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INFRASTRUCTURE AND ECOLOGY OF RURAL AREAS

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CONTENTS

INTRODUCTION

Contemporary rural development consists in improving the functioning of rural areas, and institutions acting for its benefit should stimulate, verify and implement new solutions in this regard. Improvements should encompass the issues of rational rural development and available land acreage including rationalization of the land use and agricultural economy, construction and modernization of the broadly understood housing infrastructure, production and service infrastructure related to the use and processing of local farm produce, transport infrastructure along with the development of the road network, technical infrastructure for broadly understood agriculture and agricultural economy, and many more. In addition, the organization of production, trade and services for residents, public administration, municipal and housing management as well as other areas of activity of institutions and companies not only of a public nature require constant modernization and changes. Today's countryside has started to display considerable flexibility in its functioning and adaptation to modernity against the alternative of degradation of rural areas.

Knowledge and methods of its generation and acquisition, methods of studying and rationalizing rural areas in the functioning of a modern state as well as effective implementation of rational solutions are indispensable in the scope of the aforementioned changes in rural areas. The possibility of utilizing numerous rationalization methods in organization and operation of enterprises in rural development was observed during the research. What is more, the justified opportunity of evaluating the obtained solutions employing the procedures and methods developed in the context of the qualitological achievements, mentioned by R. Kolman (1973, 2009), was noted. In connection with the above, as part of the project, research teams prepared three monographs which deal with knowledge management in rural development (Krakowiak-Bal, Łukasik, Mikuła, Pietruszka-Ortyl, Ziemiańczyk 2017), application of organizational standards as well as Anglo-Saxon and Japanese organization methods of enterprises in designing rural development in the context of information and knowledge management (Krakowiak-Bal, Wdowiak, Ziemiańczyk 2017), knowledge creation and solution generation methods in the design and management of rural development (Krakowiak-Bal, Wdowiak, Ziemiańczyk – a monograph currently being perused) and last but not least, being researched by A. Krakowiak-Bal, covering methodical problems of construction and application of techniques and a system of measurement indicators for solutions in the aspect of rural development.

The subject of the last three of the four monographs includes research methodologies and methods based on a postulate indicating that the rural development mechanism can be analyzed, understood and largely reproduced and modified. Thanks to these methods, rural development ceases to be an exception-

al, unexpected act which is based on risk but becomes a systematic action. The direct goal of these methods is to discover new regularities in rural development. It should also be emphasized that the study the reader is currently familiarizing with discusses, in Chapter 4, knowledge creation methods in managing rural development. Chapter 3 and Chapter 4 present inventive methods beneficial for adapting organizational standards for rural development in the context of information and knowledge management. Chapter 1 of this study deals with the aspects of general heuristics, hermeneutics and semiology as the basis for the presented methods in the aforementioned chapters. The starting point for considerations is the concept of D. Kahneman regarding thinking systems, heuristics and cognitive biases.

A brief perusal of the book by D. Kahneman (2012) titled „Thinking Fast and Slow" and the articles contained therein namely „Judgment Under Uncertainty: Heuristics and Biases" by A. Tversky, D. Kahneman, („Science", vol. 185, 1974) and „Choices, Values and Frame" by D. Kahneman, A. Tversky, („American Psychologist", vol. 34, 1984) cannot have been left unnoticed in the context of addressing the issues of the project „Knowledge management in the process of building competitiveness and innovativeness of rural areas on the principles of sustainable development – empirical verification taking the Małopolska Province as an example". In this context, one can immediately ask a question: 'What has happened that basically the general and global problems raised in the aforementioned publications may interest the authors of such a local issue as the topic of the project? The answer to this question seems to be unequivocal. Regardless of the geographic extent of the problem, human thought has always had a global reach and foundation. Therefore, the points of D. Kahneman and A. Tversky regarding systems, heuristics and cognitive biases in thinking described in Subchapter 1.1 are worth mentioning. They are of utmost importance due to the research topic of knowledge management and organizational design, concerning knowledge creation and generation of ideas for solutions in the process of creative thinking. The awareness of these errors allows for eliminating the pathos and inclination of too superficial approach to the solution proposal of theoretical and practical problems. Research issues and the use of heuristic techniques can counteract these negative phenomena.

The purpose of the current study is to:

- present the sample thematic areas of knowledge management in rural areas and characterization of adequate methods of creativity and innovation, used to enrich the quantity and quality of proposed ideas and proposals for solutions to these problems, including the stages of relevant methodologies and methods used,
- show the sample spheres of functioning and cooperation of institutions acting for rural development and processes and procedures for organizing or modernizing information and knowledge, and character-

izing adequate inventive methods for generating ideas, including the stages of submitting ideas for solutions in selected methodologies and research methods,
- develop principles and methodology for generating ideas, building options for solving problems, formulating criteria for assessing options, assessing options for solutions, selecting the optimal variant, implementing the chosen option as the final result of the study.

The layout of the academic work presented below was conditioned not only by the assumed goals of the study, but also on the one hand by the specificity of Anglo-Saxon epistemology, also referred to as the Western and on the other hand by the Japanese epistemology. Plato's idea stating that „absolute truth can be attained through rational reasoning based on certain axioms" is the foundation for the notion of knowledge in the Western approach, formulated on the basis of philosophy as 'justified and real conviction'. It was the cause of criticism by Aristotle who emphasized a significant role of sensual perception in this regard. However, the following issues contributed to the success of Plato's approach (Nonaka, Takeuchi 2000):

- Descartes' rationalism, allowing scepticism with the conviction ‚I think; therefore I am'
- Locke's empiricism, emphasizing experience as a source of ideas, dividing them into perceptions and reflections,
- combination of empiricism with rationalism and Kant's statement that not all knowledge results from experience,
- the Hegelian dialectical unity of opposites,
- introduction of interaction between the cognizer and the cognizing person as well as the relationship between man and the environment in Marx's view,
- linking knowledge strictly to Heidegger's action, rejecting completely the thinking subject in the concept of Descartes,
- pragmatism and the statement that 'only the effective idea is true', because ideas are devoid of values if they do not go into action, put forward by James.

In turn, the Bacon's concept of operational knowledge which emphasizes social effects and comprises the essence of civilization progress is the foundation of the organizational concept of knowledge in Japanese terms, formulated by I. Nonaka and H. Takeuchi (2000), exposing „the capability of the corporation as a whole to generate new knowledge, to disseminate and embody it in products, services and systems". These two perceptions of knowledge, the Anglo-Saxon and the Japanese, form the basis for differentiating in the study two different theoretical approaches and practical applications of methods for generating solutions (Chapter 2 and 3) and for knowledge creation (Chapter 4).

Chapter 1 of the study is the backdrop for consideration, emphasizing the role of heuristics, hermeneutics and semiology in the process of building a set of rules for creative thinking and presentation of solutions. The systems of thinking, heuristic and cognitive biases defined by D. Kahneman are the essence of this chapter. The considerations are complemented by hermeneutic analysis and exegesis, the indicated types of heuristics and their characteristics as well as the semiological aspects.

Chapter 2 presents characteristics and typology of selected inventive methods in the context of basic concepts and evolution of methods. The criteria for division and typologies of the inventive methods precede the characteristics of selected inventive principles and solutions.

The possibilities and methodologies of applying inventive methods are presented in Chapter 3. Rural areas as the subject of the study are presented in Subchapter 3.1. In the subsequent subchapters theoretical foundations of the theory of creative thinking and knowledge creation (Subchapter 3.2) as well as the methodology of knowledge creation and creatics as the basic research tool (Subchapter 3.3) are discussed. Subchapter 3.4 portrays the IDEAL method as the method of formulating decision problems. Inventive methods in organizational design are discussed in Subchapter 3.5 whereas the assumptions of the industrial inventics and the algorithm for inventive problems solving in Subchapter 3.6. Finally, Subchapter 3.7 concerning the methodology for generating solutions with the indication of the inventive methods concludes the chapter.

Chapter 4 deals with corporate models of knowledge organization and methods of knowledge creation. The former group includes and characterizes the SECI spiral, the OPEC spiral and the DCCV spiral as well as the Gilbert, Probst, Raub and Romhardt's model. The latter one includes: the EDIS spiral of debate in the aspect of the double debate principle (4.2.1.), the Experimental EEIS spiral in the context of verification (4.2.2.), the Hermeneutical EAIR spiral in the context of reflection (4.2.3.), the Triple Helix spiral of knowledge creation processes (4.2.4), the ARME spiral of revolutionary knowledge creation (4.2.5.), the Knowledge Pentagram of Nakamori in the *i-System* approach (4.2.6.), the Nanadsudaki Septagram of seven spirals of knowledge creation (4.2.7) and the Creative Space model (4.2.8.).

In the future, the thematic scope of the study should be enriched with further methods of creative thinking in management, knowledge creation and organization methods as well as considerations regarding models of intellectual resource management in rural organizations. The authors hope that the work will contribute to the dissemination of the inventive methods for solution generation as well as knowledge creation and organization methods among employees of institutions co-contributing to rural development. It can also become a source of information and a textbook for learning about these methods for students at

environmental and agricultural universities. Moreover, it might be a contribution to scientific research in this field.

1. HEURISTICS AND HERMENEUTICS AS AREAS OF CREATIVE THINKING

1.1. SYSTEMS OF THINKING, HEURISTICS AND COGNITIVE ERRORS IN KAHNEMAN'S PERSPECTIVE

The title of the first chapter explicitly suggests the influence of heuristics and hermeneutics on knowledge creation. It is highly likely that everyone who has dealt with these issues is inclined to accept this phenomenon. The very fact that most or even all adhere to this phenomenon does not determine the regularity, rationale and correctness of this view. The overview of theories and concepts in this regard, discussed in the first chapter, will help us understand these problems.

The reflections of Daniel Kahneman, professor of psychology at Princeton University, the Nobel Prize laureate (2002) in the field of economics for psychological discoveries that undermined the rationality model of human judgment and decision-making should be the starting point. The issue was presented in a book entitled "Thinking Fast and Slow". The book was divided into five parts. In the first part the author pointed out the differences between the automatic functioning of System 1 and the controlled operation of System 2. He also showed how our associative memory, which is the essence of System 1, constantly constructs a coherent interpretation of everything that is happening at the moment in the surrounding reality. He attempted to demonstrate the complex unconscious processes underlying the intuitive thinking. He also depicted how automatic thought processes help to explain the functioning of various evaluation heuristics. In the second part he, inter alia, supplemented the discussion of evaluation heuristics and attempted to unravel the mystery of the difficulties brought about by statistical thinking. He underscored that associative, metaphorical and causal thinking come easily. The latter one as well as the previous thoughts are key to the study. It should be added that in subsequent parts he indicated, among others, the limitations of the human mind, overconfidence towards everything, the underestimation of the role of coincidence in events (part three). The essence of discussion with the school of economics which studies decision-making processes assuming that the participants of economy act in a rational manner, current views based on a dual model of thinking, the key concepts of the perspective theory that is the model of decision-making processes were included in part four. The description of the research that helped to distinguish between the 'experiencing self' and the 'remembering self', aspects of personality, each of which is guided by other interests were discussed in part five whereas the effects of the distinction between

the self, the concept of economic actors in classical economics and behavioral economics, the automatic System 1, and the mental effort of System 2 in part six (Kahneman, 2012, pp. 23-26).

At the outset of his reflections, Kahneman distinguished a dual model of thinking, two personalized systems, adopting the nomenclature proposed by K. Stanovich and R. West, psychologists (Kahneman, 2012, p. 31):

- System 1 works quickly and automatically, with little or no effort; void of a sense of conscious control (fast thinking)
- System 2 divides the urgent attention between activities requiring mental effort and is often associated with subjective focus, free choice, and conscious action (slow thinking).

By thinking about ourselves, we identify ourselves with System 2, or the conscious being we call ‚I', which is able to reason, which has beliefs, decides what to think and do. System 1 effortlessly builds on impressions and emotions, which then become the primary source of conscious beliefs and deliberate choices of System 2. "The automatic operations of System 1 generate surprisingly complex patterns of ideas, but only the slower System 2 can construct thoughts in an orderly series of steps." "System 2 may have a limited impact on System 1 by programming such functions as attention and memory that normally operate automatically." "When System 1 encounters some difficulty, it seeks support in System 2, asking for more detailed and specific processing of the situation so as to address the problem." "The mobilization of System 2 takes place when System 1 does not know the answer to a question."

"System 2 is mobilized to an increased effort when it detects an error about to be made." Two systems are very efficient in sharing tasks, minimizing an effort and optimizing efficiency (Kahneman, 2012, pp. 31-43).

In most cases, we generate intuitive feedback on complex issues. If we do not come quickly to a satisfactory answer to a difficult question, System 1 finds a related but easier question and answers it. The operation of answering a question other than the posed one is called substitution. The author also pointed out the following terms:

- 'the right question' is an assessment of a situation one wants to establish,
- 'heuristic question' is an easier question which one answers in reality.

"The technical definition of heuristics is a simple procedure that helps find adequate, though often imperfect, answers to difficult questions. The word *heuristics* originates from the same source as eureka" (Kahneman, 2012, pp. 132-143). The following errors are associated with the heuristic approach:

- three-dimensional heuristics is vitiated by a cognitive error consisting in the fact that objects that seem more distant also appear to be larger on paper; thus, judgments based on substitution phenomenon are vitiated by predictive cognitive errors,

- the mood heuristics in psychological aspect is vitiated by exactly the same as the error of the illusion of size of a character in psychological aspect; happiness has not recently been easily or naturally assessed,
- affective heuristics is characterized by the System 2 personality disorder, which consists in the fact that it has so far been described as a fairly consistent observer, which leaves System 1 with considerable freedom; however, in the context of emotional attitudes, System 2 rather justifies the emotions of System 1 than criticizes them; it does not force but accepts them System 1, active, looking for consistency, provides ready-made solutions to the undemanding System 2.

Other cognitive errors (distortions) are also heuristics features. They encompass:

- decisions of psychologists about the sample size not on the basis of calculations, but on their own professional judgment, which often turns out to be imperfect, despite the existence of a mathematical procedure that determines the risk of error for a sample of a given size,
- tendency to perceive reality in an overly coherent and orderly way; System 1 constructs a detailed image without taking facts into account,
- excessive trust in small statistical samples which is the basis of the common cognitive illusion consisting in the fact that more attention to the content of the messages rather than to information about the validity of the message is paid, which makes the image of reality simpler and more coherent than justified empirical data,
- statistically a multitude of observations made that seem to ask for cause-and-effect explanation, which as a matter of fact is missing. A wide range of facts about reality result from a pure chance, including the random effects of sampling; causal explanations of random events always appear to be misleading (Kahneman, 2012, pp. 147-160).

The anchoring effects triggered by two different mechanisms – one for each of the systems are an interesting phenomenon. These include (Kahneman, 2012, pp. 161-174):

- the operation of System 2 which is part of the intended adjustment process (correction) of the size,
- the pioneering effect being an automatic manifestation of System 1. The availability heuristics and judgment heuristics indicate the following systematic cognitive errors (Kahneman, 2012, p. 177):
- salient events and those which attract attention are more easily retrieved from memory,
- a dramatic event temporarily increases the availability of its category,
- personal experiences, pictures, and vivid examples are more available to the mind than incidents that happened to others, mere words, or statistics.

The team of N. Schwarz noted that the task of enumerating examples may increase the assessment of the given feature in two ways (Kahneman, 2012, p. 179):

- by the number of examples recalled,
- by the ease with which they come to mind.

A greater number of examples exacerbate the conflict between the two ways, with a decrease in liquidity due to less ease with which they come to mind. It also emerges that people (Kahneman, 2012, p. 180-181):

- rarely use the conveniences when they have to remember numerous examples instead of several,
- are less certain of the choice made, the more arguments they have to enumerate in support of it,
- are less certain that an event could be avoided when they have to enumerate many ways that would result in avoiding it,
- are less impressed with useful items when they have to enumerate a large variety of their advantages.

Regarding the risk, the idea that it is something objective is wrong. This is expressed in the following statement (Kahneman, 2012, p. 191): "Risk does not exist 'out there,' independent of our minds and cultures, waiting to be measured. Instead, human beings have invented the concept to help them understand and cope with the dangers and uncertainties of life. Although these dangers are real, there is no such thing as real risk or objective risk." In this way the bedrock of professional knowledge of experts can be undermined in the society.

The prevalence of causal thinking over statistics is explained as follows (Kahneman, 2012, pp. 227-228). There are two types of baselines. "Statistical baseline refers to facts that relate to the population to which the given case belongs, but which are not perceived as critical to the particular case. The causal baselines change the view on how a particular case occurred. These two types of baselines are treated differently:

- when there is information about a particular case, statistical baseline values are usually underestimated or even completely ignored,
- causal baseline values are perceived as case-specific information and can easily be combined with other information about the same case.

Stereotypes are statements about a group that are considered, at least initially, to be characteristic of each member of the group. In our culture, stereotyping is perceived as something wrong; however, the author uses in a neutral way. One of the basic features of System 1 is the presentation of categories in the form of standards and patterns."

The regression toward the mean is described as follows (Kahneman, 2012, p. 247). "Our difficulties with the notion of regression toward the mean derive from both System 1 and System 2." For a person who is a little or even not at

all familiar with the statistics, the relationship between the correlation and the regression toward the mean remains unclear. Understanding and learning the relationships is very difficult for System 2. This is partly because the mind stubbornly demands a cause-and-effect interpretation, which is a feature of System 1.

The intuitive predictions are also worth noting (Kahneman, 2012, pp. 250-251). "Some intuitive judgments are based primarily on skills and expertise derived from regular experience." They are examples of professional intuition, when the solution of the current problem quickly comes to mind because the mind is able to capture some familiar signals.

There are also other types of intuitions, though from a subjective point of view they are sometimes not distinguishable from the former ones. These intuitions are the result of heuristic activities that often replace a difficult question with another one that is easily answered. Intuitive judgments can be issued with great confidence even though they are based on tenuous data and do not take into account the regression toward the mean phenomenon. Of course, many judgments, especially professional ones, are a combination of analysis and intuition."

The final issues of heuristics in Kahneman's perspective are the issues of scientific research on mental availability, emotion and risk (Kahneman, 2012, pp. 175-197), problems of precedence of causes to their effects (Kahneman, 2012, p. 225-236), regression toward the mean (Kahneman, 2012, p. 237-249) and taming intuitive predictions (Kahneman, 2012, pp. 250-262).

1.2. ANALYSIS AND HERMENEUTICAL EXEGESIS AS WELL AS SEMIOLOGY

According to the dictionary of philosophy, the word hermeneutics originates from the Greek *hermeneutikós* which means the ability to interpret and explain the text (Dictionary of philosophy. Issues Concept Terms, 2011, pp. 146-147). Plato used the word with such a meaning. Aristotle applied it as the title of his work on sentences and syllogistic conclusions. Therefore, the term is most often used in the understanding of the art of text interpretation. In addition, in historical and philological terms, thanks to a specific analysis, it leads to exegesis that is to explanation. Hermeneutics in a narrower sense developed in the context of Jewish and Christian studies on the analysis of the text of the Bible. Therefore, biblical exegesis is understood as the application of hermeneutic principles and rules in order to extract the true meaning of the biblical text (Catholic Encyclopedia, vol. IV, 1989, pp. 710 et seq.). The understanding of hermeneutics in the narrower sense was also consolidated thanks to the research of Renaissance scholars on the achievements of ancient literature. This term was also widespread during the Reformation period and continued to modern times. The merit of contemporary philosophy is the broadening of the concept of hermeneutics to include the

theory of understanding. The prerequisite of focus by the authors on this issue in the context of knowledge management was influenced by these aspects. It should also be pointed out that one of the models of methods for organizing and creating knowledge, presented in Chapter 4.2.3 is called a hermeneutic spiral and is considered in the context of reflection. Furthermore, the interpretation process uses the term 'the hermeneutic circle', which will be discussed later in this subsection.

The origin of the word hermeneutics in another perspective is presented in the Encyclopedia of Philosophy (Honderich (ed.), 1998, pp. 331-333). It is the name of Hermes, the messenger of the gods that gave birth to the words *hermeneuein* which means 'interpret, translate' and *hermeneutike (techne)* which means 'the art of interpretation, translation'. This skill gained in importance through the Reformation, which was associated with the need for Protestants to read the Bible properly. Medieval hermeneutics focused on four levels of understanding of the Bible that is literal (verbatim), allegorical, tropological (moral), anagogical (eschatological, or in other words religious doctrine as to the end of existence ...). Since the Reformation, the importance of literal exegesis ('grammatical') has been growing.

More widely hermeneutics (Greek hermeneutike (techne)) is encompassed by the Catholic Encyclopedia (vol. VI, 1993, pp. 770 et seq.), as:

- the art of announcing, translating, explaining and lecturing,
- interpretation practice leading to understanding, or
- the theory of interpretation as consideration on conditions and norms of understanding spoken and written texts (sacred and secular, especially poetic, religious and legal texts), as well as the history and the whole cultural phenomena (understood as life expressions),
- philosophical direction (philosophical hermeneutics).

Colloquially, hermeneutics means the art or the science of understanding. Contemporary, the term of hermeneutics, depending on the context, tradition and field of life, has different meanings. Hermeneutics can be understood as:

- the art of interpretation in modern times,
- the theory of interpretation in the seventeenth century; it found its full expression in the nineteenth century,
- philosophical hermeneutics in the twentieth century,
- the technical term in the title of J.K. Dannhauer, work that is "Hermeneutike sacra sive methodus exponendarum sacrarum litterarum", displacing 'ars interpretandi'.

In the humanities, hermeneutics deals with problems related to understanding, interpretation, a text, a man, its history and culture. In hermeneutics, an easily attainable sense is sufficient, what is palatable though is a defined hidden, deeper or normative truth. Differences between hermeneutic concepts derive

from the studied subject, closer and further purposes, methods of interpretation and understanding, and in more or less explicit epistemological and ontological assumptions. In this context, the following types of historical designations (denotations) of hermeneutics can be distinguished, that is, what the term indicates pursuant to its meaning (Catholic Encyclopedia, vol. VI, 1993, p. 770):

- the practice or result of the interpretation and understanding of the text,
- arrangement of rules constituting the method of interpretation and understanding of the text,
- methodology of theological, philosophical, legal or general that is humanistic interpretation,
- the general theory of interpretation and understanding of the text,
- the theory (methodology) of humanistic knowledge,
- a philosophical direction in the form of the ontological – epistemological – anthropological – historical theory of understanding in general.

The course of development of modern hermeneutics is determined by three areas (phases):

- the philosophical theory of understanding and philosophical hermeneutics (F. Schleiermacher, W. Dilthey),
- the 'reader response theory' (H.G. Gadamer),
- theological hermeneutics (M. Heidegger)

F. Schleiermacher first taught a systematic theory of understanding texts and speech. He argued that the purpose of the interpreter is "to initially understand the text not worse, and then even better than the author." Due to the fact that there is no direct knowledge about what happened in the mind of the author, attention must be paid to plethora of things that he was unaware of. Therefore, each text should be interpreted from two points of view:

- grammatical, taking into account the nature of the language in which it is written, and
- psychological, taking into consideration the personality and spiritual development of the author.

None of these aspects can be learned in a conclusive way. It is not viable to get to know the language, the author and the text completely until all the components are known. The components can be learnt only when the whole is understood. This situation is similar to moving in the hermeneutic circle, being "dispersed between the part and the whole, and as a result, no meaningful text can be comprehended immediately and instantaneously (...), though each subsequent reading improves the situation, because it broadens the reader's knowledge. Not only does this looping exclude unambiguous and ultimate interpretation, but also the context which indicates what knowledge allows for disambiguating ambigu-

ity". In addition, he treated understanding as a kind of indulging in the attitude and intentions of the author of a given text, which required a deep insight into the era in which he had created. This approach combines elements of the original hermeneutics with elements of modern methodology of historical research. The theory of understanding can be semiotically, philologically and psychologically conceptualized. The theory of understanding amounts to reading the meaning of the text and the experiences, thoughts and psyche of the author of the text.

The research of F. Schleiermacher was continued by W. Dilthey, who referred hermeneutic issues to the humanities, defending their separateness. He recognized all human behaviours and their products as a field of hermeneutics. We understand other characters (people) not directly but in analogy to our own experiences. In the understanding he emphasized the psychological reaction of readers. He proposed historical hermeneutics, the aim of which was to study the sense of products of culture, through which all manifestations of human activity externalized themselves. Therefore, he became the prioneer of hermeneutics in its widest scope. The whole of man's spiritual life can be perceived throughout history. This wider perspective of the first course of hermeneutic reflection allows treating a man as a metaphor of the text. In the second course of reflection, hermeneutics and its scope are included as a determinant of human existence, whose consideration becomes hermeneutics, or the theory of understanding of an intelligent being.

In the H.G. Gadamer's 'reader response theory', the meaning of the text is not only a function of current facts related to the author and the original public. An important role is also played by the historical location of each author. The intuitive source in this respect is the 'metaphor of fusion of horizons', whose canvas is the relationship in creating a shared meaning both by the author and the reader. Therefore, the possibility of imposing a broader range of other meanings on each text as well as the possibility of making subsequent interpretations is real. His concept assumes that the acts of understanding should be recognized in the context of a general linguistic communication. It is through the language that the true meaning of the world is revealed, and the confrontation and correction of judgments by the participants of the conversation is an indispensable element of the agreement. In addition, P. Ricoeur believed that every cognition must pass through the mediation of the world, culture and language, which require an interpretation. He worked on interpreting language symbols and distinguished them from ordinary language signals. He saw an ambiguous source of knowledge of human nature and condition in these symbols. He also dealt with the issues of metaphor and the sphere of narration.

M. Heidegger is a representative of theological hermeneutics which deals with the interpretation of ancient texts. However, the specificity of Heidegner's hermeneutics lies in the interpretation undertaken not by a scientist, but by a man defined by the *Dasein* category. The approach to *Dasein* must be hermeneutic,

because its features are not directly available and they have to be discovered due to the fact that they might be neglected and *Dasein* has a tendency to misinterpret. The process of understanding *Dasein* resembles more the interpretation of the text that was distorted by layering misinterpretations. Now, hermeneutics no longer presents the rules of interpretation or its theory, but it is the interpretation of *Dasein*. *Dasein* understands itself and its surroundings; yet, hermeneutic phenomenology presents the understanding as possibilities open to it rather than a dispassionate interpretation. Due to the fact that *Dasein* has such understanding that is earlier than the statement, it can interpret foreign texts and express itself in a philosophical way.

In this context, the terms 'semiology' and 'semantics' also need to be compared. The term of semiology, and sometimes even semantics should be understood as the intellect and research tradition with the use of the knowledge of philosophy, linguistics, logic, information theory and humanities, in which the main subject of interest is the sign, its properties and functions (Guiraud 1974). Semiological research developed quite late and until now their range has frequently been very debatable. This is best demonstrated by the fact, as above, of treating semantics as a synonym of semiotics (logical) in relation to the general theory of signs. In other terms, semantics is treated as a branch of linguistics, dealing with the meaning of words, phrases, sentences and text. This means that, unlike logical semantics, semiology is not a clearly defined scientific discipline. Linguistic semantics is also treated as part of general linguistics and part of semiotics which studies the problems of meaning in a language as well as reflection of form of a sign to the content marked in synchronous and diachronic terms (Guiraud 1976). In addition, semantics in computing is treated as semantics of a programming language.

