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INNOVATION CONCEPTS AND TYPOLOGY – AN EVOLUTIONARY DISCUSSION

This paper is devoted to the analysis of evolution of innovation concepts, aspect and types. First emergence and evolution of different aspects and concepts of innovation are analysed, then the development of innovation concepts from a historical perspective and finally an overview given of types of innovation classifications developed in the literature. Surrounding this different definitions of innovation are described and analyzed in detail. The main goal of the article is to define the trend of development of innovation conceptualization and understanding over time.

JEL Classification: B10, B20, O31, O32, O33, Q55

Keywords: innovation concepts, innovation types, aspects of innovation, innovation systems, innovation ecosystems, typology of innovation, product innovation, process innovation , service innovation , marketing innovation , organization innovation , business innovation

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Introduction

During the last thirty years, innovation has become the synonym for the development of nations, technological progress and driver of business success. Innovation nowadays is not simply the “creation of something new” but also a panacea for the solution of board range of problems. The term "innovation" is more and more often used - very frequently by policymakers, marketing specialists, advertising specialist and management consultants - not as a strict scientific concept but as metaphor, political promise, slogan or a buzzword.

Recently the “need for innovation” fever appears in all spheres of science [Nowotny, 2006, 2008; Godin, 2008]. Even biologists recently began to find features of innovation behavior in the animal world [Reader and Laland, 2003] in which specialists try to find drugs that stimulate people innovation activity [Greely et al., 2008].

More and more exotic types of innovation start to develop like “blue ocean innovation” [Kim and Mauborgne, 2005], “frugal innovation” [Tiwari and Herstatt, 2011], and “organic innovation” [Moore, 2005]. The main subject of innovation is now not only the innovator himself but also such “archetypes” as “customer anthropologist” [GE and Stone Yamashita Partners, 2005] and “roadblock remover” or “innovation faces” like “cross-pollinator” and “caregiver” [Kelley and Littman, 2005].

But throughout history innovations and innovators have not been always appreciated and (as well as inventions and inventors) and have long been rejected by society. Until the end of the XVIII century innovators were untrustworthy adventurers, and crooks for society, and just like heretics for the Church. So generally innovation has long been perceived as any deviation from the political, societal or religious norms. This was especially evident until the XIX century when innovation was not a subject of scientific research, only since the middle of the XIX century innovation came into the field of scientific research implicitly. The early 1900-s witnessed the birth of the first theories of innovations. Since the second half of XX century the concept of innovation started to spread over the different fields of science. The time span between 1960-s and 1990-s can rightly be called the golden age in the study of innovation. However in the last ten years the concept of innovation gradually shifts from sphere of strong scientific definition into the sphere of management concepts, slogans and buzzwords.

This paper is organized as follows. The first section discusses different aspects and concepts of innovation. The second section analyses the development of the innovation concept in historical perspective. Finally the third section highlights the types of innovation classifications developed in the literature. The conclusion summarizes the basic thesis of the whole work.

Concepts of innovation

In the classical Schumpeterian interpretation technical change is defined as “a historic and irreversible change in the method of production of things” and “creative destruction” [Schumpeter, 1934]. According to this definition technical change in practice can be implemented in forms related to:

- implementation of goods (products) that are new to consumers, or higher quality than their previous counterparts;
- implementation of production methods that are new to specific industries and economic activities in which they are used;
- opening of new markets;
- use of new sources of raw materials;
- implementation of new forms of competition that lead to structural changes in the industries of their implementation.

In line with the Schumpeterian concept, innovation are related to changes (large-scale (radical) or small (incremental)) that have a significant impact on the structural changes in individual industries and market segments. In this approach, new production methods are not necessarily based on new scientific discoveries. The first use of technologies that have already been used in other industries can also be attributed to new methods. Because innovation is associated with the processes of manufacturing of the product and its use, the contents of this concept in international development is based on different principles and each cluster of definitions has its specific characteristics [Linton, 2002].

The basic definitions and types of innovation (sometimes referred to as ‘shapes’ or ‘typology’ of innovation) are established by Organization for Economic Cooperation and Development (OECD). The latest revision of these is the Oslo Manual which defines innovation “the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations” [OECD, 2005, p. 46].

An earlier OECD definition describes innovation as: “Of all those **scientific, technical, commercial and financial steps** necessary for **the successful development and marketing of new or improved** manufactured products, the commercial use of new or improved processes or equipment or the introduction of a new approach to a Social service. R&D is only one of these steps” [OECD, 1981].

In these two examples an evolution of the notion ‘innovation’ is apparent. While in 1980- s the focus was on steps of innovations the main focus switched to innovation implementation

and its typology recently. More recently methodologically switches to distinguish innovation from other changes.

In general two major (conceptual) aspects of innovation can be distinguished: [Cooper 1998, Gopalakrishnan and Damanpour 1997]:

- innovation as a process that encourages change [the result of the emphasis on innovation];
- innovation as an event, object, or a discrete product, characterized by novelty.

However this classification can be further split since it is very broad. “Innovation as event, object or a discrete product” can be divided into several aspect: “innovation as event”, “innovation as physical object” and “innovation as something new (new process or method for organization of something”. Over time, a more detailed classification of aspects of innovation was developed. For example, Godin (2008) defines 12 concepts of innovation which can be described as follows:

A: innovation as process of doing of something new:

- innovation as imitation;
- innovation as invention;
- innovation as discovery;

B: innovation as human abilities to creative activity:

- innovation as imagination;
- innovation as ingenuity;
- innovation as creativity;

C: innovation as change in all spheres of life:

- innovation as cultural change;
- innovation as social change;
- innovation as organizational change;
- political change;
- technological change;

D: innovation as commercialization of new product

Another detailed classification of the aspects and dimensions of innovation is given by Ram, Cui and Wu (2010). The authors distinguish the following aspects of innovation:

- innovation as something new;
- innovation as a conduit of change
- innovation as a process;
- innovation as a value driver;
- innovation as an invention.

The variety of innovation characteristics is expressed in many different definitions of innovation. Different innovation definitions reflect the above-mentioned broad spectrum of aspects of innovation. Barnett (1953) considers **innovation as something new** “Any thought, behavior, or thing that is new because it is qualitatively different from existing forms” [Barnett 1953] whereas Drucker (1985) and O'Sullivan & Dooley (2009) describe **Innovation as a conduit of change, e.g.** “Innovation is the specific tool of entrepreneurs, the means by which they exploit change as an opportunity for a different business or a different service. It is capable of being presented as a discipline, capable of being learned, capable of being practiced [Drucker, 1985] and “The application of practical tools and techniques that make changes, large and small, to products, processes, and services that results in the introduction of something new for the organization that adds value to customers and contributes to the knowledge store of the organization” [O'Sullivan & Dooley, 2009].

Innovation as a process is thoroughly defined by Aiken and Hage (1971) and Rasul (2003). Thus Aiken and Hage see innovation as “... the generation, acceptance, and implementation of new ideas, processes, products, or services... for the first time within an organization setting” [Aiken and Hage, 1971] and Rasul (2003) as “... the process whereby ideas for new (or improved) products, processes or services are developed and commercialized in the marketplace” [Rasul, 2003]. Beyond the process dimension Wang & Kafouros (2009) recognize **innovation as value driver** “Innovation through infusion of new products and services, and provide impetus to emerging economies by opening up opportunities of international trade” [Wang & Kafouros, 2009] while Zaltman [Zaltman, Duncan and Holbek, 1973] sees **innovation as invention**: “... a creative process whereby two or more existing concepts or entities are combined in some novel way to produce a configuration not previously known by the person involved”.

However scholars increasingly contradistinguish innovations and inventions (Table 1). Innovation and invention have quite a different meanings in dictionaries. For example, according to Webster's New Dictionary (electronic version) innovation³ is:

1: the introduction of something new

2: a new idea, method, or device

According to this Dictionary invention⁴ is:

1) discovery, finding

2) productive imagination: inventiveness

3) a: something invented: as

³ <http://www.merriam-webster.com/dictionary/innovation#>

⁴ <http://www.merriam-webster.com/dictionary/invention#>

- (1): a product of the imagination; especially a false conception
- (2) : a device, contrivance, or process originated after study and experiment
and / or a short keyboard composition featuring two- or three-part counterpoint
- 4: the act or process of inventing

The other examples of contradistinguishing the innovation and invention in scientific literature are summarized in Table 1.

Table 1: Innovation and invention concepts in scientific literature.

Author(-s) of model	Innovation	Invention
Freeman, 1982	Innovation is the introduction of change via something new	Invention is the creation of a new device or process
Senge, 1990	'idea' becomes an innovation only when it can be replicated on a meaningful scale at practical costs	idea has been ' invented ' when it is proven to work in the laboratory
Rouse, 1992	Innovation is the introduction of change via something new	Invention is the creation of a new device or process
O'Sullivan and Dooley, 2009	Innovation is more than the creation of something novel. Innovation also includes the exploitation for benefit by adding value to customers. Invention is often measured as the ability to patent an idea	Invention need not fulfill any useful customer need and need not include the exploitation of the concept in the marketplace

In scientific literature in the field of economics one the first example of contradistinguishing innovation and invention can be found in Stamp (1929, 1934). Then it was further developed by Schumpeter. According to Schumpeter invention can be seen as the act of “intellectual creativity” and invention “is without importance to economic analysis” [Schumpeter, 1939, p. 105]. The innovation is the act of applying or adoption invention. Therefore, innovation is already the economic decision in Schumpeterian logic. Some scholars [for example Freeman, 1982; Rouse, 1992] show the difference between inventions and innovations, which are determined, first of all, by the practical application of innovation. Heunks, [1998] defines innovation as the successful technical and economic implementation of the idea whereas O'Sullivan and Dooley consider innovation in contrast to the present invention more than creating something new but also including the use of a new product with benefits adding the value to consumers [O'Sullivan and Dooley, 2009]. Table 1 summarizes the difference between concepts of innovation and invention.

Ahmed and Shepherd (2010) define 6 aspects of innovation in their book “Innovation management: context, strategies, systems and processes” (Table 2).

Table 2: 6 aspects of innovation

Aspect of innovation	Focus of definition
Creation (invention)	Use of resources (people, time and money) to invent or develop a new product, service , new way of doing things, new way of thinking about things
Diffusion and learning	On acquiring, supporting or using a product, service or ideas
Event	Discrete event, such as the development of a single product, service, idea or decision
Change (incremental or radical)	Enacting of change. Some innovations are minor adjustments whilst other innovations are radical or discontinuous in nature
Process (firm-level)	innovation is not a single act, but a series of activities that are carried out by a firm to lead to the production of an outcome (namely, the innovation)
Context (region, nature, etc.) level process	Act beyond the confines of an individual or firm. Focus on institutional frameworks, socio-political networks, and proximal factor endowments as important factors in the act of innovation

Source: adapted from Ahmed and Shepherd, 2010.

The analysis of innovation aspects shows that since the first innovation definitions the discussion of innovation aspects evolved. Innovation is seen not only as process of change or physical object but also as instrument of change and the condition for this change. Thus the aspects of innovation can be summarized as follows:

- innovation as something new (some real object: product, service or software);
- innovation as process of doing, creating something new;
- innovation as the instrument for doing, creating something new;
- innovation as condition (environment) for doing something new;
- innovation as idea (concept) of something new;
- innovation as human abilities for doing something new;
- innovation as process of change.

Following the analysis of the basic aspects of innovation in their historical development we now look more closely on definitions of innovations in different studies to see how these definitions reflect the aspects of innovation, selected in the previous step of analysis.

From these definitions we can see that the key feature of innovation is the presence of the element of novelty (newness) which also allows for different interpretations [Knight 1967; Gopalakrishnan & Damanpour 1997; O'Sullivan & Dooley 2009]. It has been recognized by a number of scholars that the criterion "novelty" cannot be the sole criterion of innovation but inventions or ideas become innovation in course of their transformation into application that is used in practice [Robertson 1967; Mohr 1969; Walker 2006].

Many conceptual definitions of innovation were developed in the late 1960-s. For example Robertson defines innovation as a 'process by which a new idea, behavior, or thing, which is qualitatively different from existing forms, is implemented and applied in practice' [Robertson, 1967, page 14]. Some innovation studies of the late 1960ies also focus on the concept "innovation as something new (or source of novelty)". According to Mohr, innovation

can be a source for creating a “new” that can be developed product or process that is new to her followers (adoption unit) [Mohr, 1969]. Introducing the concept of innovation, the author describes in his work an innovation as “the successful introduction into an applied situation of means or ends that are new to that situation” [Mohr, 1969, p 112].

It shows that in 1960s, innovation is interpreted mainly in the “conceptual aspects” without taking into account the complexity and diversity of definitions and generally considered in relation to companies, not markets or individual countries [Carroll, 1967; Robertson, 1967; Mohr, 1969]. In 1980ies and 1990ies a number of important methodological principles have been proposed, reflecting, in particular, the classification features of innovations such as “new to firm”, “new to market” and “new to the world economy” [Kwon and Zmud, 1987; Bacon and Butler 1998].

Rogers` definition of innovation is also important for understanding the links between innovation and the newness [Rogers, 2003]. In his understanding innovation is “an idea, practice, or object that is perceived as new by an individual or other unit of adoption” [Rogers, 2003, page 12]. This definition clarifies the essence of the term “new” on the basis of hypotheses` about the independence of “novelty” from the life time of innovation, the environment in which it operates and the characteristics of an adopter of innovation. In accordance with this definition, the criterion of “novelty” of innovation is determined by the choice and the perception of innovation of its adopters (followers). This means that the idea, object or practice is considered innovative during the period of its perception as “new” by the representative adopters. However the idea, object or practice is classified as an innovation, regardless of the fact that other followers in the system cannot attribute this idea, object, or the practice of innovation because of their earlier acceptance or knowledge about the innovation. In this context, it is also understood that the availability of information and knowledge on innovation does not distort the criteria of "novelty" and innovation is perceived as “something new” by the representative follower up to the moment of its use in practice. In the development of Rogers` concept of re-invention Walker in his research has synthesized the definition of innovation [Walker, 2006]. According to Walker innovation is “a process through which new ideas, objects, and practices are created, developed or reinvented and which are new and novel to the unit of adoption” [Walker, 2006, page 313].

However not only the “new” was the main conceptual aspect in definitions of innovation [Kwon and Zmud, 1987; Rogers, 2003; Walker, 2006]. In particular, several researchers [e.g. Vergragt, 1988; Dakhli and de Clercq, 2004] put forward the hypothesis that the changes associated with innovation, should be considered in a social context in terms of their users. Accordingly, at the institutional level, innovation must be seen as a social process, not a scientific discovery. That allows to estimate its impact on the structure and procedures of

organizations namely users. Eventually the goal of innovation is creation of value added and a positive impact on the operation and development of organizations. Therefore, innovation may include only the changes that have favorable consequences for organizations.

In subsequent developments, O'Sullivan and Dooley articulated the hypothesis which is important for conceptualization of innovation [O'Sullivan and Dooley, 2009]. Their assumption is that innovation is the process of implementation of changes directed to increasing the value of the product for the user, as well as to contribution to the development of knowledge for adopter of innovation. This concept of innovation as a factor contributing to changes more explicitly reflects the multiple aspects of innovation definition.

Innovation as a value driver concept is very important for assessing the efficiency of innovation. In this concept, innovation is defined as a source of competitive advantage and is seen as a decisive factor for economic growth and the basic condition of company development in a competitive environment [Johannessen, 2009]. From an organizational point of view, the adoption of innovation may lead to improved operational efficiency, create a better working practices, competitive advantage and flexibility that ensures sustainable development of companies in a dynamic changing business environment.

Another widely used concept defines innovation as a tool for the creation of new knowledge [Acs, Anselin and Varga, 2002; Strambach, 2002]. In this context, a new concept is based on the position that the use of new products, services, processes and paradigms that are embedded into existing innovation leads to new ways of thinking and new knowledge. This iterative cycle of knowledge and creation of new knowledge, in turn, leads to an intensification of innovative processes.

