: the difficulty of promoting solutions among potential buyers and users, attitudes and responsibility of the parties of market transactions, or defining and sharing the effects of implementing solutions into practice. Apart from theoretical aspects, problems associated with innovations as products — subjects of market exchange — are discussed on the basis of examples from the experience of the Gdańsk University of Technology as a creator and provider of innovative solutions for the industrial market. This area is in the centre of attention in this article.

The issue of innovation as a subject of market exchange is important for both sides of potential transactions, that is, for sellers and buyers. In order to contribute to improving preparation and facilitate transactions of market exchange of innovations at various stages of their development, most attention was devoted to the following issues:

- product and its characteristics as a subject of market exchange,
- innovation and the process of its development,
- areas of risk in the development of innovation,
- comparing the characteristics of products in market exchange and innovations in the process of development in particular areas of risk,
- change of knowledge and risk in the process of innovation development,

- examples of trade with innovations in the process of development at the Gdańsk University of Technology.

The deliberations end with a summary and final conclusions.

The process of product development and the characteristics of a product as a subject of market exchange

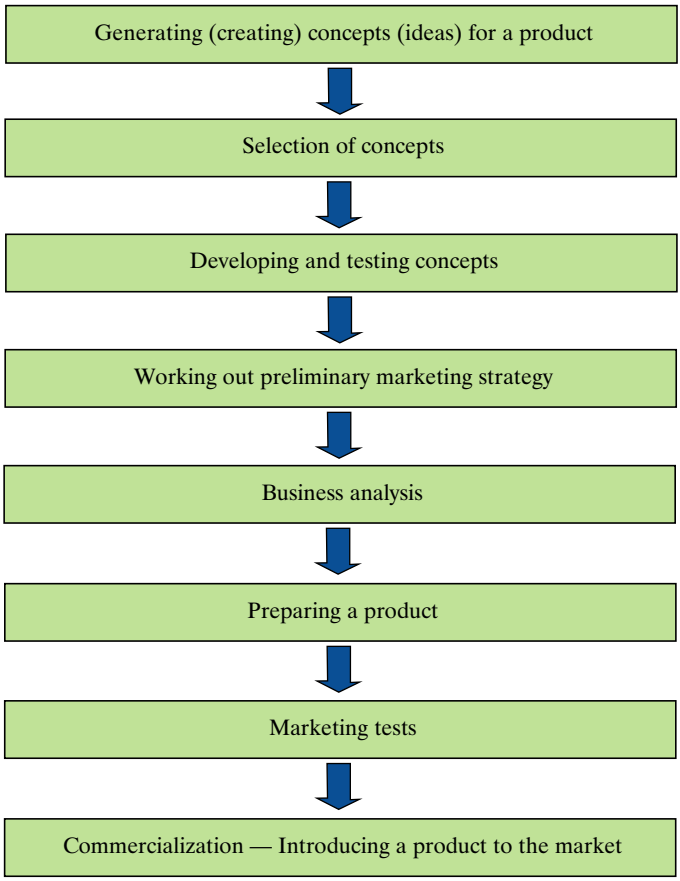
The concept of product has been known since the emergence of market economy. When people started producing more goods than they needed to satisfy their own needs, they noticed that they could exchange their surplus goods for the goods that they didn't have. Acts of exchange, now called market transactions, created the foundations of the market, without which it would be hard to imagine contemporary economy. Since the time of first transactions both products, the way they are prepared and the acts of purchase-sale have undergone a far-reaching evolution, which completely changes the conditions for people's activity and life.

Currently, the concept of "product" is very broad. G. Armstrong and P. Kotler claim that product is "everything that can be offered on the market for the purpose of attracting the interest of clients, purchase, utilization, or consumption and that satisfies some kind of need or desire"[1]. Products may be goods (material goods), services (non-material products), people, places, organizations, ideas, events or combinations of these things. Among these things services understood as "action offered to the client in order to satisfy his needs or bring benefits to him"[2] are getting more and more significant in contemporary economy. The thing that distinguishes services from products are such characteristic traits, as[3] non-material character, which means the inability to imagine a service before it is carried out, inability to detach the service from the service provider, the convergence of the place and time of provision of the service with its consumption, problems with standardization and quality control, impermanence and no possibility of storage, inability to purchase ownership rights, as well as complementarity and substitutability of services and material goods. In fact, products are a combination of material and non-material elements with varied share of each element. In reality, there are no purely material products (it is necessary to at least carry out the service of sale and client service). Services also contain a material element (e.g. in form of rooms, tools or support needed to provide them).

In market exchange understood as providing goods and/or services to all interested clients on a market in its broad sense, product is an element of every market offer. Clients regard the product as a complex composition of benefits (values) which satisfy

their expectations, which above all meet the needs and desires[4] of buyers. In marketing language, the set of instruments that the provider uses to serve recipients, is called marketing mix. Products are prepared to be offered on the market in course of activities and works described as the process of product development. Key stages in the process of product development are described below[5] (Picture 1).

Picture 1. **Main stapes in the process of product development**



Source: Ph. Kotler, G. Armstrong, *Principles of Marketing*, Pearson Education, Inc., Upper Saddle NJ 2008, p. 254.

- Generating (creating) product concept (idea) — means systematic search for concepts for new products. Their main sources are internal (own services) or external — clients, rivals, suppliers, agents or business partners — in character. Usually, as many ideas as possible are generated, as the conviction is that the higher the

number of ideas, the more likely that one of them will be exceptional and will allow the creator to gain competitive edge on the market.

