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**MODERN TRANSDISCIPLINARITY:
RESULTS OF THE DEVELOPMENT OF THE PRIME CAUSE
AND INITIAL IDEAS**

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ABSTRACT

Aim/Purpose This paper focuses on systematizing and rethinking the conformity of modern transdisciplinarity with its prime cause and initial ideas.

Background The difficulties of implementing transdisciplinarity into science and education are connected with the fact that its generally accepted definition, identification characteristics, and methodological features are still missing. In order to eliminate these disadvantages of transdisciplinarity, its prime cause and initial ideas had to be detected. It is also important to analyze the correspondence of the existing opinions about transdisciplinarity with the content of these cause and ideas.

Methodology The qualitative analysis of the literature reviews on the subject of transdisciplinarity was used in order to determine the correspondence of the opinions about the transdisciplinarity with the meaning of its prime cause and initial ideas. These opinions had to be generalized as well. Through this method, it was possible to detect and classify opinions into 11 groups including 39 stereotypes of transdisciplinarity. For substantiation of transdisciplinary approaches that are consistent with the approaches of contemporary science, C.F. Gauss random variables normal distribution was used. The “Gauss curve” helped to show the place of transdisciplinary and systems transdisciplinary approaches in the structure of academic and systems approaches. The “Gauss curve” also demonstrated the step-by-step “broadening of the scientific worldview horizon due to sequential intensification of synthesis, integration, unification, and generalization of the disciplinary knowledge.”

Accepting Editor: Eli Cohen | Received: January 8, 2022 | Revised: March 8, 2022 |
Accepted: April 19, 2022

Cite as: Mokiy, V. S., & Lukyanova, T. A. (2022). Modern transdisciplinarity: Results of the development of the prime cause and initial ideas. *Issues in Informing Science and Information Technology*, 19, 97-120.
<https://doi.org/10.28945/4951>

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Contribution	After reconsideration of the results on qualitative analysis of the literature reviews, the generalized definition of transdisciplinarity could be formulated, including the definition for transdisciplinary and systems transdisciplinary approaches. It was proven that transdisciplinarity is a natural stage for the development of contemporary science and education, and the transdisciplinary approaches were able to suggest the methods and tools to solve the complex and poorly structured problems of science and the society.
Findings	Many existing stereotypes of transdisciplinarity do not meet its prime cause and initial ideas. Such stereotypes do not have deep philosophic and theoretical substantiation. They also do not suggest the transdisciplinary methods and tools. Thus, the authors of such stereotypes often claim them to be transdisciplinary or suggest perceiving them as transdisciplinarity. This circumstance is the reason why many disciplinary scientists, practitioners, and initiators of higher education view transdisciplinarity as a marginal direction of contemporary science. Based on the generalized definition of transdisciplinarity, as well as its prime cause and initial ideas, it was shown that transdisciplinarity is presented in contemporary science in the form of two different approaches, i.e., the transdisciplinary approach and systems transdisciplinary approach. The objective of the transdisciplinary approach is to ensure science development at the stage of synthesis and integration of disciplinary knowledge, while the objective of the systems transdisciplinary approach is to ensure that the problems of modern society are solved through unification and generalization of the disciplinary knowledge.
Recommendations for Practitioners	The practitioners should take into consideration that the transdisciplinary and systems transdisciplinary approaches have different specific features. Within the limits of the transdisciplinary approach, a team of disciplinary specialists forms a new method to solve each new problem every time. As a result, the solution of the problem is created based on the consensus formed by compromises. Such a solution is difficult to be risk analyzed. Within the limits of the systems transdisciplinary approach, a team of disciplinary specialists uses a universal systems transdisciplinary methodology to solve each problem. In this case, the disciplinary specialists do not seek compromises, but perform their part of research using the disciplinary methods and tools. The disciplinary results are unified and generalized by the generalist specialist, who has a methodology of the systems transdisciplinary approach. Thus, the solution of the problem should be subject to risk analysis since it is included into the basic research process.
Recommendations for Researchers	The researchers should consider that within the limits of the transdisciplinary approach, the disciplinary specialists are managed. Within the limits of the systems transdisciplinary approach, the disciplinary knowledge is managed. Thus, the transdisciplinary approach is efficient for organization and research with participation of the scientists of the complementary disciplines. An example of such research can be a team of researchers of medical disciplines and complementary disciplines from chemistry, physics, and engineering. The systems transdisciplinary approach is efficient for organization and performance of research with participation of the scientists of non-complementary disciplines such as economics, physics, meteorology, chemistry, ecology, geology, and sociology.
Impact on Society	The prime cause of transdisciplinarity is associated with a desire of economists, politicians, and managers to find a method of efficient long-range