Studies on radical and incremental innovations are also relevant for conceptualization of innovation [Ettlie, Bridges and Okeefe, 1984; Brettel et al., 2011]. Radical innovation is considered in economic theory as a driving force for economic growth since Schumpeter works [Schumpeter, 1934, 1942]. In further theoretical studies, the term associated with the content of the various concepts and definitions [Ettlie, Bridges and Okeefe, 1984; McDermott, O'Connor, 2002; Tellis, Prabhu and Chandy, 2009].

In different studies the terminology used and the definition of radical innovation vary greatly depending on the specifics of the research [Dewar, Dutton, 1986; Verganti, 2008]. For the identification of such type of innovations, the following concepts were used: “really new” [Schmidt and Calantone, 1998; Song and Montoya-Weisse, 1998], “breakthrough” [Rice et al., 1998], “discrete innovation” [Priest and Hill, 1980]. Another problem is associated with the measurement of radical innovation. For example, in Schumpeterian theory there is no clear distinction between radical and other types of innovations. According to Schumpeter, “creative

destruction” replaces the old technology and expands new business opportunities that may be subject to quantitative measurement. Authors such as Dahlin and Behrens, associate the degree of radicality of inventions to the nature of ideas, on which innovation activity is based, as well as to content of new knowledge or systematic data in innovation [Dahlin and Behrens, 2005].

The complex nature of the innovation concept is mirrored in the definitions of innovation in different studies in late 1970-s and 1980-s as well as in 2000-s. These definitions commonly highlight the complex nature of innovation processes. The **linear models of technological innovation** are useful for describing key steps in the R&D process and in documenting projects after the fact, but are not particularly helpful in understanding the process in real time. Linear models describe what happened but not how it happened, and tend to reinforce the belief in a kind of orderliness which does not exist [Carlsson, Keane and Martin, 1976]. In other models **innovation cuts across a broad range of activities**, institutions and time spans. If any part of the pipeline is broken or constricted, the flow of benefits is slowed [Botkin, Dimancescu and Stata, 1983]. Models that **depict innovation as a smooth**, well-behaved **linear process badly mis-specify** the nature and direction of the causal factors at work. Innovation is complex, uncertain, somewhat disorderly, and subject to changes of many sorts. Innovation is also difficult to measure and demands close coordination of adequate technical knowledge and excellent market judgment in order to satisfy economic, technological, and other types of constraints - all simultaneously. The process of innovation must be viewed as a series of changes in a complex system not only of hardware, but also of the market environment, production facilities and knowledge and the social contexts of the innovation organization [Kline and Rosenberg, 1986].

Innovation is not just about technology development rather it includes the way of financing, the way of marketing and marketing relationships, the way of creating strategic partnerships, the way of dealing with governments. The innovative nature of doing business has to be pervasive in the company, and had to look at **more than just technology development**. [Rasul, 2003].

Still these definitions mainly imply that **innovation is** a synonym for **new products** but neglect or at least do not fully stress **strategy innovation**, such as entering new markets with existing products. Also **supply chain innovations** and **value-adding service innovation** are seldomly considered in the innovation context although they deliver additional customer value and have reasonable impact on the origins of the next generation of innovation from companies; perspectives by allowing real time responsiveness. Such strategy based innovations are a new frontier that many firms have never pursued [Tucker, 2004].

The following conclusion can be done from this analysis:

- 1) Innovation definitions are connected not only with newness but also with change and efficiency in terms of market conquest and fast promotion of new products.
- 2) Innovation can not be conceptualized by accurate, comprehensive and generally accepted definition (like for example “inflation”, “amortization”, “debt” and other established and generally accepted economic terms).
- 3) Innovation is board concept and for different fields of science different aspects of innovation matter. For example for economic theory, innovation is close to the “new” concept while for management “value (competitive advantage) creation” feature of innovation matters.

The following chapter draws a picture of the historical evolution of the innovation concept.

Development of innovation concept in historical perspective

The **historical development of concept of innovation** can be summarized as follows⁵. A detailed analysis of evolution of innovation studies' as well as concepts and models of innovations since 1890-s till 2000-s splitted in decades is given in annex (table A.1).

Pre XIX century

Innovation had no relations with creativity, originality and application. Innovating meant introducing change into the established order facing implicit and explicit resistance to innovations from Church and Society. Opposition to innovation existed in all spheres of life: economics, politics, law, science, education and religion. There was a negative perception of innovation and innovators. Because of weak development of science innovators are seen as heretics and suspicious people since in many cases only the innovators themselves can explain what they do and that their inventions is something good and they are profitable for society.

Second half of XIX century – first half of the XX century

There was a gradual trend to a positive perception of innovation. Theories of innovation started to develop in many fields of science accompanied by a tendency explaining revolutionary changes in all spheres of life through innovations.

The first theories of innovation were developed in the field of sociology [Tarde, 1890, 1896, 1998, 1902]. Here innovation is seen as the change in social constructs such as grammar, language, law, religion and so on. However, the first use of term “innovation” in sociological literature is found by Hart (1931) and then start to spread over the other “innovation studies” in sociology [Gilfillan, 1935, 1937; Ogburn, 1941]. The term “technological change” was preferred by sociologists [Stern, 1927, 1937; Capin, 1928, Davis, 1940]. Then in the anthropology innovation was understood as cultural changes [Smith et al., 1927]. First theories of technological inventions emerged in psychology [User, 1929; Rossman, 1931]. The first prototypes of innovation diffusion model also come from sociology [Ogburn, 1922; Chapin, 1928; Gilfillan, 1935]. Some similar “models” were done in anthropology (cultural change as a result of contact between cultures) [Redfield et al. 1936; Barnett et al., 1954]. Anthropologists also made one of the first efforts of quantification of technological innovation as acceleration and growth of material culture. First analysis of effects (social) of technological inventions was

⁵ Comprehensive analysis of historical development of innovation concept can be find in Godin (2008). The deep analysis of innovation models (on conceptual level) development in historical perspective can be found in Marinova and Phillimore work of 2003 (as one of the chapter of Shavinina's fundamental book “The international Handbook on Innovation”). The “classical” 5-generation model of innovation was developed in Rothwell (1994). But here author uses the “innovation management approach” and classifies five generation (of innovation models) in line with development of innovation management methods.

done in Stern (1937). The first conceptualization of innovation was also done in sociology – Chapin (1917) identifies innovation as social experiments.

First prototypical approaches to analysis of technological (technoeconomic paradigms) paradigm developed by Dosi [1982, 1988], Freeman and Perez [1982] and Perez [1988] can traced back to original sociological work at Odum [1937] and Davis [1940] – the “techniways” concept.

Therefore, sociologists and anthropologists look at innovation as a broad, paradigm concept. For these specialists innovation (or technological invention) was a phenomenon (process of paradigm (in social or cultural context) change) and broad construct. Therefore, anthropologists and sociologists took the “macro-level” (or, more precisely, society-level) view on innovation. For them innovation was the background of social or cultural changes. Their analysis was more descriptive rather than strongly mathematically computable.

Economists took the other view on innovation. They look more on the technical side of innovation. For economists innovation is in the first place a means (or tool) for competitive struggle, the method to increase productivity, the new product (process or service) and only after that “the concept itself”, the innovation per se. The pioneer here was Schumpeter⁶ with his creative destruction concept [Schumpeter, 1932, 1934] and classification of technical change types [Schumpeter, 1912]. Schumpeter also was one of the pioneer in innovation vs. invention dichotomy discussion [Schumpeter, 1939]⁷. Pareto (1935) initiated innovators vs. conservators discussions in economics. Pigou (and some later Hicks and Robinson) developed the first theories of classification of technologies [Pigou, 1924; Hicks, 1932; Robinson, 1938].

The Cobb-Douglas production function can be seen as the first mathematical model representing the technological change [Cobb and Douglas, 1928; Douglas, 1948]. In 1930-s the first computational analysis of technological usage and its link with the growth of productivity was run in the USA by leading centers for economic research (NBER, Bureau of Labor Statistics and Work Projects Administration).

In 1940-s (especially the second half), the period of World War II, the growing trend in innovation studies was seriously broken. However some innovation studies can be mentioned here. For example, first works on economics of technological change by Maclaurin (1947, 1949,

⁶ We can also go further back in the history and remember such “milestones” of technical change in economics such as Adam Smith with his ideas on efficient labor division for increasing the wealth of nations [Smith, 1776]; Frederick List with his concepts of “national system of production” and “mental capital” [List, 1841]; and, finally, Karl Marx [1867] with his ideas on science as the source of production force growth and approaches to conceptualization of the technological competition phenomenon [Lundvall, 2007].

⁷ One of the first documented (in article in scientific journal) discussion in economic literature was done by Stamp in 1929 [Godin, 2008].

1953) and conceptualization of technological innovation as new combination of means of production [Lange, 1943; following Schumpeter, 1939].

In 1950-s the following milestones in the development of innovation studies can be identified:

- organizational innovation concept emergence [Cole, 1959; the was followed by Aitken, 1965];
- innovation as commercialized invention (new product) concept emergence [Jewkes, 1958];
- innovation as activity and process concept emergence in sociology [Nimkoff, 1957]
- first studies on the analysis of the internal logic of innovation process [Carter and Williams, 1957];
- development of innovation diffusion studies [Brozen, 1951; Carter and Williams, 1957, 1958, 1959];
- first seminal work in the line of “innovation and economic growth” [Solow, 1957];
- first works on research evaluation [Rubinstein, 1957; Quinn, 1959]

Also the first “think tanks” for innovation studies appeared, e.g. Research AND Development Corporation (RAND, USA, 1948); the National Science foundation (NSF, USA, 1950) and the Asian Institute of Technology (AIT, Thailand, 1959).

The analysis of development of innovation studies in the first half of the XX century can be summarized as follow. During the first half of the XX century the basis of innovation studies and innovation concepts was established.

1960-s – 1990-s

Innovation was treated as the main instrument of competitive struggle in the business sphere and between nations and the development of statistics of innovation, namely the development of methodology of innovations at the international level. The leading ”think tanks” on innovation studies were founded, namely Science and Technology Policy Research Unit (SPRU, UK, 1961);UNU-MERIT (research and training center of United Nations University (UNU) and Maastricht University (UM) Netherlands, 1970); - Fraunhofer Systems and Innovation Research Institute (Fraunhofer ISI, Germany, 1972); the University of Leiden Centre for Science and Technology Studies (CWTS, the Netherlands, 1982);Science and Technology Policy Institute (STEPI, South Korea, 1987),

National Institute for Science and Technology Policy (NISTEP, Japan, 1988), Centre for European Economic Research (ZEW, Germany, 1990);

- Center for Science Statistics (CSS, Russia, 1991); International Science and Technology Center (ISTC, Russia, 1992); Technology Center of the Academy of Sciences of the Czech Republic (1994); Institute for Prospective Technological Studies (IPTS, Spain, 1994); Institute for Statistical Studies and Economica of Knowledge (ISSEK, Russia, 2002).

- The predominant type of innovation is technological innovations (however concept of non-technological innovations is also under scrutiny analysis). Innovation is purely scientific concept. It was considered the “Golden age” for the concept of innovation with key (among others) concepts and models developed.

- Technological innovation system and national innovation system models [Lundvall, 1985, 1988, 1992, 1993; Freeman, 1988, 1991, 1995; Dosi et. al, 1988; Nelson, 1993];

- Financial innovation concept [Myers and Nicholas, 1984; Miller, 1986; Allen and Gale 1988; Ross, 1988];

- User innovation concept [von Hippel, 1986, Fleck, 1988];

- Technological paradigms model [Dosi, 1982, 1988];

- Technoeconomic paradigms model [Freeman and Perez, 1988; Perez, 1983]

- Application of evolutionary models in innovation studies [Mansfield et al., 1981; Nelson and Winter, 1982];

- Innovation avenue model [Sahal, 1981];

- Innovation complexes model [Gann, 1991, 2000];

- Social innovation concept [Chambon and Devevey, 1982; Laville, 1994];

- Eco-innovation concept [Fussler and James, 1996; James, 1997]

Increasingly quantitative studies were undertaken covering **the internal logic of innovation processes** [Myers and Marquis, 1969; Langrish et al., 1972; Hayvaert, 1973; Rothwell et al., 1974; Schock, 1974; Szakasits, 1974; Rothwell, 1976; Rubenstein et al., 1976; Utterback, 1975; Cooper, 1980]; the **innovative behaviors of organizations** [Burns and Stalker, 1961; Wilson, 1966; Mulkay and Turner, 1971; Hage and M. Aiken, 1970; Zaltman et al., 1973]; **research evaluation** [Quinn, 1960; Hodge, 1963; Horowitz, 1963; Yovits et al., 1966; Lipetz, 1965; Seiler, 1965; Dean, 1968].

Also OECD launched the first editions of the series of its “Innovation studies Manuals”: the Frascati manual on ‘The Measurement of Scientific and Technical Activities: Proposed Standard Practice for Surveys of Research and Development’ [OECD, 1963]; the Oslo Manual for ‘innovation measurement’ [OECD, 1991]; the Patent Manual with ‘data on patents and their utilization as science and technology indicators’) [OECD, 1994]; the TBP Manual as a ‘Proposed Standard Practice for the Collection and Interpretation of Data on the Technological

Balance of Payments' [OECD, 1995] and the Canberra Manual 'Measurement of Human Resources in Science and Technology' [OECD, 1996].

2000-s and further

Innovation more and more became a buzzword and slogan in the 2000's. Any change in any sphere of life now is treated as innovation in many cases without any underlying scientific rationale. Innovation is no more a pure scientific concept but more a catchword for attracting investors, a useful word for top management to understand business success (and failures), a beautiful slogan for nice wording used in advertising campaigns for consumer goods but also for political programs. Main spheres of discreditation of scientific concept of innovation are marketing (through advertisement) and public policy (through election promises and ambitious "Programs of Innovation Development").

However, the "fundamental" innovation theories such as for example national innovation system model continue to develop further. Besides complementary concept evolved, e.g. the financial innovation concept, the eco-innovation concept, the user innovation concept and the social innovation concept as well as the collaborative innovation concept.

This trend of simplification of innovation concept is not a disaster or something bad rather allows to identify the driving forces behind this trend. These are:

1. **Change of the essence of scientific society, e.g.** the shift from the "closed science" model to the "open science model". Currently the platform to discuss the problems of innovation are not only peer-reviewed journal and national and international scientific conferences but also different thematic web-sites (such as <http://www.innovation-creativity.com/> <http://www.innovation-management.org/> <http://www.innovationexcellence.com/> and so on). Since these sites are designed for audiences with different levels of education and knowledge, their main goal is explaining the complex concepts and models in simple words with attractive pictures and graphs in many cases without academic rigor in terminology.

2. **Change in innovation models.** Innovation models also change. The era of "good old" fundamental models such as national innovation system model and evolutionary models of innovation is gradually drawing to its decline at least at their original setting. The main factor of this is the lack of reliable, comparable and "long" (in terms of time-series length) country-level data on innovation activity and in many cases on R&D activity. The paradox of situation is the following: we have well-developed fundamental models and strong mathematical tools for their implementation, but we lack of data which should be downloaded into the models. So the innovation models "had to" shift from macro-level to company level. New models of innovation such as disruptive innovation theory or value chain evolution theory by Christensen and Raynor (2003); strategic innovation process model by Allan Afuah (2002); Geoffrey Moore category-

maturity life cycle model (2005), or Gary Hamel business strategy innovation model (2000) can be classified as “schematic” models. Yes these models are complex by their nature and based on different hypothesis about innovation strategy of the firm by they can’t be identified as the “ancestors” of for example national innovation system models. They can be seen as a branch of this model or as continuation of technology-push and market-pull models. These model are more “for investors” or “for end user” than fundamental models. They use more fuzzy terminology and more “visual” (easy to understand) and less strict concept of innovation than fundamental theories of innovation.

3. **Shifts in innovation policy.** National innovation policy gradually shifts from “from top target setting” to “from down priorities setting”. For example EU as well as other developed countries started to coordinate their national STI policies with responses to Grand Challenges. Responses to grand challenges are linked with the specific, sometimes uniquely localized segments (sectors, parts) of the national innovation system their understanding and modeling requires new terms and concepts and old established concepts of innovation may not work here. These concepts are specific by definition and cannot be comprehensive (and everywhere applicable) concepts of innovation. For example in modeling the responses to the climate change challenges the logic of product/process innovation can hardly been used. New concepts of innovation such eco-innovation, sustainable innovation or friendly for environment innovation (and so on) should be used here.