- Selection of ideas — serves the purpose of separating concepts with a chance for implementation from the rest, which are unlikely to be successful, at the earliest possible stage. This limits unnecessary expenses and facilitates focusing on concepts worth further development work. In course of selection external criteria are taken into consideration. The main issue for consideration is whether the planned products have a chance to attract clients on the market and whether they could help satisfy the clients' needs. Internal criteria — whether a company is able to work out the appropriate solutions and introduce them to the market — are also taken into consideration.
- Developing and testing a concept — requires presenting it (them, when there are more promising concepts) to the group of target consumers (users) in a descriptive, symbolic (schematic) or physical (model of functioning) form, in order to obtain opinions about the tested concepts. This process makes it possible to learn about the future reactions of the market to the introduction of new products and improve their ability to satisfy the needs of clients, according to the voiced suggestions and remarks.
- Working out a preliminary marketing strategy — means the necessity to fine-tune three areas, namely:
  - identifying the target market, product positioning and defining sales results,
  - setting the planned price, manner of distribution and drawing up future budget for promotion and marketing research,
  - discussing long-term sales plan, planned profit and the marketing mix policy (marketing instruments).
- Business analysis — in other words this is an overview of predictions concerning the volume of sales, costs and profits associated with introducing new product to the market, as well as assessing the attractiveness of the business from the point of view of company's goals. If the results of business analysis are satisfactory, a given product can be moved to the stage of product preparation.
- Product preparation — leads to the development of a concept into a real product. This is associated with the development and technical testing of physical versions of a concept, model or prototype of a product. It is checked whether the product serves safely and efficiently the assume functions and whether it provides the consumers and users with the expected values and psychological characteristics.

- Marketing tests — this stage involves testing a new product together with marketing programme serving the purpose of introducing the product to the market under market conditions. This concerns the strategy of positioning, price policy, distribution, promotion, packaging, brand and the budget associated with these issues. These tests don't completely eliminate the uncertainties and risk associated with a new product, but substantially reduce the risks.
- Commercialization — that is, introducing a product to the market, means big costs for the company implementing the product. The costs are associated with the construction or renting production facilities (capacity), recruitment and staff training, creating or adjusting sales and distribution network or advertising and sales promotion. It is necessary to make precise decisions with regard to time, place and sequence of actions, especially when they concern many markets with varied characteristics.

Taking the above into consideration, it is possible to conclude that the process of product development is usually carried out by a particular entity, which facilitates planning, implementation and control of a project. Most often products introduced to free exchange on the market are already fully developed in terms of their technical properties and tested under market conditions. This means that there are no serious doubts about their functionality, the possibility og manufacturing under technological conditions of the producer, with regard to the assessment of interest of clients or economic profitability. Working out new products is easier when they are to a greater extent based on solutions already tested earlier. Products can be presented to buyers, who get the chance to test them and confront their own expectations with the experiences of first buyers. This limits the uncertainty and risk associated with implementation, raising the likelihood of success.

On the market the providers of products are usually producers — market entities in form of enterprises and service-manufacturing companies[6]. Currently, non-industrial producers are gaining an ever greater share in market exchange, especially in the segment of services. This concerns especially goods and services which are highly innovative. Suppliers are forced to resort to innovative solutions due to growing expectations of clients and pressure of the competition. Growing competition, specialization, distribution of work and requirements of the market lead to a situation in which the number of non-industrial producers is growing. Among them are universities, scientific institutes, research and development units or institutions from the

environment of business. More and more often they act on the market as suppliers and buyers of physical goods and services, especially those associated with pro-innovative ventures.

Innovation and the process of its development

Innovation is now subject to discussion in many works of practical character and in numerous publications highlighting the concept, kinds, characteristics or rules of creating innovation[7]. Now the most commonly used concept of innovation is defined by the OSLO textbook based on the view worked out by the Organization for Economic Co-operation and Development (OECD) and published by the European Union. Based on this concept, the concept of innovation means "implementing a new or significant improvement of a product (ware or service) or process, new marketing method or new method of organization in commercial practice, organization of workplace or relations with the surroundings"[8].

The above shows that:

- innovation can be divided into product innovations, process innovations, marketing innovation and organizational innovation,
- an invention, an idea, or solution should be treated not as an innovation, but as a concept for innovation, which becomes an innovation as soon as it is implemented into commercial practice, to organization of workplace or relations with the surroundings,
- in order to implement the concept for innovation, it is necessary to transform it during the process of innovation concept development, or shorter, the innovation development process.

Concepts for innovations come from various sources. Similarly as in case of new products, these sources are internal in character, when they come from the creativity of an organization's employees and external in character, when concept for innovation come from sources outside the organization. Considering the inspirations to creating innovations we can distinguish between:

- inventions and solutions generated in the processes of creating new knowledge, as an effect of primary research, applied research and research and development works, which lead to innovations can be described with the term technology push,

- concepts for innovations in form of observations and signals coming from clients, suppliers, agents, rivals, business partners and other market sources inspiring to create innovations, described with the term market pull.

It is worth remembering about the effects of implementation of various kinds of innovations for carrying out the processes of innovation and for the entities working them out.

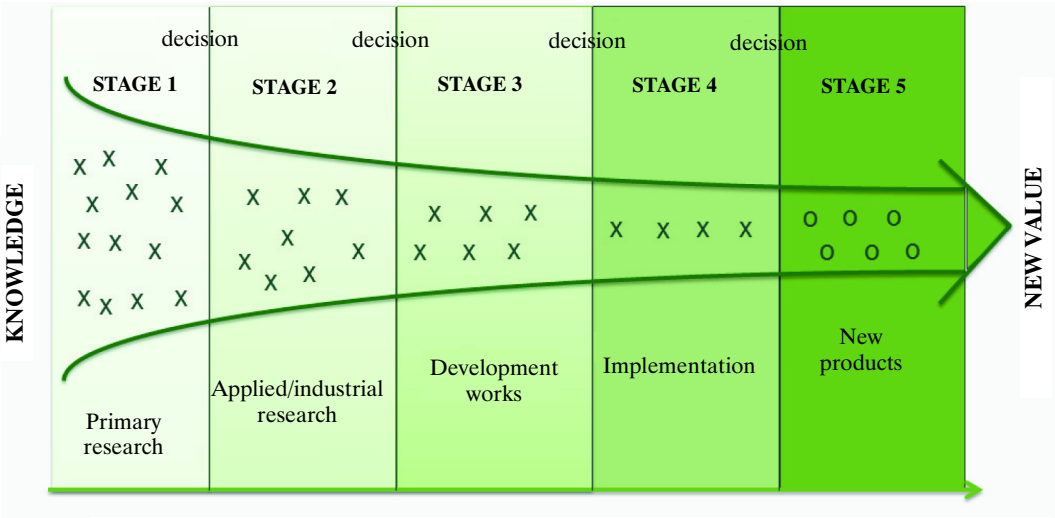
- Innovations driven by technology more often lead to changes enforcing the rejection of current solutions, inspiring to create the so-called radical innovations. An example of such innovation was the replacement of analogue telephony with digital telephony, which guarantees much higher reliability and quality of connections and the possibility of providing new function (eg. access to the Internet). The emergence of innovations driven by technology is often conditioned by broad cooperation of partners from various areas and branches, such as, representatives of science and entrepreneurs.
- Innovations pulled by the market are usually described as incremental innovations. They are created thanks to improving already existing solutions, eg. continuously raising computers' memory capacity, which enables faster and more reliable execution of intended functions and boosting the scope of their application. Innovations pulled by the market are more often prepared and commercialized on the basis of the capacities of entities implementing them.
- There is a concept of open innovation[9], which is formed as a result of cooperation, often informal, of various external partners. It exceeds beyond the boundaries of a company and its results are often available to anyone interested in the issue, even if they don't belong yo the group participating in the process. This makes it possible to limit the risk and the time needed to carry out a venture and create an optimum added value both for participants and other stakeholders.