The aforementioned 'hermeneutic circle' is the term used by philosophers who belong to the school of thought of Schleiermacher, Dilthe as well as Heidegger and Gadamer. It indicates the inevitable looping of our reasoning, which results from the fact of capturing the meaning of an utterance thanks to ready-made beliefs. In this day and age, the discussion is between those who perceive understanding in terms of a dialogue and an uninterrupted cultural conversation and those who would like to maintain a more independent role for critical thought. The 'hermeneutic circle' defines the problems that arise in the process of interpretation when one element can be understood only by understanding the other components. However, understanding these other components or the whole depends on understanding the one. In this sense, each element can be perceived and understood only in the context of the whole. This can be illustrated in the following way:

- we understand the contemporary rural development process against the background of knowledge of rural areas, but this state of knowledge of

rural areas is interpreted through the prism of the modern experience and rural development process,

- we understand modern methods of rural development research against the background of knowledge management methods for rural areas, but we interpret these methods of knowledge management in these areas through the prism of rural development methods.

In the context of the aforementioned remarks, it should be stated that the looping effect of reasoning on research and rural development can be eliminated by introducing the heuristic methods presented in Chapters 2 and 3, and above all the spiral methods of knowledge creation presented as a model in Chapter 4.

1.3. REFLECTIVE, EXPERIMENTAL, PRAGMATIC AND INFORMATIONAL HEURISTICS

Heuristics is a term listed as an equivalent to the concepts such as understanding, explanation, discovery or an object, in particular, a theorem that is heuristic. Heuristic considerations are related to trials and errors. In pedagogy, the heuristic method is a method of teaching through self-education. In logic, heuristics is such a problem solving procedure that may not lead to finding a proof (Honderich (ed.), 1998, p. 333).

The word heuristics comes from the Greek *heuriskein*, which means to find out or discover. Heuristics is also understood more broadly and encompasses the theory of problem solving methods, knowledge of methods for making scientific discoveries (hypothesizing and constructing new theories), providing rules regulating scientific creativity, the ability to apply rules that control thought processes, thanks to which a man generates ideas for solving new problems, the ability to find solutions to individual tasks, today used in logics, pedagogy and exegesis. Heuristic activities are based on the trial and error method which refers to analogies, assumptions, generalizations, associations, thought experiments, working hypotheses, models or patterns that are contrasted with strict methods of proving and justifing scientific claims. Heuristics can sometimes be treated as an empirical science when it utilizes the results of the psychology of thinking, the sociology of scientific research and the history of scientific discoveries. It differs from them when it attempts to derive general laws of discoveries and to issue heuristic rules that are praxeological-type norms, taking the form of a creative action methodology. Recently, heuristics has been related to the theory of information, cybernetics, inventiveness, synectics and morphology (Catholic Encyclopedia, vol. 6, 1993, pp. 824-826).

Heuristics as a young, developing science was described for the first time by B. Pushkin (Pushkin, 1970, p. 21). A similar point was taken by A. Góralski,

who took further steps to define heuristics as science (Góralski (ed.), 1977, p. 11). First, he distinguished the following human activities as a social being:

- a practical action whose purpose is to produce things or states of things that are intended to satisfy human material needs,
- cognition that aims at coming up with theories describing reality and the codes of conduct,
- transmission that aims at creating means of communication that are intended to perpetuate an existing human community or to ensure some continuity to the community.

Then he assumed that:

- a person noticing their own or the others needs and deciding to act to satisfy them is the subject of consideration,
- the goal is to specify the codes of conduct that authenticate the creation of a creative solution,
- interests concern both practical tasks, cognitive tasks and transmission tasks,
- the aim of the study which 'enhances creativity' is the action 'leading to a discovery',
- the valuation of how to generate a solution should be made taking into account the structure of the task.

In conclusion, he stated that all actions undertaken by people, creatively solving practical, cognitive and transmission tasks were the subject of heuristics. These actions were perceived as problem-solver creative skills which were or could be the subject of interest to other sciences (eg psychology, art theory, methodology). He pointed out that specific goals, listed below, differentiate heuristics from other sciences (Góralski (ed.), 1977, p. 12):

- distinguishing typical activities performed while executing creative actions and their analysis,
- describing procedures for creative problem solving,
- constructing and justifying the standards of creative activity.

He also noted that goals of heuristics defined in this way were related to the goals of pragmatic methodology, but they were not identical to them due to the fact that the methodology of science emphasized the justification of theorems whereas heuristics underscored the ways of reaching them. In turn, heuristics understood in this way is very close to praxeology, but differs from it in the following ways (Góralski (ed.), 1977, p. 13):

- a praxiologist considers all kinds of activities, while the one involved in heuristics considers only creative activities; in this sense, heuristics is one of the disciplines of praxeology,
- a praxiologist assumes that the overriding criterion of evaluation is the efficiency criterion, and heuristics additionally evaluates the

performed or intended action against the criterion of validity (prospective, rational, ethical, efficient, etc.).

The notion of need is combined with the concept of task, because it is the reason for undertaking it.

Execution of creative actions consists in (Góralski (ed.), 1977, p. 14):

- formulating a task,
- solving the task,
- checking and evaluating the solution.

A task is formulated correctly when a credible act is indicated, its implementation is limited by means or methods of duration or course of the solution indicated by the problem-solver and the realization and effects of the act are valuated.

The concept of task solving is understood as an arrangement of acts when (Góralski (ed.), 1977, p. 14):

- task formulation is one of its causes,
- solving the task may be one of the results,
- its realization is conditioned by the type of acts performed by the problem-solver, the limitation of means or ways or duration of acts as well as the limitation of the way in which acts are combined into systems of acts or valued by the formulator or by the problem-solver. The solution of the task is a distinguished and positively valued effect of the solution process. Description of the solution of the task is determined by the explanation of reasons for the task being undertaken, conditioning of the actions performed, the effects and ways of valuing solutions (Góralski (ed.), 1977, p. 15). These tasks can be solved by means of elementary and general methods that fit into their specific hierarchy. The way the method is described should be determined by the level of generality and should contain:
- a description of the procedure for acts execution for detailed methods,
- a directive description of the universal properties of acts for general methods.

Modern heuristics does not know the concept of the ideal method. For example, Descartes recommended applying the following stages:

- turning a task to a mathematical one,
- turning the mathematical task to an algebraic task,
- turning the algebraic task to solving one equation.

Another proposal to describe the proceedings was presented by W. Hartkopf (Hartkopf, 1976):

I. Initial phase:
   1. Task undertaking,
   2. Explication of the task,
   3. Justification of the task,

4. Task analysis,
5. Planning the method.

II. The right solution (heuristic phase):
6. Determining possible solutions,
7. Choice of solutions.

III. The final phase:
8. Imminent solution verification (that is if it meets all the operating conditions),
9. Determining the number of solutions,
10. Transcendental verification of the solution (that is whether the solution and the method of obtaining it do not go beyond the task).

Summing up A. Góralski's considerations, it should be stated that the characteristics of each method includes the following components (Góralski (red), 1977, pp. 18-19):

- a procedural description of the method, i.e. specification and characterization of the stages of the solution process, and characteristics of the system and interdependence of these stages,
- a list of actions, the taking of which is conducive to efficiently overcoming a certain stage of the solution process and has an impact on the desired course of action,
- a list of directives specifying the desired attitude of a problem-solver or valuation rules which are in force throughout the entire solution process.

Z. Martyniak, like B. Pushkin and A. Góralski, treated heuristics as science that took shape only in the 1960s. As a young discipline, it had problems with a proper term. Three terms were used interchangeably: heuristics, inventiveness and innovativeness. In addition, three trends in the new science were observed (Martyniak, 1997, pp. 7-8):

- classical, dealing with investigating creative thinking processes (along with the following issues called heuristics),
- the main one, favoring the issue of development, codification and application strategies of creative problem solving methods; in French literature called 'inventique' (in Polish, along with other fields known as inventiveness),
- implementing the 'products' of creative thinking, or innovation into practice (along with other trends in national and foreign literature called innovativeness).

Z. Martyniak also derived the names: heuristics from psychology (later strongly associated with cybernetics and computer science), inventiveness, also called pragmatic heuristics from pragmatics, and innovativeness from economics and sociology (it was Schumpeter who introduced the term innovation into scientific literature). It should also be remembered that the seeds of the science

are found in the investigations of great scholars who in their works went beyond the framework of one scientific discipline (eg Descartes, Leibnitz). It was only thanks to the works of Osborn and Gordon (pioneers in the field of psychosociology) and Zwicky and Altszuller (pioneers of inventiveness in the science and technical sciences) that imagination and intuition were rediscovered as factors determining effective solving of creative problems. Therefore, this part of Z. Martyniak's considerations can be summarized as follows:

- knowledge about creative problem solving is called heuristics, inventiveness or innovativeness,
- the sciences that are its cornerstone are humanities and natural sciences, economics and management, science and technical sciences,
- disciplines that enhance the knowledge are: logology, philosophy, sociology, psychology, praxiology, organizational science, cybernetics, combinatorics, systems engineering, computer science.

In heuristics, a number of task dimensions and therefore a number of inventive approaches and corresponding problem solving methods are distinguished. From this point of view, B. Pushkin indicates experimental heuristics (Pushkin, 1970, p. 26). A. Góralski, considering this problem in a broader perspective, enumerates reflexive heuristics, pragmatic heuristics, computer heuristics and a systemic method (Góralski, 1980). A thought test of the colloquial analysis of these concepts indicates the following order: reflexive heuristics, experimental heuristics, pragmatic heuristics and computer heuristics.

According to A. Góralski, reflexive heuristics stands out in terms of the diversity of approaches from the basic purpose of heuristics that is formulating and justifying the rules of creative conduct. The specificity of this trend "is expressed in the tendency to understand and explain the essence of conditions and methods for creative actions treated as a special course of action." In another perspective, "reflective heuristics aims at understanding the essence of creative problem solving and at discovering ways of learning and teaching them." "Heuristics defined in this way can be regarded as both the field of praxeology that is the general methodology of operation and the section of pragmatic logics" where methods for obtaining solutions are the subject of research. Reflective heuristics is attributed to the Socratic method, the Descartes' method and the Polya's method (Góralski, 1980, pp. 102-168; Polya 1993).

According to B. Pushkin, experimental heuristics is associated with the theory of trial and error. This applies, inter alia, to the first attempts of carrying out a specific psychological analysis of the process of solving tasks by a human being that is the so-called associative approach. "Representatives of this concept perceived the association of images and ideas as the basic mechanism of mental activities including the intellectual ones." When it was difficult to explain associative problem solving processes, the concept of perseveration or perseveration tendency was introduced. Associations, consisting in displacing one rep-

resentation (image) with others were replaced by strengthening one or another representation (image) in consciousness which means that the associative tendency was replaced by the perseveration tendency. Later, due to the difficulties in implementing these concepts separately, solving tasks began to be considered as a process in which the associative tendency merges into one with the perseveration tendency. However, in the long term, this concept collapsed as a result of Thorndaike's experiments on animals and Adams' research. Nowadays, the theory of trial and error is applied in cybernetics, and more specifically in the method of an exhaustive review of variants of the procedure aiming at solving a task that is in the so-called scanning method. This is one of the methods of solving tasks by machines (Pushkin, 1970, pp. 26-62).

Pragmatic heuristics is one of many possible approaches to achieving the basic heuristic goal, which includes formulating and justifying the rules of creative conduct. The most popular is the approach that draws inspiration above all from the needs of inventive practice and serving this practice. The heuristic methods for solving tasks within the pragmatic heuristic trend include, in particular, morphological analysis, brainstorming, exploration matrixes, synectics, an algorithm for solving inventive tasks, and solution evaluation principles (Góralski, 1980, pp. 169-275).

The field of heuristics using means and methods of computer science is assumed to be called computer heuristics. The origin and formation of the heuristics were conditioned by the following factors: availability of digital machines, recognition of the consequences of Godel's thesis on the mathematical and task classes' undecidability for which a solution algorithm cannot be determined as well as an intention to construct 'intelligent' machines. Furthermore, the main goals of computer heuristics can be recognized as: rational and effective use of digital machines and other technical means for solving tasks, modelling ways of reasoning and actions which solve tasks, aiming at distinguishing these components of solving procedures where machine implementation is necessary or would be desirable as well as establishing rules of constructing, evaluating and selecting along with constructing and applying general algorithmic procedures for solving task classes. The problematic aspect of this field of heuristics includes: modelling and simulations, heuristic programming languages, combinatorial tasks solving and simulating the music composition process (Góralski, 1980, pp. 276-332).

In conclusion, attention should be drawn to some of the problems that B. Pushkin addresses and to the future of heuristics. The key issues include: research on internal thinking mechanisms, heuristic programming, and reality models produced by the brain, heuristic content, heuristic recognition and operational thinking. B. Pushkin sees the future of heuristics in solving the problems of intellectual creativity management, the development of methods for increasing the effectiveness of creative thinking, elaborating special psychological methods for

determining the level of creative processes of individuals, cooperation of specialists in various fields of science, the deployment of operators or dispatchers or similar to heuristic activities, the possibilities of teaching the art of intellectual creation so that real discoveries and inventions can be made (Pushkin, 1970, pp. 231-238).

2. CHARACTERISTICS AND TYPOLOGY OF INVENTIVE METHODS

2.1. THE CONCEPT OF METHOD AND EVOLUTION OF METHODS

The concept of method is a key aspect of research methodology in various fields and disciplines of science. In the dictionary approach, including „Słownik poprawnej polszczyzny PWN" (The PWN Great Dictionary of the Correct Polish Language) written by W. Doroszewski and H. Kurkowska (1976, p. 334), the term is understood as a method of conduct, a method of scientific research and some contexts of the use of the term in this perspective are provided: a method of reasoning, educational methods, an application of a new method of work. In the encyclopaedia approach, for example in the Catholic Encyclopaedia (vol. 12) (2008, pp. 635-637), the term is derived from the Greek *methodos* (walking along the way, conduct), which means in a wider sense the way of proceedings, i.e. steps taken in a specific order to achieve the set goal, or in a narrower sense to solve theoretical or practical problems.

The method understood as a rule (directive) is a collection of more or less uniform rules (guidelines, maxims), determining the course of action, serving the effective and more economic implementation of a specific goal or solving a specific task. The functionally understood method is a system (sequence) of more or less ordered (appearing in a specific order) activities to increase the efficiency and economy of operation.

The scientific method is also defined from various points of view as (ibidem, p. 638):

- all activities performed by scientists in solving scientific problems (search for the truth),
- activities or regulations (rules) leading to scientific knowledge,
- logics underlying the foundation of scientific practice,
- procedures taken to solve a specific problem,
- a highly specialized tool of description, explanation and understanding of the world, serving researchers to seek answers to their questions and to build a non-arbitrary, credible and coherent image of the world,
- a process of searching for the best solution to the problem and checking the legitimacy of each possible solution (heuresis, heuristics),
- a credible or highly reliable process of forming beliefs (reliabilism).

In social sciences, a method is usually understood as a system of assumptions and rules that allow for the organization of practical or theoretical activities in order to achieve the goal at which one deliberately aims (Sztumski 2005,

p. 68). The following requirements are expected from the appropriate method (ibidem, pp. 71-72):

- clarity that is features of universal intelligibility and recognition,
- unambiguity, excluding the freedom of applying the regulative principles,
- targeting, aiming at the specific purpose,
- efficiency in achieving the intended purpose,
- fruitfulness in providing reasonable and other secondary results, but no less important for the same or different field of science,
- reliability in securing the achievement of the intended result with the maximum degree of probability,
- cost-effectiveness allowing to achieve the intended results with the lowest rate of consumption of appropriate resources and time.

Descriptive and normative approach to methods allows to differentiate them as scientific methods and research methods (Nowak 2010, pp. 19-26). Scientific methods, i.e. methods of a given science, are generally patterns of particular research activities, effectively applied or recommended in a given science. These methods are characteristic of formal sciences (deductive, e.g. mathematics, logics, etc.) and as schemata of deductive reasoning should be characterized by the theorems resulting from some other theorems already proven or certain primate assumptions called axioms, proven by a controllable formal, logical and mathematical demonstration. The concept of research methods, on the other hand, refers to empirical (inductive e.g. physics, chemistry, biology, sociology, economics, etc.) sciences and as inductive reasoning schemes should be characterized by statements justified by the results of the broadly understood observation and adequate interpretation of results. Each method, regardless of which group it comes from, is the more developed, better worked out and credible, the more it meets the aforementioned requirements.

M. Ćwiklicki (2011, pp. 43-86) undertook detailed considerations on methods, including organizational and management methods. At the outset of his reflections, he assumed that a method is an independent entity. This is not tantamount to making it fully animated (reviving and giving the characteristics of living beings), because methods cannot be considered in isolation from man, due to the fact that methods do not exist without a human being. He also added that reification (treating a living being or abstraction as a thing) of a method is only an assumption allowing to define it as the object of research (ibidem, p. 14). Despite these reservations, the evolutionary development of methods, which the quoted habilitation dissertation of the author dealt with, as well as their 'botany' discussed in the studies of Z. Martyniak (1987; 1997) can be investigated. The theory of evolution assumes gradual changes in species traits that are caused by natural selection. In the case of organizational methods, the parallel concerns the methods competing for resources occurring in the organization. Therefore, the

competition is won by this method, which will have the greatest ability to adapt to the conditions of the organization. In the evolution of organizational methods, the mechanisms are as follows (Ćwiklicki 2011, pp. 18-20):

- adaptation, or adjustment of the method to new organizational conditions,
- mutation that is the occurrence of changes e.g. in the structure of the method that is in the phase system and stages of conduct; mutations can also be applied to feature changes, and thus indirectly to the 'genetic code' of the method,
- divergence that is the process of differences appearing with regard to the same method used in another organization or in another country,
- convergence as a process of different methods becoming similar to each other,
- parallelism is a process of parallel development of methods deriving from the common archetype,
- coevolution, understood as the interdependent development of two or more methods and the occurrence of changes in one method due to the occurrence of metamorphosis in the second one with simultaneous process of adjustment to one another.

In a creative process, various ways which enhance finding solutions can be utilized. Due to the degree of schematization, they can be grouped into (Martyniak 1997, pp. 14-17):

- directives (rules, principles) which are general guidelines pertaining to an approach to the problems being solved; rules are fundamental and relate to all problems, regardless of their specificity; inventive principles concern only a certain class of problems and are auxiliary in nature,
- the appropriate methods which are the ways of proceedings described in more detail; some of them refer to specific phases of the creative process, and some are comprehensive and refer to the whole creative cycle,
- auxiliary techniques which are the ways of proceedings with the highest degree of schematization and which are usually of analytical character.

Another issue called pragmatic typology of J.M. Mouchot's method, which increases the degree of generalization of methods and decreases the degree of accuracy, allows to distinguish (Moles, Caude 1970):

– submethods or micromethods, or prescriptions for proceedings, or strictly programmed operation instructions,

- local methods for solving problems of a given class only,
- general methods,
- supermethods, or thinking strategies,
- the guiding myths of creative thinking in economics and organization.

Considering the above, one must not forget that methods are not rigid ways of proceedings, but they are constantly being developed, creating more and more new ways.

Z. Martyniak notes that the main tendency in the evolution of methods is the transition from general, flexible and not coherent methods to the detailed, rationalized ones and finally to programs that can be applied automatically (Martyniak 1987, pp. 126-127; Martyniak 1997, pp. 15-16). As an illustration of evolution, he mentions the example of J.M. Mouchot and A. Moles, who in this approach placed heuristic methods (means of invention, discovery processes) at the lowest level, rationalized methods (control, verification and testing procedures) a bit higher and classical methods (prescriptions confirmed by experience) that can be applied automatically at the highest level (Mouchot, Moles 1971, p. 15). In addition, Z. Martyniak specified several intermediate categories concerning the word 'method', according to the decreasing degree of generality, placing the rules at the top of the ladder and techniques at the bottom (Martyniak 1987, pp. 127-129; Krakowiak-Bal, Wdowiak, Ziemiańczyk 2017, pp. 24-27, 69-96, 118-136, 149-167, 204-206; Wdowiak 2013, pp. 30-71, 73-132):

- principles (rules), containing general guidelines, procedures for organizational activities (e.g. the principle of division of work),
- strategies (general approaches and methodologies), defining the stages of organizing proceedings and the applied set of principles, methods and techniques,
- general methods, positioning organizational activities at particular stages of the proceedings and implying the use of definite specific methods and techniques,
- groups (families) of specific methods that can be at organizer's disposal: par excellence organization (the study of methods of work, work measurement, standardization of work, job evaluation, coordination of work processes in time, the organization of work processes in the space, analysis of organization values), utilized in organizing (psycho-sociological methods, ergonomic methods, operational research, network methods, econometric methods, computer methods and heuristic methods),
- specific methodologies, identifying the characteristic approach for each of the families of specific methods (define stages and phases of proceedings),
- specific methods (e.g. a photo of a working day, timing or snapshot observations in the group of work measurement methods, etc.),
- groups of techniques at an even lower level of generalization (e.g. mapping technique, work-flow diagrams, etc.),
- techniques (individual) – work-flow cards and diagrams, Adamiecki schedules, Rytel's esograms, etc.)

Each concept of the evolution and development of heuristic methods and management can be the example of the specificity of the evolution of groups of these methods, more or less formalized. These problems will be outlined in selected examples in the last part of this chapter.

2.2. CRITERIA AND TYPOLOGIES OF INVENTIVE METHODS

Today, it is difficult to determine the number of inventive, organizational and management methods developed and used to enhance activities of economic and administrative entities in Poland and in the world. According to Z. Martyniak (1978), estimates assess the number of these methods at hundreds (1985, p. 7). W. Hurliman (1974) estimated the number at more than 600 methods, with varying degrees of generality and different purposes in organizing and management processes. In numerous scientific studies, however, the actual number of registered methods does not exceed 200, usually fluctuating in the range from 24 to 132 methods. Apart from this, no one has put together all the methods so far and therefore it is difficult to really determine their number. This is also the reason why it is challenging to classify the methods that fulfill the reason for existence (there is at least one element in the subject of classification), that they decouple (there is no overlapping of similarity classes in a given classification series) and that they are absolute (the sum of elements of at least one series corresponds with the sum of elements belonging to the general class of the object of classification) (Stabryła, Trzcieniecki 1980, p. 9). Difficulties in developing the appropriate classification of methods and techniques result also from the actual complexity and multiplication of both managerial and strictly organizational activities, in which organizational management as well as inventive methods and techniques are applicable. Accordingly, their classification may be varied and carried out in relation to the criteria that take into account different points of view. Due to, in many cases, the inseparability of performed functions, the division is inseparable and the classification cannot be rigorous. The aforementioned problems may therefore be the reason for using the term 'typology', not 'classification'. The doubts indicated are reflected in the typological concepts presented below.

The first attempt to register the methods was made by CERMA (Center for Studies and Research on Applied Methodology) under the leadership of R. Caude and A. Moles, and their results were published in 1964. The typology of methods from this set, consisting of 45 elements, was made by M. Budzanowska (1967). By grouping these inventive methods and considering 30 of them, she distinguished the following groups taking the main principle of conduct into account:

- based on free association (the analogy method, the brainstorming method, the discussion 66 method, the Gordon's method, the 'crum-

bling' method, the incompetence method, 'the new approach' method, the synectic method, the situational method, the teratological method, the use of error method),

- based on forced associations (the Delphi method, the method of 'good examples', the discovery matrix method, the overlapping method, the translation method, the analogy transfer method, the concept transfer method, the 'residual' method, the general theorems method, the 're-setting' method),
- analytical (the Altszuller's method, the defects method, the 'voluntary restrictions' method, the phenomenological method, the functional innovation method, the list of features method, the morphological method, the graphic presentation method, the 'details' method).

The same number of 30 methods, according to the criterion of the degree of schematization (specificity) in describing the proceedings, can be grouped as follows (Martyniak 1997, p. 40):

- non-systematic search (methods for the individual and the team: the analogy method, the defects method, the phenomenological method, the 'overlapping' method, the incompetence method, 'the new approach' method, the translation method, the analogy transfer method, the concept transfer method, the 'details' method, the 'residual' method, the teratological method, the general theorems method, the use of error method, methods for the team: the discussion 66 method, the Gordon's method, the situational method),
- inventive principles (or policies) (methods for the individual and the team: the Altszuller's method, the brainstorming method, the method of 'good examples', the functional innovation method, the 'crumbling' method, the list of features method, the 're-setting' method, method for the team: the synectic method),
- inventive principles and analytical techniques (methods for the individual or the team: the 'voluntary restrictions' method, the discovery matrix method, the morphological method, the graphic presentation method, method for the team: the Delphi method).

The subsequent attempt to group the same 30 inventive methods, according to their role in creative problem solving, leads to the following grouping (ibidem, p. 41):

- holistic inventive methods (the Altszuller's method, the brainstorming method, the Delphi method, the functional innovation method, the discovery matrix method, the morphological method, the synectic method),
- fragmentary inventive methods (the analogy method, the defects method, the 'voluntary restrictions' method, the method of 'good examples', the discussion 66 method, the Gordon's method, the phenomenological method, the 'crumbling' method, the list of features method, the

"overlapping' method, the incompetence method, 'the new approach' method, the graphic presentation method, the translation method, the analogy transfer method, the concept transfer method, the 'residual' method, the situational method,, the 'details' method, the teratological method, the general theorems method, the 're-setting' method, the use of error method).

An interesting concept of the inventive methods grouping was developed by J. Antoszkiewicz (1982, pp. 16-26). He first distinguished four groups of general methods, and each of them was then divided into detailed methods. The division of methods into groups of general methods is as follows:

- deferred valuation methods, FA (brainstorming, one-person brainstorming, mixed brainstorming, simultaneous assessment, Phillips 66 Buzz Session, 635, stimulation, varying the generality of the topic, gradual clarification of the problem),
- transposition methods, EB (antinomies, function analysis, Gordon analogies, inverting the problem, comparisons, CERMA, MIDE),
- methods of suggestion, EC (the 'crumbling' method, playing with words, superpositions, information sets, guidance questions, the Polya's method, critical evaluation and analysis, EM – ES – ER, for and against, heuristic tips, creative use of time),
- complex methods, ED (the synectic method, an algorithm for solving inventive tasks (ARIZ), contrast analysis of technical objects (ANKOT), the morphological method, the Delphi method).

Within each of these groups, he indicated the methods according to the problem-solving stages in the following arrangement:

- problem formulation (FA: brainstorming, one-person brainstorming, mixed brainstorming, Phillips 66, stimulation, EB: function analysis, inverting the problem, comparison, CERMA, MIDE, EC: the 'crumbling' method, playing with words, critical evaluation and analysis, heuristic tips, creative use of time, ED: the synectic method, an algorithm for solving inventive tasks (ARIZ), contrast analysis of technical objects (ANKOT), the morphological method, the Delphi method – Wdowiak 1980c),
- collecting and analyzing information (FA: all methods, EB: all methods, EC: all methods without superposition, ED: all methods),
- searching for ideas (FA: all methods, EB: all methods, EC: all methods without superposition, ED: all methods),
- analysis and evaluation of ideas (FA: no method, EB: antinomies, function analysis, inverting the problem, comparisons, CERMA, MIDE, EC: all methods without superposition, ED: all methods),
- creating solution designs (variants) (FA: no method, EB: antinomies, function analysis, comparison, CERMA, MIDE; EC: all methods ex-

cluding playing with words, superposition and critical evaluation and analysis, ED: all methods).

Details in this respect are presented in the table (Antoszkiewicz 1982, pp. 20-21).

A. Góralski and the authors' team of five subsequent sets accepted yet the other concept of the typology of the inventive methods. Not only does this concept have theoretical but also practical values. In the subsequent studies where A. Góralski is the scientific editor, selected sets of methods are presented:

- basic heuristic methods (Socratic dialogue, the Polya's method, morphological analysis, synectics, methods of computer heuristics) – set 1 (Góralski 1977),
- universal inventive methods in the context of creative actions (the Descartes' universal method, group spontaneous thinking, analogy and its formal models, method of solving the inventive tasks of ARIZ (an algorithm for solving inventive tasks), method of rationalization of research, system approach in formulating and solving tasks) – set 2 (Góralski 1978),
- methods in the context of teaching creative problem solving (shaping creative thinking groups, exploration matrices, the Pattern method, modeling and simulation methodology, heuristic programming languages, methodology for formulating decision problems in operating systems) – set 3 (Góralski 1980),
- methods in the context of mental work technology (the ideal solution method, functional analysis, general methods for solving combinatorial tasks, strategy for solving tasks in teaching of mathematics at university) – set 4 (Góralski 1982),
- methods in the context of teaching how to solve mathematical problems (heuristics in technical tasks, method of seeking ideas for solutions to technical problems, synectics in the process of solving inventive tasks, approaches to the phenomena of creativity in psychology) – set 5 (Góralski 1984).