Therefore, the main tasks for theoretical innovation studies and studies on the basic concepts of innovation will be the following:

- systematization of very broad and sometimes vague terminology;
- development of strict and easily applicable criteria for what can be treated as innovation;
- development of more or less structured classification on innovation types;
- development of new well-structured terminology for “almost innovation”, “like innovation” and “close to innovation” changes (reforms, novelties, novations, etc.) in design, process, organization, products, services, institutions and so on.

The following chapter deals with the treatment of innovation types in statistical measurement.

Classification of innovation types in modern statistical practice

In line with the evolution of innovation concepts different types of innovation were developed. The innovation classification has come a long way in its historical development from “classical” product and process innovation to such exotic types as “blue ocean innovation” and “frugal innovation”. Here the main emphasis will be done not on the process of historical development of innovation classification but on ways in which we can classify innovation types. Several types of innovation classification can be distinguished:

1. **“Multitype” classification.** Here all types of innovation are grouped into several non-crossed classes. This classification is the most widespread in the literature. The “classical” typology of innovations here is classification of innovation types proposed by OECD. The main types of innovations in accordance with OECD methodology can be summarized as follows (Table 3).

Table 3: Typology of innovation in OECD methodology.

Type of innovation	Sphere of application	Distinctive characteristic
Product innovation	Innovations related to goods and services	Significant improvements in the technical specifications, components and materials in the embedded software in the degree of friendliness to the user or other functional characteristics
Process innovations	Implementation of new or significantly improved methods of production or delivery of the product	Significant changes in technology, production equipment and / or software
Marketing innovation	Implementation of new methods of marketing , including significant changes in design or packaging of the product during its storage, market promotion and market-based prices	Increasing in the degree of consumer satisfaction , creating new markets or new, more favorable market position for production companies to increase sales
Organizational innovation	Implementation of new forms and methods of organization of business companies , the organization of jobs and external relations	Implementation of business practices in the organization of workplaces or in the external relations previously used for organizational method that represents the result of the implementation of strategic decisions

Source: author’s adaptation from OECD Oslo Manual, 3rd edition (2005)

Bessant and Tidd (2007) distinguish four type of innovation (Table 4). A close look at this classification shows that their classification is quite similar to the OECD innovation methodology. Here production innovation is clearly the analog of product innovation, position innovation can be treated as marketing innovation in OECD concept⁸. Meanwhile paradigm innovation is more broad concept than organization innovation since encompasses all the changes in company behavior and strategy according to its definition. OECD classification is some more accurate. “Paradigm innovation” in Bessant and Tidd typology is very broad and can

⁸ The “process innovation” is excluded from analysis since this type of innovation are the same in OECD methodology and in the concept of Bessant and Tidd.

in principle encompass all other three type of innovation since “shifts in modus operandi of some industry” can be the consequences of Production, process or position operation.

Table 4: Example of multitype classification of innovation types

Type of innovation	Essence of innovation
Production innovation	Introduction of new products and services or changes to products and services that has added benefits for the customer or it meets market need
Process innovations	Introduction of new device, method, tool or knowledge to produce a product or render a service
Position innovation	Positioning of a certain product in a specific industry / business segment
Paradigm innovation	Shifting of long-held assumptions about the modus operandi of some industry or businesses

Source: author’s adaptation from Bessant and Tidd (2007).

2. The other approach to classify innovations is setting in the basis of **classification the degree of “strength” or “power” of innovation**. So here the degree of innovation ranges from “incremental” till “technological revolutions” [Freeman et al., 1982], from “regular” till “revolutionary” and so on. Coccia (2006) in his work sets seven level of innovation intensity (from “lightest” till “revolutionary”) and provides the examples of classifications of innovations according to their innovation intensity. Garcia and Calantone (2002) do a comprehensive review on innovation classification types and distinguish different types of innovation categorization according to the number of innovation types in each classification. In table 5 some examples of classification of innovation types according to innovation intensity from Coccia (2006) and Garcia and Calantone (2002) works are given. Examples with two types of innovations in classifications will be considered further.

Table 5: Example of classification of innovation types according to the degree of innovativeness

Authors	Types of innovations
Mensch, 1979	Improvements → basic innovation → fundamental innovation
Freeman et al., 1982	Improvements → continuous → radical → new technological systems → change of techno-economic paradigms → technological revolutions
Kleinschmidt and Cooper, 1991	Low innovativeness → moderate innovativeness → high innovativeness
Wheelwright and Clark, 1992	Incremental → new generation → radically new
Freeman, 1994	Unrecorded → incremental → minor → major → systemic

Source: author’s adaptation from Garcia and Catalone (2002) and Coccia (2006).

3. **Multilayer classification of innovation**. This typology of innovations distinguishes several levels of innovation classification. One of the first (or may be the first) classification of such type can be found in work of Johnson and Jones, 1957. It should be noted that here authors use the term “new products”, while there “innovations” they take in quotes: “... Just what is a

new product? There are "improved products," "new uses," "new markets for old products," "related new products," "unrelated new products," "innovations," and other terms in common use. Identification of the new product function.” [Johnson and Jones, 1957, p. 51 – 52]. Scholars distinguish two direction of newness (technological and market) and three degree of this newness in each direction (Table 6). It should be noted that analogous type of classification of innovations will be repeated in future studies (for example Moore, 2005; Kumar, 2005). But in these new studies authors will use the term “innovation” without quotes.

Table 6: Example of multilayer classification of innovation types

Type of innovation	Degree of technological newness	Definition of innovation
No market change		
Reformulation	Improved technology	Maintaining an optimum balance of cost, quality, and availability in the formulas of present company products.
Replacement	New technology	Seeking new and better ingredients or formulation for present company products in technology not now employed by the company
Strengthened market		
Remerchandising	No technology change	Increasing sales to consumers of types now served by the company
Improved product	Improved technology	Improving present products for greater utility and merchandisability to consumers
Product line extension	New technology	Broadening the line of products offered to present consumers through new technology
New market		
New use	No technology change	Finding new classes of consumers that can utilize present company products
Market extension	Improved technology	Reaching new classes of consumers by modifying present products
Diversification	New technology	Adding to the classes of consumers served by developing new technical knowledge

Source: author ‘s adaptation from Jones and Johnson (1957).

The other example of such type of innovation classification can be found in the work by Zawislak et al. 2011 (Table 7). The authors identify two types of innovations: technology-driven and business-driven. Each of type in turn, is divided into two subtypes.

Table 7: Example of multilayer classification of innovation types (in Zawislak, 2011)

Type of innovation	Essence of innovation
Technology-driven innovation	
Technological Innovation	Development of new design, new materials and new products . In addition, they include the development of machinery, equipment and new components
Operations Innovation	New processes , improvements in existent processes, introduction of modern techniques , new layouts, etc. It allows the firm to produce products with quality, efficiency, flexibility with the lowest possible cost.
Business-driven innovation	
Management Innovation	Development of management skills which reduce the “internal friction” between different areas of the firm. It is intended to create new methods of management and new business strategy , improve decision making and inter-functional coordination, etc.
Transaction Innovation	Development of ways to minimize transaction costs with suppliers and customers. It is intended to create new commercial strategies, improve relationships with suppliers, streamline market knowledge , etc.

Source: author ‘s adaptation from Zawislak (2011).

Another example of such classification of innovation types can be found in the work by Walker, Avellaneda and Berry (2011). Here authors identify four types of innovation (Table 8). But only one type of innovation (process innovations) is subdivided into three subtypes.

Table 8: Example of multilayer classification of innovation types (in Walker, Avellaneda and Berry, 2011)

Type of innovation	Sphere of application	Distinctive characteristic
Ancillary innovations	Concerned with working across boundaries with other service providers, users or other public agencies	Successful adoption is dependent on factors outside an organization’s control
Service innovations	New services offered by public organizations to meet an external user or market need: they are concerned with what is produced.	Occur in the operating component and affect the technical system of an organization and include the adoption of goods (which are material) and intangible services, which are often consumed at the point of production
Process innovations	Affect management and organization. They change relationships amongst organizational members and affect rules, roles, procedures and structures, communication and exchange among organizational members and between the environment and organizational member	Concerned with how services are rendered
Subcategories of process innovations		
Organization innovations	Innovations in structure, strategy, and administrative processes; improvements in an organization’s practices and the introduction of new organizational structures	Concerned with an organization’s primary work activity and changes in the social system.
Marketization innovation	Modifying the organization’s operating processes and systems to increase the efficiency or effectiveness of producing and delivering its services to users	Concerned with methods to purchase and deliver services and revenue generation, and reflect the core new public management themes of contracting, externalization and market pricing of public services.
Technological innovations	Associated with changes in physical equipment, techniques and organizational systems	Include information technology, hardware (physical equipment) and software (organizational systems).

Source: author ‘s adaptation from Walker, Avellaneda and Berry (2011).

4. Dichotomical classification. According to this classification, only two non-crossed types of innovation are distinguished. It also should be noted that in this classification two

innovation types are the opposite. Examples of such type of innovation classification in different dimensions are shown in the Table 9.

Table 9: Examples of dichotomical classification of innovation types in scientific literature

Authors	Types of innovations
“Strong” innovation/“weak” innovation dimension	
Arrow, 1962; Gilbert and Newbery, 1982	Non drastic/drastic
Priest and Hill, 1980	Incremental/discrete
Utterback, 1996	Evolutionary/revolutionary
Schmidt and Calantone, 1998; Song and Montoya-Weisse, 1998	Really new/radical
Rice et al., 1998	Breakthrough/incremental
Freeman, 1994; Balachandra and Friar, 1997	Radical/incremental
Coccia, 2005	Elementary(micro-incremental)/cluster(new technological system)
“Genuine innovation” / reinnovation dimension	
Norman, 1971	Variations/reorientation
Maidique and Zirger, 1984	True/adoption
Yoon and Lilien, 1985	Original/reformulated
Rorthwell and Gardiner, 1988	Innovations/reinnovations
“Everyday” innovation / disruptive innovation dimension	
Grossman, 1970	Instrumental/ultimate
Meyers and Tucker, 1989	Radical/routine
Christensen, 1997	Sustaining/disruptive
Other dimensions	
Robertson, 1967; Anderson and Tushman, 1990	Discontinuous/continuous
Dosi, 1988	Market pull/technology push

Source: author’s adaptation from Garcia and Catalone (2002) and Coccia (2006).

5. Dually-dichotomical classification of innovation types. This type of innovation classification encompasses two dichotomous classifications of innovation simultaneously. Several examples of dually-dichotomical classification of innovation types developed in the scientific literature can be found in the Table 10.

Table 10: examples of dually-dichotomical classification of innovation types in scientific literature

Authors	Types of innovations
Abernathy and Clark, 1985	Regular/revolutionary; Niche/architectural
Henderson and Clark, 1990	Incremental /radical; Modular/architectural
Moriarty and Kosniik, 1990	Incremental/ radical; Evolutionary market/evolutionary technical
Tidd, 1995	Incremental/breakthrough; Architectural/fusion
Chandy and Tellis, 2000	Incremental /radical market breakthrough/ technological breakthrough

Source: author’s adaptation from Garcia and Catalone (2002) and Coccia (2006).

More detailed analysis of this classification of innovation types in work of Abernathy and Clark (1985) presented in the Table 11. Authors distinguish radical vs. regular and niche vs. architectural types of innovation (Table 11).

Table 11: Example dually-dichotomical classification of innovation types (Abernathy and Clark, 1985)

Type of innovation	Definition of innovation	Distinctive characteristic
Regular Innovation	Involves change that builds on established technical and production competence and that is applied to existing markets and customers	Can have a significant effect on product characteristics and thus can serve to strengthen and entrench not only competence in production, but linkages to customers and markets
Radical Innovation	Disrupts and renders established technical and production competence obsolete	Is applied to existing markets and customers, alters the parameters of competition, as well as by the shifts it causes in required technical competence.
Niche Innovation	Sales maximization in which an otherwise stable and well specified technology is refined, improved or changed in a way that supports a new marketing thrust	In some instances, niche creation involves a truly trivial change in technology, in which the impact on productive systems and technical knowledge is incremental
Architectural Innovation	Defines the basic configuration of product and process, and establishes the technical and marketing agendas that will guide subsequent development	Lays down the architecture of the industry, the broad framework within which competition will occur and develop.

Source: author's adaptation from Abernathy and Clark (1985).

6. **Linked to steps of innovation process classification.** Geoffrey Moore (2005) identifies 14 types of innovation according to his category maturity life cycle the degree of maturity of new technology (Table 12).

Table 12: Example of “linked to steps of innovation process” classification of innovation types (Moore, 2005)

Type of innovation	Essence of innovation
Product leadership zone	
Disruptive Innovation	Creating new market categories based on a discontinuous technology change or a disruptive business model
Application Innovation	Developing new markets for existing products by finding unexploited uses for them, often by combining them in novel ways
Product Innovation	Focuses on existing markets for existing products, differentiating through features and functions that current offers do not have
Platform Innovation	Interposes a simplifying layer to mask an underlying legacy of complexity and complication, thereby freeing a next generation of offers to focus on new value propositions
Customer intimacy zone	
Line-Extension Innovation	Structural modifications to an established offer to create a distinctive subcategory
Enhancement Innovation	Continuation of trajectory begun by line extensions, driving innovation into finer and finer elements of detail, getting closer and closer to the surface of the offer with less and less impact on the underlying infrastructure
Marketing Innovation	Differentiating the interaction with a prospective customer during the purchase process
Experiential Innovation	Value here is based not on differentiating the functionality but rather the experience of the offering
Operational excellence zone	
Value-Engineering Innovation	Extracting cost from the materials and manufacturing of an established offer without changing its external properties
Integration Innovation	Reducing the customer's cost of maintaining a complex operation by integrating its many disparate elements into a single centrally managed system
Process Innovation	Focusing on improving profit margins by extracting waste not from the offer itself but from the enabling processes that produce it
Category renewal zone	
Value-Migration Innovation	Redirecting the business model away from a commoditizing element in the market's value chain toward one richer in margins
Organic Innovation	On this path the company uses its internal resources to reposition itself into a growth category
Acquisition Innovation	Solves the problem of category renewal externally through merger and acquisition

Source: author's adaptation from Moore (2005).

An author identifies four stages (zones) of category maturity: product leadership zone, customer intimacy zone, operational excellence zone and category renewal zone. Different types of innovation are linked with each of these stages (Table 12).

The analysis of different approaches of classification of innovation gives the following picture of innovation types:

- 1) Such types as process innovation, product innovation, service innovation and so on (Block A in the Table 13) emerge in many studies on innovation typology.
- 2) The second cluster is so-called “new” types of innovation. They appeared 5 - 10 years ago and had not yet become the “classic” ones. They include such types of innovation such as frugal innovation, red ocean innovation, organic innovation and other numerous (and in many case “very exotic” from the point of view of strict terminology) types of innovation (block B in Table 13). These types of innovation are used mainly in models developed for management of innovation and in business models of new product (service). Therefore these types are more “attractive”, catchy than purely scientific and strict (in their definition).
- 3) The next block of innovation types is the innovation types, classified according to the degree of innovation. Therefore here radical, breakthrough or revolutionary innovation can be classified as “strong innovation” while non-drastric or minor innovation will be treated as “weak innovation” (Block C, Table 13).
- 4) Finally, innovations can be classified in dichotomical manner. Here the following controversial pairs of innovation types can be identified: open/closed innovation, radical/incremental, product/process and so on (Block D, Table 13).

Table 13: Summary of innovation types

Block A “Classical” types
Product innovation/Process innovation/Service innovation/Marketing innovation/Organizational innovation/Design innovation/supply chain innovation
Block B “New” types
Frugal innovation/Red ocean innovation/Blue ocean innovation/Experience innovation/Value-migration innovation /business model innovation/organic innovation / ... innovation / ...
Block C “Innovativeness degree” type
Weak innovation Incremental/routine/minor/regular/non-drastic/basic innovation
medium strength Architectural/niche(creation)/modular/fusion/evolutionary/sustaining innovation
Strong Radical/major/breakthrough/disruptive/revolutionary/paradigm/fundamental/discrete innovation
Block D “Dichotomical” types
User-driven/supply-side innovation
Open/closedinnovation
Product/process innovation
Incremental/radical innovation (and other examples of “strong”/“weak” classification of innovation)
Continuous/discontinuous innovation
Instrumental/ultimate innovation
True/adoption innovation
Original/reformulated innovation
Innovation/reinnovations

Source: classification of innovation types given in the table is based on the analysis on literature on innovation typology.