In practice, various sources, kinds and approaches to innovation are mutually complimentary, opening room for action to the participants of pro-innovative processes, accordingly to their goals and conditions for their activity.
As has already been mentioned, innovation is formed in the process of development, which serves the purpose of transforming the concept of innovation into innovation, which is the foundation of innovative products offered on the market in market exchange. Many takes on the process of innovation development have been worked out. They have

been described in much detail in literature on the subject. Basing on the results of research carried out by A. Sosnowska[10], as well as personal experiences of the authors, it was assumed that a critical asset at the entry to the process — and during the process — is knowledge. The utilization of knowledge at successive stages of innovation development serves the creation of new value for end recipients of innovation. Particular stages of the process of innovation (Picture 2) are described below.

1) *Primary research* are works taken up in order to develop existing scientific knowledge, which don't serve practical goals or the purpose of commercial application of research results[11]. The scope of research is usually determined by the interests of the researcher and the intention to explain an observed phenomenon or verified a certain scientific thesis. If the results of primary research seem to be useful for application in practice, it is possible to take the decision to go on to the phase of applied research. It happens quite often that for various reasons the knowledge generated in course of primary research doesn't have such potential.
2) *Applied research*, also called *industrial research*, are works aimed at using the effects of primary research in practice through the verification and thorough identification of characteristics of prepared solutions and their improvement. Due to the fact that quite often applied research is conducted in cooperation with industrial partners, at this stage appropriate protection of intellectual property rights of each partner is very important.
3) *Development works* serve the purpose of adapting innovative solutions to the requirements and manufacturing environment of a particular entrepreneur interested in implementing them, or of a branch in which the solution can be applied. When it is justified, at this stage testing solutions in small and medium scale production takes place. Works are carried out with cooperation an substantial, as well as financial involvement of commercial partners. If the achieved results are promising, the first, general assumptions of a business plan are prepared. The business plan is a foundation for the decision concerning transition to the next stage of the process. It can also happen that the decision to apply the results of works in practice and go on to the stage of *Implementation* is possible already after carrying out *Applied research*. In such case the stage of *development works* is skipped or carried out on a limited scale. The decisive factor here is the specific character of the developed solution, needs of the market, as well as the goals and requirements imposed by the investor financing the development of innovation.

Picture 2. **Stages of the process of innovation development**



Prepared on the basis of: Sosnowska A. Wynik badań naukowych jako przedmiot komercjalizacji, UMWM, Warszawa 2013

4) *Implementation* is understood as the stage serving the purpose of direct preparation of an innovative solution to introduction to the market. The scope of actions in this stage covers fine-tuning all parameters of the prepared product, technology, organizational or marketing method, carrying out market research, technical scale tests, obtaining necessary certificates for innovative products, fine-tuning the business plan of the venture, negotiating contracts and as long as it is commercially justified — establishing a spin-off company. If a university is company's shareholder, at this stage the role of the Centre for Transfer of Technology, which is usually involved in the process of innovation development at all its stages, is very important.
5) Works in course of the stage *New products, services, marketing, sales* serve the purpose of fine-tuning developed products and/or services to offering them on the open market and to regular sales. An exception is a situation in which an innovation is developed exclusively to satisfy the internal needs of the implementing entity, as a new technology, marketing or organizational method. In case of preparation of sales, especially in a new market entity, the business

experience of the entity implementing the innovation, as well as own observations of the implementation team and the opinions of first clients are very helpful. This stage is exceptionally important in a pro-innovative venture, which is associated with:

a) accumulation of capital, knowledge and time invested in all previous actions,
b) the necessity to step outside safe laboratory environment (at a university or in a company),
c) real verification of of assumptions on which a venture was based.

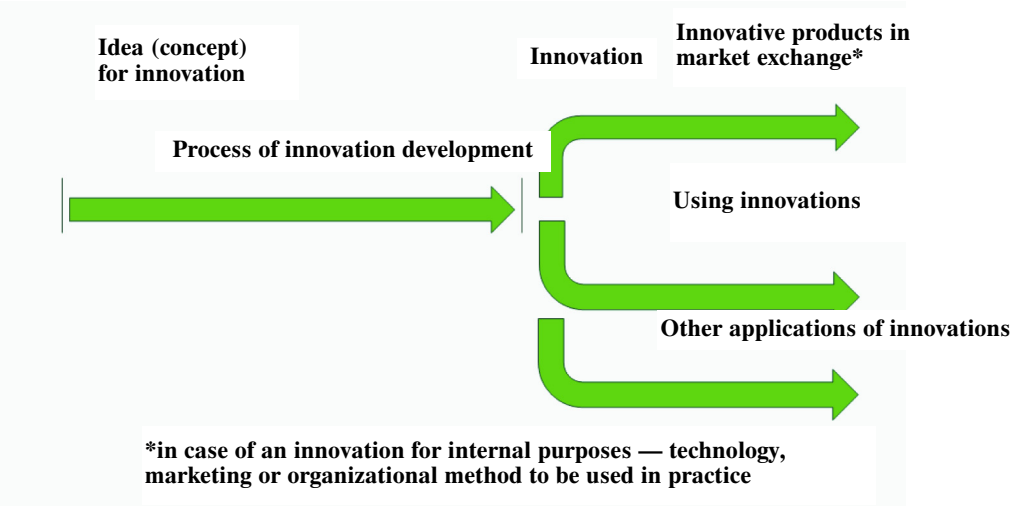
In case of successful conclusion, the stage *New products, services, marketing, sales* is also associated with satisfaction and achievement recognized both in business and scientific environment. In such case it is possible to conclude that a particular innovation is successful. In practice, many innovations, especially innovations developed by companies using only their own resources, don't require carrying out all stages of the process of innovation development. This depends on many factors such as nature of the problem which requires a solution, the degree of its novelty, experience in carrying out innovation process, as well as the volume and character of available resources.