The inventive methods compiled in these sets were supplemented and configured in another approach by A. Góralski (1980). On its basis, he distinguished groups of inventive methods according to the developmental trends of heuristics, taking the following solution:

- reflective heuristic methods (the Socratic method, the Descartes' method and the Polya's method),
- pragmatic heuristic methods (methods: morphological analysis, brainstorming, exploration matrices, synectics, algorithm for solving inventive tasks),

- computer science heuristics methods (modeling and simulation, heuristic programming languages, combinatorial tasks solving, simulating the music composition process),
- the system method.

Summing up, in the following subchapter, attention will be paid to the system of actions and inventive methods as well as their characteristics in order to supplement the aforementioned considerations.

2.3. CHARACTERISTICS OF SELECTED INVENTIVE PRINCIPLES AND METHODS

Three types of issues are distinguished in the life of a contemporary man (Kozielecki 1969, pp. 18-21):

- cognitive (orientation) problems,
- decision problems,
- performance problems.

The purpose of cognitive problems is to get information about the surrounding world. Problems of this kind arise in orientation activities. The reason for their formation is the desire to get to know the grounds for the occurrence or nonoccurrence of events. These types of problems most often dominate in the surrounding environment. Decision-making problems arise due to the lack of an exhaustive knowledge of the decision-maker about the actions that can be selected or the effects that can be achieved. Every now and then these actions have identical or almost identical utility and give rise to doubts about which ones should be chosen. Performance problems arise during the implementation of a decision. Practical activity is usually problematic and can be reduced to two types of variants. Lack of sufficient knowledge does not allow for determining a set of specific properties.

Problem solving is the subject of research in many sciences. It includes the following topics that are of interest to researchers (ibidem, pp. 21-22): researching the problem solving process, examining the results to which the solving process is carried out, examining the traits of a human who solves problems, examining the environment in which problems are solved, exploring learning opportunities for problem solving.

Descriptions of creative processes in scientific activity, appearing in the literature, can be reduced to two approaches (Martyniak 1997, pp. 12-13): the first covers the phases of a creative process in the logical-methodological sense, and the second refers to the phases in the psychological sense. According to G. Wallas, in the creative process the following phases in the psychological sense are dominant: preparation (conscious attempts to solve a problem), incubation (the period in which one does not think intentionally and consciously about

a problem), enlightening (the emergence of an idea of solution in consciousness), verification (the phase of conscious evaluation and refining of the idea). The logical-methodological structure includes: identifying and defining a problem, looking for possible solutions by 'renewing' the problem, assessing the solution variants and selecting the optimal variant.

The following selected inventive principles are essential in the creative process and in creative thinking (Góralski 1980, pp. 216-223; Martyniak 1987, pp. 80-83):

- assimilation which involves the use of processes, structures, materials and other elements known in other fields but not yet utilized or used sporadically in the field of the study; the premise of the effectiveness of the policy is to have erudition and access to various sources of information,
- adaptation which is characterized by adjustment of familiar processes, structures, materials and other solutions to the given specific conditions; assimilation and adaptation are two policies known at the dawn of history and used then in a natural way,
- integration which is a combination and simplification of functions, forms, various elements and a system as a whole; it is contrasted with differentiation, although they are related in some respects,
- differentiation which is characterized by the division of functions and elements of the system by weakening functional relationships between elements, by the increased number of degrees of freedom, by the division of processes into phases, etc.,
- multiplication which involves a multiple increase or decrease in certain characteristics of the system,
- questioning the facts – it allows to see the possibilities of positive rationalizing changes; a set of questions is helpful in this regard: Other applications? (what can the new applications be?), Should it be adopted? (What is similar to a given object?), Should it be modified? (Should it be given a new form?, Should other changes be implemented?), Should it be expanded? (What can be added or multiplied?), Should it be reduced? (What can be deducted?, How should it be divided into parts?), should it be replaced? (What are the other alternatives or solutions?), Should it be reorganized? (Should the components be replaced?, Should other models be adopted?), Should it be reversed? (Should a negative and a positive be presented?, Should the opposite be considered?), Should it be contrived? (Should a combination be created?, Why don't we try it?),
- playing with words: etymological research, exploration of related languages, syllable inversion, synonym research are the variants of this game; it stimulates heuristic inventiveness, brings new solution ideas,

- interference which assumes that all discoveries arise as a result of the bisociation, i.e. the intersection of two different objects or techniques in the mind of the creator; as a result, new objects or techniques are generated; the starting point is the accidental enumeration of a series of objects which do not have direct connections with the object in question; subsequently, these objects are juxtaposed in sequence with the object in question, whilst trying to determine what characteristics of the juxtaposed object could be used to improve the object in question,
- analogy is a special case of interference; instead of objects being selected randomly, objects are juxtaposed, in a certain analogous respect, with the one in question, and then it is examined to what extent a related object could contribute to the improvement of the object in question,
- experienced analogy is an extension and intensification of the previously mentioned inventive principles; out of all the accumulated analogies, the most characteristic ones are chosen; subsequently, the participant of the team, selected accidentally, tries to identify themselves with the analogue object; it is desirable that the person does not have too much knowledge of the object with which they are identified; the experienced analogy is the more effective the more eloquence and talents are represented by the „experiencing" person; the inventiveness can also be enhanced by other team members, e.g. by asking questions,
- inversion: the essence is to reverse the function, form or arrangement of elements of the system as a whole; shrewdness supports the effectiveness and efficiency of inversion,
- impulsion is a group of inventive principles related to the discreteness of processes; the impulse can occur periodically or aperiodically, optionally only once,
- dynamization is a group of inventive principles connected with the continuity of processes; the parameters of the system as a whole and its elements are aimed at being variable, and at the same time close to optimal, and for each stage of the process,
- idealization is a principle consisting in finding an ideal solution that satisfies all inventive expectations and gradually moving away from this solution until it becomes feasible to implement.

Historically, the area of application and scope of the study should also take into account the following characteristic inventive methods (Góralski (ed.) 1977, pp. 174-185):

- the Socratic dialogue was developed in the course of cognitive and pedagogical actions; Socrates, by establishing the dialogue, aimed to seek the truth as well as the method of searching for it; the natural area of application of the Socratic dialogue is the field of cognition and this part of the field of communication, which is called teaching; the

Socrates method is based on two main contradictory parts: the elenctics (the negative part which slays away from 'the trail') and the maieutics (the positive part which directs), heuristic directives addressed to the 'master' and to the 'student' are assigned to each stage,

- the Descartes method (Rene Descartes) is based on two works „Rules of mind management" (an attempt to construct a universal and effective method for solving tasks, i.e. an algorithm) and „Dissertation on the method" (a description of evidently heuristic method applicable to an extensive class of cognitive tasks); the Descartes's goal was to develop a method as certain knowledge, which would be an opposition to unfounded beliefs; certain knowledge is attainable and must be acquired methodically; this is the first premise and the second one is the belief in the unity of nature of human knowledge; the third premise concerns the view that while learning about the world, one should strive to get to know as detailed as possible, in given conditions, its simple natures; the distinction of these natures of objects underpins the strategy of systematic construction and deduction as well as the transition from simple to more complex objects; the method is based on three directives, the first one says that nothing should be assumed as genuine as long as it is not evidently recognized, the second maintains that each of the issues studied should be divided into as many particles as would be needed for the best solution and the third one claims that the thoughts should be conducted in order from the easiest objects to grasp and gradually to the more complex ones,
- Polya's methods are the work of a mathematician and pedagogue who, continuing the reflection of Descartes, Leibniz and Bolzano on the universal method, developed a general method for solving tasks; he verified it in the field of forms of practical action and cognition, which can be expressed in the language of mathematics, reaching the idea of Socrates; the area of application of all practical and cognitive actions is the scope that can be condensed to the form of mathematical tasks, pedagogy of mathematics and those sciences that refer to the language of one of the branches of mathematics; Polya had two kinds of tasks in his mind: a task type which involved proving (its aim was to determine whether the theorem was genuine or false) and a task type which involved finding (its aim was to find, construct, produce, receive, identify a certain object, an unknown of a task); a task is usually solved in five stages (understanding of a task, laying out a solution plan, utilizing the plan, checking the result, reflection on the solution),
- the brainstorming method belongs to the basic methods of searching for ideas, improving any field of human activity, designing or modernizing an organization and management, processes (production, technology,

work, etc.), objects (products, structures, factories, etc.) and ventures; it is a team work method (preferably interdisciplinary teams), although it can be utilized in individual work; the basic principle is a deferred valuation, that is, separating in time the creation phase from the assessment phase of ideas; it is based on a few basic methodological requirements, and these are a ban on criticism, generation of the maximum number of ideas, reporting all ideas that come to mind, combining and improving ideas, reporting only one idea at a time, presenting ideas clearly and briefly, lack of authorship of ideas, introducing teams: one that would deal with generating of ideas and the second one that would handle evaluation of ideas and lack of authorship of ideas; the time of generating ideas should not exceed 1 hour, although it is advisable to shorten this period to the necessary minimum; the following stages and steps should be distinguished in the cycle of investigation and search for ideas: preparation for brainstorming (clarifying a problem, gathering information), creation – creative sessions (an informal meeting, a creative session, a summary of creative session), evaluation (setting an evaluation criterion, an analysis and evaluation of ideas),

- the function analysis is a transposition method, used to study objects (products, objects, machines, devices, systems, etc.) and to search for solutions; the transition from thinking in terms of an object to thinking in terms of functions (tasks), focusing on determining the degree of function implementation, the detachment from the existing state, separation essential matters from irrelevant ones, expanding the search for new ideas; it derived from the need to diagnose products, to recognize the actual state with determining the correct directions of improvements, to search for ideas in order to develop new solutions; the function analysis is a study of detailed and general principles and dependencies; in the study, the function analysis is used many times, in the analysis stage, the function plays a diagnostic role, in the stage of seeking a heuristic role, and in the stage of selecting the optimal variant, a diagnostic-heuristic role; when formulating the function, one should be guided by methodological guidelines concerning the use of two words (a noun and an infinitive), should forget about the function carrier, balance the meaning of the words used; the function analysis is carried out in the context of the degree of function fulfillment and costs,
- the morphological method is a complex method of forced associations that can be used in the design, analysis and modernization of every sphere of human activity; a two-dimensional matrix or a three-dimensional morphological box of anticipated solutions can be beneficial in solving tasks; the advantage of the method is a holistic way of con-

ducting the research, and the application of the method avoids bias in conducting the study, creating a wide panorama of the analyzed problem and determining the conditions for comprehensive formulation of the task, obtaining all solutions, especially the unconventional ones; the basic rules of the methodical procedure concern the problem to be solved which should be specified precisely; the same applies to the characteristics of the analyzed problem, the problem should be divided into subproblems or features, parameters, attributes, etc. should be distinguished, all permutations of produced ideas for all parameters, so-called morphological products should be established; each morphological product is a potential solution to the problem; the cycle of searching for solutions is condensed to the implementation of three ventures: formulation of a problem (defining a goal, determining the field of the study, determining the subject and scope of the study, clarifying the task), analysis (problem analysis, determining subproblems, determining the characteristics of subproblems, searching for ideas), synthesis (creating morphological products, setting evaluation criteria, classification of solutions, solutions selection), results elaboration.

3. POSSIBILITIES AND METHODOLOGIES FOR APPLYING INVENTIVE METHODS

3.1. RURAL AREAS AS A RESEARCH SUBJECT

The long-term program of socio-economic growth of the European Union assumes three priorities: sustainable development, smart growth and social inclusion. In implementing these priorities, agriculture is to play an important role. As part of the common agricultural policy, the EU aims to achieve three objectives: warranting profitable food production, ensuring sustainable management of natural resources and actions in the field of climate change, and contributing to the balanced territorial development.

Achieving these goals requires formation, dissemination and practical application of new knowledge, new technologies, new products and new ways of organizing, learning and cooperation. It is essential to ensure that research activities meet general needs and the solutions created are implemented by farmers and foresters. The EU has taken steps to bring science and practice closer together. The aim is to establish a scientific research policy which would be more oriented towards the needs and agricultural policy which would be based more on actual data. To support this goal, the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI) was established. As part of the partnership, efforts are being made to broaden the practical application of research results and innovative solutions and to develop a research program that takes greater account of the needs of farmers and foresters. The purpose of the European Innovation Partnership is to promote competitive and sustainable agriculture which achieves more with less expenditure and functions in harmony with natural environment. The partnership should contribute to building a competitive primary production sector ensuring global food availability, product and production diversity, long-term supply of various raw materials for producing food and other products as well as better distribution of added value within the food supply chain. Innovation is the way to ensure sustainable and smart growth in the economy, including agriculture.

In building cooperation between scientific and technological entities and farmers, entrepreneurs and consultants, it is necessary to gather relevant information (database, project lists, etc.), ensure effective consulting and information flow, exchange best practices and accompanying research, maintain a systematic transfer of expectations (needs) between science and practice, exchange with Technology Platforms (ETP), Research Area Networks (ERA-NET). The joint initiatives concern cooperation with the Agricultural Research Committee in the

scope of: gathering information (research, innovative projects, etc.), effective information flow (website, clear flow procedures, etc.), exchange of innovation issues (seminars, workshops, conferences), knowledge share about practical actions (discussion groups, thematic groups), systematic feedback.

Summing up this part, it should be stated that there are a number of barriers that inhibit the development of innovation in agriculture. These include the specificity of agriculture, fear of newness, high average age of farmers and lower level of education in comparison with city dwellers and shortage of financial resources. The European Innovation Partnership in the Field of Agriculture (EIP-AGRI) works for competitive and sustainable agriculture and forestry so that these sectors can achieve more with less resource use. The EIP creates a wide range of opportunities to establish cooperation, find partners, share knowledge and exchange experiences in the field of innovation in agriculture. The opportunities created in the current program period enable to build an efficient system of innovation transfer in agriculture and in rural areas (Network for Innovation in Agriculture ... 2015, pp. 5-27). One of the conditions for constructing a rational and efficient system of innovation transfer in agriculture and in rural areas is the implementation of the concept of the use of management, organizational and inventive methods and techniques proposed in the studies prepared under the project called „Knowledge management in the process of building competitiveness and innovativeness of rural areas on the principles of sustainable development – empirical verification taking the example of the Małopolska Province". These studies include:

- 'Knowledge management in rural development' (Krakowiak-Bal, Łukasik, Mikuła Pietruszka-Ortyl, Ziemiańczyk 2017),
- 'Organizational standards and rural development in the context of information and knowledge management' (Krakowiak-Bal, Wdowiak, Ziemiańczyk 2017), and
- 'Knowledge creation and solution generation methods in the design and management of rural development' (Krakowiak-Bal, Wdowiak, Ziemiańczyk 2018 – now in the hands of the reader).

In Poland, rural areas are located within the boundaries of rural communes, in accordance with administrative provisions in this regard. An important organizational element of rural areas is the concept of network. The Network for Innovation in Agriculture and in Rural Areas functions within the framework of the National Rural Network (NRN subnetwork) and is open to the public. All entities involved in the development of agriculture and rural areas may be the network participants. The functioning of the NRN organizational structure including the National Network for Innovation in Agriculture and Rural Areas (SIR) and the implementation of the Network's tasks, in particular the implementation of the action plan, in the years 2014-2020 are financed using the funds of RDP Technical Assistance 2014-2020. The main objective of SIR is to support innovation

in agriculture, food production, forestry and rural areas. The specific objectives of SIR were formulated as follows: facilitating the creation and functioning of a network of contacts between farmers, advisory entities, scientific units, entrepreneurs in the agri-food sector and other entities supporting the implementation of innovation in agriculture and rural areas, facilitating the exchange of expertise and good practices in innovation in agriculture and rural areas, assistance in establishing operational groups for innovation and assistance in the development of projects by operational groups and innovation partnerships.

The tasks of SIR are as follows (Network for Innovation in Agriculture and Rural Areas... 2015, pp. 5-27):

- carrying out information and activating operations and initiating cooperation, inter alia: among farmers, entrepreneurs, scientific research units and advisors,
- identifying cooperation partners in the area of implementation of innovative projects,
- cooperating with national scientific and research units, institutions and organizations working for innovation and the European Network for Innovation,
- propagating knowledge about innovative solutions in the agri-food sector and in rural areas, good practices in this field and the effects of the work of operational groups,
- disseminating information and knowledge about the manner of cooperation in scientific research projects,
- developing a methodology for creating and identifying cooperation projects and maintaining a project database,
- advice and assistance in creating and organizing operational groups for innovation,
- advice and assistance in the development of projects by operational groups and partnerships for innovation.

The Network's tasks for innovation in agriculture and in rural areas, including the tasks of the innovation broker, are performed by Regional Agricultural Advisory Centers (RAACs) located in all 16 provinces, and the coordination of these tasks is provided by the Agricultural Advisory Center (AAC). The implementation of SIR tasks within the organizational framework of AAC and RAACs is possible thanks to the advisory staff having considerable experience in cooperation with farmers, entrepreneurs operating in rural areas and with scientific and research units. As part of maintaining and operating the network, the organizational unit for innovation in agriculture and its counterparts at the level of RAACs are isolated in the AAC. 'Brokers' positioned in the AAC and in Regional Agricultural Advisory Centers make the link between the SIR partners.

Brokering in innovation focuses on: discovering innovative ideas, articulating demands, linking partners, acquiring funding, preparing project proposals.

If a good innovation project plan is created with the assistance of the innovation broker, the broker will have a better chance of obtaining the adequate financing for the project.

Brokers' tasks include:

- identification of partners who can/want to act for innovation in the area of agriculture, forestry, food production and in rural areas, including activating operations at the province level and transferring information to Regional Points (RAACs) and the National SIR Point (AAC),
- creation of operational groups (linking partners), including assistance in preparing formal documents related to the functioning of the group (contracts, etc.),
- preparation of draft operational plans for groups, an operations business plan, feasibility studies and application for support under the Cooperation Act,
- monitoring the functioning of groups and projects implementation, and transferring information to the RP and KP SIR,
- participation in meetings organized by the AAC,
- ensuring that the group formation process is transparent and that the objectives and expectations are clearly defined,
- ensuring consistency so that the partners understand each other and want to cooperate with each other.

The implementation of the aforementioned principles of cooperation and tasks should be supported by the partnership model for innovation, which aims at:

- building a cooperation network between business organizations (farmers), the research and development sector, and other participants in economic life at the local level, including local government units,
- shaping the principles of transparent and effective cooperation between sectors, in particular between the public and non-governmental sectors,
- supporting economic environment,
- creating new business initiatives,
- motivating companies to use research and scientific studies and to implement their results.

The Strategy of the Partnership Model for Innovation is based on four pillars: dialogue, cooperation, attitude, adaptability. The development should condition cooperation between institutions, organizations and enterprises in the three sectors, with the most complete form, which is partnership.

Dialogue means creating conditions and climate for understanding between entrepreneurs and other participants in economic life. It involves overcoming communication and mental barriers, providing information to parties of dialogue, organizing meetings and joint ventures together with representatives of the world of science, business, local government units and other participants

of economic life at the local level. Dialogue partners include: research and development units, entrepreneurs (farmers), business environment institutions, local governments.

Cooperation is based on the activation of local centers supporting development (entrepreneurship) in the area of building and stimulating cooperation between enterprises (various entities). As part of the cooperation, seminars, trainings are organized and the idea of cooperation is promoted. The cooperation partners include: agricultural (business) environment institutions, as well as agricultural advisory centers, private companies providing services to farmers, training institutions, research and development units, business associations, and entrepreneurs themselves (farmers).

The change in the attitude of entrepreneurs concerns the creation of pro-innovative building of innovative awareness. The basis of the activity is to provide knowledge in the area of innovation, promotion of good practices and promotion of innovative solutions. In this case, the partners include: agricultural (business) environment institutions such as agricultural advisory centers, technology transfer centers, technology parks, farmers' (entrepreneurs) associations, research and development units as well as farmers (entrepreneurs).

Adaptability is characterized by increasing knowledge and skills of change management, implementation of innovations, modern forms of work organization, business problem solving techniques. The action consists in advisory, consulting and creating a knowledge base for farmers (entrepreneurs). Partners include agricultural (business) environment institutions such as farmers' and entrepreneurs' associations, loan funds, guarantee funds, agricultural advisory centers, private companies providing services to farmers (entrepreneurs), business support centers, and research and development units, as well as farmers (entrepreneurs).

Currently, there are three partnership models: centralized, linear and umbrella models (Network for Innovation in Agriculture ... 2015, pp. 5-27).

The centralized model of partnership is based on joint partners' decisions. Partners fully devolve project and partnership management to the project leader, while others perform executive functions only, performing tasks specified in the project.

The linear model assumes that the partners divide the project into specific, separated parts, which they individually manage, and in their part the entrusted tasks are implemented. This model is mainly based on the exchange of information and experience between partners and on the coordination of autonomous actions.

The umbrella model imposes executive functions both on the project partners and on the project leader. Each of them also manages the partnership.

The choice of a specific partnership model (partnership management) is based on a joint decision of the project partners and results from specific actions as well as the degree of preparation of partners for their joint activities.

Introducing innovations into agricultural practice faces numerous barriers. The factors limiting the introduction of innovations include:

- a huge gap between the themes and results of research and the application of innovative solutions in practice and the implementation of new solutions is too slow,
- the system of financing research (science) and the evaluation of researchers significantly limits the transfer of innovation to agricultural practice,
- the specificity of agriculture in Poland, significant farm fragmentation, poor saturation with biological, technical and organizational progress, effectively delays innovative processes, automatically inhibiting its development,
- relatively low level of education of farmers; it will be difficult for a low-educated farmer to face a high level of competition in the EU structures,
- deficient use of land resources and accumulated production assets due to the low technical level and a limited number of agricultural machinery and equipment,
- shortage of financial resources,
- high average age of farmers,
- insufficiently exploited potential of universities in the area of consulting; teaching programs for students at Polish universities are subordinated to the didactic hours and related to the promoted modes, students' teaching programs at Polish universities are subordinated to the didactic hours and associated with promoted trends,
- weak links between producers, weak trade unions which are the problem of producer groups, lack of necessity to associate, integrate and thus poor competitiveness,
- shortages of domestic capital,
- difficult access to financing sources and cumbersome procedures for obtaining them (including, for example, the EU funds, etc.),
- lack of cooperation between the agri-food sector companies and lack of banks' engagement in implementing technological progress,
- regional priorities in the field of innovation often remain in the sphere of provisions in strategies and programs,
- lack of an appropriate information system.
- The last problem to be considered is the transfer of knowledge and innovation, which under the RDP 2014-2020 includes:

- knowledge transfer and information activities,
- – activities implemented under the NRN plan for the years 2014-2020.

The first issue aims at expanding the knowledge base in rural areas in terms of innovation, the environment and climate change mitigation and adaptation, and strengthening links between agriculture as well as forestry and research and innovation, along with promoting lifelong learning in order to increase human potential in the agricultural and forestry sectors.

The scope includes trainings and information made available as part of operations focused on topics valuable to people working in the agriculture and forestry sectors for their professional development and improvement of the functioning of their farms; they provide people with access to the most up-to-date knowledge in a given area, including research results and new and innovative solutions, also in the field of environmental protection and climate change, in particular trainings and workshops on the use of tools useful in the development of professional activity of farmers and forest owners.

The projects may include horizontal themes and topics dedicated to groups of recipients. However, it will be possible to give preferences in access, in particular to beneficiaries of the RDP 2014-2020 activities. Particular importance will be attached to issues related to the cross-cutting objectives of the RDP 2014-2020, including raising awareness among consumers and expanding knowledge of running farms in a manner consistent with the needs of the environment and mitigating and adapting to climate change, including the use of energy from renewable sources (RES).

Support under this measure includes the following sub-measures:

1. support for vocational education and skills acquisition,
2. support for presentations and information activities.

Support under the measure will affect the implementation of the aforementioned specific objectives of the program:

- improving the economic performance of all farms and facilitating the restructuring and modernization of farms, in particular with a view to increasing market participation and market orientation and diversification of agricultural production;
- improving the competitiveness of major producers by better integrating them into the agri-food chain through quality schemes, adding value to agricultural products, promoting on local markets and short supply cycles, producer groups and organizations and interbranch organizations;
- supporting risk management in farms;
- reconstruction, protection and enhancement of ecosystems dependent on agriculture and forestry,

The measure will contribute to the achievement of specific objectives under Priority 1, i.e.: increasing innovation and the knowledge base in rural areas

or promoting lifelong learning and vocational training in the agricultural and forestry sectors (Network for Innovation in Agriculture ... 2015, pp. 5-27).

3.2.CREATIVE THINKING AND KNOWLEDGE CREATION IN SOLVING PROBLEMS

Creativity, according to B. Poskrobko (2017, pp. 108-113), is a manifestation of creation and there is a close correlation between these concepts. J. Fazlagic (2015, p. 16) even states that these concepts can be regarded as synonyms, provided; however, that there is a possibility of defining one term using the other one. K.J. Szmidt (2010, p. 10) defines creativity as a personally understood creation in the sense of human activity and attitude. M. Karwowski (2009, p. 17) claims that creation is a concept describing a social phenomenon whereas creativity is an individual feature. In the case of creativity it is reasonable to talk about the potential to recreate something in the future. This, in turn, allows for defining creativity as the personality potential of the majority of people to achieve significant results in terms of creation. In addition, creativity can be treated as an elementary level of creation. G. Torr (2013, p.11), citing the opinion of T.M. Amabile, understands creativity as creating the right, innovative ideas by individuals or small groups. M. Boden (2004, p.20) understands creativity in a broader sense that is as discovering new meanings of ideas, concepts, laws, principles in various areas of life and experience. Therefore, several types of creativity are distinguished:

- psychological creativity which refers to new ideas for people who create them,
- historical creativity referring to new ideas in the context of human history,
- exploratory creativity that is associated with a specific conceptual area,
- combinatorial creativity which includes several conceptual dimensions.

The first of these creativities is the simplest whereas the latter one is the most complex, requiring knowledge, experience and group cooperation. Concluding these considerations, it is worth quoting the definition of creative thinking by D. Gmitrzak, which the author formulated as follows (Gmitrzak 2013, pp.25-27): creative thinking means seeking new solutions, doing something in a different way, creating something new, original, perceiving a problem from different points of view, going beyond the usual patterns, combining ideas and things in an original way.

The relationship between creativity and problem solving is also a debatable issue. Numerous researchers assume that this mutual relationship is basically devoid of differences, because creativity is a special form of problem solving. However, R. Nickerman (2003, p. 36) believes that creativity depends largely on the problem being solved. If the solution to the problem requires knowledge

acquired and is done using well-known procedures or algorithms, it will only be creative to a limited extent or not at all. On the contrary, if it requires original thinking and, in principle, an unknown procedure or a little-known algorithm, then it will be creative. In this situation, the degrees of creativity of the solution will fit between the components of these two cases.