In conclusion it can be shown that the innovation typology has about the same way of development as concept of innovation itself. It has evolved from a more or less structured system to a very complex and impossible to structure system of classification. In addition the bulk of this classification can hardly be classified as classification with the strict terminology.

Conclusion

The analysis of concepts, aspects, definitions and types of innovation was done in this work. The following conclusions can be made from this analysis.

- 1) The innovation concept has a long history of development. Till the end of the XIX century innovations and innovators were explicitly or implicitly denied and decried society. Since the last decades of the XIX century till the 1960-s years the interest to innovation has grown and the basis for innovation studies was established. In 1960-s – 1990-s can be called the “golden age” for the conceptualization of innovation. During this period the key concepts of innovation as well as well-structured methodology and models for analysis the innovation processes were developed. However in 2000-s innovation more and more became the buzzword and conception of innovation start to vague. The innovation models shift from macro level to individual firm level. There is also no unified and commonly accepted understanding of the innovation concept.
- 2) The innovation typology shifted from a more or less well-structured system to a system with a big number of very different elements. Now along with the already well-established types of innovation (such as product or process innovation), there are also completely new types of innovation (such as frugal innovation or organic innovation). These new types of innovations are often called differently by different authors and rarely have the commonly understood concept
- 3) Aspects of innovation developed from “innovation as process” and “innovation as an object” to a more detailed one including innovation as tool for changing and innovation as context for changing as well as innovation as human abilities for doing something and innovation as change itself.
- 4) The trends in the evolution of innovation concepts and typology pose the following challenges for theorists of innovation studies:
 - development of new generally accepted and strict terminology for new types and concepts of innovation;
 - classification of new innovation concepts and types into a well-structured system;
 - development of strict criteria for separation true innovation from “dramatic changes”, “minor improvements” and other novelties, novations and reforms that are really cannot be treated as innovation.

Eventually the challenge will be to refine the innovation definition and classification of innovation types and streamline them into a usable and understandable set of definitions,

concepts and types which are of use for academics and practitioners. For private sector practitioners this is of utmost importance since it shows that too many different concepts appeared in the last years which are more of marketing and advertising style rather than adding real value to company operations. In the political sphere such understanding should emphasize the potential impacts of innovation for the given political and societal goals but these need a clear communication beyond the respective communities involved. Overall innovation needs to be considered as a long time investment. There is still the assumption that actors (companies or countries) investing in innovation are the most successful ones but in reality the tie dimension of impact from innovation is neglected. Furthermore marginal innovation is obviously the preferred innovation type for companies which are I duty to report to investors quarterly. A changing understanding of the nature of innovation and it's implications is hence needed.

Annex

Table A.1. Development of innovation concepts and models in its historical developments (pre-1920-s – 1930-s)

Pre 1920-s
<ul style="list-style-type: none"> - first theories of innovation in sociology, innovation is seen as social change (changes in grammar, language, religion, law, constitution, economic regime, industry and arts) [Tarde, 1890, 1895, 1898, 1902]; - first classification of technical changes [Schumpeter, 1912]; - first appearance of innovation as social experiment concept in sociology [Chapin, 1917]
1920-s
<ul style="list-style-type: none"> - first linear “models” of invention – imitation sequences in sociology [Ogburn, 1922]; - first appearance of innovation as social invention concept in sociology [Bernard, 1923; Chapin, 1928; Weeks, 1932] - theoretical classifications of technologies in economics [Pigou, 1924; Hicks, 1932; Robinson, 1938]; - innovation as cultural change concept (changes in culture traits, but also inventions in agriculture, trade, social and political organizations (law, customs, religion, family) and technology) in anthropology [Smith et al. 1927] - term “technological change” instead of “innovation” in the first innovation studies in sociology [Stern, 1927, 1937; Chapin, 1928]; - first works on innovation in public institutions [Chapin, 1928]; - first study geometrical laws of diffusion of inventions [Chapin, 1928]; - production function logic as interpretation of technological change [Cobb and Douglas, 1928]; - technical change as creative destruction concept in economics [Schumpeter, 1928]; - first discussion on innovation vs. invention in economic literature [Stamp, 1929]; - first theories on technological inventions in psychology [Usher, 1929]
1930-s
<ul style="list-style-type: none"> - first appearance of innovation as novelty concept in sociology [Kallen, 1930]; - first qualitative analysis of productivity as an indicator of technology usage in the US scientific organizations such as National Bureau of Economic Research, Bureau of Labor Statistics and Work Projects Administration [1930-s]; - first theories on technological inventions in psychology [Rossman, 1931]; - analysis of the shift of innovation process from “lonely innovator” into organized laboratories [Hart, 1931; Gilfillan, 1935] - first effort to analyze technological innovation as acceleration and growth of material culture by quantitative methods [Hart, 1931]; - one of the first use of term “innovation” in sociology [Hart, 1931]; - first theories on technological inventions in psychology [Rossman, 1931]; - first appearance of innovation as social invention concept in sociology [Weeks, 1932]; - theoretical classifications of technologies in economics [Hicks, 1932; Robinson, 1938]; - technical change as creative destruction concept in economics [Schumpeter, 1934]; - first discussion on innovation vs. invention in economic literature [Stamp, 1934]; - first survey of industrial incentives to invention [Rossman, 1935]; - one of the first effort to contradistinguish innovators in conservators in the economic literature [Pareto, 1935] - technological invention as social concept idea [Gilfillan, 1935]; - first linear “models” of invention – imitation sequences in sociology [Gilfillan, 1935]; - term “innovation” starts to spread over the innovation studies in sociology [Gilfillan, 1935, 1937]; - first “approaches” to innovation diffusion theories in anthropology – cultural change as a result of contact between cultures [Redfield et al., 1936]; - analysis of “technicways” in sociology (some analog to technological paradigms in Dosi (1982, 1988) and technoeconomic paradigms in Freeman & Perez (1988) and Perez (1983)) [Odum, 1937]; - first analysis of social effects of technological inventions [Stern, 1937]; - further discussion on innovation vs. invention in the economic literature [Schumpeter, 1939]; - technological innovation as new combinations of means of production [Schumpeter, 1939]

Note: milestones in development of innovation studies were identified on the basis of analysis of Rothwell (1994), Marinova and Phillimore (2003) and Godin (2008) papers, as well as on the basis of material of Web of Science, Scopus and Google Scholar databases.

Table A.1 – Development of innovation concepts and models in its historical developments, continuation (1940-s – 1950-s)

1940-s
<ul style="list-style-type: none"> - analysis of “technicways” in sociology (some analog to technological paradigms in Dosi (1982, 1988) and technoeconomic paradigms in Freeman & Perez (1988) and Perez (1983)) [Davis 1940]; - term “technological change” instead of “innovation” in the first innovation studies in sociology [Davis, 1940]; - first works on innovation in public institutions [McVoy, 1940]; - term “innovation” starts to spread over the innovation studies in sociology [Ogburn, 1941]; - technological innovation as new combinations of means of production [Lange, 1943]; - first works in the economics of technological change [Maclaurin, 1947, 1949]; - further development of production function method [Douglas, 1948];
1950-s
<ul style="list-style-type: none"> - more “mature” discussion on diffusion and imitation of innovation in economics [Brozen, 1951]; - innovation as the first commercialization of new product idea in economics [Maclaurin, 1953]; - comprehensive theory of innovation in anthropology [Barnett, 1953]; - first “approaches” to innovation diffusion theories in anthropology – cultural change as a result of contact between cultures [Barnett et al., 1954]; - one of the first use of term “technological innovation” in the economic literature [Maclaurin, 1953]; - development of methods of qualitative analysis of technological innovations proposed in Hart (1931) [Hart, 1957, 1959]; - first works on research evaluation [Rubinstein, 1957; Quinn, 1959]; - further development of innovation diffusion concept [Carter and Williams, 1957, 1958, 1959]; - innovation as activity and innovation as process concepts in sociology [Nimkoff, 1957]; - residual in production function as technology [Solow, 1957]; - one of the first attempt to analyze the internal logic of innovation process itself [Carter and Williams, 1957]; - innovation as deviant behavior concept in sociology [Merton, 1957]; - first theories of technological development in sociology [Jewkes, 1958]; - innovation as commercialized invention concept in sociology [Jewkes, 1958]; - first works on organizational innovations [Cole, 1959]; - more constructive view of Merton thesis on innovation as deviant behavior [Dubin, 1959]
1960-s
<ul style="list-style-type: none"> - further development of the research evaluation studies after their start in the late 1950-s [Quinn, 1960; Hodge, 1963; Horowitz, 1963; Yovits et al., 1966; Lipetz, 1965; Seiler, 1965; Dean, 1968]; - first studies on scientific innovation in sociology [Ben-David, 1960a, 1960b; 1964; 1966; Mulkay, 1969]; - emphasis on the role of the marketplace in innovation process [Cook and Morrison, 1961]; - some opposition to the term “innovation”: “innovation has come to mean all things to all men” [Ames, 1961, p. 371]; - studies on innovative behaviors of organizations [Burns and Stalker, 1961; Wilson, 1966]; - more developed theories of innovation diffusion and imitation in economics [Mansfield, 1961; Posner, 1961; Schmookler, 1966]; - first use the term “lead user” [Enos, 1962]; - board theory of innovation in sociology [Rogers, 1962]; - some opposition to the term “innovation”: “we shall do better without the word innovation” [Machlup, 1962, p. 179]; - first edition of methodological manual for collecting statistics on R&D: Frascati manual (The Measurement of Scientific and Technical Activities: Proposed Standard Practice for Surveys of Research and Development) [OECD, 1963]; - development of theories of organizational innovations [Aitken, 1965]; - developed methodology for measurement the technological innovations through patents [Schmookler, 1966]; - first studies on scientific and technological productivity [Pelz and Andrew, 1966; Myers and Marquis, 1969]; - one of the first use the term “innovation” in the economics [Schmookler, 1966]; - first governmental survey of technological innovation per se [Charpie Report; US Department of Commerce, 1967]; - first empirical studies on innovation process [Myers and Marquis, 1969]; - further developments in theory of political innovation [Walker, 1969; Mohr, 1969]

Note: milestones in development of innovation studies were identified on the basis of analysis of Rothwell (1994), Marinova and Phillimore (2003) and Godin (2008) papers, as well as on the basis of material of Web of Science, Scopus and Google Scholar databases.

Table A.1 – Development of innovation concepts and models in its historical developments, continuation (1970-s – 1980-s)

1970-s
<ul style="list-style-type: none"> -further development studies on innovative behaviors of organizations [Aitken and Hage, 1970; Zaltman et al., 1973]; - development of studies on scientific innovation in sociology [Mulkay and Turner, 1971; Mulkay, 1969, 1972a, 1972b, 1975]; - further theoretical developments on the concept of innovation as the first commercialization of new product (process) [Freeman, 1971; 1974; SPRU, 1972]; - emphasis on the importance of scientific autonomy and independence for the flourishing of science [Merton, 1973]; - further development of empirical studies on innovation process [Langrish et al., 1972; Hayvaert, 1973; Rothwell et al., 1974; Schock, 1974; Szakasits, 1974; Rothwell, 1976; Rubenstein et al., 1976; Utterback, 1975]; - some opposition to the term “innovation”: “use of the term innovation is counterproductive” [Roberts and Romine, 1974, p. 4]; - technological imperatives model [Rosenberg, 1976]; - need-pull model of innovation [Roessner, 1979; Herbert and Hoar, 1982; Rothwell, 1984, Rothwell & Zegveld, 1985]
1980-s
<ul style="list-style-type: none"> - empirical studies on innovation process [Cooper, 1980]; - innovation avenues model [Sahal, 1981]; - comprehensive theories of innovation diffusion and imitation in the view of evolutionary theory in economics [Mansfield et al., 1981; Nelson and Winter, 1982] - one of the first comprehensive research on social innovation [Chambon and Devevey, 1982]; - black box innovation model [Rosenberg, 1982] - technological paradigms model [Dosi, 1982, 1988]; - further theoretical developments on the concept of innovation as the first commercialization of new product in evolutionary models (process) [Nelson and Winter, 1982]; - emergence the concept of financial innovation [Myers and Nicholas, 1984; Miller, 1986; Franklin and Gale, 1988; Ross, 1989]; - iterative (circular) process of innovation model [Kline & Rosenberg, 1986]; - emergence of the concept of user innovation [von Hippel, 1986; Fleck, 1988]; - real development of the lead user concept in the framework of user innovation concept [Von Hippel, 1986; Urban and Von Hippel, 1988]; - technoeconomic paradigms [Freeman & Perez, 1988; Perez, 1983]; - strategic networks model (alliances) [Jarillo, 1988]; - technological innovation system and national innovation system concept emergence [Lundvall, 1985; Dosi et al, 1988, Freeman, 1988]; - technological trajectories model [Pavitt et al., 1989],

Note: milestones in development of innovation studies were identified on the basis of analysis of Rothwell (1994), Marinova and Phillimore (2003) and Godin (2008) papers, as well as on the basis of material of Web of Science, Scopus and Google Scholar databases.

Table A.1 – Development of innovation concepts and models in its historical developments, continuation (1990-s)

1990-s
<ul style="list-style-type: none"> - innovation complexes model [Gann, 1991, 2000]; - innovation milieu model [Camagni, 1991]; - national systems of innovation model development [Freeman, 1991, 1995; Lundvall, 1992, 1993; Nelson, 1993]; - development of technological innovation system model [Carlsson and Stankiewicz, 1991; Van Lente, 1993, 1998]; - problem of “bounded rationality” in application to innovation studies [Dosi & Egibi, 1991]; - innovation chains model [Marceau, 1992; Dodgson, 1993]; - technological trajectories model [e.g. Biondi & Galli, 1992], - first edition of a methodological manual for measuring innovation Oslo Manual [OECD, 1992]; - regional network model [Dodgson, 1993]; - strategic networks model (alliances) [Sako, 1992]; - technological opportunities and established decision-making rules as dynamic self-organized systems [Dosi & Orsenigo, 1994]; - further development of social innovation concept among Fernch theoretichoians [Laville, 1994] - theories of growth of regional clusters of innovation and high technology [Feldman, 1994]; - first edition of methodological manual for patent statistics OECD Patent Manual (Data on Patents and Their Utilization as Science and Technology Indicators) [OECD, 1994] - imperfections as drivers for technical change concept [Metcalfe, 1995]; - development of the financial innovation concept [Duffe and Rohit, 1995; Persons and Warther, 1997]; - emergence of innovation intermediary concept [Bessant and Rush, 1995; Stankiewicz, 1995; Hargadon, 1998]; - learning regions model [Florida, 1995; Kirat & Lung, 1999; Macleod, 1996] - first edition of methodological manual for technology balance of payments statistics – OECT TBP Manual (Proposed Standard Practice for the Collection and Interpretation of Data on the Technological Balance of Payments) [OECD, 1995]; - emphasis on innovation product diversity [Dowrick, 1995]; - theory of successful and failure innovations [Tisdell, 1995]; - “technological gap” studies [Dodgson & Bessant, 1996]; - first edition of methodological manual for Human Resources in R&D – Canberra Manual (<i>Manual on the Measurement of Human Resources in Science and Technology</i>) [OECD, 1996] - concept of the result and process equivalence in R&D [OECD, 1996]; - emergence of eco-innovation concept [Fussler, and James, 1996; James 1997]; - innovation in the context of territorial organization (Bramanti & Ratti, 1997); - regional system of innovations model [Cooke, 1998]; - innovation clusters model [OECD, 1999]

Note: milestones in development of innovation studies were identified on the basis of analysis of Rothwell (1994), Marinova and Phillimore (2003) and Godin (2008) papers, as well as on the basis of material of Web of Science, Scopus and Google Scholar databases.