forecasting, planning, and control of social and economic development of the modern society, as well as the search for the solution to current problems accompanying this development. The transdisciplinary approaches formed the methods and tools to solve these tasks. Although society could use the advantages of the transdisciplinary approaches, it is necessary to ensure that in the consciousness of the disciplinary specialists, “the desire to have such approaches” should coincide with “the desire to apply such approaches” for the benefit of the society.

Future Research	In terms of the main initial idea, transdisciplinarity is formed as a global approach. The global approach should have a traditional institutional form. This implies that it should be a science discipline (meta-discipline) and have carriers with the transdisciplinary worldview. Training for such carriers can be organized by the universities within the limits of the systems transdisciplinarity departments and Centers of Systems Transdisciplinary Retraining for Disciplinary Specialists. Thus, it is reasonable to initiate discussions for the idea to reform the disciplinary structure of the universities while considering the creation of such departments and centers.
Keywords	transdisciplinarity, transdisciplinary research, systems approach, systems transdisciplinary approach, higher education

[Note: This paper is an extension of the previously published paper Mokiy, V., & Lukyanova, T. (2021). Transdisciplinarity: Marginal direction or global approach of the contemporary science? *Informing Science: The International Journal of an Emerging Transdiscipline*, 24, 1-18. <https://doi.org/10.28945/4752>]

INTRODUCTION

Between 1968 and 2021, many books, articles, and reports on transdisciplinary topics have been published. However, depending on the specific situation, the authors of these publications perceive transdisciplinarity and the transdisciplinary approach differently. The authors interpret their purpose and identification features in a wide range. This circumstance allowed some researchers to draw the following conclusions on transdisciplinarity:

Despite its increasing popularity, transdisciplinarity is still far from being academically established, and current funding practices do not effectively support it at universities and research institutions. One reason for this deficit is that a universally accepted definition for transdisciplinarity is not available yet. Consequently, quality standards that equally guide researchers, program managers, and donors are widely lacking. Therefore, a rhetorical mainstreaming of transdisciplinarity prevails. This puts at risk the marginalization of those who seriously take the integrative efforts that creative collaboration requires (Jahn et al., 2012).

Consequently, such conclusions are a bad advertisement for transdisciplinarity. They limit attention to it on the part of students and young researchers who have to solve the ‘wicked’ problems of modern science. To change the attitude towards transdisciplinarity for the better, it was shown that transdisciplinarity and transdisciplinary approaches develop interdisciplinary and multidisciplinary interaction between academic (disciplinary) and systems science. In doing this, the opinions about transdisciplinarity were rethought and systematized, which are given in literature reviews on transdisciplinary topics. In addition, we have formed a generalized definition of transdisciplinarity, which can become a generally accepted definition. Next, we showed a significant difference between transdisciplinary and systems transdisciplinary approaches and made recommendations for researchers, practitioners, and leaders of sponsoring organizations on the targeted use of these approaches. In general, the article is intended to systematize and rethink the correspondence of modern transdisciplinarity to its root cause and initial ideas.

The section “Methodology” describes the method that was used to analyze the literature on transdisciplinary topics. The main stages of this analysis were also described. In the “Prime” section, the cause and initial ideas of transdisciplinarity describe the content of the root cause, as well as the main and additional initial ideas of transdisciplinarity. Under “Rethinking” and systematization of the opinions about transdisciplinarity, a literature review on transdisciplinary topics is presented, as well as the content of 39 stereotypes of transdisciplinarity, which are divided into 11 groups. Generalized definitions of transdisciplinarity, transdisciplinary approaches, and systems transdisciplinary approaches are given. Under consistency of the transdisciplinary approaches with academic and systems scientific approaches, the substantiation of the natural belonging of the transdisciplinary and systems transdisciplinary approaches, respectively, to academic (disciplinary) and systems approaches are given. In the “Discussion” section, a description of the obvious advantages and hidden disadvantages of the transdisciplinary and systems transdisciplinary approaches are given. In the “Conclusion” section, recommendations are formed for the organizers of higher education, politicians, and heads of funding organizations on the advisability of the practical application of a transdisciplinary and systems transdisciplinary approach.