The process of innovation development and its implementation are elements of an innovation development cycle (Picture 3). It is necessary to explain here that the implementation of an innovation, along with offering innovative products on the open market, may bring other applications, which were not originally planned.

Treating innovation as a subject of market exchange, it is possible to conclude that not only innovative products are subject to market exchange. More and more often, especially in case of breakthrough innovations, also concepts of innovations at various stages of development are subject to exchange. Products in the process of innovation development can take the shape of:

- patent (invention),
- industrial design,
- utility model,
- technology,
- business model,
- software,

Picture 3. Innovation development cycle



Source: Own materials.

- know-how,
- research results,
- technical model,
- prototype,
- product,
- service (ordered research, expertise), etc.

A common feature of products in the process of innovation development is that generally they are not ready to generate innovative goods and services and to be offered in market exchange. In order to introduce a product to the market, it is usually necessary to finish the process of innovation development, which means the necessity to carry out scientific, research, development, design, production and commercial works, depending on the level of progress of the transformation of the innovation concept.

Areas of risk in innovation development

From the point of view of innovation as a subject of market exchange at various stages of the development process, the goal (function) of the development process is transforming a concept for innovation into innovation as a basis for offering innovative products in market exchange. This means that as a result of the development process:

- the final shape of a product or service, which were used as the foundation for the concept for innovation and the development process, is fine-tuned, which allows starting production and distribution of products and services in market exchange,
- uncertainty and risk[12] coming from unfinished transformation of the concept for innovation, are reduced. This is a goal for both the entity handling the innovation development process, striving to achieve the effect (innovation and innovative products) in an efficient and smooth way, as well as for the potential client buying the concept of innovation in the process of development for the purpose of achieving own business targets more efficiently.

It can be assumed that uncertainty and risk in the process of innovation development is present in 5 main areas, namely:

- intellectual property rights to the developed solutions,
- functionality of developed solutions necessary to secure planned utilitarian and emotional features important for the buyers,
- technological solutions securing efficiency and facility of preparing and producing innovative products,
- marketing aspects associated with proper choice of clients and market, identifying their needs and offering products providing the recipients with the expected values, satisfaction and even delight,
- financial-economic aspects concerning the financing and profitability of the process of innovation development.

Uncertainty and risk in the above areas have a strong impact on innovations as subjects of market exchange in the development process.

Products in market exchange and innovations in the development process

Below the differences between products in market exchange and innovations in the development process, in particular areas of risk, are discussed (Table 1).

Table 1. **Comparison of characteristics of products in market exchange and innovations in the development process in various areas of uncertainty and risk**

Area of risk	Criterion	Product in market exchange	Innovation in the development process
1	2	3	4
Intellectual property right	Ownership of a solution before sale (concerns goods)	Supplier — producer and/or entitled agent	Not always clear and regulated among the creator and other involved entities (eg. lack of intellectual property rights regulations in an organization)
	Securing intellectual property rights	Usually complete and unambiguous	Diversified, depending on the awareness and capacity of the owner (eg. availability of funds for patent fees)
	Relations between creators/ /owners	Usually clearly defined	Not always clear and regulated (eg. lack of regulations concerning intellectual property rights in an organization)
	Exchange contract supplier — buyer	Commercial, comparably simple unambiguous, complying with the negotiated terms	Difficult, requiring detailed negotiations in many legal, technical, economic, financial aspects
Functionality of solutions	Development process	Finished, solution perfected depending on the strategy of supplier and results of market monitoring	In progress, it is not always possible to plan and implement unambiguously
	Technical specifications of a solution	Standardized and most often unambiguously defined	In the process of development, depends on the results of work in the development process
	Functions of a solution (the purpose it is supposed to serve)	Tested and clearly defined	Probable/presumable, tested in the development process
	The efficiency of a solution (effect in a time unit)		

1	2	3	4
	Durability of a solution (period in which an effect is guaranteed)	Comparably unambiguous definition confirmed in the testing process	Presumable/probable, but not confirmed
	Parameters confirmed by certificates	Yes, when it is required by applicable regulations allowing the introduction of a product to market exchange	No, confirming parameters with certificates may be one of elements of innovation process development
Technology of solutions	Technical possibility of generating a solution	Guaranteed, unambiguously defined parameters and requirement	Unclear/uncertain till the moment the functionality, technology of production and production system supervision for a solution are designed
	Structure and parameters of production system Supervision over the production system	Clearly determined and tested in the process of launching the production of a solution	
	Staff carrying out production processes	Completed, trained, tested in the process of launching the production of a solution	Not clearly defined with regard to competences and number, determined in course of planning the production process
Marketing aspects	Recipients/users and the market Expectations of recipients/users	Defined with the percentage of segmentation, choice of the market and offer positioning, often confirmed by marketing research	Defined on the basis of presumptions, often requiring confirmation with marketing research
	Original (unique) and competitive character of solutions	Worked out in the process of offer positioning, often confirmed with the results of marketing research	
	Number of recipients/users	Determined in the process of segmentation and choice of market often confirmed with marketing research	
	Manner of reaching the recipients Manner of providing service to the recipients Building long-lasting relationship with the recipients	Determined in the process of planning marketing mix	Rarely defined, especially at early stages of the innovation development process

cont. table 1

1	2	3	4
	Product brand	Very important	Less important/doesn't exist
	Reputation of supplier/seller	Less significant	Very significant
Economic-financial aspects	Spending and costs	Unambiguously defined thanks to technical-economic planning, confirmed by the results of activities	Estimated, defined in more detail along with progress of work on the development process
	Revenues		
	Profitability of solutions		Absent, financing has to be obtained from other sources
	Sources of financing	Current revenues from sales	
	Collateral	Held assets and credit rating	

Source: Own materials.