The concept of „creation" (creatio) appeared in ancient Rome and meant the gift for creation. Currently, it is defined taking into account the process and effect of creation. Analyzing the concept of creation in a wide spectrum, one can conclude that creation is above all a process that culminates in new work, a new concept, or a new understanding of a certain area of life. E. Hurlock came up with an interesting definition of creation according to which creation is the ability to all kinds of compositions, products, ideas that are basically new or innovative and have not been known to an inventor. It can be an imagination activity or a mental synthesis whose product is not just a summary. It may involve creating new models and combining information from previous experiences and transferring old relationships to new situations and introducing certain variables to them. Creation must be intentional or goal-oriented rather than be a figment of imagination although it does not have to be directly applicable or be a perfect or finished product. It may also take the form of an artistic, literary or scientific product, or be of procedural or methodological nature (Hurlock, 1985, p. 74-75). Creation, according to the classic definition of Morris I. Stein is a process leading to the invention of some novelty, having a chance to survive and meeting the expectations of a group of people who at a given time constitute a specific social environment (Poskrobko, 2017 p. 77). Creation is the ability of a person to generate ideas or products that are both new and appropriate to the circumstances in which they were created (Gerrig, Zimbardo, 2008 p. 302). Władysław Tatarkiewicz (1975 p.303) and Edward Nęcka (1994 p.29) claimed that the basic features that distinguish creation are the novelty and value of work.

Creation, as Edward Nęcka emphasizes, is worth seeing as an element of a larger system; creation should be considered in a systemic way. The systemic approach to creation consists in taking into account numerous factors that, acting together and mutually interacting, lead to the formation of a new and valuable work. Creation cannot be reduced to a single process or a factor, especially a psychological one, because only the interaction of cognition, emotion, motivation, personality and social context can result in the construction of significant piece of work. Creation cannot be considered in isolation from macro-social factors: cultural, political and economic ones. Systemic concepts, therefore, break the 'personal' point of view, according to which creation is limited to a human being, its cognition, psyche and personality. In systemic terms, the human individual is part of a wider system involved in the construction of creative piece of work (Nęcka, 2012 p.183).

Creativity can be defined as creating useful and valuable products, services, ideas, and procedures by cooperating individuals (Woodman et al., 1993, p.293). Creating new knowledge and creation (creative thinking) are the key source of innovation and long-term development in an organization. Due to globalization and the pressure of change, organizations are forced to make the best use of all their resources, especially creative human resources. This, however, requires creative abilities of the people managing the organization, who can make a considerable contribution and ensure the success of the undertaking. Creative thinking in the organization management includes numerous elements, among which, familiarity with the so-called environment stimulating or limiting creative thinking, activity and creating new knowledge in the workplace play an important role (Ujwary-Gil, 2004):

- challenges: the challenges that the employees face which will motivate them to undertake new tasks and the mission, with which they will identify, seem to be vital. Thus, the chance to externalize the creative potential inherent in each individual is increasing,
- support of co-workers: helping in group's implementation of projects, interpersonal relations accepting the emergence of new ideas or concepts and in creating new knowledge,
- support of the organization's management for searching for new solutions,
- support from a supervisor: such features as openness, flexibility, respect to different opinions, the ability to engage employees in thinking about new ways of solving problems,
- freedom and autonomy: indispensable when making decisions at a given time, or deciding on the manner and time of performing tasks,
- organizational structure: with a limited number of levels in the hierarchy, flexible rules and decentralization of power,
- remuneration and incentive allowances: they should include creative work in accordance with the adopted reward policy and support the willingness to acquire new knowledge,
- technological and material resources (broadly understood the ICT infrastructure): supporting work processes, creating knowledge, sharing new ideas and knowledge,
- creativity training: focused on developing the ability of creative thinking of employees and creating innovations,
- physical environment: elements such as adequate lighting, furniture, space and ventilation of rooms make the workplace more comfortable for thinking (although there is no convincing evidence of the impact of these factors on the creative activity of employees).

Creative thinking is the phenomenon of awakening new thoughts, reformulating existing knowledge and analyzing assumptions in order to formulate new theories and paradigms or to build awareness. It is a process that in-

volves revealing, selecting, exchanging and combining facts, ideas and skills (Proctor 1998).

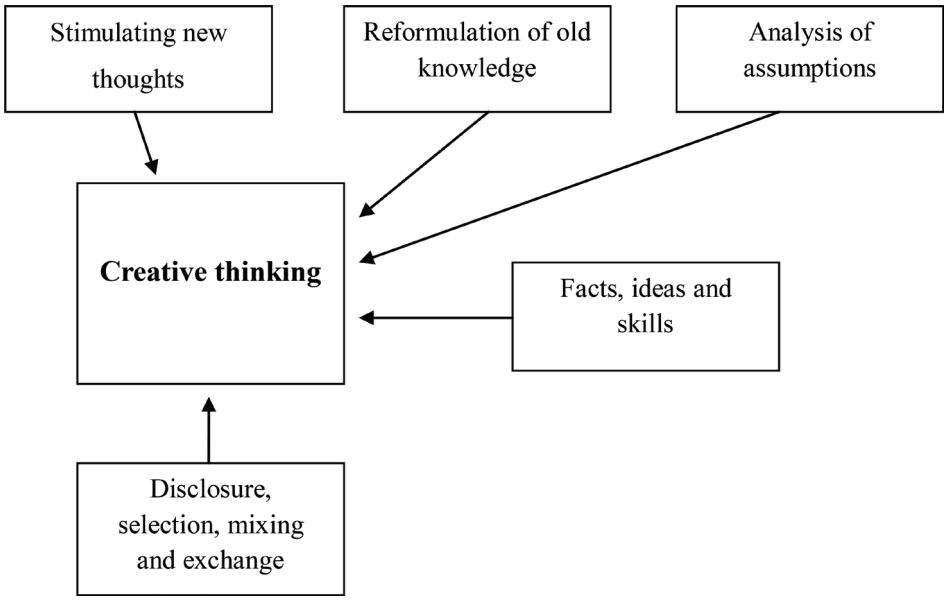


Figure 1. Nature of a creative approach (Proctor 1998)

Knowledge creation has its source in the creativity of man as an individual. Creativity is a category that defies both unambiguous definition and formal procedures and management tools. There is no doubt; however, that modern organizations operating in conditions of environmental change must participate in creating reality in an active way; they must therefore create knowledge: new products, services, new work methods and projects. Organizations need to understand how new knowledge is created. Observing the trends and sources of competitive advantage of leading organizations, it can be noticed that knowledge-forming organizations will play an increasingly important role in the contemporary world.

An interest in the concept of creativity and the perception of creativity as a key organizational resource as the basis for innovation, and as a result, the source of competitive advantage can be found in studies conducted by numerous authors (Zorska et al., 2014, Kozarkiewicz, 2015).

Creativity should not be perceived as a domain of people of a specific category or industry, because creative behavior can be disclosed anywhere in social and economic life (Szopiński, 2013). According to Gilda Waisburd (1996), creative people are characterized by (Trias de Bes, 2013):

- flexibility (they go beyond the obvious things),
- liquidity (they create numerous ideas referring to a given problem),
- detail (they go into details of a task),
- tolerance of ambiguity (they are good at conflict situations),
- the ability to perceive the whole (the systematic approach),
- inquisitiveness (interest in various disciplines),
- sensitivity to the interests of others (they understand the needs of others),
- curiosity (they want to 'play with things'),
- independence (thinking),
- reflexivity (they ponder on the things they see and hear about),
- focus on action (they go far beyond thinking and ideas, they act),
- ability to focus (they work systematically),
- perseverance (in pursuit of the goal despite obstacles),
- involvement (in what they do),
- sense of humor (they can laugh to get a distance to reality).

Numerous studies show that creative achievements do not depend on outstanding intellectual abilities, but rather on the desire to overcome habits, stereotypes and conventions in everyday life and the ability to look at problems from various perspectives (Drozdowski and others 2010).

Undoubtedly, creation is a multi-faceted phenomenon due to the fact that the environment (internal and external), the person and its predispositions, inhibitors and stimulators of creativity as well as the goal of creative activities in the form of a creation or product have their significance (Figure 2). This understanding was presented by M. Rhodes (1961), according to whom creation is constituted by the following aspects:

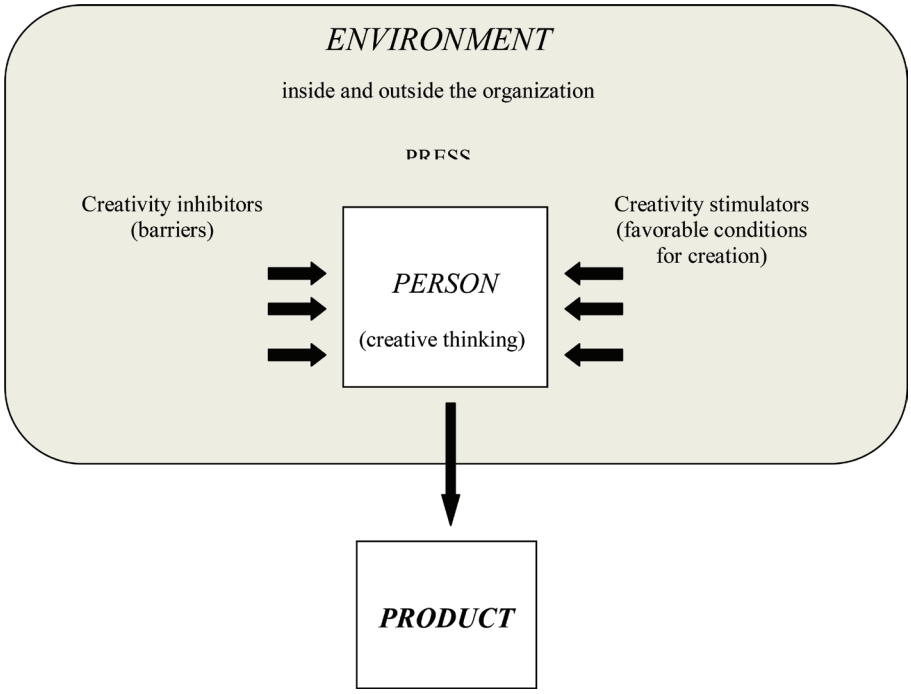
- person: it includes all information regarding personality, intellect, temperament, psyche, customs, attitudes, value systems, defense mechanisms and behaviors,
- process: it refers to motivation, learning, thinking, communication,
- environment (press): people between themselves and in relation to their surroundings may adopt attitudes which are conducive to creativity or which restrict it,
- product: when one mentions an original idea then a certain level of novelty contained in it is pointed out.

The original; however, does not mean the same as the creative one. Creation combines novelty with some usefulness, while the original (e.g. product, service) means unique, unprecedented so far, being a response to a given initial situation for which original solutions were sought (Ujwary-Gil, 2004).

Based on numerous studies, Torrance (1962) compiled a list of factors stimulating the emergence of creative behaviors:

- not treating oneself too seriously and being ready to take risks,
- self-awareness, interaction with feelings being experienced,

- perceiving oneself as different from others, perceiving one's specificity,
- openness both to the ideas of others, and appreciation of one's own views and perception of the world,
- good interpersonal relations, balance between the pursuit of social contacts and ponderence on them,



Source: own study based on *Inventiveness or creativity in business (in Polish)* (Ujwary-Gil 2004).

Figure 2. A multi-faceted approach to creative thinking

Research proves that creative skills detected by Guilford (Grabowska, Budohoska, Kozielecki, 1998, p.151) are of utmost importance for creative thinking:

- the ability to notice new problems (sensitivity to problems). This ability is of paramount importance for science, art and organization. The higher the level of ability to notice problems, the easier the creator discovers previously unknown problems. This ability makes it easier for a person to ask questions, search for shortcomings, deficiencies or gaps in a given organization or a situation,
- the ability called flexibility of thinking. This ability makes it easier for a person to quickly change the direction of search, overcome erroneous attitudes and adapt methods of solving problems to a changing situation. The opposite of flexibility is the rigidity of thinking,

- the ability called originality of thinking. Thanks to it, a person can come up with ideas that are surprising, unusual and very different from previously known attempts at finding solutions. It makes it easier to overcome learned patterns and habits of thinking.

Creative abilities such as noticing problems, flexibility and originality of thinking play an important role in creative activity since the type of product and its social utility depend largely on them (Ujwary-Gil, 2004, p. 41).

3.3. METHODOLOGY FOR KNOWLEDGE CREATION AND CREATICS

In the process of solving various problems including, theoretical scientific problems and practical professional ones as well as even everyday life problems, one finds numerous common features. Initially, one makes an intensive and fruitless mental effort, seeking a rational and satisfactory solution. Then, after a long-lasting search, even during long-lasting thought processes and the lack of specific ideas, one falls into a feeling of helplessness and feels locked in the stalemate. Finally, after several, and often repeated, attempts, one achieves a state of satisfaction with the results obtained. However, it is not always possible to find a solution and one has no options but to resign from these activities for the time being. Then again, one renews their attempts until they get the desired results. This also applies to the search for solutions in relation to the issues of development and functioning of rural areas.

In order to find a way out of such a situation, a new strategy of actions should be contrived which means that a creative act ought to be made. Such a situation is usually called a problematic situation, and the psychological process by which a new strategy will be developed or a new solution found, is called productive thinking. Using the term derived from Archimedes, one can also call it the heuristic activity, or heuresis. The importance of inventiveness, productive and creative thinking is therefore important. Based on them, one can judge how important it is to study these activities and learn about the regularity they are subject to. The concept of heuresis is narrower than the concept of thinking. Therefore, heuresis should be understood as a kind of human thinking, for which it is characteristic to develop new systems of actions or to discover previously unknown regularities (Puszkin 1970, pp. 7-8).

Already in the seventeenth century, rationalist philosophers identified intuition as an important component of creative thinking. They stated that there were truths which the human mind detected, not on the basis of logical proof, reasoning, but through a direct ‘intellectual view’. They also believed that intuitive learning about the truth was the highest form of cognition. Also, many contem-

porary scholars emphasize that, along with the logical structure of thinking, one should examine its components which cannot be reduced to proving but which constitute an important link of heuresis (Puszkin 1970, pp. 10-11).

Contemporary pedagogy compares intuitive and analytical thinking. The first one has no clearly separated stages. The basic tendency is the synthetic approach to the whole problem. In this case a solution to the problem is obtained without realizing the process by which it was achieved. The thinking process itself is carried out here in a stepwise manner and is carried out in the form of quick transitions, bypassing individual links. In the analytical proceedings, its individual stages are clearly visible and can be expressed in words. Thinking in this case may take the form of correct reasoning, from the general to the specific, or from what is specific to what is general (Puszkin 1970, pp. 12-13).

The issue of the relationship between intuitive thinking and heuristic methods of problem solving is also vital. Heuristic methods are rather not strict ways by which the desired result can or cannot be obtained. Heuristic methods of solving tasks are opposed to algorithms that guarantee a solution if they are applied accurately. Heuristic methods are often used when an appropriate algorithm is not known. It also happens that in case of knowing the algorithm, application of a heuristic method may lead to a solution of a task much faster. In addition, constant and conscious use of heuristic methods may result in the intuitive process being essentially reduced to analytical thinking (Puszkin 1970, pp. 13-14).

Creative problem solving should be considered in the context of:

- the definition of the problem
- the goals structure one intends to achieve,
- the areas of possible considerations and changes,
- analyzing the situation as to potentially exhaust all possibilities of further analyzing the problem with traditional methods,
- clarifying the nature of the problem in the light of the bad structure of information and knowledge,
- considerations about potential solutions to problems,
- qualitative and quantitative effects of results, using the most useful and effective research methodology and adequate methods and detailed techniques.

The concise and practically expressed definitions of a problem are usually the most suitable definitions. For example, Van Gundy describes a problem as the difference between the current state of affairs and the one, one is heading for (Van Gundy 1988). T. Proctor also states that this difference can be perceived as the distance between the "actual state" and "how it should be" (Proctor 1998, p. 4 et seq.). He further notes that what makes this difference is relative and subjective, that is why two or more people may perceive the same situation completely differently, that is, 'how things are' and 'how they should be'. If the problem lies in the gap between the two states of affairs, then the solution to the problem lies

in the elimination of this gap. However, the current and desired state of affairs can be relatively easy defined and the situation can be explained in various ways.

Other issues are more intricate. They usually provide much less information about their nature and result from the bad structure of the information. As a result, they cannot be unambiguously defined or transformed into a desired situation. Solving such problems requires thorough rethinking and consideration of many potential solutions. In this case, both the current and the target states can be difficult to be clearly determined, and the methods of achieving the goal can even be less obvious. That is why, inter alia, the attempt to apply the method of creatics for solving problems of rural areas is undertaken.

The methodology of knowledge creation can be formulated theoretically in the aspect of the division of creative thinking or practically in the aspect of solving problems of broadly understood knowledge management, with particular emphasis on rural areas. Treating the above approach to the construction of the methodology of knowledge creation as a process will allow, on the one hand, the examination of the impact of creative thinking and the specificity of solving knowledge management problems, including rural areas and on the other, its specific conceptualization.

A. Osborn proposed the division of creative thinking into three stages (Osborn, 1957):

- establishing facts,
- determining concepts and
- finding a solution.

Fact establishing consists of two stages: problem determination and preparation. Defining a problem allows for correct, clear, error-free, current and desirable formulation. Determination of the concept helps in creating ideas for solutions. Finding a solution allows to evaluate and select the best option. A. Osborn also proposed to separate in time the process of generating ideas from the process of their evaluation. In his view, this provides much more ideas and increases the probability of finding the best solution. Separating the session of creating and evaluating ideas helps to create a more favorable climate for generating new ideas. S. J. Parnes, a psychologist, added new stages: finding a problem and acceptance. In these stages, he proposed that the emphasis should be put on defining a problem and practical implementation of its solution. In turn, S. Isaksen and D. Treffinger took into account the preliminary stage that is seeking a goal that helps to determine the area of the target activity (Proctor, 1998, pp. 5-6).

The contemporary concept assumes that the process of creative problem solving involves six stages, which are not always all to be implemented. These include (Proctor, 1998, p. 7 et seq.):

- searching for a goal,
- establishing facts,
- finding a problem,

- determining a concept,
- finding a solution,
- finding acceptance.

The basic principle of this methodology is to refrain from the assessment, and before this occurs, lists with data should be prepared and thoroughly analyzed. In addition, creative thinking encompasses two types of thinking processes: divergent thinking and convergent thinking. Divergent thinking develops and broadens the thinking process, starting with a specific problem or concept and creates different points of view. The aim is to eliminate all restrictions and consider all possibilities. Convergent thinking is an extension of divergent thinking, which limits the available options and provides many beneficial solutions to problems or decisions. It begins with a broad view of a problem in order to focus later on specific issues and options. In each of the aforementioned stages, there is room for both convergent and divergent thinking. It brings consequences in the form of first searching for data and then with their refinement.

In searching for a goal, a problem point is determined in divergent thinking, first by listing all problems and then while analyzing them, critical problems, a key place or problem points are identified. Determining facts in convergent thinking allows for collecting relevant data, and even looking at the identified problem(s) from a new point of view. This helps to better understand the problem and favors the emergence of unusual ideas. In order to find a problem, 'a guesstimate' from the fact finding process is applied so that the problem is defined most productively. In determining the concept, the search is focused on seeking potential solutions using a variety of means. In the stage of finding a solution, a selection of solutions which enable to solve the problem is made. This stage aims at transforming ideas into practical solutions. Finding acceptance is the stage in which the chosen solution is implemented. Activities undertaken at this stage include: identification of potential difficulties and ways to overcome them, preparation of preventive actions and strategies for dealing with unforeseen circumstances, and development of a solution(s) implementation plan (Proctor, 1998, pp. 7-10).

G. Probst, S. Raub and K. Romhardt developed a model of the general concept of intellectual property management in the organization. In the model, they distinguished the following six processes related to knowledge management (Probst, Raub, Romhardt, 2002):

- knowledge localization,
- knowledge acquisition,
- knowledge development,
- knowledge sharing and dissemination,
- application of knowledge,
- preservation of knowledge.

Knowledge localization consists in finding sources of knowledge; developing methods of its acquisition, taking into account the structuring of the organization's intellectual resources and mapping the processes of its location. The acquired knowledge results from the interaction with the external environment which consists of customers, suppliers and partner companies. In order to attain knowledge, external experts can be employed or hired. It is also possible to take over innovative organizations. Developing knowledge is related to research, creation of new products, improvement of processes and skills development. Additionally, employers should also pay attention to employees' ideas and reward their creativity. Knowledge sharing and dissemination is related to the employees' and the organization's knowledge as well as employees' access to creation of information, which in combination with their skills will serve the whole organization. It is worth knowing what knowledge individual units in the organization need, what it should refer to, what it should influence and what it should change, and how it should be disseminated safely. The use of knowledge should be productive which means that it should provide added value in the conditions of overcoming routine barriers, fears of the unknown, discerning own real position and value and learning from one's own and others' mistakes as well as using other peoples' achievements that can be inspiring. The storing of knowledge should be guaranteed by its appropriate selection, administration and frequent updating. Access to such information ensures the organization's development, avoidance of repetition of the same mistakes and the full use of intellectual resources. All the above should be done in the context of establishing goals and knowledge management assessments. The set goals indicate the direction of knowledge management, allow for adopting appropriate assumptions, preparing a strategy and plans as well as defining specific tasks. These should contribute to the creation and maintenance of a market advantage corresponding to a long-term strategy. The system for measuring the effectiveness of its use is indispensable for this purpose, taking into account the achievements of individual departments, the financial profits of the organization in the conditions of developed and adopted models of knowledge utilization assessment.

Creatics is an inventive method (Martyniak 1997, pp. 64-79), which contrary to the brainstorming method rejects the principle of free associations, finding creative ideas without accepting the freeing of imagination from the disincentive in education and experience as well as other limitations. In such a situation, it is necessary to adopt a specific problem solving methodology that would allow creatively using the entire educational resource of individuals and groups. This methodology does not make creative thinking free. On the contrary, this scheme is a means of modifying thinking and guiding it towards the inventive perspective which leads to new solutions.

The research methodology includes four phases: event exploration, problem exploration, qualitative exploration and prospective exploration.

The starting point in the scheme is the so-called zero point that only expresses a certain intention to solve a problem. The problem is not yet formulated but pre-determined.

Now the first phase of exploration takes place which is associated with a pre-outlined problem. In this phase of ingenuity, the facts (phenomena) associated with the problem defined in the zero point are compared, unlike new ideas in the brainstorming method. In practice, a dozen to several dozens of such facts (phenomena) are recorded, from technical, through legal, to socio-economic ones. This set of facts is then ordered through structuring into specific groups and families. The next step in this phase consists in finding one or more general tendencies whose events grouped into separate families are specific and at the same time special expression. Further proceedings are reduced to determining the directions of changes in the subject matter based on the previously formulated general trend for the group of events. Successively, the general tendency is determined and the direction of changes is sought in relation to other groups of events. In effect, the problem is investigated from different perspectives, which minimizes the risk that the important aspect related to the problem in question will be omitted. The analysis of the successive steps in the exploration phase takes place in the system and gives way to three general methods: exploration, structuring and reduction. In total, the model of this phase includes the following steps: the outline of the problem in the zero phase, the event exploration, the event structuring, finding general tendencies and determining possible directions of changes (Martyniak 1997, pp. 64-79).

After the event exploration phase, the problem phase takes place, which can also occur after the zero point, omitting the exploration phase. The problem phase allows for a thorough and comprehensive analysis of the problem and its operational formulation. In the problem phase, the researcher can see the initial problem in a completely new light and change the traditional way of thinking for the so-called 'near thinking'. The first step of the problem phase involves exploration of three categories of elements: related to the object (the system) constituting the underpinning of the problem, related to the external environment (surroundings) with respect to the object being considered and connected to the functions expected by the user. For the exploration, the so-called lambda technique, indicating three zones of the exploration is applied. The exploration, as the step of the second phase (the problem phase), starts with the zone for the object (the system). Elements that create (or which may create) the object and their properties, not events as in the second step of the first phase, are recorded. Subsequently, the zone of elements of the external environment (the second step) is explored, and only in the third phase are the expected functions explored which are defined with two words, the infinitive and the noun (the third step). In the first stage, the expected functions should be defined by a mixed-up inventive team. Only after such a general exploration, if necessary, can a series of exploration

of expected functions in specific user groups be performed. In general, there are no major difficulties in the first exploration stage. Should they occur, however, one should proceed to the examination of relations between elements located in the object zone and elements located in the external environment zone. Then, the expected functions will be easily deducted from these relations. The following step in the problem phase is to determine the 'inventive paths' in the random selection of one element from each zone of the lambda chart, while maintaining the following order: object – expected function – external environment (the fourth step). If one notices the first impression of the uselessness of random combinations, further attempts should be made until a more perfect solution has been found. It seems, apparently, that this step is very labor-intensive, but in fact after just a few or a dozen attempts, satisfactory results in the form of concepts already previously found or constituting their association (a) are achieved. The lambda technique, however, has limited capabilities as a tool for creating new concepts, in contrast to unlimited possibilities when recognizing problems. As a result of using the path analysis, it is difficult to find original solutions. The next step (the fifth one), the most difficult and the most fruitful one, involves minimization of zones. It is about finding a common denominator for all elements in a given zone. Attempts to find a relation between abstract zone-specific terms lead to a comprehensive and full formulation of the problem, pre-outlined in the zero point. Therefore, the graphic model of the problem phase contains the following steps: the zero point, the lambda exploration, structuring in the form of three lambda zones, minimization of lambda zones, and formulation of a problem.

The first step in the qualitative phase is the exploration of limitations of the object (system) considered in the following steps: the zero point or problem formulation, exploration of limitations, search for the functioning principle, structuring limitations, selection of type A limitation, searching for elimination of the limitation. Limitations are treated here as some difficulties, inconveniences related to the use of the object. In a wider sense, the limitations express the differences between the existing object and the ideal object. The exploration of limitations of the existing object creates the ground for determining the ideal object. This does not mean, however, that it is necessary to create a projection of the ideal object to explore the limitation. The limitations analysis can be performed using a normal, simplified version (selective selection of limitations from the list obtained in the previous step, and searching for such solution ideas that will eliminate the given limitation) or an in-depth version (if one wants to find innovative solutions, they need to perform limitations structuring in the list obtained in the first step of the qualitative phase; the structuring consists in the division of the received set of limitations into two groups, A – not questioning the rules of functioning of the object in question, B – these limitations whose formulation undermines the current principle of functioning of the subject matter).

The purpose of the prospective phase is to find a solution that meets the expected functions, but on a different basis than the previous one. The graphical model includes the following steps: collection of type B limitations, selection of type B limitation, searching for possible elimination of the limitation, searching for new operating rules, finding specific solutions under new operating rules.

The presented order of phases and steps is classic. In fact, the application of creatics assumes the free selection of phases and steps depending on the type of the problem, research goals and the capacity of the subject of the proceedings (Martyniak 1997, pp. 64-79).

3.4. METHODOLOGY FOR FORMULATING DECISION PROBLEMS AND THE IDEAL MODEL IN MANAGEMENT

Creative management is an issue known since 1984-1985. It was introduced as a subject at Manchester Business School and at Keele University by T. Rickards. In this spirit, in the 1970s, the engineering of operating systems was intensively developing and within its framework J. Konieczny created a methodology for formulating decision-making problems. This methodology can be successfully adapted in the field of management in the decision-making aspect as part of the management decision-making function. The IDEAL problem solving model can be the bedrock for its implementation.

This model was developed by J.D. Bransford and B.S. Stein. The IDEAL system includes the following stages (Bransford, Stein 1993):

- I; identification of problems and opportunities,
- D; defining goals,
- E; exposition of possible operating strategies,
- A; anticipation of results and taking actions,
- L; lustration and drawing conclusions.

In the first stage, potential problems should be identified and accepted as an opportunity to implement a creative approach. The second stage includes defining objective(s), for example in the context of stating the lack of a company's development strategy, developing an activity on the international market, developing activities on domestic markets, achieving profitability growth, and others. Specifying a goal is an important step to solve a problem. The exposure of possible action strategies (the third stage) may include, for example: re-analyzing objectives and considering options or strategies for their implementation, writing down collected information and creating an external database, preparing mathematical models, event simulations and so forth. The fourth stage of anticipating results and taking actions consists in selecting action strategies and testing in terms of possible outcomes as well as the results of specific action strategies, etc. In the final stage of the overview and drawing conclusions, the effects of

a given action strategy are checked, the successive steps of the methodology are analyzed, the results of actions carried out are determined and adverse solutions are eliminated (Proctor, 1998, pp. 10-13).