METHODOLOGY

To achieve the goal of the study, a qualitative study of the results of 53 years of development of the initial ideas of transdisciplinarity was applied. Qualitative research relies on non-numeric data (Creswell, 2014). The role of non-numerical data was displayed by the terms with which the authors of numerous published thematic articles and literature reviews associated with the concept of “transdisciplinarity”.

For qualitative research, thematic data analysis was used (Braun & Clarke, 2008). Thematic analysis is the most common form of analysis in qualitative research. As part of the thematic analysis, special attention was given to the identification, systematization, and rethinking of non-numerical data. The identification, systematization, and rethinking of non-numerical data was carried out within the framework of interpretive phenomenological analysis (IPA) – one of the areas of thematic analysis (Gill, 2014). Recall that IPA is an idiographic approach to qualitative research (an attempt to understand the meaning of unique, cultural, and subjective phenomena which include transdisciplinarity). Therefore, the use of the IPA allowed us to get an idea of how a certain group of people in a certain context understands transdisciplinarity.

At the first stage, articles and literature reviews were selected. The criterion for the selection of articles and literature reviews was the use of the term “transdisciplinarity” in their title, as well as in the description of the purpose and methodology. At the second stage, terms with which their authors associated the concept of “transdisciplinarity” were selected from these documents. At the third stage, the systematization of these terms was carried out. Terms that have a similar meaning were divided into appropriate groups. At the fourth stage, the correspondence between the meaning of the terms of these groups and the meaning of prime cause and initial ideas of transdisciplinarity were analyzed. At this stage, the conclusion was drawn that modern transdisciplinarity has subjective (practically useful) and objective (conceptual-theoretical) basis prime cause and initial ideas (Mokiy & Lukyanova, 2022).

The *subjective (practically useful) basis* of prime cause and initial ideas consists of the urgent need of specialists and politicians for long-term planning, forecasting, and management of the global (sustainable) development of modern society, as well as the emergence of a new global (systems) approach that can be used to carry out this long-term planning, forecasting, and management.

The *objective (conceptual-theoretical) basis* of prime cause and initial ideas consists of the natural desire of modern scientific disciplines to “go beyond disciplinary boundaries”, as well as in the search for ways and approaches that allow such a “way out”. This desire is due to the limiting development of the disciplines themselves and the accelerated development of interdisciplinary interactions.

The final stage rethought and generalized the meaning of the term “transdisciplinarity” used within the framework of subjective and objective grounds. This rethinking allowed us to do the following:

- form a generalized definition of transdisciplinarity;
- to form generalized definitions of systems transdisciplinary and transdisciplinary approaches that embody the prime cause and initial ideas of the two main types of transdisciplinarity;
- to provide a generalized classification of academic and systems approaches, in which the systems transdisciplinary approach and the transdisciplinary approach have taken their rightful place.

This article is focused on the subjective (practically useful) basis of prime cause and initial ideas, as well as on a systems transdisciplinary approach, which, in our opinion, is most consistent with these ideas.

PRIME CAUSE AND INITIAL IDEAS OF TRANSDISCIPLINARITY

The *prime cause* is an expectation associated with the necessity to solve the current problem that is assumed to be solved by the transdisciplinarity.

The *initial idea* is a formulated thought expresses the essence, objectives, and prospects of transdisciplinarity, and it is an initiator for actions that contribute to the achievement of these objectives and prospects.