As table 1 shows, the differences between goods in market exchange and innovations in the development process are significant and concern almost all areas of uncertainty and risk.

Examples of innovations as subjects of market exchange — comparison of cases

Despite the generalizations proposed in literature, in practice every innovation development process has individual goal, scope, conditions and course and by definition differs from other processes of this kind. Applying the previously discussed model to describe the reality of commercialization of technology at the Gdańsk University of Technology, basing on the practices of the university Centre for Knowledge and Entrepreneurship, below two examples of successful cooperation of academic and business environments in the process of innovation development are presented.

1) The first one is a case of carrying out joint research-development and implementation works by a university research team and a business partner — big pharmaceutical company with many years of experience in the branch. The goal of the cooperation was develop a new technology for the synthesis of alendronate

sodium used in the production of medicine for the treatment of osteoporosis. Eventually, the application of this and three other jointly developed innovative technologies allowed the business partner to raise the efficiency of production processes, raise competitive potential of the produced substances and minimize the impact of production on the environment. The company eliminated the utilization of solvents harmful for the environment and reduced the consumption of water by 25–70% and the consumption of energy by 25–55%. The company also delivered first Polish medication for treatment of osteoporosis — Ostemax 70 Comfort — to the market. The innovative character of the technology and the involvement of a business partner in the whole process of development and commercialization of innovation allowed the company and the university to achieve substantial, material and non-material benefits from the implementation, thanks to achieving high and stable level of sales on the European market.

2) The second example is a model in which a university research team started cooperation with a business partner — a capital investor without experience in the branch. The assumed goal of cooperation was commercializing innovative indicators of defrosting of food products, Thanks to the application of a completely different technology, the costs of manufacturing rival products are many times higher, moreover rival products are less reliable. By order of partners, many papers, analyses and reports were prepared. However, lack of experience in the branch caused and still brings about many problems with production, organization and especially the market. The reasons for these problems come mainly from the necessity to create a mass market for defrosting indicators in Poland, which is associated with: difficulty of reaching and convincing potential clients — innovation users to cooperate, the necessity to build product distribution channels, carrying out an effective promotion etc. The process of innovation development hasn't been finished yet — currently stage IV Implementation is in progress. Partners have jointly established a spin-off company which is supposed to lead the process of innovation to a successful conclusion. The introduction of the indicator to the market is planned for 2014.

The characteristics of exemplary innovation development processes based on cooperation with an industrial partner and a capital partner are presented in table 2. Table 3 shows a comparison of characteristics of innovation in the process of the development of alendronate sodium technology (with participation of an industrial partner) and the defrosting indicator fir food products (with the participation of a capital partner).

Table 2. **Characteristics of exemplary processes of innovation development based on cooperation with an industrial partner and a capital partner**

Name	Industrial partner	Capital partner
Kind of product innovation	Technology	Product
Essence of innovation	Technology for the synthesis of alendronate sodium	Food product defrosting indicator
Process	Started with the stage of applied research, carried out in 200–5005 From the start to the end the process was carried out with full involvement of business partner who was the leader of cooperation	Started with the stage of primary research carried out in the years 2006–2013currently at the stage of industrial research, suspension of cooperation due to lack of expected effects, return of the partner, after overcoming technological problems by the scientific employees of the university
Involvement of the business partner	From the beginning of the process to implementation — full creative and financial involvement in the area of: ● market analysis ● analysis of customers' needs ● financial and economic analysis ● participation in development works ● obtaining certificates and approvals ● patent protection of intellectual property	Creative and financial involvement of business partner in the area of: ● market analysis ● analysis of customers' needs ● financial and economic analysis Financial involvement in the area of: ● running industrial works till the moment of suspension of cooperation ● patent protection of intellectual property
University's involvement	Carrying out research-development works by order of the business partner	Carrying out research-development works and patent protection of intellectual property by order of business partner, creators cover their own costs
Model of commercialization	1) Defining rights to the results of the innovation process 2) Agreement on distribution of benefits from the application of the invention 3) Full responsibility of the business partner for the commercialization of technology	1) Sale of the results of primary research to the business partner 2) Carrying out R&D works by order of the business partnerSuspension of agreement due to lack of expected effects of cooperation. Restarting the process of commercialization with the involvement of capital partner by establishing a joint spin-off/out company with the Gdańsk University of Technology
Current stage of work	Works concluded with the introduction of a new product to the market, stage V *New products is in progress*.	Stage IV *Implementation* works are in progress. Stage V *New products* is planned

Source: Own materials prepared on the basis of internal materials of the Gdańsk University of Technology.

Table 3. **Comparison of the characteristics of innovation in the process of development of the technology for the synthesis of alendronate sodium and food defrosting indicator**

Stage	Criterion	Technology for the synthesis of alendronate sodium	Food defrosting indicator
1	2	3	4
Primary research Stage I	Intellectual property		Invention reported for protection by the Polish Patent Office in cooperation with the Centre for Knowledge and Entrepreneurship and patent agents, clear distribution of intellectual property rights
	Functionality		Discovery and concept for application of T/N indicator in practice
	Technology		Little knowledge about possible problems in this area
	Market		Preliminary identification of the needs of potential users/producers carried out by the creator
	Financial aspects		Own research and protection of intellectual property financed by the university
Applied/ /industrial research Stage II	Intellectual property	Registering the invention for protection — co-ownership of the university and the business partner regulated by an agreement (majority of rights belong to the company)	Investigating the state of technology, registration of 5 inventions with a big number of patent reservations, ownership of the business partner, transfer of rights to the Gdańsk University of Technology
	Functionality	At the start the basic characteristics of the designed technology were defined: ● environment-friendly ● economically competitive	Working out the T/N defrosting indicator
	Technology	Business partner defined boundary conditions for the process of production	Works completely stalled. Company withdrew due to insufficient reliability and problems with raising the scale of production
	Market	Chosen by the creator; business partner responsible for the analysis of the needs of target recipients and identifying target markets	Inclusion of business partner, who was responsible for defining target recipients and markets
	Financial aspects	Inclusion of the business partner, who financed research, protection and implementation of technology in 100%	Getting the business partner involved in financing technical, market research and protection of intellectual property, company buys intellectual property from the university, the value of the market is estimated