Table A.1 – Development of innovation concepts and models in its historical developments, continuation (2000-s)

2000-s
<ul style="list-style-type: none"> - further development of financial innovation concept [Friedman, 2000; Goodhart, 2000; Woodfor, 2000; Tufano, 2003; Alvarez and Lippi, 2009] - further development of the eco-innovation concept [Jones and Harrison, 2000; Rennings, 2000; Jones et al. 2001; Nuij, 2001; Smith, 2001; Rai and Allada, 2005; Beveridge and Guy, 2005; Pujari, 2006; Carrillo-Hermosilla del Río and Könnölä, 2009]; - further development of the lead user concept in the framework of user innovation concept [Luthje, 2000; Lilien, et al. 2002; Intrachooto, 2004; Luthje and Herstatt, 2004; Skiba and Herstatt, 2009; Skiba, 2010, Oliveira and Von Hippel, 2011] - national systems of innovation mode (in theoretical as well as empirical direction) further development [Chudnovsky Niosi and Bercovich, 2000; Etzkowitz and Leydesdorff, 2000; Nasierowski and Arcelus, 2000, 2003; Nelson, 2000; Edquist, 2001, 2004; Lundvall, 2002, 2007; Lundvall et al., 2002, Niosi, 2002; Monttobio, 2008, Pan, Hung, Lu, 2010]; - theories of growth of regional clusters of innovation and high technology [Keeble & Wilkinson, 2000]; - emergence of the toolkits for user innovation concept in the framework of user innovation concept [von Hippel, 2001; von Hippel and Katz, 2002]; - further development of methodology for the international and national R&D statistics and STI policy measurement [Gokhberg, Gaslikova and Sokolov, 2000; Boekholt et al., 2001; ESCWA, 2003; Katz, 2006; Tijssen and Hollanders, 2006; Gokhberg L. and Boegh-Nielsen, 2007; OECD, 2007; Gokhberg, Kuznetsova and Roud, 2012] - establishment of the theory of social innovation in academic literature [Mumford, 2002; Moulaert and Sekia, 2003; Westley, Zimmerman and Patton M. 2006; Kohli and Mulgan 2007; Mulgan Ali and Tucker 2007; Nichols, 2007; James, Deiglmeier and Dale, 2008; Nambisan, 2008, 2009; MacCallum, Moulaert, Hillier and Vicari, 2009; Goldsmith, 2010; Howaldt and Schwarz 2010; Murray, Caulier- Grice and Mulgan, 2010; Gill, 2012] - further development of innovation intermediary concept [Wolpert, 2002; Stewart and Hyysalo, 2008; Sieg, Wallin and von Krogh, 2010] - further development of technological innovation system concept [Bergek, 2002; Smits, 2002; Hekkert et al., 2007; Negro, 2007; Bergeck et al, 2008; Suurs, 2009]; - further development of open innovation concept [Chesbrough 2003; Vemuri and Bertone, 2004; Zhao and Deek, 2004; Chesbrough, Vanhaverbeke and West, 2008; von Hippel, 2011; Penin, Hussler and Burger-Helmchen, 2011; Pearce, 2012]; - emergence of the collaborative innovation network concept in the framework of open innovation concept [Gloor, 2005; Gloor and Cooper, 2007; Silvestre and Dalcol, 2009]; - further development of user innovation concept [von Hippel, 2005; Braun, 2007; Bilgram, Brem, Voigt, 2008; Nambisan and Nambisan, 2008; Bogers, Afuah, Bastian, 2010];

Note: milestones in development of innovation studies were identified on the basis of analysis of Rothwell (1994), Marinova and Phillimore (2003) and Godin (2008) papers, as well as on the basis of material of Web of Science, Scopus and Google Scholar databases.

References

- Abernathy W.J., Clark K.B. (1985). Innovation: Mapping the Winds of Creative Destruction // *Research Policy*, Vol. 14, pp. 3–22.
- Acs Z. J., Anselin L., Varga A. (2002). Patents and Innovation Counts as Measures of Regional Production of New Knowledge // *Research Policy*, Vol. 31, No. 7, pp. 1069–1085.
- Afuah A. (2002). Innovation Management: Strategies, Implementation, and Profits // New York: *Oxford University Press*, 2nd edition.
- Ahmed P.K., Shepherd C. (2010). Innovation Management: Context, Strategies, Systems And Processes // Harlow: *Financial Times Prentice Hall*.
- Aiken M., Hage, J. (1971). The Organic Organization and Innovation // *Sociology*, Vol. 5, No. 1, pp. 63–82.
- Aitken H.G.J. (1965). Explorations in Enterprise // Cambridge (Mass.): *Harvard University Press*.
- Allen F., Gale D. (1988). Optimal Security Design // *Review of Financial Studies* 1 (3): 229–263. doi:10.1093/rfs/1.3.229.
- Alvarez F., Lippi F. (2009). Financial Innovation and the Transactions Demand for Cash // *Econometrica*, Vol. 77, No. 2), pp. 363–402.
- Ames E. (1961). Research, Invention, Development and Innovation // *American Economic Review*, Vol. 51, No. 3, pp. 370–381.
- Anderson P., Tushman P.M. (1990). Technological Discontinuities and Dominant Designs: A Cyclical Model of Technical Change // *Administrative Science Quarterly*, No. 35, pp. 604–633.
- Arrow K. (1962). Economic Welfare and the Allocation of Resources For Invention. In: Nelson R. (Ed.). The Rate and Direction of Inventive Activity: Economic and Social Factors // Princeton: *Princeton University Press*.
- Bacon F.R., Butler T.W. (1998). Achieving Planned Innovation: A Proven System For Creating Successful New Products and Services // New York: *Free Press*.
- Balachandra R., Friar J.H. (1997). Factors in success in R&D projects and new product innovations: a contextual framework // *IEEE Transaction on Engineering Management*, Vol. 44, No. 3, pp. 266–287.
- Baregheh A., Rowley J., Sambrook S. (2009). Towards A Multidisciplinary Definition of Innovation // *Management Decision*, Vol. 47, No. 8, pp. 1323–1339,
- Barnett H.G. (1953). Innovation: the Basis of Cultural Change // New York: *McGraw Hill*.
- Barnett H.G., Broom L., Siegel B.J., Vogt E.Z., Watson J.B. (1954). Acculturation: An Exploratory Formulation // *American Anthropologist*, Vol. 56, No. 6, pp. 973–1000.
- Bartlett W., Čučković N. (2006). Knowledge Transfer, Institutions, and Innovation in Croatia and Slovenia // *Social Research Journal for General Social Noues (Društvena istraživanja Časopis za opća dru tvena pitanja)*, No. 3, pp. 371–399.
- Ben-David J. (1960a). Roles and Innovations in Medicine. // *American Journal of Sociology*, Vol. 65, No. 6, pp. 557–568.
- Ben-David J. (1960b). Scientific Productivity and Academic Organization in Nineteenth Century Medicine // *American Sociological Review*, Vol. 25, No. 6, pp. 828–843.
- Ben-David J. (1964). Scientific Growth: a Sociological View // *Minerva*, Vol. 2, No 4, pp. 454–476.
- Ben-David J. (1966). Social Factors in the Origins of a New Science: the Case of Psychology // *American Sociological Review*, Vol. 31, No. 4, pp. 451–465.
- Bergek A. (2002). Shaping and Exploiting Technological Opportunities: The Case of Renewable Energy Technology in Sweden (Thesis) // *Chalmers University of Technology*, Göteborg, Sweden.

- Bergek A., Jacobsson S., Carlsson B., Lindmark S., Rickne A. (2008). Analyzing the functional dynamics of technological innovation systems: A scheme of analysis // *Research Policy*, Vol. 37, pp. 407–429.
- Bernard L. (1923). Invention and Social Progress // *American Journal of Sociology*, Vol. 29, No. 1, pp. 1–33.
- Bessant J., Rush H. (1995). Building Bridges for Innovation: The Role of Consultants in Technology Transfer // *Research Policy*, Vol. 24, pp. 97–114.
- Bessant J., Tidd, J. (2007). Innovation and Entrepreneurship // Chichester: *John Wiley*.
- Beveridge R. Guy S. (2005). The Rise of the Eco-Preneur and the Messy World of Environmental Innovation // *Local Environment*, Vol. 10, No. 6, pp. 665–676.
- Bilgram V., Brem A., Voigt K.-I. (2008). User-Centric Innovations in New Product Development. Systematic Identification of Lead User Harnessing Interactive and Collaborative Online-Tools // *International Journal of Innovation Management*, Vol. 12, No. 3, pp. 419–458.
- Biondi L., Galli, R. (1992). Technological trajectories // *Futures*, Vol. 24, No. 580–592.
- Boekholt P., Lankhuizen M., Arnold E., Clark J., Kuusisto J., de Laat B., Simmonds P., Cozzens S., Kingsley G., Johnston R. (2001). An International Review of Methods to Measure Relative Effectiveness of Technology Policy Instruments // *Technopolis*, Brighton/Amsterdam.
- Bogers M., Afuah A., Bastian B. (2010). Users As Innovators: A Review, Critique, And Future Research Directions // *Journal of Management*, Vol. 36, No. 4, pp. 857–875.
- Botkin J., Dimancescu D., Stata R. (1983). The Innovators: Rediscovering America's Creative Energy // Harper and Row.
- Bramanti A., Ratti, R. (1997). The Multi-Faceted Dimensions of Local Development. In: Ratti R., Bramanti A., Gordon R. (Eds). The Dynamics of Innovative Regions: The GREMI Approach // Aldershot, U.K.: *Ashgate*, pp. 3–44.
- Braun V.R.G. (2007): Barriers to User-Innovation and the Paradigm of Licensing to Innovate // *Doctoral dissertation: Hamburg University of Technology*.
- Brettel M., Heinemann F., Engelen A., Neubauer S. (2011). Cross-Functional Integration of R&D, Marketing, and Manufacturing in Radical and Incremental Product Innovations and Its Effects on Project Effectiveness and Efficiency // *Journal of Product Innovation and Management*. Vol. 28, No. 2, pp. 251–269.
- Brozen Y. (1951a). Invention, Innovation, and Imitation // *American Economic Journal*, May, pp. 239–257.
- Brozen Y. (1951b). Research, Technology and Productivity. In: Tripp L.R. (ed.). Industrial Productivity, Industrial Relations Research Association // *Champaign, Illinois*, pp. 25 - 49.
- Burns T., Stalker G.M. (1961). The Management of Innovation // London: *Tavistock Publication*.
- Burt R. (2004). Structural Holes and Good Ideas // *American Journal of Sociology*, Vol. 110, pp. 349–399.
- Camagni R. (1991). “Local Milieu”, Uncertainty and Innovation Networks: Towards a New Dynamic Theory of Economic Space. In: Camagni R. (Ed.). Innovation Networks: Spatial Perspectives // London: *Belhaven Press*, pp. 12–143.
- Carlsson B., Keane P., Martin J.B. (1976). R and D Organizations as Learning Systems // *Sloan Management Review*, Vol. 17, Iss. 3, pp. 1–15.
- Carlsson B., Stankiewicz R. (1991). On the Nature, Function, and Composition of Technological systems // *Journal of Evolutionary Economics*, Vol. 1, pp. 93–118.
- Carrillo-Hermosilla J., del Río P., Könnölä T. (2009). Eco-innovation: When Sustainability and Competitiveness Shake Hands // Hampshire: *Palgrave Macmillan*.
- Carroll J. (1967). A Note on Departmental Autonomy and Innovation in Medical Schools // *The Journal of Business*, Vol. 40, No. 4, pp. 531–534.
- Carter C., Williams B. (1957). Industry and Technical Progress // London: *Oxford University Press*.

- Carter C.F., Williams B.R. (1958). *Investment in Innovation* // London: Oxford University Press.
- Carter C.F., Williams B.R. (1959). *Science in Industry: Policy for Progress* // London: Oxford University Press.
- Chambon J.-L., Devevey J.-M. (1982). *Les Innovations Sociales* // *Presses Universitaires de France*, Paris
- Chandy R.K., Tellis G.J. (2000). The Incumbents Curse: Incumbency, Size, and Radical Product Innovation // *Journal of Marketing*, Vol. 64 pp. 1–17.
- Chapin F.S. (1917). The Experimental Method and Sociology // *The Scientific Monthly*, pp. 133–144 and pp. 238–247.
- Chapin F.S. (1928). *Cultural Change* // New York: *The Century Co.*
- Chesbrough H.W. (2003). *Open Innovation: the New Imperative for Creating and Profiting from Technology* // Boston: *Harvard Business School Press*.
- Chesbrough H.W. (2003). The Era of Open Innovation // *MIT Sloan Management Review* Vol. 44, No. 3, 35–41.
- Chesbrough H.W. Vanhaverbeke W., West J., eds. (2008). *Open Innovation: Researching a New Paradigm* // *Oxford University Press*.
- Christensen C.M. (1997). *The Innovation's Dilemma: When New Technologies Cause Great Firms to Fail* // Harvard Business School Press, Boston, MA.
- Christensen C.M., Raynor M.E. (2003). *The Innovator's Solution: Using Good Theory to Solve the Dilemmas of Growth* // Boston: *Harvard Business School Press*.
- Chudnovsky D., Niosi J. Bercovich N. (2000). National Innovation Systems, Learning Processes and Technology Policy: Comparison of Canada and Argentina // *Desarrollo Economico-Revista de Ciencias Sociales*, Vol. 40, No. 158, pp. 213–252.
- Cobb C.W., Douglas P.H. (1928). A Theory of Production // *American Economic Review*, Vol. 18, March, pp. 139–165.
- Coccia M. (2005). Measuring Intensity of Technological Change: The Seismic Approach // *Technological Forecasting and Social Change*, vol. 72, n. 2, pp. 117–144.
- Coccia M. (2006). Classifications of Innovations Survey and Future Directions. // *Working Paper CERIS-CNR, Anno 8, N° 2–2006*
- Cole A.H. (1959). *Business Enterprise in its Social Setting* // Cambridge (Mass.): *Harvard University Press*.
- Cole B. (1995). Titan and the Idea of Originality in the Renaissance. In: Ladis A. (ed.). *Craft of Art* // Athens: *University of Georgia Press*.
- Cook L.G., Morrison W.A. (1961). The Origins of Innovation // Report No. 61-GP-214, June, *General Electric Company, Research Information Section*, New York, NY.
- Cooke P. (1998). Introduction. In: Braczyk H.-J., Cooke P., Heidenreich M. (Eds). *Regional Innovation Systems: The Role of Governance in a Globalised World* // London: *UCL Press*, pp. 2–25.
- Cooper J.R. (1998). A Multidimensional Approach to the Adoption of Innovation // *Management Decision*, Vol. 36, No. 8, pp. 493–502.
- Cooper R.G. (1980). Project New Prod: Factors in New Product Success // *European Journal Marketing*, Vol. 14 No. 5/6.
- Dahlin K., Behrens D. M. (2005). When Is an Invention Really Radical? Defining and Measuring Technological Radicalness // *Research Policy*, Vol. 34, No. 5, pp. 717–737.
- Dakhli M., De Clercq D. (2004). Human Capital, Social Capital, and Innovation: A Multi-Country Study // *Entrepreneurship and Regional Development*, Vol. 16, No. 2 pp. 107–128.
- Damanpour F. (1991). Organizational Innovation: A Meta-Analysis of Effects of Determinants and Moderators // *Academy of Management Journal*, Vol. 34, No. 3, pp. 555–590.
- Davis A. (1940). Technicways in American Civilization: Notes on a Method of Measuring Their Point of Origin // *Social Forces*, Vol. 18, No. 3, pp. 317–330.