The prime cause of transdisciplinarity was formulated during the Working Symposium on Long-Range Forecasting and Planning (Jantsch, 1969), which was organized by the Organization for Economic Cooperation and Development (OECD). Jantsch, an Austrian philosopher and astrophysicist, was one of the Rome Club founders who had a hand in the description of this prime cause. The participants of the symposium unambiguously spoke in favor of the problem solving, long-range forecasting, planning, and control of social and economic development of the society by creation and use of *the global approach*. The participants of the symposium expressed assurance that within the limits of the global approach, a deep synthesis of disciplinary knowledge and different initial data should occur which allows forming the comprehensive worldview. Thus, the following was recorded in the final symposium declaration:

Planning must be concerned with the structural design of the system itself and involved in the formation of policy. Mere modification of policies already proved to be inadequate will not result in what is right. Science in planning today is too often used to make situations which are inherently bad, more efficiently bad. The need is to plan systems as a whole, to understand the totality of factors involved and to intervene in the structural design to achieve more integrated operation. All large, complex systems are capable of some degree of self-adaptation. But in the face of immense technological, political, social and economic stresses, they will have to develop new structures. This can easily lead to grave social disturbances if the adaptation is not deliberately planned, but merely allowed to happen.

Many of the most serious conflicts facing mankind result from the interaction of social, economic, technological, political, and psychological forces and can no longer be solved by fractional approaches from individual disciplines. The time is past when economic growth can be promoted without consideration of social consequences and when technology can be allowed to develop without consideration of the social prerequisites of change or the social consequences of such change. (Jantsch, 1969, p. 7-8)

The international presentation of transdisciplinarity took place during the seminar on Interdisciplinarity in Universities, which held in Paris, September 7th - 12th, 1970. This seminar was organized by the Centre for Educational Research and Innovation (CERI), which was a part of the Organization for Economic Cooperation and Development (OECD) in collaboration with the French Ministry of

Education at the University of Nice, France (Apostel, 1972). During the preparation and debates for the seminar, the participants formulated two initial ideas of transdisciplinarity: main and additional.

The main initial idea confirmed that transdisciplinarity as a global approach had to have traditional institutional form, i.e., being a special discipline, more precisely, and meta-discipline. However, the scientific approach and discipline cannot exist without carriers such as scientists, teachers, students, and specialists having the worldview of systems transdisciplinary. Training such specialists required reforming the disciplinary structure of the universities. On this subject, Jantsch, an author of the main initial idea of the transdisciplinarity, stated that ultimately, the entire education/innovation system can be coordinated as a multilevel multigoal hierarchical system through the transdisciplinary approach. This implies generalized axiomatics and mutual enhancement of disciplinary epistemology (Jantsch, 1970, p. 403). During the seminar, Jantsch specified his position in his report:

Transdisciplinarity – the coordination of all disciplines and interdisciplines in the education/innovation system on the basis of a generalized axiomatic and an emerging epistemological pattern. A system approach as it is proposed in this paper would consider science, education, and innovation, above all, as general instances of purposeful human activity, whose dynamic interactions have come to exert a dominant influence on the development of society and its environment. Knowledge would be viewed here as a way of doing, a certain way of management of affairs. (Jantsch, 1972, p. 105-106)

However, an idea of global approach creation seemed to be so ambitious that some participants of the seminar perceived a desire to perform the deep synthesis of disciplinary knowledge and different initial data as a basis for independent (additional) initial idea of transdisciplinarity. The essence of additional initial idea of transdisciplinarity was formulated by Piaget, a French philosopher and psychologist. According to his opinion, transdisciplinarity would become an efficient method for deep synthesis of disciplinary knowledge. Within the limits of the additional initial idea, transdisciplinarity did not have to be the global approach to perform vertical or external form of coordination for organization principles, actively modifying disciplinary concepts, limits, and interfaces as Jantsch proposed. Subsequently, psychologist Piaget was interested in the prospects of natural integration (improvement of relations) of disciplinary discourses (verbal, language communication), but not in their external form of coordination. Thus, within his meaning transdisciplinarity was associated with the highest form of such integration. On this subject, Piaget wrote:

We may hope to see a higher stage succeeding the stage of interdisciplinary relationships. This would be ‘transdisciplinarity’, which would not only cover interactions or reciprocities between specialized research projects but would place these relationships within a total system without any firm boundaries between disciplines. (Piaget, 1972, p. 138)

A key term “verbal, language disciplinary integration” assumes that for transdisciplinarity implementation, it is sufficient to use the services of the experienced facilitator (a specialist ensuring successful group communication) in order to reach a consensus of opinions based on compromises of the disciplinary specialists. For the verbal, language disciplinary integration, the conditions which are formed within the limits of interdisciplinary and multidisciplinary research are required. Thus, it was assumed that within the limits of the additional initial idea, transdisciplinarity had to be a skill of specialist which was obtained within the limits of temporary creative team of the disciplinary specialists, but not in classrooms of the university.