cont. table 3

1	2	3	4
Development works Stage III	Intellectual property	Invention registered for protection — co-ownership	Additional, significant know-how worked out by the creator, expanding the functionality of the original solution
	Functionality	Verification and optimization of achieved parameters of technology, separating "secondary" technologies	Functionality expanded to indicating the time of defrosting and usefulness, proper reliability achieved, technical specifications defined
	Technology	Carrying out technological testing in small and medium scale production at the business partner, under supervision of the university, start of work on technological aspects of "secondary" technologies	Research carried out by the creator, supported by Centre for Knowledge and Entrepreneurship, company returns to cooperation
	Market	Business partner carries out deeper market analysis	Business partner carries out deeper market analysis
	Financial aspects	Works 100% financed by the business partner	Volunteer work of the creator, involvement of employees of the Centre for Knowledge and Entrepreneurship
Implementation Stage IV	Intellectual property	Extending protection to an international procedure, granting an exclusive license to the business partner regulated by an agreement	Maintaining the previous state in terms of intellectual property rights
	Functionality	Fine-tuning detailed specifications of the process, confirmation of parameters with certificates, appearance of new functionality (fewer side-effects)	Working out a solution and preparing the final product
	Technology	Carrying out technological trials on technical scale at the business partner, under the supervision of the university, structure and parameters of the production process known, training employees	Working on change in scale of production
	Market	Defined, business strategy defined as B2B (export) and B2C (national market)	Business partner updates market analysis, change of business strategy for product implementation: from B2C to B2B+B2C
	Financial aspects	Works 100% financed by the business partner	Own works of the university and business partner, financing from capital investor (seed capital), preparation of a business plan

1	2	3	4
Ready products Stage V	Intellectual property	Maintaining protection (3 patents, 1 patent application) on interesting markets (EP, JP, KR, IN, CN, US, KOLNP)	Plan to maintain protection of results. Preparation of new inventions, extending protection through an international procedure
	Functionality	Parameters of the technology are known, production process is cheaper, more environment-friendly and less complex than the technology used up till now	
	Technology	Clearly defined parameters of the production process	
	Market	Entering new foreign markets, gradually gaining the position of the leader of European market	
	Financial aspects	Maintaining protection and all activities financed by the business partner, price beats competition	

Source: Own materials prepared on the basis of internal resources of the Gdańsk University of Technology.

Conclusions that can be drawn from the analysis of data from tables 2 and 3 can be formulated as follows:

- Comparison of the discussed innovation development models clearly shows how important the involvement of a strong, competent business partner at the earliest stage of the process is for a research-scientific team. This involvement stabilizes the implementation of pro-innovative venture, securing greater creative potential of cooperating partners, it allows to clearly define the direction and scope of research and development works, complying with the intention of the business partner. This also means that in such case the innovation is better adapted to the needs of the market and the partner's business strategy. It is necessary to emphasize that in case of cooperation of a university with a business partner who has substantial experience in implementing innovations, it is possible to significantly reduce the time of innovation and reduce the uncertainty coming from risks associated with the innovation development process.
- Business partner usually has more experience in the area of desirable and possible directions of market expansion of a developed solution thanks to greater capacity to collect appropriate data or carry out necessary marketing research. It is the partner

implementing an innovation that should take decisions with regard to the choice of final clients and markets, desired characteristics of a product, strategy for protection of intellectual property rights, choice of markets of protection or defining the scope of protection. Even though universities usually have specialists from the discussed area, even despite best intentions they are unable to make optimum decisions. The strategy for protection of developed solutions has to be subordinated to a thoroughly thought-through business strategy taking into consideration the needs of both partners. Thanks to this activities can be more coherent and purposeful and the costs of protection can be possibly lowest.

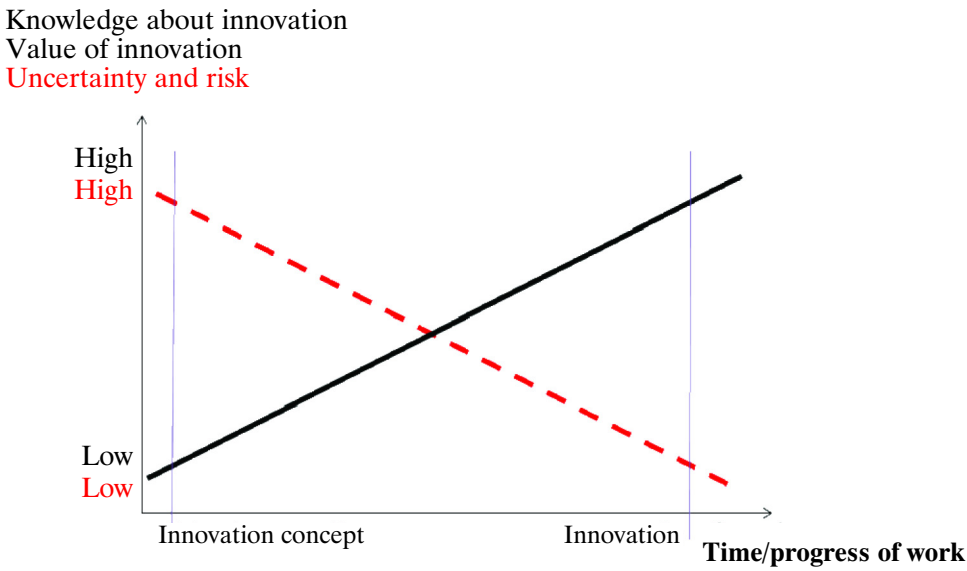
- In academic-business partnership it is companies that are better prepared to define the characteristics of products and paths for their development, to form technological processes, formulate the strategy of introducing new solutions to the market, as well as to assess the profitability and determine the sources of financing. For this reason business partners usually take care of these tasks. Based on a properly balanced relationship between entities carrying out pro-innovative ventures, the success of commercialization brings benefits to all participants, also thanks to sale of results of conducted works and the possibility of further development of solutions. This is why for a university team the choice of the right business partner is so important. It is also important to be open to the expectations of the business partner and to strive to meet these expectations.
- What has a big impact on the preparation of innovation, which attracts the interest of buyersm is the attitude of creators. Taking into consideration high uncertainty concerning the results of the innovation development process, the involvement of creators, adapting the invention to the users' needs and stubbornly striving to achieve the final, commercially useful effect often decide whether a venture is successful or not. Openness, flexibility, hard work and the ability to attract partners in various situations help solve problems at every stage of innovation development.
- An important condition for the efficiency of actions in the processes of innovation development is the participants' awareness of the assumed goals and strategy, access to knowledge necessary to solve problems according to the adopted distribution of work and open communication. All of this makes it possible to limit uncertainty and risk hampering progress in carrying out tasks and eliminate threats. This is also a foundation for building mutual trust, which provides the opportunity for long-lasting cooperation beneficial for all sides. Cooperation can concern problems and solutions that weren't defined earlier.