- Dean B.V. (1968). *Evaluating, Selecting, and Controlling R&D Projects* // New York: *American Management Association*.
- Dewar R.D., Dutton J.E. (1986). The Adoption of Radical and Incremental Innovations - an Empirical-Analysis // *Management Science*, Vol. 32, No. 11, pp. 1422–1433.
- Dodgson M. (1993). *Technological Collaboration in Industry: Strategy, Policy and Internationalization In Innovation* // London: *Routledge*.
- Dodgson M., Bessant J. (1996). *Effective Innovation Policy: A New Approach* // London: *International Thomson Business Press*.
- Dosi G. (1982). Technological Paradigms and Technological Trajectories: A Suggested Interpretation of the Determinants and Directions of Technical Change // *Research Policy*, Vol. 11, pp. 147–162.
- Dosi G. (1988). Sources, Procedures, and Microeconomic Effects of Innovation // *Journal of Economic Literature*, Vol. 26, pp. 1120–1171.
- Dosi G., Egibi M. (1991). Substantive and Procedural Uncertainty: An Exploration of Human Behavior in Changing Environments // *Journal of Evolutionary Economics*, Vol. 1, pp. 145–168.
- Dosi G., Freeman C., Nelson R., Silverberg G., Soete L. (Eds.). (1988). *Technical Change and Economic Theory Innovation as an interactive process: from user-producer interaction to the national system of innovation* // *Pinter*, London.
- Dosi G., Orsenigo L. (1994). Macrodynamics and Microfoundations: An Evolutionary Perspective. In: Granstrand O. (Ed.). *Economics of Technology* // Amsterdam: *North-Holland*, pp. 91–123.
- Douglas P.H. (1948). Are There Laws of Production? // *American Economic Review*, Vol. 38, March, pp. 1–41.
- Dowrick S. (Ed.) (1995). *Economic approaches to innovation* // Aldershot, U.K.: *Edward Elgar*.
- Drucker P. F. (1985). *Innovation and Entrepreneurship* // Heinemann, London.
- Drucker P.F. (1998). The Discipline of Innovation // *Harvard Business Review*, pp. 149–156.
- Dubin R. (1959). Deviant Behavior and Social Structure: Continuities in Social Theory // *American Sociological Review*, Vol. 24, No. 2, pp. 147–164.
- Duffie D., Rohit R. (1995). Financial Market Innovation and Security Design: An Introduction // *Journal of Economic Theory*, Vol. 65, No. 1, pp. 1–42.
- Edquist C. (2001). The Systems of Innovation Approach and Innovation Policy: An account of the state of the art // *Lead paper presented at the DRUID Conference*, Aalborg, June 12–15, 2001.
- Edquist C. (2004). Systems of Innovation – A Critical Review of The State of the Art. In: *Handbook of Innovation*. Fagerberg J., Mowery D., Nelson, R.R. (Eds.). // *Oxford University Press*.
- Enos J.L. (1962) *Petroleum Progress and Profits: A History of Process Innovation*, Cambridge // MA: *MIT Press*.
- ESCWA (2003). *New indicators for science, technology and innovation in the knowledge-based society* // NY.
- Ettlie J.E., Bridges W.P., Okeefe R.D. (1984). Organization Strategy and Structural Differences for Radical versus Incremental Innovation // *Management Science*, Vol. 30, No. 6, pp. 682–695.
- Etzkowitz H., Leydesdorff L. (2000). The Dynamics of Innovation: From National Systems and “Mode 2” to Triple Helix of University-Industry-Government Relations // *Research Policy*, Vol. 29, No. 2, pp. 109–123.
- Feldman M. (1994). *The geography of innovation* // Dordrecht: *Kluwer Academic Publisher*.

- Fleck J. (1988). Innofusion or Diffusation? The Nature of Technological Development in Robotics // *Edinburgh PICT*, Working Paper No. 7.
- Florida R. (1995). Toward the Learning Region // *Futures*, Vol. 27, pp. 527–536.
- Freeman C. (1971). The Role of Small Firms in Innovation in the United Kingdom. Report to the Bolton Committee of Enquiry on Small Firms // London: *HSMO*.
- Freeman C. (1974). The Economics of Industrial Innovation // London: *Penguin*.
- Freeman C. (1982). The Economics of Industrial Innovation // *The MIT Press*.
- Freeman C. (1988). Japan: a New National System of Innovation? In Dosi G. et al. (eds.). *Technical Change and Economic Theory* // Pinter Publishers, London
- Freeman C. (1991). Networks of innovators: A synthesis of research issues // *Research Policy*, Vol. 20, pp. 499–514.
- Freeman C. (1994). Critical Survey. The Economics of Technical Change // *Cambridge Journal of Economics*, Nol. 18, No. 5, pp. 463–514.
- Freeman C. (1995). The National System Of Innovation In Historical Perspective // *Cambridge Journal of Economics*, Vol. 19, pp. 5–24.
- Freeman C., Clark J., Soete L. (1982). Unemployment and Technical Innovation: A Study of Long Waves and Economic Development // *Frances Printer*, London.
- Freeman C., Perez C. (1988). Structural crises of adjustment: Business cycles and investment behaviour. In: Dosi G. et al. (Eds). *Technical Change and Economic Theory* // London: *Pinter*, pp. 38–66.
- Friedman B.M. (2000). Decoupling at the Margin: The Threat to Monetary Policy from the Electronic Revolution in Banking // *International Finance*, Vol. 3, No. 2, pp. 261–272.
- Fussler C., James P. (1996). Driving Eco-Innovation: A Breakthrough Discipline for Innovation and Sustainability // London: *Pitman Publishing*.
- Gallivan M. (2001). Organizational Adoption and Assimilation of Complex Technological Innovations: Development and Application of a New Framework // *ACMSIGMIS Database*, Vol. 32, No. 3, pp. 51–85.
- Gann D. (1991). Technological Change and the Internationalization of Construction in Europe. In: Freeman C., Sharp M., Walker W. (Eds). *Technology and the Future of Europe* // London: *Pinter*, 231–244.
- Gann D. (2000). Building Innovation: Complex Constructs in a Changing World // London: *Thomas Telford*.
- Garcia R., Calantone R. (2002). A Critical Look at Technological Innovation Typology and Innovativeness Terminology: A Literature Review // *Journal of Product Innovation Management*, Vol. 19, No. 2, pp. 110–132.
- General Electric, Stone Yamashita Partners (2005). An Adventure Inside the World's Largest Innovation Lab // *GE Inc.; Stone Yamashita Partners, Inc*.
- Gilbert R., Newbery D. (1982). Pre-Emptive Patenting and Persistence of Monopoly // *American Economic Review*, Vol. 72, pp. 514–526.
- Gilfillan S.C. (1935). The Sociology of Invention // Cambridge (Mass.): *MIT Press*.
- Gilfillan S.C. (1937). The Prediction of Inventions. In: *US National Resources Committee*, Technological Trends and National Policy, Subcommittee on Technology, Washington, pp. 15–23.
- Gilfillan S.C. (1952). The Prediction of Technical Change // *Review of Economics and Statistics*, Vol. 34, No. 4, pp. 368–385.
- Gill P.S. (2012). Technological Innovation and Public Health: A Descriptive Exploratory Investigation of Relationship between Technological Innovation Indicators and Public Health Indicators in the United States from 2003 to 2007 // *Global Journal of Medical Research*, Vol. 12, No. 6, pp. 63–81.
- Gloor P. (2005). Swarm Creativity: Competitive Advantage through Collaborative Innovation Networks // *Oxford University Press*.

- Gloor P., Cooper S. (2007) Coolhunting: Chasing Down the Next Big Thing. // *AMACOM Div American Mgmt Assn.*
- Godin B. (2006). The Linear Model of Innovation – The Historical Construction of An Analytical Framework // *Science Technology & Human Values*, Vol. 31, No. 6, pp. 639–667.
- Godin B. (2008). Innovation: the History of a Category // *Working Paper No. 1, Project on the Intellectual History of Innovation*, Montreal: INRS. 62 p.
- Godin B. (2009), The Making of Science, Technology and Innovation Policy: Conceptual Frameworks as Narratives, 1945–2005 // *Montreal: Centre - Urbanisation Culture Société de l'Institut national de la recherche scientifique.*
- Gokhberg L., Boegh-Nielsen P. (eds). (2007) Information Society Statistics in the Russian Federation: Harmonization with International Standards. Moscow: *State University - Higher School of Economics.*
- Gokhberg L., Gaslikova I., Sokolov A. (2000). A Survey of Information Technology in Russia // *Working Group: Statistics on the Information Society*, IS-WG/00/09, Luxembourg: Eurostat.
- Gokhberg L., Kuznetsova T., Roud V. (2012). Exploring Innovation Modes of Russian Companies: What Does the Diversity of Actors Mean for Policymaking? // *HSE Working papers, Series: Science, Technology and Innovation*, WP BRP 01/STI/2012.
- Goldsmith S. (2010). The Power of Social Innovation: How Civic Entrepreneurs Ignite Community Networks for Good // *Jossey-Bass.*
- Goodhart C.A.E. (2000). Can Central Banking Survive the IT Revolution? // *International Finance*, Vol. 3, No. 2, pp. 189–209.
- Gopalakrishnan S., Damanpour F. (1997). A Review of Innovation Research in Economics, Sociology and Technology Management // *Omega*, Vol. 25, No. 1, pp. 15–28.
- Greely H. et al. (2008). Towards Responsible Use of Cognitive Enhancing Drugs by the Healthy // *Nature*, Vol. 456, 11 December, pp. 702–705.
- Grossman J.B. (1970). The Supreme Court and Social Change: A Preliminary Inquiry // *American Behavioral Scientist*, No. 13, pp. 535–551.
- Hage J., Aiken M. (1970). Social Change in Complex Organizations // New York: *Random House.*
- Hamel G. (2002). *Leading the Revolution* // Boston: *Harvard Business School Press.*
- Hargadon A.B. (1998). Firms as Knowledge Brokers: Lessons in Pursuing Continuous Innovation // *California Management Review*, 40, 3, 209–227.
- Hart H. (1931). The Technique of Social Progress // New York: *Henry Holt and Co.*
- Hart H. (1957). Acceleration in Social Change. In: Allen F.R. (ed.). *Technology and Social Change* // New York: *Appleton*, pp. 27-55.
- Hart H. (1959). Social Theory and Social Change. In: Gross L. (ed.), *Symposium on Sociological Theory* // New York: *Harper and Row*, pp. 196–238.
- Hayvaert C.H. (1973). Innovation Research and Product Policy: Clinical Research in 12 Belgian Industrial Enterprises // Belgium: *Catholic University of Louvain.*
- Hekkert M.P., Suurs R.A.A., Negro S.O., Kuhlmann S., Smits R.E.H.M. (2007). Functions of Innovation Systems: A New Approach for Analysing Technological Change // *Technological Forecasting & Social Change*, Vol. 74, pp. 413–432.
- Henderson R.M., Clark K.B. (1990). Architectural Innovation: The Reconfiguration of Existing Product Technologies, and the Failure of Established Firm // *Administrative Science Quarterly*, No. 35, pp. 9–30.
- Herbert R., Hoar R.W. (1982). Government and Innovation: Experimenting with Change. // *Final Report of ETIP, National Bureau of Standards*, Washington DC, NBS-GCR-ETIP-82-100.
- Heunks F. J. (1998). Innovation, Creativity, and Success // *Small Business Economics*, Vol. 10, No. 3, pp. 263–272.
- Hicks J.R. (1932). *The Theory of Wages* // London: *Macmillan.*

- Hodge M.H. (1963). Rate Your Company's Research Productivity // *Harvard Business Review*, November, pp. 109-122.
- Horowitz I. (1963). Evaluation of the Results of Research and Development: Where We Stand // *IEEE Transactions on Engineering Management*, Vol. 10, June, pp. 42–51.
- Howaldt J., Schwarz M. (2010). Social Innovation: Concepts, research fields and international trends // *IMO international monitoring*.
- Howells J. (2006) Intermediation and the role of intermediaries in innovation // *Research Policy*, Vol. 35, pp. 715–728.
- Intrachoto S. (2004). Lead Users Concept in Building Design: Its Applicability to Member Selection in Technologically Innovative Projects // *TQM Magazine*, Vol. 16, No. 5), pp. 359–368.
- James A.P., Deiglmeier K., Miller D.T. (2008). Rediscovering Social Innovation // *Stanford Social Innovation Review*, Fall 2008.
- James P. (1997). The Sustainability Circle: A New Tool for Product Development and Design // *Journal of Sustainable Product Design*, Vol. 2, pp. 52–57.
- Jarillo J. (1988). On Strategic Networks // *Strategic Management Journal*, Vol. 19, pp. 31–41.
- Jewkes J. Sawers D., Stillerman R. (1958). The Sources of Invention // London: *Macmillan*.
- Johannessen J.-A. (2009). A Systemic Approach to Innovation: The Interactive Innovation Model // *Kybernetes*, Vol. 38 No: 1/2, pp. 158–176.
- Johnson S.C., Jones C. (1957). How to Organize for New Products // *Harvard Business Review*, No. 5–6 , pp. 49–62.
- Jones E. et al. (2001) Managing creative eco-innovation: structuring outputs from eco-innovation projects // *Journal of Sustainable Product Design*, Vol. 1, No. 1, pp. 27–39.
- Jones E., Harrison D. (2000). Investigating the Use of TRIZ in Eco-innovation // *TRIZCON2000 Conference proceedings*, Altshuller Institute, May 2000.
- Kallen H.M. (1930). Innovation. In: Seligman E.R.A., Johnson A.S. (eds.). *Encyclopedia of the Social Sciences* // New York: *Macmillan*, pp. 58–61.
- Kamal M.M. (2006). IT Innovation Adoption in the Government Sector: Identifying the Critical Success Factors // *Journal of Enterprise Information Management*, Vol. 19, No 2, pp. 192–222.
- Katz J.S. (2006). Indicators for Complex Innovation Systems // *Research Policy*, Vol. 35, No. 7, pp. 893–909.
- Keeble D., Wilkinson F. (2000). SMEs, Regional Clustering and Collective Learning: An Overview. In: Keeble D, Wilkinson F. (Eds.). *High-Technology Clusters, Networking and Collective Learning in Europe* // Aldershot, U.K.: *Ashgate*, pp. 1–20.
- Kelley T., Littman J. (2005). The Ten Faces of Innovation: IDEO's Strategies for Defeating the Devil's Advocate and Driving Creativity Throughout Your Organization // New York: *Currency*.
- Kim W.C., Mauborgne R. (2005). Blue Ocean Strategy: How to Create Uncontested Market Space and Make Competition Irrelevant // *Harvard Business Press*.
- Kirat T., Lung Y. (1999). Innovation and Proximity: Territories as Loci of Collective Learning Processes // *European Urban and Regional Studies*, Vol. 6, pp. 27–38.
- Kleinschmidt E.J., Cooper R.G. (1991). The Impact of Product Innovativeness on Performance // *Journal of Product Innovation Management*, No. 8, pp. 240–251.
- Kline S. J., Rosenberg N. (1986). An Overview of Innovation. In: Landau R., Rosenberg N. (Eds). *The Positive Sum Strategy* // Washington, D.C.: *National Academy Press*, pp. 275–305.
- Knight K. (1967). A Descriptive Model of the Intra-Firm Innovation Process // *The Journal of Business*, Vol. 40, No. 4, pp. 478–496.