This concept is ideally suited to the methodology of formulating decision-making problems in J. Konieczny's systems of action, and is based on the following principles (Góralski (ed.) 1980, p. 202):

- the principle of systemicity, each intentional action is implemented in the system of action,
- the operational principle, there is at least one operating system for each system of action,
- the principle of purposefulness, the purpose of each system of action is to create conditions for the implementation of the tasks of its operating system,
- the security principle, there is at least one security system for each system of action,
- the principle of collectivity, action systems can consist of action systems.

These principles allowed formulating specific analytical procedures which were formulated as follows (Góralski (ed.) 1980, pp. 205-209):

A. The procedure of the preliminary formulation of problems,

- generate a data bank of problems orientated towards the initial list of the decision-maker's questions using the free association method,
- number the generated problems,
- choose a significant criterion for classifying problems,
- classify problems and organize them into a spanning tree,
- remove random problems from the databank,
- set the criterion for problem importance,
- remove irrelevant problems from the data bank,
- determine problem layers in the spanning tree in accordance with the order of solution,
- consider the possibility of aggregation of problems,
- consider the need of decomposition of problems,
- list the initial problems,
- estimate the following parameters for each initial problem: indeterminacy, validity, urgency, cost of solution, probability of solution.

B. Test of the preliminary formulation of problems,

- check the data bank against any random problems (that is the ones which are not related to the preliminary list of questions of the decision-maker),
- check the data bank against any unrealistic problems (these which cannot be solved by a given team, at a given time and given funds),

- check whether the result, which should be obtained, can be determined for each problem present in the data bank
- check if the problem layers in the spanning tree were correctly identified,
- check if there are any problems that should be aggregated,
- check if there are any problems that should be decomposed,
- check if the list of initial problems is complete,
- check if the parameters of the initial problems were correctly estimated.

C. The procedure of the block formulation of problems,

- the basic system, the operating system and the security system should be specified for each problem present in the data bank,
- determine the form of the decision variable,
- specify the optimization criterion,
- define operational limitations,
- limit the possibilities,
- define internal restrictions.

D. Test of the block formulation of problems,

- check whether the system interval was correctly determined for each problem,
- check whether the criterion of system optimization in a given problem was determined from the point of view of its operating system,
- check whether the block of operational limitations is not empty for a given problem,
- check whether the block of security restrictions is not empty for | a given problem,
- check if the block of internal restrictions is not empty for a given problem,
- check if there are dependencies between external (operational and security) restrictions of individual problems present in the data bank,
- check if there are dependencies between the forms of decision variables of individual problems present in the data bank,
- check if there are dependencies between internal restrictions belonging to the data bank,
- check whether there is a relationship between the optimization criteria of individual problems present in the data bank.

E. The procedure of the analytical formulation of problems,

- the analytical characteristics of the model system should be determined for each problem of the formulated block,
- specify parameters that appear in system characteristics,
- write down analytically the criterion of system optimization,
- write down analytically the restrictions of the optimized system,
- write down analytically the form of the decision variable,
- formulate analytically the problem of system optimization.

F. Test of the analytical formulation of problems,

- check whether the analytical description of the decision problem is adequate to the problem characteristics of a given system of action,
- check whether the form of the decision variable is not identical to the form of the operational task or the form of securing the optimized action system,
- check whether there is a declared form of the decision variable in the optimization criterion and in the constraints of the formulated problem.

G. Results of problem analysis,

Three analytical data banks are the result of the system problem analysis (Góralski (ed.) 1980, p. 209):

- the data bank of problems,
- the criteria and limitations data bank,
- the data bank of parameters and characteristics.

3.5. INVENTIVE METHODS IN RURAL DEVELOPMENT MANAGEMENT

According to the subject of this study, rural area should be the domain of considerations of this sub-chapter in the field of organizational design. This is the specific subject of the study which should be examined in two aspects. The first aspect is the management of the development of this area, understood objectively, as a separate area within the boundaries of the rural commune together with its natural environment, broadly understood infrastructure, residents living within its borders and all other living organisms and all other material elements of this area. The second aspect of this area is a diverse institutional and socio-economic system contributing in any way to its proper and improper functioning and development.

In this sense, one should also adopt the methodology of improvement of rural areas management and the institutional system of these areas in the following approach (Krakowiak-Bal, Wdowiak, Ziemiańczyk 2017, pp. 207-210):

Phase 1. Modeling rural development.

A. Designing the information and knowledge system.
   Research on information needs and objectivity of information.
   Creating and generating explicit and formal knowledge.
   Classification and construction of the information and knowledge system.
   Identification of processing and flow of information and knowledge.

B. The threshold analysis and the assessment of rural development.
   1. Task definition.
   2. Determination of extreme thresholds.
   3. Determination of interim and critical thresholds.

4. Calculation of threshold costs.
5. Interpretation of results and formulation of conclusions.
6. Operationalization of the 'level of development' term.
7. Synthetic assessment of the level of socio-economic development.

Phase 2. Modeling of the institutional system of rural areas.

A. Designing the flow of information and knowledge.
   1. Research on information needs and information flow.
   2. Assessment of the information availability of knowledge cells.
   3. Evaluation of information and knowledge flow procedures.
   4. Correcting information and knowledge flows.

B. Threshold analysis and designing the course of procedures.
   1. Elaborating action and development strategies.
      1.1. Formulating the mission and vision.
      1.2. The macro-environment analysis.
      1.3. The analysis of the competitive environment.
      1.4. Specifying the development strategy.
   2. Strategic management design.
      2.1. Market position research.
      2.2. The analysis of the strategic potential of the organization.
   3. Organization of management and developmental restructuring.
      3.1. Selection and collection of information.
      3.2. Construction of a reference system.
      3.3. Designing a system of procedures.
      3.4. System checking and correction.
      3.5. Development of a new organization project.
   4. Reorganization and restorative restructuring.
      4.1. Study of methods of work.
      4.2. Analysis of the value of procedures.
      4.3. Spatial organization of work and procedures.
      4.4. Measuring and regulating procedures and working time.
      4.5. Coordination of work processes and procedures over time.
      4.6. Job valuation.
   5. Management of operational activity.
      5.1. Operational audit.
      5.2. Operational controlling.
   6. Assessment of operational, strategic and development activities.
      6.1. Strategic audit.
      6.2. Strategic controlling.
      6.3. Tax full cost accounting and evaluation of the institution's activities.
      6.4. Break-even point in the institution's variable cost accounting.
      6.5. Settlement of process costs in the internal process cost account.

In every element of this methodology, there are various methods and techniques of research procedures, including inventive methods and techniques, which in some aspects should be given some attention and time. These are the methods and techniques that create knowledge about rural areas and allow generating lists of ideas contributing to the modernization of the functioning and development of rural areas and the system of institutions together with information processes and formalized procedures. The following examples will be the essence of the inventive methods in the modernization of rural areas and of their system of institutions contributing to the development.

The first example of the method concerns the construction or modernization of the rural area system employing the method of the ideal solution of G. Nadler, the creator of this method (Góralski (ed.) 1982, pp. 55-79). The method can be applied to point A phase 1 and point A phase 2 of the presented methodology. The primary goal, as already mentioned, is to improve the functioning of rural areas. The ideal solution method is a design strategy, an organized program of project proceedings, used to determine existing or being planned systems. The underpinning of this strategy is to formulate an ideal system that satisfies the most desirable functions. Subsequently, at the expense of resigning from certain requirements, the ideal system adapts to the actual conditions. When constructing the ideal system model, information about the actual existing system and its surroundings is not used or is used to a limited extent. The ideal system is a kind of pattern, the best, the most desirable, in which the basic function is carried out optimally. This is a template at which the designed system aims. Three types of ideal systems were introduced: the theoretical, the ultimate and the least ideal but possible to perform systems. The latter is most often implemented. However, it cannot always be attainable and then a recommended system can be implemented, which is also the result of a conventional approach.

When solving a task with the described method, one should notice the system character of the undertaking (rural area) and describe it in systemic terms, in accordance with the concept of system, system element, dimension etc. presented in this method. In addition, a scheme of the best solution of a task should be proposed as an inseparable part of thinking about the system. The ideal solution strategy includes ten basic steps:

- determining the function of the system that was identified as the desired function(s),
- defining the theoretical system and subsequently the extreme system,
- gathering information about the existing system and about the situation in which the system functions and will possibly function in the future,
- presenting different versions of modifications of the extreme system,
- version selection,
- formulation of the recommended system and the system possible to be implemented,

- a thorough analysis of the formulated recommended system,
- the system testing,
- implementation of the system,
- determining the degree of fulfillment of the assumed desired function by the system.

In emergency cases, the following steps should be taken as rudimentary steps:

- determining the desired function of the system,
- determining the extreme system,
- finding the optimum between the extreme system and the real possibilities existing in a given situation,
- results presentation in the form enabling their implementation.

The second example discussed below pertains to points 3.3 and 3.5 of the methodology and is associated with the functional analysis (Góralski (ed.) 1982, pp. 80-109). The creator of this method is M. Fustier. The most characteristic feature of the Fustier method in the preparation phase is the analysis of functions to be performed by an unknown object or process. The functional analysis procedure includes the following seven steps:

- perception of the need,
- research of the environment,
- designation of functions,
- searching for the concept of a solution,
- choosing the good concept,
- refining the solution,
- implementation of the solution.

The function analysis triggered lively discussions with various specialists which resulted in exposing the essential attribute of this approach and adoption of team work as a principle in the course of the proceedings, which ensured the possibility of using positive attributes of creative thinking and cooperation of specialists from various disciplines. Moreover, the functional analysis as a heuristic technique could be treated on the one hand, as a way of solving a problem, and on the other, as a heuristic auxiliary method for the value analysis, useful in searching for different variants of the function realization, which can be seen in the above functional analysis methodology.

The problems of the value analysis indicated in point 4.2 are worth considering here, for it will allow to understand the meaning and the essence of the functional analysis and to distinguish the analysis from the value analysis. The key aspect is that the value analysis is an organizational method in which the functional analysis can be used as a tool for creating knowledge as well as information and applied to search for variants of solutions in the organizational design. It is worth remembering that the functional analysis is part of the value analysis, which is also characterized by the functional approach.

However, the method of value analysis is separate from the functional analysis by the organizational method.

The value analysis, in contrast to the functional analysis, is a method used in the study of the designed or manufactured product, production processes as well as administrative and office work (Biliński, Cerafícki, Nowakowski 1973, p. 15). A. Garrat defines the value analysis as the application of the accurate functional analysis combined with creative thinking in order to create a new product that at least meets all the functions of the previous product but at a lower cost (ibidem, pp. 15-16). H. Benz perceived the value analysis as an organized, creative-critical study of the interrelationships of construction, functions, production costs, material or activity conducted in order to reduce costs. (...) Creative skepticism in regard to each element of costs (Benz 1965, p. 16). Another definition of the value analysis underlines that it is a method of improving the company's results and can be utilized to increase efficiency, reduce costs, increase usability (for recipients), improve quality, increase the sold value (VDI – Richtlinien 1965, p. 16).

The value analysis, initiated in the General Electronic Company in Philadelphia in 1947 by H. Erlicher and L. D. Miles, being in its essence a derivative of the classical methodology of organizational research, differed; however, from them by a kind of 'philosophy' of action. H. Erlicher's observation of the postwar use of substitutes instead of traditional raw materials that were hardly available during the war was essential. It turned out that in many cases these materials fulfilled the function of natural resources but were much cheaper. H. Erlicher together with L.D. Miles found that this was the way of continuous reduction of production costs, and called this procedure 'The Value Analysis'. The aim of the action was to analyze the value of the product, the functions it fulfilled, and only later the costs of implementing these functions. In addition, L.D. Miles noticed that analyzing the functionality of products resulted in lively discussions with various specialists and consequently distinguished two important attributes of this method (Mikołajczyk 1994, p. 294):

- adopting team work in the course of analytical and project proceedings as a principle, which ensured the possibility of using positive attributes of creative thinking and cooperation of specialists from various disciplines,
- using the 'functional approach' to assess cost reduction and to increase the efficiency of manufacturing processes which resulted in the adoption of the name 'Value Engineering', and in the late sixties, to administrative procedures and the analysis of fulfillment of the organization's functions and its components (Value Administration, Value Organization), bringing them even closer to the organizational techniques.

The American "Encyclopedia of Management" (1961, p. 1) considers the value analysis as the application of techniques that serve to determine the func-

tion of a product, determine the value of the function and eventually fulfill this function at the lowest overall cost of manufacturing. This definition emphasizes attention focus on the functions fulfilled by the object of the analysis in question, and not on the object itself. If the analysis is started with the function, it leads to the adjustment of the product or organization to the needs of the environment. Changes in the environment therefore evoke specific recipients' needs, and, in turn, modernity of products or the effectiveness of organizational activities affect the scope of these needs (ibidem, pp. 294-295).

Z. Martyniak emphasizes that the bedrock of the value analysis lies in the notion of the system, understood as a complex of interrelated elements due to the fulfilled functions. Each system is a subsystem of a larger whole and at the same time constitutes a super-system for lower-order systems. Each system is created in order to meet specific needs of the external environment by fulfilling the functions arising from these needs. In fact, the phenomenon of disharmony of functions and systems that meet them is recognized. In this context, the purpose of the value analysis is to eliminate the disharmony by establishing such a system composition that satisfactorily fulfills all the necessary functions at the relatively lowest cost.

So instead of a question: 'How does the system work?' one should ask 'What is the system for?'

The answer to this second question must go beyond the system in question, must recognize its external environment and define the needs of the environment. Then, the basic functions of the system should be defined. It should also be determined to what extent they are met and at what cost. Only on this basis can one consider the directions of improvements.

In the value analysis, it is recommended to erase the existing solutions from memory and appeal to the creative power of imagination and even fantasy. This requires the use of inventive methods, also known as heuristic methods, and in Polish the techniques (methods) of creative thinking.

The approach to costs is different from traditional. Traditionally, the aim is to reduce the own costs of creation and operation of a system, bypassing the costs incurred by the external environment (users, clients, claimant, etc.).

In addition, the possibilities of reducing the costs of individual system components are traditionally sought. In contrast, in the value analysis the possibility to reduce the costs of fulfilling particular functions is sought (Martyniak 1987, p. 201-204).

W. Biliński, J. Cerafícki, A. Nowakowski (1973, pp. 36-93) formulated the methodology of the value analysis as follows:

1. Specifying a task,
    - selection criteria,
    - area and detail of research,
    - setting tasks and appointing a team.

2. Collection of information,
    - sources, content and methods for collecting and registering information,
    - collecting basic information,
    - collecting information on costs,
    - testing of foreign products,
    - supplying the team with models,
    - the function analysis.
        - function formulation (verb + noun; basic function, sub functions, table of functions),
        - determining the necessity of the function,
        - setting the functions values or their hierarchy,
        - determining the functions costs of the producer and consumer (external).
3. Critical evaluation of the current solution, development of proposals for new solutions,
    - creative discussion (brainstorming) and some of its versions,
    - association technique (comparison),
    - synectic technique,
    - questionnaires of auxiliary questions,
    - morphological technique,
    - Delphi technology,
    - discussion 66,
    - influence study,
    - analysis of problem relations,
    - scenarios,
    - inverting the problem.
4. The choice of the optimal solution.
5. Developing the solution project – research.
6. Implementation.

The research procedure in the value analysis according to Z. Mikołajczyk (1994, pp. 295-305) includes the following stages:

1. Selection of the object of the study (orientation phase),
2. Determining functions (main, supplementary, general) and collecting information (redundant, unfulfilled, unsatisfactorily fulfilled functions, cost of functions fulfillment, target functions and minimum costs of their implementation),
3. Search for solutions (speculation phase),
4. Evaluation and selection of a solution (planning and implementation phase).

Stages of the value analysis of the organizational systems according to Z. Martyniak (1987, pp. 204-216) are as follows:

1. Preparation of the human factor.
2. Choosing the object of the study.
3. System recognition.
4. Collection of information.
5. Function analysis and searching for new solutions.
6. Preparation of a detailed design.
7. Implementation of the project.

Research procedure in the value analysis according to I. Sobańska (2003, pp. 409-412):

Stage 1. Defining the function.

1. Collection of information.
2. Description of the function.
3. Structuring the function.

Stage 2. Valuation of the function.

4. Calculation of the costs of estimated functions.
5. Calculation of the assumed costs (purpose) of the function.

Stage 3. List of proposals for improving the function.

6. List of improvement plans.
7. Comprehensive evaluation and detailed description.
8. Detailed valuation.

To carry out the value analysis, the term 'value' should be clarified. It usually includes the following components (Jarugowa 1986, pp. 197-198; citing Sawicki 1996 (vol. II), pp. 568-579):

a) cost value – the sum of all costs that were incurred in order to manufacture a given product,
b) exchange value – the price that can be obtained for a product sold, if it can be determined in ex ante mode,
c) use value – all properties (features) that the object has in connection with the functions it performs; before including them in an account, they require an objective and technically justified determination; the functional ability of the object (the perishability or lifetime of the product, unnecessary properties causing the emergence or increase of costs) is of particular importance
d) attractive value or impressive value – features that may be of interest to a buyer; they stimulate the desire to possess a product; the appearance, shape, color, reputation and producer's trademark may play an important role.

From the consumer's point of view, there must be a relationship between value and price. In the value analysis, this relationship can be presented as follows:

use value + attractive value = price,
hence: (use value + attractive value)/price
expresses the so-called chance of value.

From the producer's point of view interested in achieving value and maximum profit, the equation is as follows:

use value + attractive value = own cost,
hence: use value + attractive value/own cost
means the so-called chance of profit.

The value in the value analysis can also mean the lowest cost of fulfilling certain functions (according to the view of L. D. Miles) (Mikołajczyk 1994, p. 300). According to M. Lisiński and Z. Martyniak (1978, p. 18), the functions of the product (system) can be divided as follows:

- main function justifying the purpose and existence of the product (system), also referred to as the external function resulting from the needs of the environment (user),
- complementary (elementary) functions that create conditions for the main function and result from connections between elements of the product (system) and can be defined as internal functions.

Other authors believe that it is possible to distinguish (Mikołajczyk 1994, p. 301):

- general functions resulting from information and external needs,
- elementary functions resulting from information and internal needs.

In practice, it is also vital to isolate:

- unnecessary functions that is those that should not be realized (implemented),
- functions that are not realized and should be implemented, and
- functions performed to an unsatisfactory degree in the light of the needs of the internal and external user.

3.6. INDUSTRIAL INVENTICS AND ALGORITHM OF INVENTION

Constructing a theory of solving inventive tasks in industry has always been a time-consuming task. This type of research began in the 1960s with the improvement of mainly production technologies and has been carried out with

a greater or lesser intensity to this day. The same applies to the practical application of this theory. Achievements in this field should accompany inventions and patents, but only an inventor can say if it is so. In a spirit of the theory of solving inventive tasks, numerous books and thousands of articles have been written. A number of more or less useful inventive methods have been developed in this field. Inventive methods in the field of inventiveness include a number of methods, including algorithm of the invention, the synectic method and many others.

The G.S. Altszuller's Theory of Inventive Problem Solving or Algorithm of Inventive Problem Solving (ARIZ) is a kind of methodology that shows an inventor the successive steps. However, a number of principles and guidelines for this method have a more general value. It is highly likely that thousands or even millions of patents and inventions resulted in creation of this method. Application of the method can take place when the conviction about the impossibility of solving problems is overcome and ossified traditional concepts and terms are rejected.

At the core of the Altszuller's algorithm, there are two fundamental ideas in the process of solving an inventive task (Martyniak 1985, p. 119):

– the principle of searching for the perfect solution,

– the principle of overcoming technological contradictions.

The algorithm of invention in the 1977 version is a methodology enriched in relation to the original version dating back to 1968, which is why the later version is presented that includes the following steps and actions (Martyniak 1985, pp. 127-132):

1. Selection of a task
- define the final goal related to solving the task,
- check whether one can achieve the same goal using an alternative way,
- determine which solution is more purposeful,
- define the required quantitative indicators,
- expand the required quantitative indicators, taking into account the time needed to implement the invention,
- clarify the requirements, considering the specific conditions under which the invention is to be implemented,
- check if the task can be solved by applying standards of solutions for inventive tasks,
- refine the task using patent information,
- use the DTC operator.

2. Constructing the task model,
- determine the terms of the task without using specialist terminology,
- single out and note down the conflicting pair of elements,
- note down two mutual interactions; the one which exists and the one

which must be introduced, destructive and useful,
- note down the standard formulation of the task model, indicating the conflicting pair and technical contradiction.

3. The analysis of the task model,
- among the elements included in the task model, the one that can be easily changed, replaced, etc. should be selected,
- note down the standard IFR formulation (the ideal final result),
- single out the area of the element, indicated in the previous action, which is able to cope with the compound of these two actions demanded by the IFR,
- formulate opposing physical requirements, put forward by conflicting effects (actions, properties) in relation to the state of the singled out area of the element.

4. Overcoming the physical contradiction,
- one should consider a simple transformation of the singled out area of the element, i.e. to separate contradictory properties in space, time, through the use of transient states at which the contradictory properties come into action or appear in sequence and by changing the structure, the molecules of the singled out element area,
- the table of typical task models and systemic transformations should be used,
- the table of effects and physical phenomena should be utilized,
- the table of basic ways of overcoming technological contradictions (inventive principles) should be employed,
- it is necessary to move from a physical solution to the technical one and to formulate a method and provide a device layout implementing this method.

5. The initial assessment of the solution obtained,
- a preliminary assessment of the solution obtained should be carried out,
- formal discovery of the solution obtained should be checked (with reference to patent data),
- what constituent tasks can appear in the technical development of the suggested idea; it is necessary to note down the possible inventive, constructive, computational and organizational components of tasks.

6. Developing the solution obtained,
- it should be specified how the super-system, which the changing system is part of, should be transformed,

- it ought to be checked whether new applications of the changed system are possible,
- the solution obtained ought to be used to solve other technical tasks.

7. The analysis of the course of the solution process,
- one should compare the actual course of the solution with the theoretical one(predicted by ARIZ) and the differences should be noted,
- one should compare the obtained solution with table data and the differences should also be noted.

The Altszuller's laws of technical systems evolution: the law of the completeness of parts of the system, the law of energy conductivity of the system, the law of harmonizing the rhythms of parts of the system, the law of increasing the degree of ideality of the system, the law of uneven development of parts of the system, the law of transition to the super-system, the law of transition from macro to micro level, the law of increasing complexity of the technical system structure are the reference to the correct use of ARIZ. This reference is also provided by the standards of solutions for inventive tasks developed also by Altszuller (Martyniak 1985, pp. 117-136; Altszuller 1983).

The synectic method (synectics) is also useful in solving inventive tasks. Gordon is the creator of this method. The method is based on the main directives which are defined as follows (Góralski 1980, pp. 232-233):

- the principle of rejecting the usual rules and seemingly irrefutable truths,
- recommendation to create while acting collectively,
- combining different elements together,
- the diversity of the group allows to strengthen the domination effect of specialist knowledge,
- it is not possible to combine knowledge from various fields in one mind.
- A typical sequence of actions includes the following stages (Góralski 1980, pp. 233-245):
- undertaking a task,
- determining what is obvious,
- transforming the extraordinary into the ordinary,
- determination of the task,
- transforming the ordinary into the extraordinary.

The undertaking of the task is presented by a competent, in the field of the task, team member who becomes a team leader. The leader is responsible for dynamizing the team's work and the ongoing assessment of the team's work as well as the results obtained. At the stage of determining what is obvious, synectors work on the problem. The main goal of this stage is to raise awareness of patterns of thinking. The transformation of the extraordinary into the ordinary aims at modifying the task in such a way that it is more understandable and expressed

through well-known concepts. Analogy is the tool of reasoning. Defining the task aims at indicating the basic difficulties and eliminating the main contradictions. Transformation of the ordinary into the extraordinary is to give an effect in the form of a solution (problem, task). There are four mechanisms of stimulating creativity in synectics:

- personal analogy,
- direct analogy,
- symbolic analogy (transforming the extraordinary into the ordinary),
- a fantastic analogy (transforming the ordinary into the extraordinary).

A different view of the sequence of actions is as follows (Góralski (ed.) 1984, pp. 128-146):

A. The preliminary stage,

- presentation and analysis of the problem,
- reporting ready solutions,
- determination of the task.

B. The mental tour,

- submission of a wishfully and individually determined goal,
- moving away from the task and focusing on the analogy being developed,
- moving from one operating mechanism to another,
- recreation i.e. group specification of knowledge constructed personally,
- multiple repetition of the analogy construction cycle.

C. The final stage,

- noting prolific metaphors and associations by an expert (the hawk eye method),
- forced submission of any ideas and coming up with a solution to a task (the forced method).

D. Evaluation of results,

- the analysis of the quality of solutions obtained (individual evaluation of group members and experts),
- the assessment of work and efficiency of the group.

The premises for the effectiveness of the method are: emotional climate, motivation, intellect, the capacity of analogy, choice of task and errors.

3.7. METHODOLOGY FOR GENERATING SOLUTIONS

The solutions generation is a key element of the process of improving the organization, including the organization of rural areas. This activity consists of the following groups of activities: preparation and definition of a project problem, creation of solution variants and setting evaluation criteria, assessing variants and developing the best solution. Taking into account the review and methodologies of research conducted by us (Krakowiak-Bal, Wdowiak, Ziemiańczyk

2017, pp. 118-127), their stages in generating solutions can be specified. And so in:

- the descriptive-improving approach, the stage was described as 'the critical analysis and evaluation of the empirical material accumulated in the course of observation' (ibidem, p. 118),
- the functional modeling approach, the stage was expressed as 'the analysis of the latest, model solutions' (ibidem, p. 118),
- the diagnostic functional approach, the stage was defined as 'a method of idealization in finding optimal solutions' (ibidem, p. 118),
- the general outline of the above approaches in view of J. Trzcieniecki – in the phase of 'analysis and assessment of improvements' (ibidem, p. 118),
- the classical methodology as 'preparation of conditions and means' (ibidem, p. 119),
- the diagnostic methodology as 'analysis and synthesis' (ibidem, p. 119),
- the prognostic methodology as 'building a reference system' (in the context of purpose, entry, exit, the course of organization process, environment, set of system elements) (ibidem, pp. 119-120),
- the study of methods of work as 'critical analysis and assessment of the facts' (ibidem., pp. 120-122; Wdowiak 1980b),
- the analysis of values according to W. Biliński – stages 3 and 4, i.e. 'reflections – creative discussion' and 'selection of the optimal solution' (ibidem, p. 124),
- the analysis of values according to Z. Martyniak – stage 5 'the analysis of functions and searching for new solutions' (ibidem, p. 122-125) and W. Wdowiak (1980a, 1983, 1986),
- the methodology of spatial organization of work – stage 3 'the analysis of solution variants' (ibidem, pp.125-127).

Details in this regard are also presented by M. Lisiński (1992, pp. 50-57).