- The rules of distribution of benefits among the cooperating participants should be clear and transparent. It is essential that every participant of the process of innovation development, understood both as teams from participating organizations and individuals, should be motivated to contribute to the success of the venture with just share in its benefits. This can guarante full involvement of participants, which in case of innovation development processes often plays a crucial role.

Changes in knowledge and risk in the process of innovation development

On the basis of the above deliberations and the analysis of real cases, it is possible to observe the following regularities in the process of development of innovation as subject of market exchange (Picture 4).

Picture 4. **Changes in knowledge and risk in the process of innovation development**



Source: Own materials.

- Along with the progress of research, analytical, project, technical and implementation works, along with specification of a concept or idea, gradually the knowledge about the developed solution grows. The solution starts gradually taking shape of an innovation and an innovative product with capacity to attract the interest of clients and the market.

By providing the recipients with values giving them satisfaction and even evoking the feeling of delight, they can give the provider a competitive edge on the market.

- Thanks to implementation of subsequent stages of the development process, which guarantees the growth of applicable knowledge, the concept of innovation takes a real shape. It becomes clearer and clearer what benefits the buyer of an innovative product can expect, which leads to a drop of associated uncertainty and risk.

As picture 4 shows, there is a close correlation between knowledge and the value of innovation. When the knowledge about innovation and its value are the lowest, the associated risk and uncertainty are the highest. At the same time, growing knowledge and value of innovation is accompanies by dropping uncertainty and risk, which are highest at the moment of implementation of innovation, which takes the shape of a product in market exchange.

It is possible to conclude that possibly highest progress of development works should be the main goal of a team carrying out an innovation development process, which would like to sell the results of its works. It is because this raises the value of sold product in market exchange, limiting the risk for the buyer. The goal of a buyer of innovation subject to development, especially one who wants to pay the possibly lowest price, is to purchase the innovation at the moment when the level of progress of development works is possibly lowest. However, the buyer has to be aware of the fact that the lower the level of progress of innovation development process, the lower its value and the higher the risk associated with the transaction.

Thus, it is possible to conclude that both sides to the transaction should be interested in long-term cooperation. This limits uncertainty and risk on both sides and gives chances for higher mutual benefits.

Conclusions

The above deliberations give ground to formulate the following final conclusions:

1) Innovation as an implementation of a new or substantially improved product, process, marketing method or organizational method is produced in the process of development, which is associated with the need to carry out scientific, research, development, project, production and marketing works transforming the concept for innovation into a product fit for free market exchange.

2) The process of innovation concept development is associated with uncertainty and risk. The main areas of risk are issues of intellectual property rights, functionality of solutions, technology used in solutions, marketing aspects and economic-financial aspects.
3) Along with the progress of works in the process of innovation development, the value of innovation grows, which is the effect of working out the details, fine-tuning the concept for innovation and confirming its legitimacy.
4) Along with the progress of the innovation development process, uncertainty and risk associated with the innovation concept in the process of development drop. Uncertainty and risk drop when more problems causing them are solved.
5) Possibly highest level of progress of required development works should be the goal of the supplier of innovations in the process of development, as it limits the risk for the buyer, raising the value of products sold in market exchange.
6) The buyer of innovation in the process of development pays the lowest price for the innovation when the level of progress of development works is the lowest, however, in such case he takes the highest risk associated with transaction.
7) Both sides of the transaction of exchange of innovation in the process of development should be interested in long-term cooperation, which reduces uncertainty and risk and gives a chance for possibly highest mutual benefits.

References

[1] G. Armstrong, Ph. Kotler, *Marketing. Wprowadzenie*, Oficyna a Wolters Kluwer business, Warszawa 2012, p. 311.

[2] Ibidem, p. 312.

[3] Prepared on the basis of M. Pluta-Olearnik, *Marketing usług*, PWE, Warszawa 1994, pp. 23–24.

[4] Desire is an individual need, formed by culture, personality, taste of a particular person. It takes various forms and is subject to frequent, unpredictable changes, also in case of clients or business partners known by the supplier.

[5] Prepared on the basis of Ph. Kotler, G. Armstrong, *Principles of Marketing*, Pearson Education, Inc., Upper Saddle NJ 2008, pp. 254–263.

[6] Company is understood as a "name under which natural or legal persons run an enterprise; (...) colloquially company also means enterprise itself" [Wielka Encyklopedia PWN t. 3, PWN, Warszawa 1964, p. 703].