- Kohli J., Mulgan G. (2007). Capital Ideas. How to Generate Innovation in the Public Sector // *The Young Foundation and Center for American Progress*.
- Kumar Vijay (2005). Innovation Planning Toolkit // MetaDesign, San Francisco.
- Kwon T., Zmud R. (1987). Unifying the Fragmented Models of Information Systems Implementation // *Critical Notes in Information Systems Research*, Edited By R.J. Boland Jr. and R.A. Hirschheim, pp. 227–251 // *John Wiley & Sons, Inc.*
- Lange O. (1943). A Note on Innovations // *The Review of Economic Statistics*, Vol. 25, No. 1, pp. 19–25.
- Langrish J., Gibbons M., Evans W.G., Jevons F.R., (1972). Wealth from Knowledge // London: *Macmillan*.
- Laville J.-L. (Ed.) (1994). L'économie Solidaire, une Perspective International // *Desclée de Brouwer*, Paris
- Lilien G., Morrison P.D., Searls K., Sonnack M., Von Hippel E. (2002). Performance Assessment of the Lead User Generation Process for New Product Development // *Management Science*, Vol. 48, No. 8, pp. 1042–1059.
- Linton J. 2002. Implementation Research: State of The Art and Future Directions // *Technovation*, Vol. 22, No. 2, pp. 65–79.
- Lipetz B.-A. (1965). The Measurement of Efficiency of Scientific Research // Carlisle (Mass.): *Intermedia*.
- List F. (1841). Das Nationale System der Politischen Ökonomie // Basel, Kyklos (translated and published under the title: “The National System of Political Economy” by Longmans, Green and Co., London 1841).
- Lundvall B.A. (1985). Product Innovation and User-Producer Interaction // Aalborg, *Aalborg University Press*.
- Lundvall B.A. (1988) Innovation as an Interactive Process: From User-Producer Interaction to the National System of Innovation. In: Dosi G., Freeman C., Nelson R., Silverberg G., Soete L. (Eds.). Technical Change and Economic Theory Innovation as an interactive process: from user-producer interaction to the national system of innovation // Pinter, London.
- Lundvall B.-A. (1992). National Systems of Innovation: Towards a Theory of Innovation And Interactive Learning // London: *Pinter*.
- Lundvall B.A. (1993). User-Producer Relationships, National Systems of Innovation and Internationalization. In: Foray D., Freeman, C. (Eds.). Technology and the Wealth of Nations // *Pinter Publishers*.
- Lundvall B.A. (2002). Innovation, Growth and Social Cohesion: The Danish Model. Cheltenham, Edward Elgar.
- Lundvall B.A. (2007). National innovation systems—analytical concept and development tool // *Industry & Innovation*, Vol. 14, No. 1, pp. 95–119.
- Lundvall B.A. (2007). Post Script: Innovation System Research Where it came from and where it might go. // *Globelics Working Paper Series*, No. 2007-01.
- Lundvall B.A., Johnson A., Andersen E.S., Dalum B. (2002). National Systems of Production, Innovation and Competence Building // *Research Policy*, Vol. 31 No. 2, pp. 213–231.
- Luthje C. (2000). Characteristics of Innovating Users in a Consumer Goods Field, an Empirical Study of Sport-Related Product Consumers // *MIT Sloan School of Management working paper*.
- Luthje C. Herstatt C. (2004). The Lead User Method: An Outline of Empirical Findings and Issues for Future Research // *R&D Management*, Vol. 34, No. 5), pp. 553–568.
- MacCallum, D., Moulaert F., Hillier J., Vicari S. (Eds) (2009). Social Innovation and Territorial Development // *Ashgate, Aldershot*.
- Machlup F. (1962). The Production and Distribution of Knowledge in the United States // Princeton: *Princeton University Press*.

- Machlup F. (1962). *The Production and Distribution of Knowledge in the United States*, Princeton: Princeton University Press.
- Maclaurin W.R. (1947). Federal Support for Scientific Research // *Harvard Business Review*, Spring, pp. 385–396.
- Maclaurin W.R. (1949). *Invention and Innovation in the Radio Industry*, //New York: *Macmillan*.
- Maclaurin W.R. (1953). The Sequence from Invention to Innovation and its Relation to Economic Growth // *Quarterly Journal of Economics* Vol. 67, No. 1, pp. 97–111.
- Macleod G. (1996). The Cult of Enterprise in a Networked, Learning Region? Governing Business and Skills in Lowland Scotland // *Regional Studies*, Vol. 30, pp. 749–755.
- Maidique M. (1980). Entrepreneurs, Champions, and Technological Innovation // *Sloan Management Review*, Vol. 21, No. 2, pp. 59–76.
- Maidique M.A., Zirger B.J. (1984). A Study of Success, and Failure in Product Innovation: The Case of US Electronics Industry // *IEEE Transaction on Engineering Management*, EM-31, No. 4, pp. 192–203.
- Mansfield E. (1961). Technical Change and the Rate of Imitation // *Econometrica*, Vol. 29, No. 4, pp. 741–765.
- Mansfield E., Schwartz M., Wagner S. (1981). Imitation Costs and Patents: An Empirical Study // *The Economic Journal*, Vol. 91, pp. 907–918.
- Marceau J. (1992). *Reworking The World: Organizations, Technologies and Cultures in Comparative Perspective* // Berlin: *De Gruyter*.
- Marinova D., Phillimore J. (2003). Innovation models. In: Shavinina L.V. (Ed.). *The International Handbook on Innovation* // *Elsevier*, pp. 44 – 53. Marinova
- Marx K. (1990) (1867). *Capital, Volume I* // Trans. Ben Fowkes. London: Penguin Books.
- Mcdermott C.M. O`Connor G.C. (2002). Managing Radical Innovation: An Overview of Emergent Strategy Noues // *Journal of Product Innovation Management*, Vol. 19, No. 6, pp. 424–438.
- McVoy E.C. (1940). Patterns of Diffusion in the United States // *American Sociological Review*, Vol. 5, No. 2, pp. 219–227.
- Mensch G. (1979) *Stalemate in Technology: Innovations Overcome the Depression* // *Ballinger*, NY.
- Merton H. (1986). Financial Innovation: The Last Twenty Years and the Next // *Journal of Financial and Quantitative Analysis*, Vol. 21, No. 4, pp. 459–471.
- Merton R. K. (1973). *The Sociology of Science: Theoretical And Empirical Investigations*. // Chicago: *N. W. Storer*.
- Merton R.K. (1957). Social Structure and Anomie. Reprinted in R.K. Merton (1957). *Social Theory and Social Structure* // Glencoe: *Free Press*, pp. 131–160.
- Metcalf S. (1995). Technology Systems and Technology Policy in an Evolutionary framework // *Cambridge Journal of Economics*, Vol. 19, pp. 25–46.
- Metcalf S. (1995). The Economic Foundations of Technology Policy: Equilibrium and Evolutionary Perspective. In: Stoneman P. (Ed.), *Handbook of the Economics of Innovation and Technological Change* // London: *Blackwell*, pp. 409–512.
- Meyers P.W., Tucker F.G. (1989). Defining Role for Logistics during Routine and Radical Technological Innovation // *Journal of Academy of Marketing Science*, Vol. 17, No 1, pp. 73–82.
- Miller M.H. (1986). Financial Innovation: The Last Twenty Years and the Next // *The Journal of Financial and Quantitative Analysis*, Vol. 21, No. 4, pp. 459–471.
- Mohr L.B. (1969). Determinants of Innovation in Organizations // *American Political Science Review*, Vol. 63, No. 1, pp. 111–126.
- Monttobio F. (2008). *National Innovation Systems. A Critical Survey*. CESPRI Bocconi University // *Working Paper, ESSY Deliverable N° 2*, Milan, Italy.

- Moore G.A. (2005). *Dealing with Darwin: How Great Companies Innovate at Every Phase of Their Evolution* // New York: *Penguin Group*.
- Moriarty R.T., Kosnik T.J. (1990). High-Tech Concept, Continuity and Change // *IEEE Engineering Management Review*, No. 3, pp. 25–35.
- Moulaert F., Sekia, F. (2003). Territorial Innovation Models: a Critical Survey // *Regional Studies*, Vol. 37, No. 3, pp. 289–302.
- Mulgan G., Ali R., Tucker S. (2007). Social Innovation: what It is, why It Matters, how It Can Be Accelerated // *Saïd Business School*.
- Mulkay M.J. (1969). Some Aspects of Cultural Growth in the Natural Sciences // *Social Research*, Vol. 36, No. 1, pp. 22–52.
- Mulkay M.J. (1972a). Conformity and Innovation in Science // *Sociological Review Monograph*, Vol. 18, pp. 5–23.
- Mulkay M.J. (1972b). *The Social Process of Innovation: a Study in the Sociology of Science* // London: *Macmillan*.
- Mulkay M.J. (1975). Three Models of Scientific Development // *Sociological Review*, Vol. 23, pp. 509–526.
- Mulkay M.J., Turner B.S. (1971). Over-Production of Personnel and Innovation in Three Social Settings // *Sociology*, Vol. 1, No. 1, pp. 47–61.
- Mumford M.D. (2002). Social Innovation: Ten Cases from Benjamin Franklin // *Creativity Research Journal*, Vol. 14, No. 2, pp. 253–266.
- Murray R., Grice C., Mulgan G. (2010). *The Open Book of Social Innovation* // *The Young Foundation and NESTA*.
- Myers S., Marquis D.G. (1969). Successful Industrial Innovations: A Study of Factors Underlying Innovation in Selected Firms // NSF 69-17, Washington: *National Science Foundation*.
- Myers S.C., Nicholas S., Majluf M.N.S. (1984). Corporate Financing and Investment Decisions when Firms Have Information that Investors do not Have // *Journal of Financial Economics*, Vol. 13, No. 2, pp. 187–221.
- Nambisan S. (2008). Transforming Government through Collaborative Innovation // *IBM Center for the Business of Government*, April 2008.
- Nambisan S. (2009). Platforms for Collaboration // *Stanford Social Innovation Review*, Summer 2009.
- Nambisan S., Nambisan P. (2008). How to Profit from a better Virtual Customer Environment // *MIT Sloan Management Review*, pp. 53–61.
- Nasierowski W., Arcelus F. J. (2000) On the Stability of Countries' National Technological Systems. In: Zanakakis S.H., Doukidis G., Zopounidis C. (Eds.). *Decision making: recent developments and worldwide applications* // Boston: *Kluwer*, pp. 97–111.
- Nasierowski W., Arcelus F. J. (2003). On the Efficiency of Innovation Systems // *Socio-Economic Planning Sciences*, Vol. 27, No. 3, pp. 215–234.
- Negro S.O. (2007). Dynamics of Technological Innovation Systems – The Case of Biomass Energy (Thesis) // *Utrecht University*, Utrecht.
- Nelson R. (2000). National Innovation Systems. In: Acs Z. (Ed.). *Regional Innovation, Knowledge and Global Change* // London: *Pinter*, pp. 11–26.
- Nelson R.R. (1993). *National Innovation Systems: A Comparative Analysis* // New York: *Oxford University Press*.
- Nelson R.R. (1995). Recent evolutionary theoritising about economic change // *Journal of Economic Literature*, Vol. 33, pp. 48–90.
- Nelson, R.R., Winter S.G. (1982). *An Evolutionary Theory of Economic Change* // Cambridge (Mass.): *Belknap Press*.
- Nichols A. (2007). *Social Entrepreneurship* // *Oxford University Press*.
- Nimkoff M.F. (1957). Obstacles to Innovation. In: Allen F.R. et al. (eds.). *Technology and Social Change* // New York: *Appelton-Century Crofts*, pp. 56–71.

- Niosi J. (1999). Fourth-Generation R&D: From Linear Models to Flexible Innovation // *Journal of Business Research*, Vol. 45, No. 2, pp. 111–117.
- Niosi J. (2002). National Systems of Innovations are “X-Efficient” (and X-Effective). Why some are Slow Learners? // *Research Policy*, Vol. 31, No. 2, pp. 291–302.
- Norman R. (1971). Organisational Innovativeness: Product Variation, And Reorientation // *Administrative Science Quarterly*, No. 16, pp. 203–215.
- Nowotny H. (2006). The Quest for Innovation and Cultures of Technology. Nowotny H. (ed.). *Cultures of Technology and the Quest for Innovation* // New York: Berghahn Books, pp. 1–38.
- Nowotny H. (2008). *Insatiable Curiosity: Innovation in a Fragile Future* // Cambridge (Mass.): MIT Press.
- Nuij R. (2001). Eco-Innovation: Helped or Hindered by Integrated Product Policy // *Journal of Sustainable Product Design*, Vol. 1, No. 1, pp. 49–51.
- Odum H.W. (1937). Notes on the Technicways in Contemporary Society // *American Sociological Review*, Vol. 2, No. 3, pp. 336–346.
- OECD (1963). The Measurement of Scientific and Technical Activities: Proposed Standard Practice for Surveys of Research and Development (Frascati manual) // Paris, OECD.
- OECD (1981). The Measurement of Scientific and Technical Activities // *OECD*, Paris.
- OECD (1991). OECD: Proposed Guidelines for Collecting and Interpreting Innovation Data (Oslo Manual) // *OECD*, Paris..
- OECD (1994). Data on Patents and Their Utilization as Science and Technology Indicators // Paris, OECD.
- OECD (1995). Proposed Standard Practice for the Collection and Interpretation of Data on the Technological Balance of Payments // Paris, OECD.
- OECD (1996) Manual on the Measurement of Human Resources in Science and Technology (Canberra manual) // Paris, OECD.
- OECD (1996). The OECD Jobs Strategy: Technology, Production and Job Creation (Vol. 2) // Paris: *OECD*.
- OECD (1999). *Managing National Innovation Systems* // Paris: *OECD*.
- OECD (2005). Oslo Manuals. Guidelines for Collecting and Interpreting Innovation Data, 3rd edition // *OECD*, Paris.
- OECD (2007). Science, Technology and Innovation Indicators in a Changing World: Responding to Policy Needs // Paris: *OECD*.
- Ogburn W.F. (1922). *Social Change with Respect to Culture and Original Nature* // New York: The Viking Press.
- Ogburn W.F. (1941). National Policy and Technology. In: Rosen S.M. and Rosen L. (eds.). *Technology and Society: the Influences of Machines in the United States* // New York: *Macmillan Co.*, pp. 3–29.
- Ogburn W.F. (1950). *Social Change with Respect to Culture and Original Nature*, Second edition // New York: *The Viking Press*.
- Oliveira P., Von Hippel E. (2011). Users as Service Innovators: The Case of Banking Services // *Research Policy*, Vol. 40, No. 6, pp. 806–818.
- O’Sullivan D., Dooley L. (2009). *Applying Innovation* // *Sage Publications, Inc.*
- Pan T.W., Hung S.V., Lu W.M. (2010). DEA Performance Measurement of the National Innovation System in Asia and Europe // *Asia-Pacific Journal of Operational Research*, Vol. 27, No. 3, pp. 369–392.
- Pareto V. (1935). *Mind and Society* // New York: *Harcourt, Brace & Co.*
- Pavitt K. (1984). Sectoral patterns of technical change: Towards a taxonomy and a theory // *Research Policy*, Vol. 13, No. 6, pp. 343–373.
- Pavitt K., Robson M., Townsend J. (1989). Accumulation, Diversification and Organization of Technological Activities in U.K. Companies, 1945–83. In: Dodgson M. (Ed.).

- Technology Strategy and the Firm: Management and Public Policy // Harlow, U.K.: *Longman*, pp. 38–67.
- Pearce J.M. (2012). The Case for Open Source Appropriate Technology // *Environment, Development and Sustainability*, Vol. 14, No. 3, pp. 425–431.
- Pelz D.C., Andrews F.M. (1966). Scientists in Organizations: Productive Climate for Research and Development // New York: *John Wiley*.
- Penin J., Hussler C., Burger-Helmchen T. (2011). New Shapes and New Stakes: A Portrait of Open Innovation as a Promising Phenomenon // *Journal of Innovation Economics*, Vol. 7, p. 11–29.
- Perez C. (1983). Structural Change and the Assimilation of New Technologies in the Economic System // *Futures*, Vol. 15, pp. 357–375.
- Persons J.C., Warther V.A. (1997). Boom and Bust Patterns in the Adoption of Financial Innovations // *The Review of Financial Studies*, Vol. 10, No. 4, pp. 939–967.
- Pierce J., Delbecq A. (1977). Organizational Structure, Individual Attitudes and Innovation // *Academy of Management Review*, Vol. 2, No. 1, pp. 26–37.
- Pigou A.C. (1924). The Economics of Welfare, Second edition // London: *Macmillan*.
- Posner M.V. (1961). International Trade and Technical Change // *Oxford Economic Papers*, Vol. 13, pp. 323–341.
- Priest W.C., Hill C.T. (1980). Identifying and Assessing Discrete Technological Innovations: An Approach to Output Indicators // *National Science Foundation, Washington*.
- Pujari D. (2006). Eco-Innovation and New Product Development: Understanding the Influences on Market Performance // *Technovation*, Vol. 26, No. 1, pp. 76–85.
- Quinn J.B. (1959). Yardsticks for Industrial Research: The Evaluation of Research and Development Output // New York: *Ronald Press Co*.
- Quinn, J.B. (1960). How to Evaluate Research Output? // *Harvard Business Review*, Vol. 38, March–April, pp. 69–80.
- Rai R. Allada V. (2002). Adaptive-Agent Based Simulation Model to Study Diffusion of Eco-Innovation Strategies // *Proceedings of the ASME Design Engineering Technical Conference*, Vol. 2, pp. 495–503.
- Ram J., Cui B., Wu M.L. (2010). The Conceptual Dimensions of Innovation: A Literature Review // *Proceedings of the International Conference on Business and Information*, Sapporo, Japan, 3rd–5th July, 2010.
- Rasul F. (2003). The Practice of Innovation—Seven Canadian Firms in Profile // *Industry Canada*.
- Reader S.M., Laland K.N. (2003). Animal Innovation // Oxford: *Oxford University Press*.
- Redfield R., Linton R., Herskovits M.J. (1936). Memorandum for the Study of Acculturation // *American Anthropologist*, Vol. 38, No. 1, pp. 149–152.
- Rennings K. (2000). Redefining Innovation—Eco-Innovation Research and the Contribution from Ecological Economics // *Ecological Economics*, Vol. 32, No. 2, pp. 319–332.
- Rice M.P., Colarelli O'Connor G., Peters L.S., Morone J.B. (1998). Managing Discontinuous Innovation // *Research technology Management*, Vol. 41, No. 3, pp. 52–58.
- Rich P. (1992). The organizational taxonomy: definition and design // *Academy of Management Review*, Vol. 17, No. 4, pp. 758–781.
- Roberts R. E., Romine C.A. (1974). Investment in Innovation // Report produced for the US National Science Foundation, *Midwest Research Institute*, Kansas City.
- Robertson T.S. (1967) The Process of Innovation and Diffusion of Innovation // *Journal of Marketing*, No. 31, pp. 14–19.
- Robinson J. (1938). The Classification of Inventions // *Review of Economic Studies*, February, pp. 139–142.
- Roessner D. (1979). The Local Government Market as a Stimulus to Industrial Innovation // *Research Policy*, Vol. 8, pp. 340–362.
- Rogers E.M. (1962). Diffusion of Innovations // New York: *The Free Press*.