Numerous remarks result from the theory and practice of the variation process, which is one of the elements of solutions generation:

- a wide variety of variation research methods and tools are recognized,
- the aforementioned methodological remarks allow to state that the course of research proceedings boils down to specific phases, stages or steps of the research procedure,
- the division of the variation process comes down to two main parts: creating solution variants as well as evaluating and selecting the rational solution,
- so far, the issues of determining evaluation criteria that have a significant impact on the outcome of research proceedings in terms of criteria selection and their hierarchy are most frequently omitted,

- creating solution propositions is based in most research concepts on inventive methods which employ the deferred valuation principle (e.g. the most popular brainstorming method and its mutations),
- apart from the brainstorming method and its mutations, methods based on the classic combinatorial assumption of juxtaposing the parameters of the design problem (e.g. the morphological method) might be employed in this regard,
- methods for diagnosing an existing condition, identifying errors that can be combined into cause-and-effect chains that form the underpinning for formulating improvements (e.g. the chain method for the improvement of variations) may be utilized in the search for solutions,
- the application of simulation techniques for rational variation of solutions in conditions corresponding to research assumptions even with the use of computers is permissible,
- the key drawback of the variation problem is the lack of unambiguous, efficient and effective methods and detailed techniques corresponding to individual sub-objectives of the research procedure,
- a very general list of directives and research guidelines regarding the variation of organizational solutions is the fundamental negative consequence resulting from the above remarks.

According to M. Lisiński, the variation method includes the following phases, stages and research tasks (Lisiński 1992, p. 66):

I. The description of the design problem for the needs of the variation process.

1. The analysis of the design problem,
   - definition of the object, purpose and function,
   - determination of parameters of the design object,
   - specification of conditions, requirements and restrictions.
2. Determining the premises for evaluating the solution of the design problem,
   - determining the situational requirements of the system operation,
   - adoption of the additive usability difference rule as the selection strategy.

II. Creating solution variants.

1. Selection of parameters for generating variants,
   - determining parameters for generating variants.
2. Generating parameter values,
   - determining the parameter values.
3. Determining the solution variants,
   - creating solution variants.

III. Determining the criteria for evaluating solutions.

1. Defining a set of evaluation criteria,
   - determining a set of evaluation criteria.

2. Determining the relevance of the evaluation criteria,
   - indication of the relevance of the evaluation criteria

IV. Evaluation and selection.

1. Reduction of solution variants,
   - determination of a reduced set of variants.
2. Evaluation of solution variants,
   - determination of the value of the assessment criteria for the solution variants.
3. Selection of a rational solution,
   - selection and decision.

The generalization of the above phases, stages and research tasks allows building a methodology for the variation of organizational solutions, including its stages, research steps and auxiliary methods and techniques in the following layout (Lisiński 1992, p. 67):

1. The analysis of the design problem for the needs of the variation process.
   1.1. Recognition of the design problem (auxiliary selection procedure).
   1.2. Establishing the premises for evaluating the solution of the design problem.
2. Creating solution variants.
   2.1. Selection of parameters for creating variants (auxiliary selection procedure).
   2.2. Generating parameter values (discussion 66, technique 635, and the Gordon technique).
   2.3. Determination of solution variants (method of systematic calculation).
3. Determining criteria for solutions evaluation.
   3.1. Defining a set of evaluation criteria (the analytical technique for the selection of evaluation criteria).
   3.2. Determining the relevance of the evaluation criteria (the modified method of objectivity of the relevance of the evaluation criteria).
4. Evaluation and selection of a rational variant of the organizational solution.
   4.1. Reduction of solution variants (the variants reduction method – R-RP).
   4.2. Evaluation of solution variants (the evaluation technique of solution options, the expert method).
   4.3. Selection of a rational organizational solution.

4. MODELS OF KNOWLEDGE ORGANISATION IN THE CONTEXT OF RURAL AREAS

4.1. ORGANISATIONAL KNOWLEDGE CREATION SPIRALS AND MODELS

The future of development will shortly be conditioned by agricultural holdings, economic entities and institutions acting in rural areas which make use of knowledge and information. The knowledge embodied in new technologies and products as well as highly qualified labor resources will determine the innovation of the economy of these areas, their modernity and dynamics as well as a competitive advantage. The key to success will be the recruitment and retention of farmers and employees with unique competencies who are perfect in operation and ensure the increase in efficiency mainly through technological and production innovation and innovation of methods and procedures. This approach focuses on knowledge management processes and integrates areas of creativity, innovation, customer relations as well as the application of the best practices of learning and developing skills and culture based on knowledge. One should also agree with the statement that information, knowledge and intellectual capital are increasingly dominating over material capital, labor and land becoming factors of a competitive advantage. In this context, it ought to be noted that the so far considerations in the field of hermeneutics, heuristics and inventive methods deal rather with the subject of generating solutions (the unaware and unpredictable process) than with knowledge creation (the aware and predictable process due to the succeeding elements of forced associations). This is also supported by the fact that the vast majority of innovative methods utilize free associations in their solutions. Creative inventive methods based on forced associations, which favor the creation of specific and innovative knowledge such as morphological analysis, synectics or creatics, are unfortunately rare and are also seldom used in this field.

The basic concepts and definitions in the considered area of research on creativity are elaborated in M. Kłak's study, co-financed by the European Social Fund, the state budget, and the budget of the Local Government of the Podkarpackie Province, in the framework of a systemic project entitled "Enhancement of the institutional system of implementing the Regional Innovation Strategy in the period of 2007-2013 the Podkarpackie Province", implemented under the Human Capital Operational Program, published by the Publishing House of the Professor Edward Lipinski School of Economics, Law and Medical Sciences in Kielce in June 2010. Some of these concepts are worth considering here. For

example, the literature indicates that information and data are the keystone of knowledge and they become knowledge only after they have been processed (Kłak 2010, p. 14). Data are treated as information components that are raw and unprocessed facts, numbers and events. The processed data create messages and shape information. Information is defined as organized data and all relevant factors employed to reach decisions (ibidem, p. 15). Among a plethora of knowledge definitions one should pay attention to the denotation of E. Turban who emphasizes a number of components such as truth, beliefs, predictions, ideas, judgments, expectations, methodology and know-how (ibidem, p. 17). It is also claimed that knowledge is information embedded in the right context that allows effective and efficacious action (...). Knowledge understood in the aspect of the human factor is defined as tacit knowledge, and in the aspect of technology (IT) as explicit knowledge. When defining knowledge belonging to people as personalized knowledge, it should be assumed that the knowledge consists of explicit knowledge and tacit knowledge, and its key element is the core. This core allows transforming personalized knowledge into a codified and well-established form, and vice versa. In addition to the personalized knowledge, the organization also has codified knowledge (documentation, projects, publications, databases) and well-established knowledge (products, services, systems, processes, brands, relationships, technologies) that remain in the organization regardless of the presence of people in it. Intellectual capital is defined as assets such as knowledge, collective competences, clientele and reputation of the company, brand value or patents that generate profits which cannot be measured by traditional accounting methods, (ibidem, pp. 18, 19). The most interesting knowledge management formulation is the definition of NASA which defines it as making the right knowledge available for the right people at the right time and helping in its creation, share and in reaching decisions with the use of it in such a way so as to achieve measurable results (ibidem, p. 20).

Knowledge management functions should be considered in the context of knowledge-related processes, such as (ibidem, p. 43) acquisition, creation, distribution, storage, monitoring and evaluation. The cyclic functions of knowledge management include planning the knowledge generation process, organizing the knowledge generation process and controlling the knowledge generation process. The continuous functions are: cooperation with people, financial and material resources acquisition, work on information, decision making and coordination.

The specific concept of processes in the knowledge management cycle includes (ibidem, p. 53): discovery of knowledge (data, information, knowledge, the history of knowledge management, philosophical concepts of knowledge), knowledge generation (organizational learning, knowledge management tools and technologies), knowledge valuation (knowledge management systems, different approaches to strategies in the context of knowledge management), dissemination of knowledge (knowledge management and organizational culture,

intellectual capital), the use of knowledge (knowledge management in a learning organization, intellectual capital). In broad concepts, knowledge management processes such as location of knowledge (by developing structures for presenting existing resources and methods for discovering organizational knowledge), archiving knowledge (by selecting, storing and updating data), protection of knowledge (explicit, protected and confidential, and also its compilation), selling of knowledge (in the form of patents, new products, services, technologies, etc.) are additionally described.

The analysis of the aforementioned processes and their conditions leads in consequence to indicating the selection factors of the dominant approach to the organization of the knowledge management process in an enterprise. These factors include (ibidem, p. 55): adopted mission and strategy of the enterprise, type of business, previous experience and skills in knowledge management, skills possessed in exploiting modern information technologies, financial capabilities of the enterprise as well as the level of employee competencies.

Taking into account the above factors, the process of knowledge management at the operational level will be implemented in four stages (ibidem, p. 56):

- learning about the information indispensable to perform duties at workplace,
- utilizing the knowledge in action,
- acquiring new knowledge by assimilating, understanding and enriching knowledge assets in the organization,
- developing own skills and competences.

At the strategic level, it is necessary to implement the subsequent stages (ibidem, p. 56):

- assessment of knowledge assets; knowledge is available from various sources,
- construction (codification) of knowledge so that its strategic elements such as the intellectual capital of the company remain even after resignation of key employees,
- maintaining assets of knowledge strongly associated with people and IT systems of the enterprise,
- elimination of knowledge unnecessary and inadequate to the needs.

The exemplary knowledge management model can additionally be based on the IT research proposal for the research model for the area of mediation in scientific communication (Sapa 2009, pp. 151-178). The key assumptions and the modelling concept include the following conditions (ibidem, pp. 151-156):

- the proposed model will primarily have an ontological and, in a sense, symbolic character,
- the model, regardless of which side is considered, will always fall between *shear* theory and *shear* empiricism, from theory to empiricism or from empiricism to the theory,

- the adoption of the IT perspective allows for the construction of research, determinants of formulation processes, processing and transferring scientific resources mainly recorded for the purpose of their transfer,
- the IT approach also means the interdisciplinary nature of exploration and the pursuit of integration of various research perspectives on resources (data, information and knowledge),
- the integration approach allows to avoid the fragmentation of research and enables a coherent analysis of process conditions,
- the rejection of extreme determinisms and acceptance of the fact that the multidimensionality of the studied phenomenon does not have to mean consent to chaos, provided that a coherent research model and interpretation of process conditions are built,
- the search for universalism must mean the adoption of a very broad scope of the proposed model, and the integration approach enables to maintain its cohesion,
- the proposed model is to concern the area of mediation in scientific communication, capable of performing all its functions,
- the concept of the model as an area of mediation in scientific communication allows to build a holistic image of the phenomena occurring,
- assumed universality and holistic character of the model may lead to its excessive expansion or too broad generality, which is to be counteracted by the desire to represent not all specific relations and entities involved in the processes of mediation, but the conditions for the formation and maintenance of these relations, principles of ordering, describing and interpretation of facts and phenomena that are perceived empirically and the specification of theoretical findings, as well as the application of levels in modelling,
- the adoption of the foundations of the actor-network theory allows for taking into account different factors (social, technical, economic and other) conditioning the actions of the subject and treat it as a whole, capable of making specific decisions and entering into relationships with other entities,
- the processes which are subjected to scientific resources in the area of mediation, will be treated as a resultant of specific structures built by entities operating in this area,
- the initial (basic) model is to be universal and holistic, while the specific and theoretical models at the other extreme should reflect various aspects of the heterogeneity of the area of mediation in scientific communication, taking into account the epistemological, social, economic and technical specifics of different spaces of communication,

- the basic model is not supposed to show what a given fragment of reality looks like, but what factors and in what relations it should be examined to obtain such a conceived picture,
- the operational models, created between the initial model and empiricism of specific phenomena, may take a different shape due to different results of empirical research in various disciplines, domains or social groups,
- the constructed model should be perceived in the 'horizontal' dimension, determined by the metatheoretical plane and the concept of the object of transfer and entities functioning in the area of mediation and in the 'vertical' one which defines its place between theoretical models and the constructed ones at a level directed towards empiricism,
- the 'horizontal' dimension of the model regarding the formation of structures is static and can be presented graphically, while the 'vertical' dimension allowing to capture processes at the level of empirical or theoretical research is dynamic and represents not one specific solution, but directions of transforming the basic model leading to many different representations of the studied reality,
- the basic model is to be mainly used for methodological purposes, but it can also be employed as the basis for the construction of normative models, supporting conceptual and design activities in order to improve, in practice, the functioning of the entire system.

The basic research model of the area of mediation in communication is based on the following tenets (ibidem, pp. 156-161):

- the model is built around the issues of creating, defining and modifying structures of participation in communication, within which formulation, processing and transfer of knowledge resources take place,
- the formation of new structures occurs in conditions of competition and rivalry between the interested entities,
- the model includes the concepts of division of communication into the sphere of direct creation of resources and the sphere of managing these resources,
- the constitution of various structures of the communication system through the prism of rivalry of individual entities allows to clearly define the limits of the scope of the subject model, taking into account the economic perspective and the right to bring the 'added value',
- the requirement to establish the basic condition for the functioning of various structures within the framework of communication is fulfilled, according to the concept of the SCOT theory which assumes that the choice of an option is determined by its ability to perform such a function at the level expected by the social groups concerned with particular emphasis on social usability,

- the conditions of formation of various structures and processes occurring within them are taken into account with particular emphasis on the inclusion of factors shaping the analyzed phenomenon in the basic model,
- the media of all determinants are entities of the mediation area, hence these determinants are treated as not existing objectively,
- allowance is made for the fact that determinants are rooted in entities understood as elementary structures, built of human, social, technical, economic elements and epistemological convictions,
- the basic model is simplified in this way, creating, at the same time, favorable conditions for its realization in the form of an entity with specific beliefs, dependent on its other social roles, possessing a certain set of knowledge and skills, equipped with technologies and economic resources, which can be more easily defined and characterized,
- 'entities-media' for all factors conditioning the analyzed phenomena are identified at the stage of realization of the basic model,
- it is assumed that participation in the system means participation in the implementation of at least one of its functions, that is, their derivatives in the form of tasks that are undertaken to implement them,
- it is also assumed that the tasks on the one hand are a derivative of the communication function, and on the other hand their character and dimension result from the specificity of the entities involved being an indispensable and specific component of research for each of the structures functioning in the area of mediation, subject to the 'vertical' model,
- it is anticipated that building the model upon processes would mean its segmental analysis, which could result in the model not being universal,
- it is pointed out that a melting pot, in which specific structures are 'melting' and relations between entities are established in relation to a given available good which is work, and at the level of the black box of the model, entities and tasks 'come in' and specific structures, conditioning the implementation of communication processes, 'come out', is the core of the model.

This is also characterized by the flexibility and usability of the model.

The possibilities of theoretical development of the basic model should take place in the following areas (ibidem, pp. 161-167):

- searching for and developing theories enabling modelling of the formation and functioning of structures, providing a coherent system of concepts, theorems and laws regarding the causes and consequences of establishing relations between interested stakeholders, as well as the decision-making system of these entities,

- employing, in the considerations, the actor-network theory due to its scalability, which allows to model the formation and transformation of both small structures built of elements available at the empirical level as well as networks constructed on the basis of conceptual categories, elements of which are elementary networks as 'products' of modelling at a lower level,
- verifying the methodology not only on the basis of sociology, but also, for example in epidemiological studies, the development of terrorist networks, the functioning of telecommunication and organizational systems as well as in the science of information and knowledge,
- the analysis of social networks in connection with the theory of social capital in the science of information and research on information behavior, in broadly understood communication problems, including scientific communication,
- the game theory as a basis for studying behavior in conflict situations in conditions of rivalry and competition in order to understand the strategic elements of various economic and social situations by means of formal models.

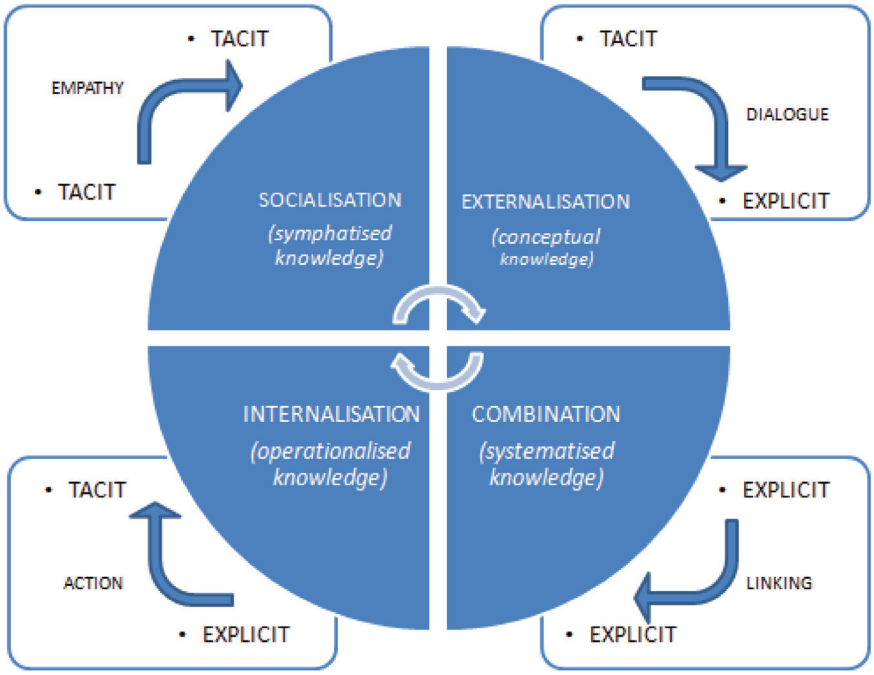
It can be heard more and more frequently that knowledge is a key element; development, scientific research or investments in human capital are subject to it. However, people keep forgetting essential things due to the fact that they are in a hurry, they simplify things under the pressure of time, and they express misleading opinions and predictions.

To help us and the organization manage knowledge, a plethora of models have been created. They make us aware of the importance of knowledge and the need to pay special attention to it in a dynamic environment. They also make people aware of how knowledge is created and what actions can be taken to increase the potential of an individual or an organization.

Details and specifics of the construction of Japanese models of knowledge management are analyzed in the following subchapters.

4.1.1. THE SECI SPIRAL IN THE INTERPLAY BETWEEN GROUP AND INDIVIDUAL KNOWLEDGE

The first model – most often cited by specialists – was proposed by Professor Ikujiro Nonaka. It was created in the 1990s and was published in the book *The Knowledge Creating Company* (Oxford University Press, USA 1995) (Polish translation: Nonaka, Takeuchi 2000). The model illustrates the creation, transfer and reproduction of knowledge in organizations and is presented in Figure 3.



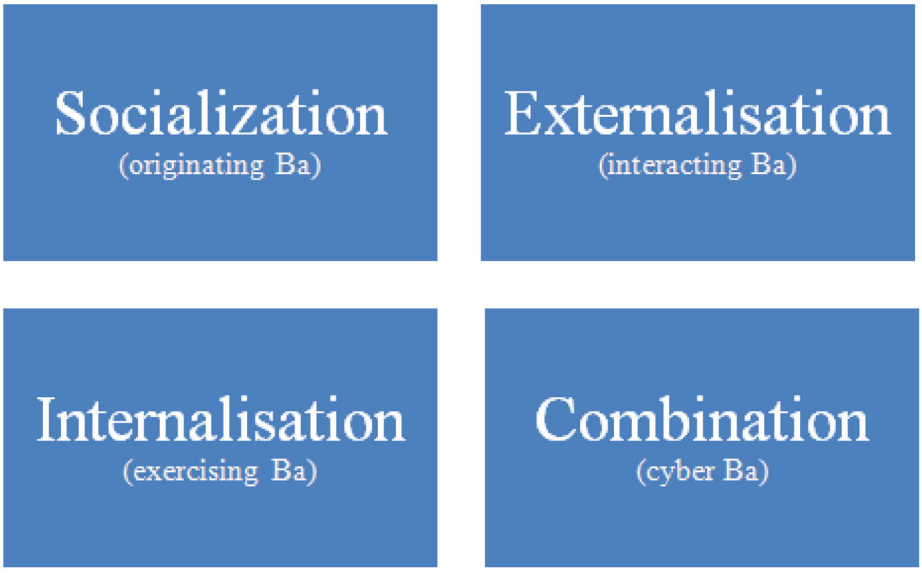
(Source: own study, based on Nonaka, Takeuchi 2000)

Figure 3. Model according to Ikujiro Nonaki

Knowledge is created by individuals and that is why it is worth using tools, strategies and creating a mechanism that helps transform tacit knowledge into explicit one. Nonaka and Takeuchi distinguished four ways of knowledge conversion which are arranged in a specific spiral consisting of the following stages:

- socialisation – from tacit knowledge to tacit knowledge. The key is to acquire knowledge through a direct contact with another person. The key is the experience of people who pass knowledge further that is, for example, teachers conveying knowledge to their students or in organizations meetings including brainstorming, trainings and workshops conducted by managers.
- externalisation – from tacit knowledge to explicit knowledge. This is the key to creating knowledge and delivering new ideas.
- combination – from explicit knowledge to explicit knowledge. It allows systematizing the available knowledge by categorizing and unifying the information possessed.
- internalisation – from explicit knowledge to tacit knowledge. It allows learning by doing.

It should also be mentioned that knowledge in the Nonaki model is of individual, group, organizational and inter-organizational character. The interaction between forms of knowledge and organizational levels is also essential for the concept. In 1998, Nonaka and Konno adapted the concept of "Ba" originally modelled by the Japanese philosopher Kitaro Nishida and which was then developed to the SECI model (short for the English words: Socialization, Externalisation, Combination, Internalisation) by Shimizu. Ba is the equivalent of the place, the space in which interactions between explicit and tacit knowledge take place, which in turn lead to the emergence of new knowledge. Adapting Ba to the SECI model is shown in Figure 4.



(Source: own study, based on Nonaka, Takeuchi 2000)

Figure. 4. Adaptation of Ba to the SECI model

The original Ba defined by Nonaka is the space for sharing feelings, emotions, experiences and mental models. Through direct contact and communication, the first step is taken towards conversion and transfer of tacit knowledge. In the world of Ba interaction, there is a change of tacit knowledge into explicit one. A dialogue, exchange of individual mental models and the combination of skills of people selected for a team create in effect common conditions and ideas. Two processes take place here: individuals share the models of others but also consider and analyze their own mental models. The Cyber Ba is a virtual space of interaction that converts explicit knowledge into a more complex set of ex-

plicit knowledge. At this level, the processes of communication, diffusion and systematization of knowledge are critical. In practice, the combination phase consists of three processes: the consolidation and integration of new explicit knowledge; dissemination of knowledge directly at a meeting or through a presentation; editing or processing of explicit knowledge in such a way that it is more useful (e.g. a report, a plan or market data). Special space must be created for all these activities – it is often a virtual world instead of a real one, hence the name Cyber Ba.

Explicit and tacit knowledge intertwine during the conducted activity in the organization; the literature describes four ways of knowledge conversion which create a spiral of knowledge and are constantly repeated. According to the authors of the concept, the launch of the spiral of knowledge in the organization is favored by (Nonaka, Takeuchi 2000):

- providing employees with autonomy which motivates them and contributes to the emergence of new ideas,
- presenting the employees with intentions, aims and goals of the organization and then making them become their goals,
- instability and creative chaos that make it easier to break routine and react to changes in the environment, and thus induce changes in the way of thinking and implementing new ideas replacing earlier procedures,
- redundancy of knowledge, going beyond the needs of current activity; it is substantial at the stage of creating ideas,
- internal diversity; the diversification of members of the organization allows for better functioning in conditions of diversity and complexity of the environment.

Among the tools and instruments that support the development and dissemination of knowledge, one can point to various forms of meetings, groups and teams of knowledge, groups of common interests, communities of practitioners, open space technology, quality circles, teams of creative quality development, 'yeast fermentation' concepts, the internal marketing strategy, brainstorming and others (Mikuła et al. 2007). Knowledge can be created inside an organization or imported from the outside. In order for knowledge to be created in the organization, it is necessary to create favorable conditions. However, in the process of knowledge creation, the human factor plays a decisive role. This role was emphasized in the model of knowledge creation by Nonaka and Takeuchi which focuses primarily on the process of creating new individual and organizational knowledge owing to people.

The integrated model of organizational knowledge creation consists of five phases (Nonaka, Takeuchi, 2000): sharing tacit knowledge, searching for ideas, confirming ideas, building a pattern and equaling knowledge levels. A brief description of the phases is presented below (Skrzypek, 2013):

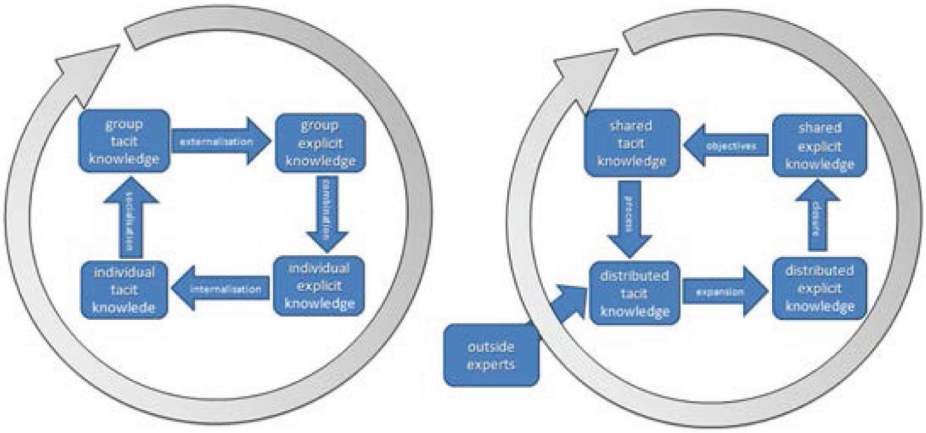
1. Disseminating tacit knowledge of individuals in the process of socialization, building independent teams, direct contact between team members, creating an atmosphere of trust that allows sharing knowledge.
2. Interaction between explicit knowledge and tacit knowledge in the externalization process, dialogue and cooperation, agreement, development of a common idea, an unambiguous definition of concepts and articulation of new knowledge that employees will be able to absorb. Common ideas are most often fostered by autonomy of the individual, diversification of team members, creative chaos and information redundancy.
3. Verification of a new idea, because knowledge is a confirmed belief, the verification is to provide information whether the idea will be beneficial and effective from the point of view of the organization and society.
4. Building a pattern, creating a prototype or mechanism of action. At this stage, the concept takes on a material form. This phase is related to the combination process. The pattern is created as a result of combining new knowledge with already available knowledge. The development of the pattern is the result of cooperation of specialists from various departments. This process usually supports diversity, information redundancy, strategy and internal interaction.
5. Balancing knowledge between levels both in intra-organizational and inter-organizational dimension.

Organizational knowledge creation is a continuous process. The concept created in one cycle initiates the next process at a higher level.

4.1.2. THE OPEC SPIRAL AND THE INVITATION OF EXTERNAL EXPERTS

Due to the great interest in the theory of Nonaki and Takuchi, a myriad of competing theories were created, especially in the United States. The Gasson theory (2004), which can be called the OPEC spiral, is worth mentioning here. It is illustrated in the Figure below. It is the Western reaction/response to: *America creates knowledge differently but emphasizes the privatization of knowledge, the hiring of experts. Will the full privatization of knowledge not end up polluting the intellectual heritage of humanity (analogy to environmental pollution in the industrial era)?*

The OPEC Spiral (S.Gasson) The SECI Spiral



(Source: based on Wierzbicki and Nakamori 2006, Wierzbicki 2012)

Figure 5. Comparison of the OPEC spiral with the SECI spiral

The network nodes considered by Gasson, although they have slightly different names, are virtually identical to the Nonaki and Takeuchi network nodes.

However, the transitions between these nodes have the opposite direction and different character; they include Objectives, Process, Expansion and Closure. Without going into a detailed description of these transitions, suffice to say, they describe rather typical activities of Anglo-Saxon organizations, starting with a collective discussion of goals (while the socialization of Nonaki and Takeuchi is of Japanese culture). Gasson in her spiral does not underscore the creation of knowledge within the organization, but takes the typically Anglo-Saxon assumption that in the case of shortage of knowledge, the organization will acquire it through the hire of external experts (Wierzbicki, Nakamori, 2007).