[7] Among the most important ones there are: J.D. Antoszkiewicz, *Innowacje w firmie. Praktyczne metody wprowadzania zmian*, Poltext, Warszawa 2008; *Zarządzanie innowacjami technicznymi i organizacyjnymi*, red. M. Brzeziński, Difin, Warszawa 2001; Z. Cygan, W. Grudzewski, R. Kulikowski (red.), *Nowe możliwości i metody działań innowacyjnych małych i średnich przedsiębiorstw (MŚP) w układach wirtualnych*, Wydawnictwo Wyższej Szkoły Ekonomiczno-Informatycznej w Warszawie, Warszawa 2003; T. Davila, M. Epstein, R. Shelton, *Making Innovation Work. How to Manage It, Measure It, and Profit from It*, Wharton School Publishing, New Jersey 2006; M. Dolińska, *Innowacje w gospodarce opartej na wiedzy*, PWE, Warszawa 2010; W. Janasz, K. Kozioł-Nadolna, *Innowacje w organizacji*, PWE, Warszawa 2011; T. Kelley, J. Littman, *Sztuka innowacji,* MT Biznes, Warszawa 2009; B. Kryk, K. Piech, *Innowacyjność w skali makro i mikro*, Instytut Wiedzy i Innowacji, Warszawa 2009; T. Pakulska, *Podatność innowacyjna Polski na napływ zagranicznego kapitału technologicznie intensywnego*, SGH w Warszawie, Warszawa 2005; A. Pomykalski, *Zarządzanie innowacjami*, Wydawnictwo Naukowe PWN, Warszawa–Łódź 2001; E. Stawasz, *Innowacje a mała firma*, Wydawnictwo Uniwersytetu Łódzkiego, Łódź 1999; S.D. Anthony, M.W. Johnson,

J.V. Sinfield, E.J. Altman, *Przez innowację do wzrostu*, Wolters Kluwer business, Warszawa 2010; H. Chesbrough, *Open Innovation. The New Imperative for Creating and Profiting from Technology*, Harvard Business School Press, Boston 2003; C.M. Christensen, M.E. Raynor, *Innowacje. Napęd wzrostu*, Studio EMKA, Warszawa 2008; A. Sosnowska, S. Łobejko (red.), *Drogi do sukcesu polskich małych i średnich przedsiębiorstw*, SGH, Warszawa 2008; V.K. Narayanan, *Managing Technology and Innovation for Competitive Advantage*, Prentice Hall, New Jersey 2001.

[8] Prepared on the basis of *Podręcznik OSLO. Zasady gromadzenia i interpretacji danych dotyczących innowacji*, OECD, Wspólnoty Europejskie 2005, p. 48.

[9] H.W. Chesborough, *Open Innovation. The New Imperative for Creating and Profiting from Technology*, Harvard Business School Press, Boston 2003, pp. XX–XXV.

[10] A. Sosnowska, *Wyniki badań naukowych jako przedmiot komercjalizacji*, UMWM, Warszawa 2013.

[11] T.W. Nowacki, *Leksykon pedagogiki pracy*, Wydawnictwo i Zakład Poligrafii Instytutu Technologii Eksploatacji, Radom 2004, p. 22.

[12] Uncertainty is treated as a state, in which future, possible situations and the chances for their emergence are unknown. At the same time risk means a situation in which future state is unknown, however, it is possible to define its future alternatives and estimate the likelihood of their appearance. Thus, uncertainty is a broader concept than risk.

Bibliography

1. Anthony S.D., Johnson M.W., Sinfield J.V., Altman E.J., *Przez innowację do wzrostu*, Wolters Kluwer business, Warszawa 2010.
2. Antoszkiewicz J.D., *Innowacje w firmie. Praktyczne metody wprowadzania zmian*, Poltext, Warszawa 2008.
3. Armstrong G., Kotler P., *Marketing. Wprowadzenie*, Oficyna a Wolters Kluwer business, Warszawa 2012.
4. Brzeziński M. (ed.), *Zarządzanie innowacjami technicznymi i organizacyjnymi*, Difin, Warszawa 2001.
5. Chesbrough H., *Open Innovation. The New Imperative for Creating and Profiting from Technology*, Harvard Business School Press, Boston 2003.
6. Christensen C.M., Raynor M.E., *Innowacje. Napęd wzrostu*, Studio EMKA, Warszawa 2008.
7. Cygan Z., Grudzewski W., Kulikowski R. (ed.), *Nowe możliwości i metody działań innowacyjnych małych i średnich przedsiębiorstw (MŚP) w układach wirtualnych*, Wydawnictwo Wyższej Szkoły Ekonomiczno-Informatycznej w Warszawie, Warszawa 2003.
8. Davila T., Epstein M., Shelton R., *Making Innovation Work. How to Manage It, Measure It, and Profit from It*, Wharton School Publishing, New Jersey 2006.
9. Dolińska M., *Innowacje w gospodarce opartej na wiedzy*, PWE, Warszawa 2010.
10. Janasz W., Kozioł-Nadolna K., *Innowacje w organizacji*, PWE, Warszawa 2011.
11. Kelley T., Littman J., *Sztuka innowacji*, MT Biznes, Warszawa 2009.
12. Kryk B., Piech K., *Innowacyjność w skali makro i mikro*, Instytut Wiedzy i Innowacji, Warszawa 2009.
13. Kotler Ph., Armstrong G., *Principles of Marketing*, Pearson Education, Inc., Upper Saddle NJ 2008.
14. Marcińczyk Z., *Nagroda Gospodarcza Prezydenta Rzeczypospolitej Polskiej dla Polpharmy*, Pismo PG, no. 7/2013, pp. 10–13.
15. Narayanan V.K., *Managing Technology and Innovation for Competitive Advantage*, Prentice Hall, New Jersey 2001.
16. Nowacki T.W., *Leksykon pedagogiki pracy*, Wydawnictwo i Zakład Poligrafii Instytutu Technologii Eksploatacji, Radom 2004.
17. Pakulska T., *Podatność innowacyjna Polski na napływ zagranicznego kapitału technologicznie intensywnego*, SGH w Warszawie, Warszawa 2005.
18. Pluta-Olearnik M., *Marketing usług*, PWE, Warszawa 1994.
19. *Podręcznik OSLO. Zasady gromadzenia i interpretacji danych dotyczących innowacji*, OECD, Wspólnoty Europejskie 2005.

20. Politechnika Gdańska — materiały wewnętrzne.
21. Pomykalski A., *Zarządzanie innowacjami*, Wydawnictwo Naukowe PWN, Warszawa–Łódź 2001.
22. Sosnowska A., Łobejko S. (ed.), *Drogi do sukcesu polskich małych i średnich przedsiębiorstw*, SGH, Warszawa 2008.
23. Sosnowska A., *Wyniki badań naukowych jako przedmiot komercjalizacji*, UMWM, Warszawa 2013.
24. Stawasz E., *Innowacje a mała firma*, Wydawnictwo Uniwersytetu Łódzkiego, Łódź 1999.
25. *Wielka Encyklopedia PWN* t. 3, PWN, Warszawa 1964.

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