- Rogers E.M. (2003). *Diffusion of Innovation (5th Ed.) // New York, NY 10020: The Free Press.*
- Rosenberg N. (1976). *Perspectives on Technology // Cambridge: Cambridge University Press.*
- Rosenberg N. (1982). *Inside the Black Box: Technology and Economics // Cambridge: Cambridge University Press.*
- Ross S.A. (1989). Institutional Markets, Financial Marketing, and Financial Innovation // *The Journal of Finance*, Vol. 44, No. 3, pp. 541–556. doi:
- Rossman J. (1931). *The Psychology of the Inventor // Washington: The Inventors Publishing Co.*
- Rossman J. (1935). Stimulating Employees to Invent, *Industrial and Engineering // Chemistry*, Vol. 27, No. 11, pp. 1380–1386, and Vol. 27, No. 12, pp. 1510–1515.
- Rothwell R. (1976). Innovation in Textile Machinery: Some Significant Factors in Success and Failure // *Science Policy Research Unit, Occasional Paper Series No 2*, June.
- Rothwell R. (1984). Technology-Based Small Firms and Regional Innovation Potential: The Role of Public Procurement // *Journal of Public Policy*, Vol. 4, No. 4, pp. 307–332.
- Rothwell R. (1994). Towards the Fifth-Generation Innovation Process // *International Marketing Review*, Vol. 11, No. 1, pp. 7–31.
- Rothwell R., Freeman C., Horsley A., Jervis V.T.P., Robertson A.B., Townsend J., (1974). SAPPHO Updated: Project SAPPHO Phase II // *Research Policy*, Vol. 3 No. 3, pp. 258–291.
- Rothwell R., Gardiner P. (1988). The Strategic Management of Re-innovation // *R&D Management*, Vol. 18 No. 2, pp. 147–160.
- Rothwell R., Zegveld (1985). *Reindustrialization and Technology // Harlow, U.K.: Longman.*
- Rouse W.B. (1992). *Strategies for Innovation // John Wiley and Sons, Inc.*
- Rubenstein A.H. (1957). Looking Around // *Harvard Business Review*, Vol. 35, No. 3, pp. 133–145.
- Rubenstein A.H., Chakrabarti, A.K., O’Keefe R.D., Sonder W.E., Young, H.C. (1976). Factors Influencing Success at the Project Level // *Research Management*, Vol. XIX, No. 3, pp. 15–20.
- Sabatier P.A. (1998). The Advocacy Coalition Framework: Revisions and Relevance for Europe // *Journal of European Public Policy*, Vol. 5, pp. 98–130.
- Sahal D. (1981). *Patterns of Technological Innovation // New York: Addison-Wesley.*
- Sako M. (1992). Price, Quality and Trust: How Japanese and British Companies Manage Buyer Supplier Relations // *Cambridge: Cambridge University Press.*
- Schmidt J.B., Calantone R.J. (1998). Are Really New Product Development Projects Harder to Shut Down? // *Journal of Product Innovation Management*, Vol. 15, No. 2, pp. 111–123.
- Schmookler, J. (1966). *Invention and Economic Growth // Cambridge (Mass.): Harvard University Press.*
- Schock G. (1974). *Innovation Processes in Dutch Industry // TNO, Policy Studies and Information Group, Apeldoorn.*
- Schumpeter J.A. (1912). *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle // Cambridge: Harvard University Press, 1934.*
- Schumpeter J.A. (1928). The Instability of Capitalism // *Economic Journal*, September, pp. 361–386.
- Schumpeter J.A. (1934). *The Theory of Economic Development: An Inquiry Into Profits, Capital, Credit, Interests and The Business Cycle // London: Oxford University Press.*
- Schumpeter J.A. (1939). *Business Cycles: A Theoretical, Historical, and Statistical Analysis of the Capitalist Process // New York: McGraw-Hill.*

- Schumpeter J.A. (1942). *The Process of Creative Destruction, in Capitalism, Socialism and Democracy*, Chapter 7 // New York: *Harper*, 1962.
- Seiler R.E. (1965). *Improving the Effectiveness of Research and Development* // New York: *McGraw Hill*.
- Senge P. (1990). *The Fifth Discipline* // *Doubleday Currency*.
- Sieg J.H., Wallin M.W. von Krogh G. (2010). *Managerial Challenges in Open Innovation: A Study of Innovation Intermediation in the Chemical Industry* // *R&D Management*, Vol. 40, No. 3, pp 281–291.
- Silvestre B.S. Dalcol P.R.T. (2009). *Geographical Proximity and Innovation: Evidences from the Campos Basin Oil & Gas Industrial Agglomeration — Brazil* // *Technovation*, Vol. 29, No. 8, pp. 546–561.
- Simmie J. (Ed.). (1997). *Innovation, networks and learning regions?* // London: *Jessica Kingsley*.
- Skiba F. (2010). *Service Users as Sources for Innovation – An Empirical Study in the German Services Industry* // *Norderstedt: Books on Demand*.
- Skiba F., Herstatt C. (2009). *Users as Sources for Radical Service Innovations: Opportunities from Collaboration With Service Lead Users* // *International Journal of Services Technology and Management*, Vol. 12, No. 3), pp. 317–337.
- Smith A. (1776/1904). *An Inquiry into the Nature and Causes of the Wealth of Nations* // London, Methuen and Co., Ltd., ed. Edwin Cannan, 1904, 5th edition.
- Smith G.E. et al. (1927). *Culture: The Diffusion Controversy* // New York: *Norton and Co.*
- Smith M.T. (2001). *Eco-innovation and market transformation* // *Journal of Sustainable Product Design* Vol. 1, No. 1, pp. 19–26.
- Smits R.E.H.M. (2002). *Innovation Studies in the 21st Century* // *Technological Forecasting and Social Change*, Vol. 69, pp. 861–883.
- Solow R.M. (1957). *Technical Change and the Aggregate Production Function* // *Review of Economics and Statistics*, Vol. 39 (August), pp. 312–320.
- Song M.X., Montoya-Weisse M.M. (1998). *Critical development activities for really new versus incremental products* // *Journal of Product Innovation Management*, Vol. 15, No. 2, pp. 124–135.
- SPRU (1972). *Success and Failure in Industrial Innovation: A Summary of Project SAPPHO* // London: *Centre for the Study of Industrial Innovation*.
- Stamp J. (1929). *Invention, in Some Economic Factors in Modern Life* // London: *P S. King*, pp. 89–121.
- Stamp J. (19343). *Must Science Ruin Economic Progress?* // *The Hibbert Journal*, Vol. 32, pp. 383–399.
- Stankiewicz R. (1995). *The Role of the Science and Technology Infrastructure in the Development and Diffusion of Industrial Automation in Sweden*. In: Carlsson B. (Ed.). *Technological Systems and Economic Performance: The Case of Factory Automation* // *Dordrecht, Kluwer*, pp. 165–210.
- Steiner G.A. (ed.). (1965). *The Creative Organization* // Chicago: *University of Chicago Press*.
- Stern B. J. (1927). *Social Factors in Medical Progress* // New York: *Columbia University Press*.
- Stern B.J. (1937). *Resistance to the Adoption of Technological Innovations*. In: US National Resources Committee, *Technological Trends and National Policy*, Subcommittee on Technology // Washington: *USGPO*.
- Stewart J., Hyysalo S. (2008). *Intermediaries, Users and Social Learning in Technological Innovation* // *International Journal of Innovation Management*, Vol. 12, No. 3, pp 295–325

- Strambach S. (2002). Change in the Innovation Process: New Knowledge Production and Competitive Cities–The Case of Stuttgart // *European Planning Studies*, Vol. 10, No. 2, pp. 214–231.
- Suurs R.A.A. (2009). Motors of sustainable innovation. Towards a theory on the dynamics of technological innovation systems (Thesis) // *Utrecht University*, Utrecht.
- Szakasitz G.D. (1974). The Adoption of the SAPPHO Method in the Hungarian Electronics Industry // *Research Policy*, Vol. 3.
- Tarde G. (1890). *Les Lois de l'imitation* // Paris: *Seuil*, 2001.
- Tarde G. (1895). *La Logique Sociale* // Le Plessis-Robinson: *Institut Synthelabo*, 1999.
- Tarde G. (1898). *Les Lois Sociales: Esquisse d'une Sociologie* // Le Plessis-Robinson: *Institut Synthelabo*, 1999.
- Tarde G. (1902). L'invention, Moteur de Revolution Sociale // *Revue internationale de sociologie*, juin, pp. 561–574.
- Tellis G.J., Prabhu J.C., Chandy R. K. (2009). Radical Innovation Across Nations: the Preeminence of Corporate Culture // *Journal of Marketing*, Vol. 73, No. 1, pp. 3–23.
- Tidd J. (1995). Development of Novel Products through Intraorganizational, and Interorganizational Networks: The Case of Home Automation // *Journal of Product Innovation Management*, No. 12, pp. 307–322.
- Tijssen R., Hollanders H. (2006). Using Science and Technology Indicators to Support Knowledge Based Economies // *United Nations University, Policy Brief*, Number II, 2006.
- Tisdell C. (1995). Evolutionary Economics and Research and Development. In: Dowrick S. (Ed.). *Economic Approaches to Innovation* // Aldershot, U.K.: *Edward Elgar*, pp. 120–144.
- Tiwari R., Herstatt C. (2011). Frugal Innovations for the “Unserved” Customer: An Assessment of India's Attractiveness as a Lead Market for Cost-effective Products // Working Paper No. 69, Institute for Technology and Innovation Management, Hamburg University of Technology.
- Tucker R.B. (2004). American Manufacturers: It's time to Innovate or Evaporate // *Springs*, Vol. 43, No. 3, pp. 49–60.
- Tufano P. (2003). Chapter 6 Financial innovation. *The Handbook of the Economics of Finance*. Volume 1, Part 1 // *Elsevier*, pp. 307–335.
- Urban G., von Hippel E. (1988). Lead User Analyses for the Development of New Industrial Products // *Management Science*, Vol. 34, No. 5, p. 569–582.
- Usher A. P. (1929). *A History of Mechanical Inventions* // New York: *Dover*, 1988.
- Utterback J.M. (1975). *The Process of Innovation in Five Industries in Europe and Japan* // *Centre for Policy Alternatives*, MIT Press, Cambridge, MA.
- Van Lente H. (1993) *Promising Technology – Dynamics of Expectations in Technological Developments* (Thesis) // Twente University, Enschede.
- Van Lente H., Rip, A. (1998). Expectations in Technological Developments: An Example of Prospective Structures to be Filled in by Agency. In: Disco C., van der Meulen B. (Eds.). *Getting New Technologies Together Expectations in Technological Developments: An Example of Prospective Structures to be Filled in by Agency* // *Walter de Gruyter*, Berlin - New York.
- Vemuri V. K. Bertone V. (2004). Will the Open Source Movement Survive a Litigious Society? // *Electronic Markets*, Vol. 14, No. 2, pp. 114–123.
- Verganti R. (2008). Design, Meanings, and Radical Innovation: A Metamodel and a Research Agenda // *Journal of Product Innovation Management*, Vol. 25, No. 5, pp. 436–456.
- Vergragt P.J. (1988). The Social Shaping Of Industrial Innovations // *Social Studies of Science*, Vol. 18, No. 3, pp. 483–513
- von Hippel E. (1986). Lead Users: A Source of Novel Product Concepts // *Management Science*, Vol. 32, No. 7, pp. 791–805.
- Von Hippel E. (2005). *Democratizing Innovation* // Cambridge, MA: *MIT Press*.
- Von Hippel E. (2011). *Open User Innovation* // Aarhus, Denmark: *The Interaction Design Foundation*.

- Von Hippel E., Katz R. (2002). Shifting Innovation to Users via Toolkits // *Management Science*, Vol. 48, No. 7 pp 821–833.
- Von Hippel R. (2001). User Toolkits for Innovation // *Journal of Product Innovation Management*, July, 2001.
- Von Hippel, Eric (2005), *Democratizing Innovation* // MIT Press.
- Walker J.L. (1969). The Diffusion of Innovations among the American States // *American Political Science Review*, Vol. 63, No. 3, pp. 880–899.
- Walker R. (2006). Innovation Type and Diffusion: an Empirical analysis of Local Government // *Public Administration*, Vol. 84, No. 2. 311–335.
- Walker R.M., Avellaneda C.N., Berry F.S. (2011). Exploring the Diffusion of Innovation among High and Low Innovative Localities: A Test of the Berry And Berry Model // *Public Management Review*, Vol. 13, No. 1, pp. 95–125.
- Wang C., Kafouros M. (2009). What Factors Determine Innovation Performance in Emerging Economies? Evidence from China // *International Business Review*, Vol. 6, No. 6, pp. 606–616.
- Weeks A.D. (1932). Will There Be an Age of Social Invention? // *The Scientific Monthly*, Vol. 35, No. (4), pp. 366–370.
- Westley F., Zimmerman B., Patton M. (2006). *Getting to Maybe* // Toronto: Random House.
- Wheelwright S.C., Clark K.B. (1992). *Revolutionising Product Development* // Free Press, New York.
- Wilson J.Q. (1966). Innovation in Organization: Notes toward a Theory. In: Buck V.E. and Thomson J.D. (eds.). *Approaches to Organizational Design* // Pittsburg: *Pittsburgh University Press*, pp. 194–218.
- Wolpert J.D. (2002). Breaking out of the Innovation Box // *Harvard Business Review*, Vol. 80, No. 2, pp. 77–83.
- Woodford M. (2000). Monetary Policy in a World without Money // *International Finance*, Vol. 3, No. 2, pp. 229–260.
- Yoon E., Lilien G.L. (1985). New Industrial Product Performance: The Effect of Market Characteristics and Strategy // *Journal of Product Innovation Management*, No. 3, pp. 134–144.
- Yovits M.C. et al. (1966). *Research Program Effectiveness* // *Proceedings of the Conference Sponsored by the US Office of Naval Research*, Washington, July 27–29, 1965, New York: Gordon and Breach.
- Zaltman G., Duncan R., Holbek J. (1973). *Innovations and Organizations* // John Wiley & Sons, Inc.
- Zawislak P.A. et al., (2011). Innovation Capabilities of the Firm: The Brazilian Experience // *9th Globelics International Conference (GLOBELICS)*, 2011.
- Zhao L. Deek F.P. (2004). User Collaboration in Open Source Software Development // *Electronic Markets*, Vol. 14, No. 2, pp. 89–103.

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