4.1.3. THE DCCV SPIRAL OF BRAINSTORMING

Developed by A. Osborne, an American scientist, this method, also known as ‘the exchange of ideas’, ‘the ideas factory’ or ‘the creative discussion’, was first employed in 1938. It engages all participants, giving everyone the opportunity to speak freely. Brainstorming is easy and does not take long to prepare. No special teaching aids are needed to utilize it. The advantage of this technique is that it stimulates creative thinking. Brainstorming enables to develop listening skills while refraining from criticizing other people’s opinions. Chronologically, the first of these methods appeared much earlier (Osborn 1957) than the brain-

storming method. However, it was not until much later that it was fully formalized and described as the DCCV spiral of brainstorming (Kunifuji et al. 2004, Kunifuji et al., 2007).

Brainstorming has a myriad of definitions, its very name implies an intense inspiration and a group generation of new ideas, a group type of creative transition, which in the rational theory of intuition is called enlightenment (abductive reasoning, illumination, aha, eureka). However, after the publication of the book entitled *Applied Imagination* (Osborn 1957), the word 'brainstorming' took on a specific meaning. Brainstorming is a group process of creating new ideas and postponing the assessment of their value. It was not observed until later that the brainstorming method could also be applied individually because its essence is to generate and record new ideas with postponement of their evaluation and selection, although, by all means, in the group process not only generation of a larger number of ideas takes place, but also specific positive feedback stimulating such a generation. This brainstorming phase is called divergent, divergent thinking or divergent production. The brainstorming rules developed on this basis (in its divergent phase) included the following statements:

1. The purpose of brainstorming in its divergent phase is to create a large number of ideas, not necessarily the best ones,
2. The assessment of the quality of the idea should be suspended (in the sense of good or bad ideas, realizable or not, etc.),
3. Original ideas should particularly be sought after,
4. The use or modification of ideas already submitted is also desirable.

The idea of brainstorming is presented in the Figure below.

Brainstorming has a plethora of advantages and disadvantages. A significant advantage is primarily the fact that the group utilizing this method usually leads discussions in informal tone, presenting their ideas in succession. Everyone has the right to speak, express their opinion, can get inspired by the idea of a friend or a colleague and develop the idea that at first did not have a positive projection. The fact that some participants might dominate over others is the disadvantage. Being evaluated is a sensitive issue which in turn causes that not all ideas break through, and naturally the whole group loses. The rudimentary disadvantage is connected with its incoherence: after the divergent phase, the convergent phase, selection and choice of ideas should launch, and such a switch interferes psychologically with the attitude of 'let all flowers flourish' of the first phase which is the divergent phase. In other words, who is to be responsible for the selection of ideas, the whole group or the host of brainstorming? Who do the ideas generated during the stage of brainstorming belong to? Despite these drawbacks, brainstorming has become one of the most commonly used methods for solving problems or creating useful ideas in industrial and other organizations. However, in the processes of academic knowledge creation, it is less frequently applied. Yet, it is the oldest and fairly widely used organizational process of

knowledge creation, of intercultural character, which is pre-emptive and more widely used than the processes described by the discussed SECI spirals (of Far Eastern nature, Nonaka and Takeuchi 1995) or the OPEC spiral (of the West Anglo-Saxon nature, Gasson 2004). The first applications of brainstorming took place at NASA and were associated with planning of space research. There are numerous attempts to determine the general brainstorming model (see Kunifuji et al., 2007), however, the phases relevant to this process, marked as appropriate transitions in the model shown in Figure 6 are as follows:

A) Divergent thinking (Divergence) as in the aforementioned divergent phase of the process,

B) Convergent thinking (Convergence) appraisal and selection of ideas,

C) Crystallization of ideas (Crystallization), their more specific elaboration (particularly of analytical character since the previous phases have a considerably intuitive character),

D) Verification of ideas (Verification), application and testing of selected ideas in this way.

The method consists of three stages:

1. Introduction

The leader prepares and guides through understanding the problem to be solved (it can be a lecture or a talk), then presents the problem to be solved (e.g. in the form of a question, presentation of the issue). Their task is also to talk through the rules of participation in brainstorming. The following rules should be taken into account:

- unimaginable imagination – ideas can be the most daring and ridiculous,
- everyone has the right to submit any number of ideas,
- the number is important, not the quality of ideas,
- no criticism – ideas cannot be evaluated, criticized and commented on on a regular basis,
- one can use previously submitted ideas, change them or develop them,
- the author of the idea is not identified,
- the leader/teacher appoints speakers,
- ideas should be written on board.

2. The ingenuity session

Participants present their ideas to solve the problem. The session lasts 5 – 15 minutes. Its end is marked by a clear drop in the number of ideas submitted or the leader's decision that the collected material is enough to solve the problem.

3. The analysis and evaluation of ideas

The solutions are evaluated only after submitting all proposals. There is a discussion about the ideas presented. Then, the best solutions to the problem are chosen and justified.

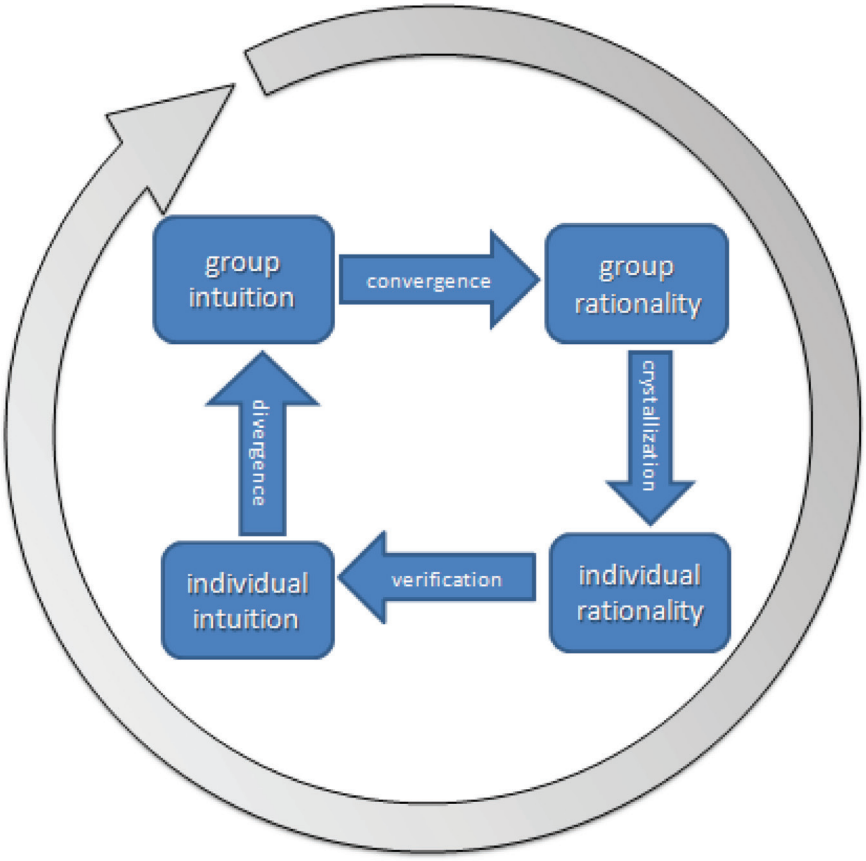


Figure 6. The DCCV spiral of brainstorming (Konifuji et al. 2004, 2007)

4.1.4. THE HEDLUND'S MODEL AND HIERARCHY LEVELS

In 1994 Professor Gunnar Hedlund[1] from the Stockholm School of Economics presented a model that included primarily creation, representation, storage, transfer, processing, application and protection of organizational knowledge. In this model, there are relations between tacit and explicit knowledge at four levels (which were also noticed by Nonaka): individual, group, organizational and inter-organizational, at which knowledge is created and through which it flows. In his article (Hedlund 1994, pp. 73-90), Hedlund pointed to the differ-

[1]After the death of prof. Gunnar Hedlund (1997), the board of the Institute of International Trade of the Stockholm School of Economics and the European International Business Academy established the international Gunnar Hedlund Award for the best doctoral dissertation in amount €10,000, details: www.hhs.se

ences between the Western and Japanese models of knowledge management. These models are related to the characteristic of the organization, which inter alia includes the employment system, career models and the organizational structure. According to Hedlund, the hierarchical form is not effective because it is based on the M-form structure. It is composed of branches which despite being able to be controlled, similarly to administrative costs, strategic decisions are not made at this level, but only operational ones, while the board, analyzing performance indicators, monitors branch performance. Therefore, although the organization can be diversified, the branches start to compete with each other rather than co-operate. Additional hierarchy levels are created that are characterized by myopia and opportunism.

He presented an alternative 'N-form' structure, in which groups of people would create freely and temporarily, and communication between them would be horizontal (parallel). In such a structure, a lot of attention would be paid to middle and lower level personnel, and the managers would play a catalytic role in the organization. The basic principle of the N-form structure is that it involves combination of knowledge rather than its division. The additional Hedlund's observation is the division of two types of knowledge (tacit and explicit) into three forms: cognitive, skills and innate (embedded). Knowledge, as previously mentioned, can be transferred at four levels (areas) – see Table 1.

Table 1. Types of knowledge and levels of its formation/transfer

	Areas			
	Individual	Group	Organizational	Inter-organizational
Explicit knowledge	Account of knowledge	Quality indicator Documented analyses of performance	Organizational plan	Suppliers' patents documented practices
Tacit knowledge	International negotiation skills	Team management utilising comprehensive work	Corporate culture	Customer attitudes and expectations

Source: own study based on McAdam, McCreedy 1999, pp. 91-101.

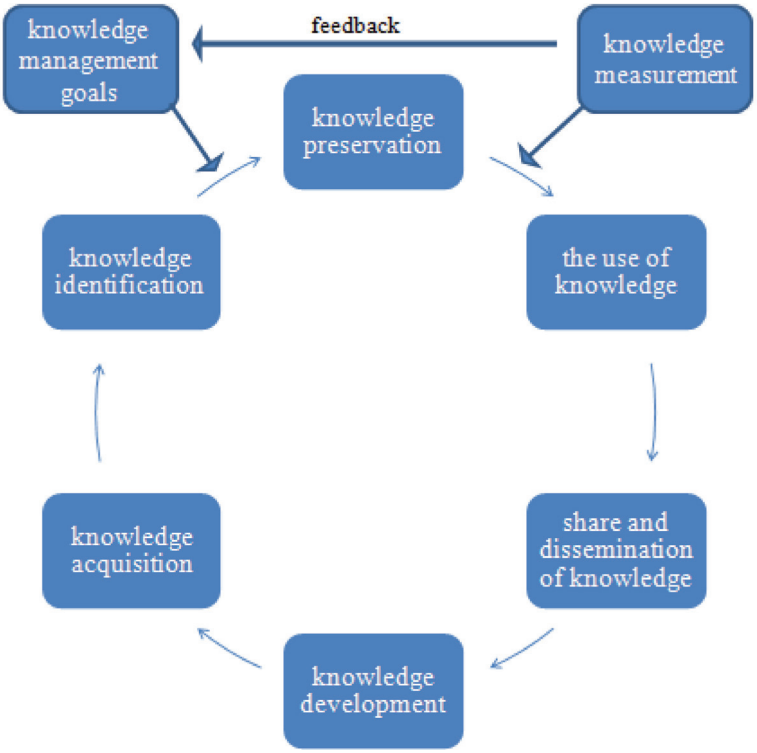
There are several processes taking place here:

a) knowledge verbalization and its internalization at the individual level,
b) expansion and combination of knowledge through a dialogue and joint execution of tasks at the group and organizational level,
c) assimilation and dissemination of knowledge through interaction with environment at the inter-organizational level (examples given in Figure 3).

In addition, Hedlund pointed out that the dynamics of the flow and processing of knowledge is not only about its storage or transmission, but should also consider its transformation, which was not the interest of previous researchers. In order to contribute to the formation of the N-form structure, interaction between all the mentioned processes at different levels should be made. In this way, new knowledge will be created, and the structure of N-forms will enable to manage it better.

4.1.5. THE GILBERT, PROBST, RAUB AND ROMHARDT'S MODEL AND MANAGEMENT OF INTELLECTUAL RESOURCES

This model presents the general concept of intellectual resources management in the organization (Probst, Raub, Romhardt 2002). According to its authors, there are six processes related to knowledge management, presented below in Figure 7.



(Source: Probst, Raub, Romhardt 2002, p.46)

Figure 7. Six knowledge management processes

The specified processes can be described as follows:

- Knowledge identification concerns the discovery of knowledge sources and is also related to the creation of methods for acquiring knowledge, by structuring the intellectual resources of the organization and creation of knowledge identification maps.
- Knowledge acquisition is primarily related to interactions with the external environment that is customers, suppliers or partner companies. External experts can be hired or innovative organizations can be taken over.
- Knowledge development involves researching, creating new products, streamlining processes and developing skills. Employers at this stage should also pay attention to employees' ideas and reward their creativity.
- Knowledge share and dissemination is a complex problem. On the one hand, knowledge possessed by an employee or an organization consists in a competitive advantage over others (it is unique and people are reluctant to share it). On the other hand, employees need access to certain information, so that, combined with their skills, they serve the whole organization. It is worth considering exactly what knowledge individual units need in the organization, what it refers to, what it should influence and what should change, and how to distribute it safely.
- The use of knowledge. Knowledge should be properly exploited, preferably in a productive way creating added value. It is also necessary to overcome barriers related to routine, fear of the unknown, worries about losing a job, not overestimate one's position and values, and above all learn from own and other people's mistakes and draw on own and external resources (achievements of others should not be rejected but should inspire).
- Preservation of knowledge. If knowledge is acquired and used, it must also be preserved. The relevant data are selected, stored and updated now and again. Access to such information means that the organization develops, the same mistakes are not repeated, and the intellectual resources are fully utilized.

The other areas included in the Figure are knowledge management goals and knowledge measurement. By setting goals, which enable to adopt appropriate assumptions, prepare a strategy, plans and define specific tasks, the direction of knowledge management is set. Assumptions refer to building knowledge-based culture of the organization. Plans and strategy relate to the resources, available to the organization, which manages them in such a way so as to gain a market advantage in the future. Tasks consist in the operational approach to the assumptions and plans of a long-term strategy. Knowledge can only be assessed if a system for measuring the effectiveness of its use can be created. One can

do it taking into account the achievements of individual departments, financial profits of the organization, but one can also create their own models for assessing the use of knowledge.

4.2. SPIRALS AND MODELS AS FORMS OF KNOWLEDGE CREATION

When presenting models of knowledge creation, it is necessary to distinguish the so-called organizational and academic models. Micro-models of knowledge creation are of organizational character when they are used by a specific group or organization, and the knowledge commonly generated is the property of this group, not its individual members. This aspect distinguishes organizational models of knowledge creation from analogical academic models of its creation (Wierzbicki 2012).

In the process of knowledge creation at universities, the interest of the individual creator prevails, although accepted and supported by the group's activities. At least three types of knowledge creation processes can be considered: a debate, an experiment, and hermeneutics – understood more broadly as art of interpreting selected elements of the intellectual heritage of humanity, regardless of whether they concern theology, humanities or technical sciences.

Simultaneously, all organizational processes of knowledge creation such as brainstorming, the SECI Spiral, the OPEC Spiral, the ETC Spiral are group-motivated. It is assumed that created knowledge will belong to the entire group or organizers of the knowledge creation process. Therefore, the popular brainstorming process has not gained wide acceptance, has not widely been adopted and used in academic settings. This shows that there are significant differences between the academic and organizational processes of knowledge creation. This can also hinder and slow down the transfer of knowledge between research units and the industry. At the same time, awareness of these differences can enhance and combine these processes. An example of a combination of knowledge creation processes in scientific and business units is the Nanatsudaki Septagram (Nakamori, 2016).

Processes describing the emergence of knowledge in organizations (including scientific and research units) were collected as part of the theory of 'creative environment' (Wierzbicki, Nakamori 2007) which is a synthesis of studies initiated on operational grounds (Nonaka 1991, Chudzian et al. 2011).

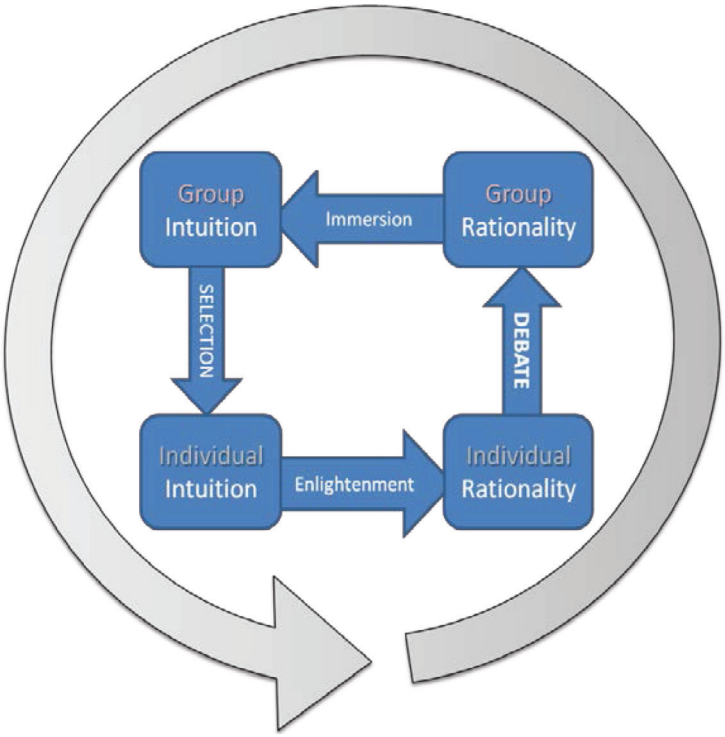
The dynamic model of the creative process by M. Csikszentmihalyi, an American psychologist of personality, assumes that the essence of creativity is the interaction between three systems: domains, fields and individuals. Therefore, creativity is not only a psychological phenomenon concerning the individual's potential, but an extensive system in which cultural and social factors

play a significant role. The system of the field includes "(...) culturally structured patterns, symbol systems, experiments and creative procedures" (Szmidt, 2007). It is therefore a specific area of science or art. Mentioning the models of the creative process, one should also recall the Schulz model (1990) or the concept of the ecosystems of Stasiakiewicz's work (1999).

The EDIS Spiral, the EEIS Spiral, the EAIR Spiral, the Triple Helix Spiral, the ARME Spiral, the Nakamori Pentagram, the Nanadsudaki Septagram and the Creative Space Model are presented in the subsequent subchapters as the examples of the aforementioned issues.

4.2.1. THE EDIS SPIRAL OF DEBATE AND THE DOUBLE DEBATE PRINCIPLE

Debate is a process that runs through the same nodes of creative space as the SECI Spiral or the OPEC Spiral, only with other transitions and a different interpretation. The process of creating academic knowledge in this context is presented using the EDIS Spiral of Debate (Wierzbicki 2012).



Source: based on (Wierzbicki and Nakamori 2006)

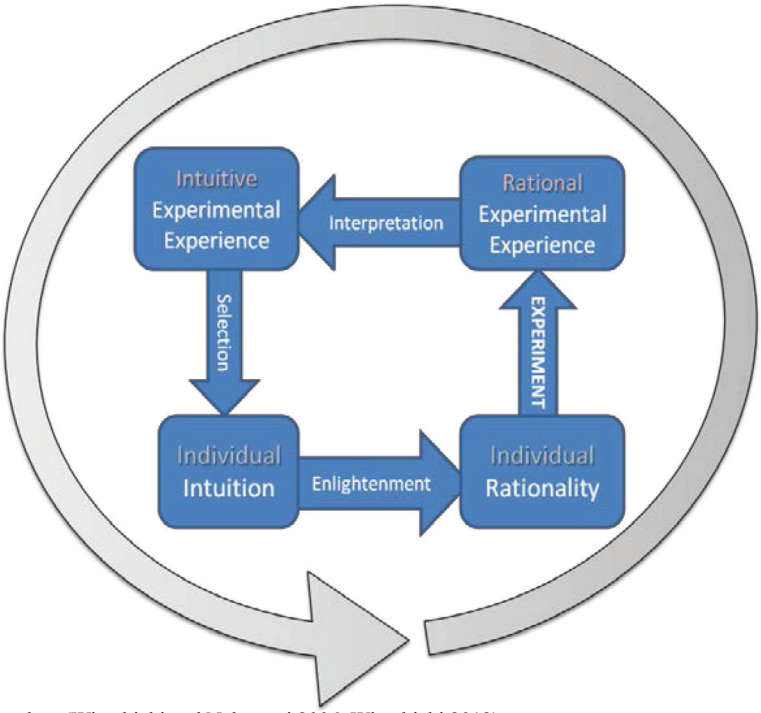
Figure 8. The EDIS Spiral of Debate

A single researcher, owing to their intuition, has either a good or bad idea, and the idea itself is not enough, it needs to be rationalized, that is, to be articulated or put into equations – it is so-called *Enlightenment*. The group supports the researcher primarily by providing him/her with a forum for discussing his/her ideas; the more insightful the debate, the better the group support – (Debate). The schema also shows an element resulting from the rational theory of intuition. This theory indicates that a deeper, more insightful debate will be generated if the group is given time to reflect, to shape comments, to develop (Immersion) group rationality in group intuition. Hence the practical conclusion, the Principle of Double Debate: the debate of new ideas should be repeated, e.g. after a week or two, if one wants to support an individual researcher, not only with the explicit knowledge of the group, but also with its tacit knowledge or at least group intuition. After receiving the group's remarks, an individual researcher selects these remarks (*Selection*), which will be included in further research. However, everyone who has participated in such processes is fully aware that this choice takes place at an intuitive rather than a rational level.

4.2.2. THE EXPERIMENTAL EEIS SPIRAL IN THE CONTEXT OF VERIFICATION

The spiral describing experimental creation of knowledge is a modification of the EEIS Spiral taking into account the situation when the verification of new ideas takes place not through a debate but through an experiment. The modified EEIS Spiral (Enlightenment-Experiment-Interpretation-Selection) is shown in Figure 9. First of all, in the experimental sciences instead of a debate, ideas are verified through experiments.

The transition Experiment (Experiment) means verification through an experiment. However, every researcher using this tool knows that raw data as the basis of experiment do not contribute to novelty. Their interpretation (Interpretation), which is a form of deepening of the raw data analysis based on the researcher's experimental intuition and his/her experience, is indispensable. Subsequently, selection (Selection) of such aspects of experimental data that have the greatest impact on the development of the researcher's ideas takes place. The experiment is usually of an individual type, although more complex experiments can be organized and implemented in groups.



Source: based on (Wierzbicki and Nakamori 2006, Wierzbicki 2012)

Figure 9. The Experimental EEIS Spiral

4.2.3. THE HERMENEUTICAL EAIR SPIRAL IN THE CONTEXT OF REFLECTION

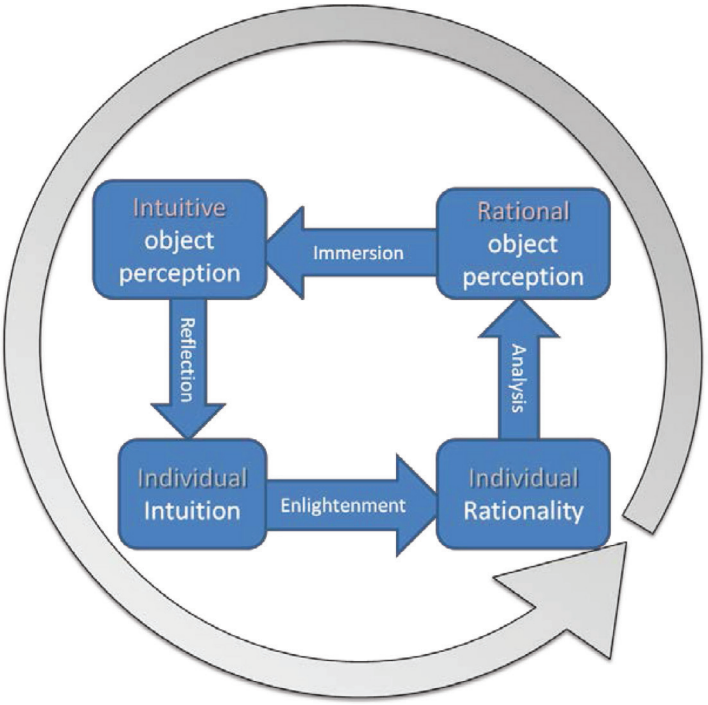
The EAIR Spiral, also called the hermeneutic spiral, consists of four stages:

- *Enlightenment* – this stage starts with an idea that is considered worth exploring and includes the process of searching for and gathering potential sources of information,
- *Analysis* – it is a stage of rational analysis of materials that were considered significant,
- *Hermeneutic immersion* (in-depth hermeneutic interpretation) – at this stage ideas analyzed in the previous stage begin to be understood intuitively,
- *Reflection* – it is a stage of intuitive consideration of new ideas.

Hermeneutics, as a humanistic concept, is used to describe the most basic activities of any research, i.e.:

a) gathering relevant information and knowledge (research materials) from external sources,
b) its interpretation and reflection. Humanists often use this concept to distinguish humanities and science, maintaining that the humanistic creation of knowledge forms goals, focusing on people, as opposed to explanation of the goals by science which focuses on the outside world. Hermeneutics is the core of humanistic knowledge creation.

However, in trying to distance themselves from science and technology, humanists try to omit them, and each study involves the interpretation of human heritage in a given field. Thus, hermeneutics is not limited to humanistic research, but is also used in the context of science or technological development. Wierzbicki and Nakamori (2006) also drew attention to the wrong suggestion of closing the hermeneutic circle which differs from the classical one in that it is based not only on infallible intuition, but also on resorting to transcendental powers. They observed, however, that this circle is in fact a spiral of knowledge creation and can be closed only by a rational theory of intuition (Wierzbicki 1997). This is the subject of considerations in the hermeneutic EAIR spiral shown in Figure 10.



Source: based on (Wierzbicki and Nakamori 2006)

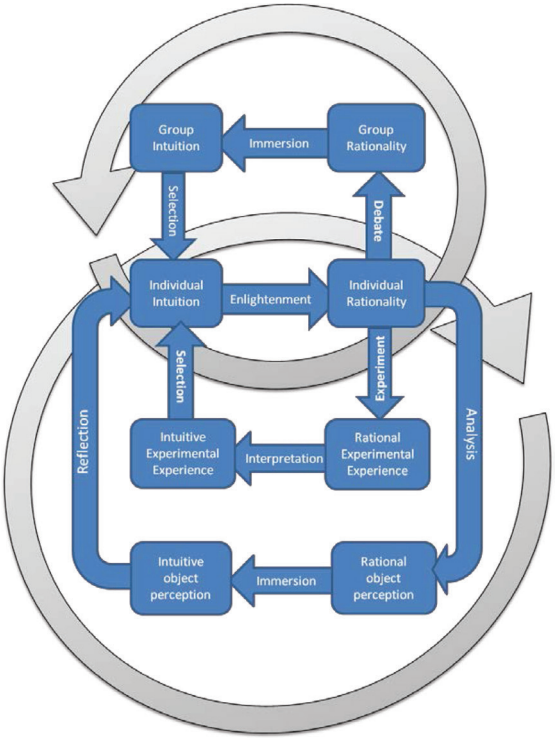
Figure 10. The Hermeneutic EAIR Spiral using the dimension of reflection

The hermeneutic spiral is the most individual process of knowledge creation, most often typical, but not only, of academic knowledge creation (Nakamori 2016). Most academic micro-processes of knowledge creation, even if they assume the participation of a group (debate), are usually the result of work of an individual. Group work is helpful in improving individually created solutions or knowledge.

4.2.4. THE TRIPLE HELIX SPIRAL OF KNOWLEDGE CREATION PROCESSES

One of the elements of this theory is a model of scientific activity called the Triple Helix which describes a typical way of creating knowledge in scientific and research institutions. It consists of three co-existing processes of previously described spirals of knowledge creation, presenting:

- the literature research (the EAIR spiral),
- experiments (the EEIS spiral),
- debates (the EDIS spiral).



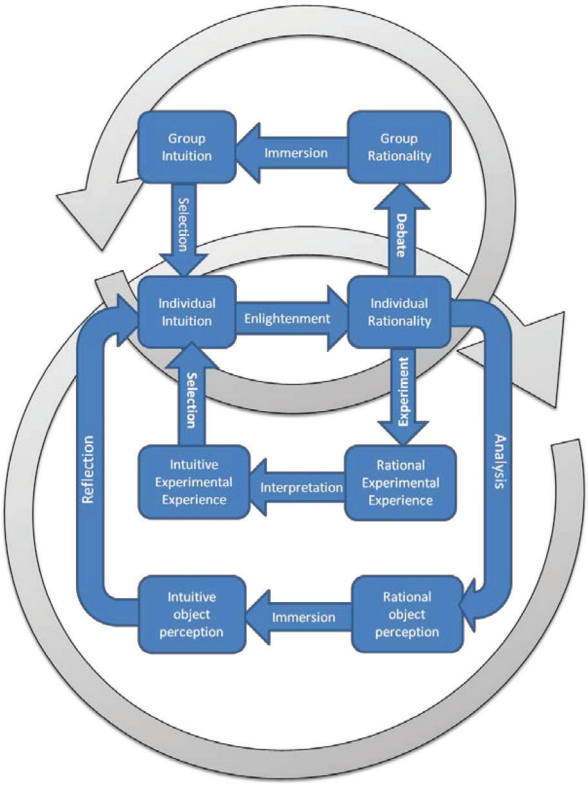
Source: based on (Wierzbicki and Nakamori 2007)

Figure 11. The Triple Helix Spiral of Knowledge Creation Processes

The names of spirals are acronyms derived from the English names of the constituent activities of a given process. The cyclical nature of spirals reflects the continuity and repeatability of the knowledge creation process.

4.2.5. THE ARME SPIRAL OF REVOLUTIONARY KNOWLEDGE CREATION

The ARME spiral is an attempt to explain the revolutionary knowledge creation (Motycka, 1998). This is a theory independent of the Nonaki and Takeuchi approach (SECI) and refers to the problem of creating revolutionary changes in rudimentary knowledge in times of crisis in scientific discipline. It can be assumed that this is the Motycka's macro theory of creation of a new scientific view (approach). However, it should be underscored that the revolutionary knowledge creation occurs infrequently and in unexpected places. The ARME theory can be presented as a spiral (Figure 12.)



Source: based on (Tsubaki et al. 2008).

Figure 12. The ARME Spiral (Motycka)

If a group of scientists cannot find a satisfactory solution in Intuitive Heritage, then they are searching for it through Regress in Emotive Heritage (along with elements of tacit knowledge).

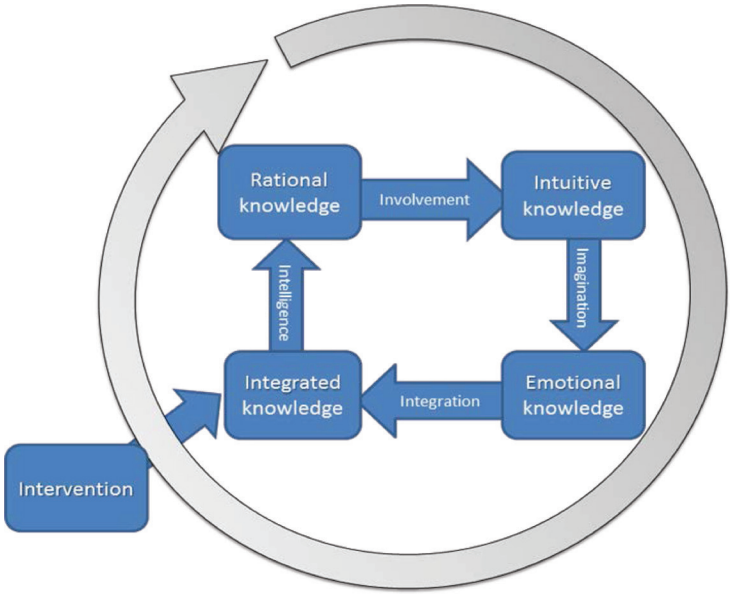
Solutions found in the collective sub-consciousness lead to new ideas that should be discussed at the emotional level until they become through empathy an intuitive solution. If these solutions are sufficient to form new ideas, the process ends, if not, it should be repeated starting with regression.

4.2.6. THE I^5 SYSTEM (KNOWLEDGE PENTAGRAM) OF NAKAMORI IN SYSTEM AND PROCESS APPROACH

The I^5 System (Knowledge Pentagram) of Nakamori presents a systemic and process approach to knowledge creation and is the development of the concept of the Shinayakana Systems Approach.

The system, shown in Figure 13, consists of five ontological elements (subsystems), i.e.:

- intervention (and the will to solve problems),
- intelligence (and existing scientific knowledge),
- involvement (and social motivation),
- imagination (and other aspects of creativity)
- integration (using systemic knowledge).



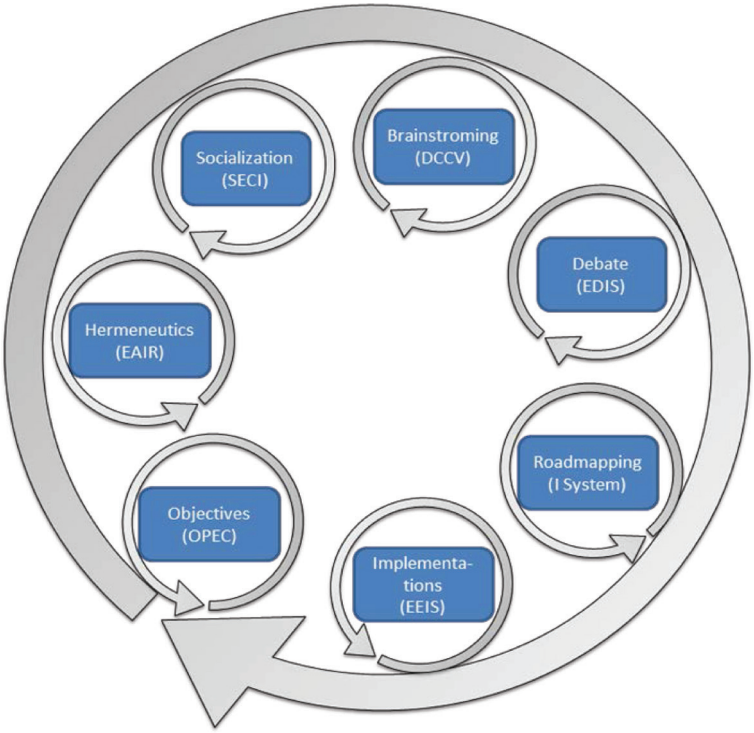
Source: based on (Nakamori, Zhu, 2004; Nakamori, Wierzbicki, 2012)

Figure 13. The I^5 System (Knowledge Pentagram) of Nakamori

According to the Shinayakana's assumptions, there is no defined automatic path (algorithm) to move between these ontological nodes: all transitions are appropriate, recommended, depending on individual needs. That is why the *i-System* emphasizes the need to move freely between different dimensions of creative space (Nakamori, Wierzbicki, 2012). The *i-System* can be treated as a structured model of knowledge management (Nakamori, Zhu, 2004). Knowledge is created by actors (entities) that are limited and activated by structures consisting of scientific-real, cognitive-mental and social relations. The *i-System* can be used as a guideline for developing knowledge archiving systems, technology roadmaps, evaluation systems for research activities or the academic environment.

4.2.7. THE NANATSUDAKI SEPTAGRAM OF SEVEN SPIRALS OF KNOWLEDGE CREATION

The Nanatsudaki Septagram (seven waterfalls), binding seven successive spirals of knowledge creation, is called a joint model of knowledge creation and is presented in Figure 14.



Source: based on (Wierzbicki 2012)

Figure 14. The Nanatsudaki Septagram of Seven Spirals of Knowledge Creation

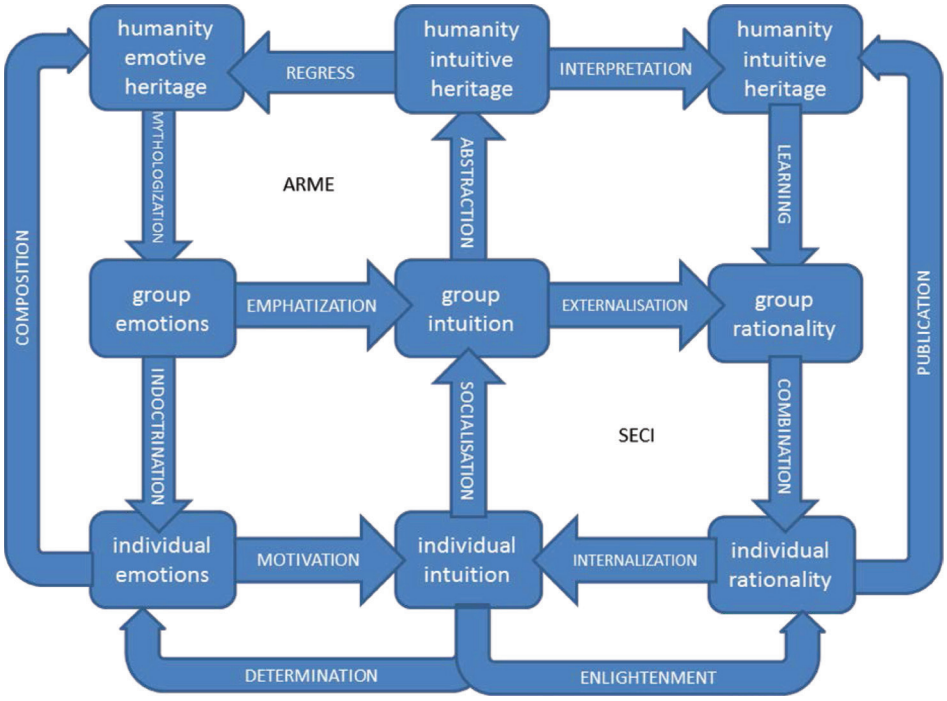
The Septagram presents the suggested order of application of knowledge creation spirals described above. Therefore, the process of knowledge creation should begin with a detailed discussion of project goals with its participants, using (even part of it) the OPEC spiral.

Each participant should then research the literature and networks and interpret the results of these studies using the EAIR hermeneutic spiral. Subsequently, it would be beneficial to employ the Far Eastern methods and apply *socialisation from the SECI spiral* at least once, informally exchanging ideas (e.g. at a reception for project participants). After such hermeneutics and socialization, participants are well prepared to partake in brainstorming, the DCCV spiral, especially in its divergent part.

Its *convergent* part, and especially the crystallization of ideas, can be better supported by the classic debate, the EDIS spiral. After the crystallization of ideas, time comes for detailed planning of further work, the Roadmapping spiral, and the most time-consuming process, at least in technical science projects that is the Experimental EEIS spiral. The completion of the project may require repeating the *OPEC spiral*, and perhaps also elements of other spirals (Wierzbicki 2012).

4.2.8. THE NETWORK MODEL – THE CREATIVE SPACE (CS)

Hackerspace or hackspace (also often called hacklab, makerspace or creative space) is a place where people with common, usually IT, scientific or related to digital or electronic art, interests meet and collaborate. Hackerspace can be understood as a laboratory open to the local community where there are also electronic or carpentry workshops. Hackers and people interested in technology and DIY enthusiasts meet in these places. Numerous specialists often gather there and jointly create new projects. Wierzbicki and Nakamori (2006) assumed that the integration and synthesis of the micro-theory of knowledge creation takes the form of the so-called creative space – a network model of various creative processes with a number of nodes and transitions between them which is based on the general SECI spiral. Numerous spirals of knowledge creation can be presented as processes in creative space. One of the astute observations is that a clear distinction between group and industrial processes of creating organizational knowledge – such as the SECI spiral, the OPEC spirals (Gasson 2004) or the older and well-known organizational process called ‘brainstorming’, which can also be represented as the DCCV spiral (Kunifuji et al., 2007), should be made. In contrast to these processes, the processes of creating academic knowledge, describing how knowledge is usually created in academic and research environments, ought to be distinguished.



Source: based on (Wierzbicki, Nakamori, 2006)

Figure 15. The dimensions of Creative Space

The concept of *Creative Space* is generalization of the SECI Spiral of Nonaka and Takeuchi. The schema includes 9 nodes of Creative Space along with various connections between them. The authors emphasize that the concept is an attempt to explain creative processes, especially the creation of knowledge and technology.

At the same time, the concept of creative space is an attempt to integrate the recognized theories of knowledge creation. The basic assumptions of the model include (Wierzbicki, Nakamori, 2006):

- using at least three-valued logic (three levels of ontological elements),
- using the epistemological and social (ontological) dimensions of the SECI spiral as a basis, taking into account other dimensions (as in the I^5 system),
- an appropriate definition of the nodes (ontological elements) of Creative Space and verification of possible connections between them (not related to the conversion of knowledge),
- creating a network-like general model of creative processes.

There are several convergences between the Creative Space model and the SECI spiral. The 'individual rationality' node corresponds to the 'individual explicit knowledge' node. The difference lies in including individual emotions in the SECI spiral. In Creative Space they are in the 'individual emotions' node.

In Poland, two independent theories for knowledge creation were formed. Chronologically, a Rational Theory of Intuition was first generated (Wierzbicki 1997), being the result of contacts with Japanese scientists such as Sawaragi, Nakayama and Nakamori as well as with the Shinayakana Systems Approach, which recommends the use of intuition, but it does not analyze it. Almost in parallel and independently, Alina Motycka (1998) used the concept of Jung's collective unawareness to present the theory of creating rudimentary knowledge during a crisis or a scientific revolution in a certain field of science, referring to the creation of quantum theory. Although this is not a micro-model of knowledge creation, but a macro-theory of scientific revolutions, this theory can also be expressed in the form of a spiral in creative space (Wierzbicki and Nakamori 2006).

CONCLUSION

The presented monograph, entitled "*Knowledge Creation and Solution Generation Methods in the Design and Management of Rural Development*", presents a thematic scope of two problems of scientific analyses. The first one concerns the issue of generating solutions in organizational design, and the second one refers to knowledge creation methods in management. Both of them particularly focus on rural development. In both cases, the aim of the authors was to formulate methodology and indicate methods and detailed techniques for solving these problems. The first aspect of the issue is related to the study, entitled "*Organizational standards and rural development in the context of information and knowledge management*", (Krakowiak-Bal, Wdowiak, Ziemiańczyk, 2017), and the second one with the article, entitled "K*nowledge management in rural development*" (Krakowiak-Bal, Łukasik, Mikuła, Pietruszka-Ortyl, Ziemiańczyk, 2017), prepared and published as part of a project funded by the National Science Centre, granted on the basis of decision number DEC-2011/01/D/HS4/05909 and entitled "*Knowledge management in the process of building competitiveness and innovativeness of rural areas on the principle of sustainable development – empirical verification taking the Małopolska Province as an example*". As part of this project, this monograph, which the reader is perusing, was also written.

The first scope of issues of the monograph is known especially to those readers who, for years, have been interested in the problems of management and designing of an organization and functioning of enterprises. The presented methodology as well as detailed methods and techniques will be found in a number of studies in the field of organization and management as well as heuristics (inventiveness). The reader will also find relevant content in Chapter 1, Chapter 2 and Chapter 3. The aspects referring to heuristics and complementary hermeneutics, as well as thinking systems and cognitive biases in the perspective of D. Kahneman, the Nobel Prize winner are particularly noteworthy. Chapter 3, which deals with the possibilities and scope of applying the inventive methods in the context of the modified methodology of generating solutions, can also engage the reader. The underpinnings of this part of the study are numerous literature publications of books and magazines in the field of management and inventiveness, including authors' own studies, as well as practical and didactic experience in designing organizational changes in enterprises. It should also be added that the discussed theoretical and practical issues fulfill the assumed objectives of the study in this regard, mentioned in the introduction.

Summarizing the second aspect of the issues, it should be stated that it is much less known than the former one due to the fact that the issue of knowledge management and its creation appeared more visibly in the literature not until the late twentieth century, and has developed only in this century. Hence, typologi-

cal problems and classification methods for creating knowledge are difficult to solve. Therefore, in Chapter 4, the need to initially pre-order these methods was the underpinning for the considerations. Then, these methods were characterized to enable, on this basis, broader generalizations and to establish appropriate classifications of the indicated methods. Thus, in the first set of presented methods (Subchapter 4.1) there are simpler methods that in some ways are closer to the features and assumptions of heuristic methods. This was due to the reasons of group work, inviting experts, or simply the brainstorming method and other simplified models of the methods considered. The second set of methods for knowledge creation (Subchapter 4.2) was devoted to complex features that were not directly related to heuristic methods, which included the double debate principle, an experiment in dimension of verification, hermeneutics in dimension of reflection, revolutionary creation of knowledge, or other more complex than heuristic methods of knowledge creation. At this point, it should also be recalled that the commonality of methods for knowledge creation is the Japanese principle of continuous development, similarly to the Japanese methods of organizing production and business administration (Krakowiak-Bal, Wdowiak, Ziemiańczyk, 2017). Hence probably the use of the word 'spiral' in the name of these methods.

Attempts of classifying these methods found in the subject literature so far are not satisfactory from the authors' point of consideration. This also applies to the most general attempt to divide models of methods into the so-called organizational and academic models. Micro models of knowledge creation are organizational in nature when they are used by a specific group or organization, and knowledge commonly generated is the property of this group, not its individual members. This aspect distinguishes organizational models of knowledge creation from analogous academic models of its creation (Wierzbicki 2012, pp. 137-149). The interest of an individual creator prevails at universities albeit accepted and supported by actions of a group.

At the same time, it is difficult to clearly divide the models for creating knowledge into those dedicated to the academic and organizational environment, while at the same time distinguishing those that describe individual and group processes of knowledge creation. An attempt of such a division is displayed in Table 2.

In addition, one can consider a debate, an experiment and hermeneutics in the understanding of the art of interpretation as the three basic types of knowledge creation processes. Classification into the models of knowledge organization and the models of knowledge creation as well as other such classifications proposed in the literature of the subject are not sufficient.

Table 2. Classification of methods for knowledge creation

	individual	group
organizational	SECI	SECI
		DCCV brainstorming
		OPEC, Hedlund's model
academic	EDIS, EEIS, EAIR, Triple helix	ARME

Source: own elaboration

In conclusion, one should agree with the view that the research problems of organizing and creating knowledge presented in the study as well as their hypothetical solution methods proposed should be verified in future studies of selected rural areas. Verification should also be carried out with reference to the proposed methodology for designing rural development and their institutional system (Krakowiak-Bal, Wdowiak, Ziemiańczyk 2017, pp. 204-206), also taking into account the efficacy of utilizing heuristic methods in research. Particular attention, while conducting research, should be paid to the specificity of using the methods of organizing and creating knowledge, taking into consideration the criteria for their classification in these aspects. The possibility of associating thinking systems, heuristics and cognitive biases by Kahneman with regard to the methods used to organize and create knowledge, being aware that there is no ideal method for solving research problems is also worth considering. The statement, however, that all these methods can be utilized in rural development activities seems certain.

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List of figures

List of tables

KNOWLEDGE CREATION AND SOLUTION GENERATION METHODS IN THE DESIGN AND MANAGEMENT OF RURAL DEVELOPMENT

Abstract

The goal of the monograph was to:

- show sample spheres of functioning and cooperation of institutions acting for rural development and principles of developing processes and procedures for organizing or modernizing information and knowledge as well as define adequate inventive methods for generating ideas,
- elaborate on principles and rules of the methodology for generating ideas in the construction of options for solving problems, formulating criteria and conducting the evaluation of solution variants, selecting the optimal variant and implementing the chosen variant as the final result of the study,
- distinguish the sample thematic areas of knowledge management in rural areas and define adequate methods of creativity and innovation, with pointing out the stages of appropriate methodologies and methods applied.

The presentation of the typology and characteristics of inventive methods for generating solutions and creating knowledge, in the context of methodologies to improve organization of rural areas, which strengthen their competitiveness and innovation based on the principles of sustainable development, was assumed as the main research problem requiring a solution. Problems and methods for generating solutions were defined in conjunction with the study entitled "Organizational standards and rural development in the context of information and knowledge management" (Krakowiak-Bal, Wdowiak, Ziemiańczyk 2017 – subsection 3.3), and the issue of knowledge creation and corresponding methods with the study entitled "Knowledge management in rural development" (Krakowiak-Bal, Łukasik, Mikuła, Pietruszka-Ortyl, Ziemiańczyk 2017). These connections in the case of the aforementioned studies consisted in:

- emphasizing the possibilities of applying heuristic methods in generating ideas of solutions presented in Chapter 2 and 3 of this monograph together with the methodologies and Anglo-Saxon methods of improving the organization, including rural areas, presented in the aforementioned Subchapter 3.3, and
- emphasizing also the possibilities of applying the heuristic Japanese methods of continuous improvement in knowledge creation, presented in Chapter 4 of this monograph in conjunction

with the Japanese methods of continuous improvement of the organization, presented in the aforementioned Subchapter 3.3, in the context of the second study cited above.

Solutions generation is a fundamental element of the process of improving the organization, including the organization of rural areas, presented in the monograph. This activity is carried out through the following groups of activities: preparation and definition of a project problem, creation of solution variants and setting evaluation criteria, evaluating options and developing the best solution. Taking into account the review and defined research methodologies (Krakowiak-Bal, Wdowiak, Ziemiańczyk 2017, pp. 118-136), their stages in which solutions are generated can be pointed out. And so in:

- the descriptive and improvement approach the stage was described as 'the critical analysis and evaluation of the empirical material accumulated in the course of observation',
- the functional modeling approach the stage was expressed as 'the analysis of the latest, model solutions',
- the diagnostic functional approach the stage was defined as 'a method of idealization in finding optimal solutions',
- the general outline of the above approaches in view of J. Trzcieniecki – in the phase of 'analysis and assessment of improvements',
- the classical methodology as 'preparation of conditions and costs',
- the diagnostic methodology as 'analysis and synthesis',
- the prognostic methodology as 'building a reference system' (in the context of purpose, entry, exit, course of organization process, environment, set of system elements),
- the study of methods of work as 'critical analysis and assessment of the facts',
- the analysis of values according to W. Biliński as 'reflections – creative discussion" and "selection of the optimal solution',
- the analysis of values according to Z. Martyniak as 'analysis of functions and searching for new solutions',
- the methodology of spatial organization of work as 'analysis of solution variants'.

Basic processes with the application of knowledge, also in rural areas, i.e. operational knowledge management tasks include (Krakowiak-Bal, Łukasik, Mikuła, Pietruszka-Ortyl, Ziemiańczyk 2017, p. 68 et seq.):

- identification (localization of knowledge),
- transfer (acquiring, disclosing, disseminating knowledge and sharing knowledge),
- gathering (systematic collection of knowledge and its codification),
- selection of sets of knowledge,

- new knowledge creation,
- combining sets of knowledge,
- saving, or registration of knowledge in a codified form,
- storage of knowledge carriers,
- assessing the usefulness of knowledge,
- applying knowledge (creating visions and concepts of action, solving problems and performing current tasks).

Knowledge creation consists in the appropriate selection and use of the specificity of selected methods in knowledge management. This specificity concerns the Japanese methods of so-called continuous improvement in knowledge creation, presented in Chapter 4 of this monograph.

The detailed layout of the study presented below was conditioned not only by the assumed aims of the elaboration, but also by the specificity of Anglo-Saxon epistemology, also referred to as the Western or the Japanese epistemology. The mainstay for the notion of knowledge in the western perspective, formulated on the basis of philosophy as 'justified and true belief', is the Plato's idea stating that 'absolute truth can be derived from rational reasoning based on certain axioms'. This was the cause of criticism by Aristotle who emphasized the pivotal role of sensual perception in this regard. However, the following issues contributed to the success of Plato's approach (Nonaka, Takeuchi 2000):

- Descartes' rationalism, allowing skepticism with the conviction 'I think; therefore I am',
- Locke's empiricism, emphasizing experience as a source of ideas, dividing them into perceptions and reflections,
- combination of empiricism with rationalism and Kant's statement that not all knowledge results from experience,
- the Hegelian dialectical unity of opposites,
- introduction of interaction between the cognizer and the cognizing person as well as the relationship between man and the environment in Marx's view,
- linking knowledge strictly to Heidegger's action, rejecting completely the thinking subject in the concept of Descartes,
- pragmatism and the statement that 'only the effective idea is true', because ideas are devoid of values if they do not go into action, propagated by James.

In turn, the Bacon's concept of operational knowledge which emphasizes social effects and comprises the essence of civilization progress is the foundation of the organizational concept of knowledge in Japanese terms, formulated by I. Nonaka and H. Takeuchi (2000), exposing "the ability of the corporation as a whole to generate new knowledge, its dissemination and embodiment in products, services and systems". These two perceptions of knowledge, the Anglo-Saxon and the Japanese, form the basis for differentiating in the study two different theoretical approach-

es and practical applications of methods for generating solutions (Chapter 2 and 3) and for knowledge creation (Chapter 4).

Chapter 1 of the study, consisting of three subchapters, is the background for reflection, emphasizing the role of heuristics, hermeneutics and semiology in the process of building a set of rules for creative thinking and presentation of solutions. The systems of thinking, heuristic and cognitive biases defined by D. Kahneman are the essence of this chapter. The considerations are complemented by hermeneutic analysis and exegesis, the indicated types of heuristics and their characteristics as well as the semiological aspects.

Chapter 2, containing three subsequent subchapters, presents the characteristics and typology of selected inventive methods in the context of the basic concepts and evolution of methods. The criteria for division and typologies of the inventive methods precede the characteristics of selected inventive principles and solutions.

The possibilities and principles of applying inventive methods are presented in Chapter 3. First, rural areas as the subject of the study are presented (Subchapter 3.1). In the subsequent subchapters theoretical foundations of the theory of creative thinking and knowledge creation (Subchapter 3.2) as well as the methodology of knowledge creation and creatics as the basic research tool (Subchapter 3.3) are discussed. Subchapter 3.4 presents the IDEAL model as the method for formulating decision problems. Inventive methods in organizational design are discussed in Subchapter 3.5 whereas the assumptions of the industrial inventics and the algorithm for inventive problems solving are described in Subchapter 3.6. Subchapter 3.7 concerning the methodology for generating solutions with the indication of inventive methods finalizes the chapter.

Chapter 4 deals with corporate models of knowledge organization and methods of knowledge creation. The first group includes and defines the SECI spiral, the OPEC spiral and the DCCV spiral as well as the Gilbert, Probst, Raub and Romhardt's model. The second one includes: the EDIS spiral of debate in the aspect of the double debate principle (4.2.1.), the Experimental EEIS spiral in the context of verification (4.2.2.), the Hermeneutical EAIR spiral in the context of reflection (4.2.3.), the Triple Helix spiral of knowledge creation processes (4.2.4), the ARME spiral of revolutionary knowledge creation (4.2.5.), the Knowledge Pentagram of Nakamori in the *i-System* approach (4.2.6.), the Nanadsudaki Septagram of seven spirals of knowledge creation (4.2.7) and the Creative Space model (4.2.8.).

In the future, the thematic scope of the study should be enriched with further methods of creative thinking in management, knowledge creation and organization methods as well as considerations regarding models for intellectual resource management in rural organizations. The authors hope that the work will contribute to the dissemination of the inventive

methods for generating solutions as well as knowledge creation and organization methods among employees of institutions co-contributing to rural development. It can also become a source of information and a textbook for learning about these methods for students at environmental and agricultural universities. Moreover, it might be a contribution to scientific research in this field.

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