Since 1970, the initial ideas of transdisciplinarity have initiated two parallel processes of the targeted actions in the area of science and education. Studying the literature on the transdisciplinary subject, it was concluded that a major part of Russian and foreign authors preferred to develop and describe a personal opinion about transdisciplinarity, not often paying attention to the specific features of its prime cause and initial ideas. Therefore, this paper focused on rethinking and systematizing existing opinions about transdisciplinarity so as to give its generalized definition and also show the

fundamental differences of transdisciplinarity approaches that have formed two different initial ideas of transdisciplinarity.

RETHINKING AND SYSTEMATIZATION OF THE OPINIONS ABOUT TRANSDISCIPLINARITY

The most suitable primary documents for problem solving are the literature reviews. The authors of such reviews initially select the books and reports that contain complementary opinions about transdisciplinarity and also perform primary generalization of the opinion content. Thus, such reviews contain description of the parameters, characteristics, and properties that can play a role of identifying the characteristics of the transdisciplinarity. In order to detect these parameters, characteristics, and properties, qualitative analysis was carried out for 20 literature reviews and 80 analytical articles on the transdisciplinary subject, which were published within the period of 1968 till 2021. The literature reviews on the transdisciplinary subject are in free access in the subject section of large scientific social networks: Academia.edu (Academia, n.d.), Researchgate.net (Researchgate, n.d.), Scholar.google.com (Scholar, n.d.).

The literature reviews contain special internet projects: Td-net (Td-net. Network for transdisciplinary research, n.d.) and ATLAS (Academy of Transdisciplinary Learning and Advanced Studies, n.d.).

Examples of the literature reviews could be articles of the following authors: Alvargonzalez, 2011; Baptista & Rojas-Castro, 2019; Bernstein, 2015; Brandt et al., 2013; Brenner, 2014; Collection of articles, 2015; Darbellay, 2015; Jahn et al., 2012; Kiyshenko & Moiseev, 2009; Lawrence, 2015; Markus, 2013; Max-Neef, 2005; McGregor, 2014; Mobjörk, 2010; Mokiy, 2019a; Mokiy & Lukyanova, 2022; Montuori, 2013; Osborne, 2015; Pasquier & Nicolescu, 2019; Rigolot, 2020; Rimondi & Veronese, 2018; Scholz & Steiner, 2015a, 2015b; Thompson, 2013, 2014.

This list can be supplemented with the articles on transdisciplinary subject that are published within the last years in the specific issues of Informing Science: The International Journal of an Emerging Transdiscipline (InformingSciJ) (<https://www.informingscience.org/Journals/InformingSciJ/Articles>) and Transdisciplinary Journal of Engineering & Science (TJES) (<https://www.atlas-tjes.org/index.php/tjes>).

In these articles and literature reviews, a similar position of many transdisciplinarity researchers was found. For example, Bergmann and Jahn (2019) said:

Today, transdisciplinary research is regarded as standard where the issues of change, transformation, and sustainable development are concerned – even if there are different ideas about what transdisciplinarity is and how it should be practiced in research. Recent years have seen the development of new approaches and framings in an attempt to strengthen the effectiveness of research in societal transformations. One consequence has been a weakening of the theoretical foundations of transdisciplinary research. Research that draws on the trans-disciplinary research mode tends to transition from *a scientific approach* to the *mere application of participatory processes*. (p. 161)

Kasa and Pohl (2019) noted several problems. They said:

Co-creation is most needed when we face complex challenges where there is no known best practice. When it is obvious that no party has the answer or even the ability to find the answer by themselves, transdisciplinarity is required. Transdisciplinarity is also required when it takes a multitude of perspectives and experiences to jointly explore and find ways forward. In these cases, the answers lie in diversity and at the same time diversity in itself is a big challenge and a potential pitfall. Over the last decade, several collections evolved that suggest methods and tools for co-creation, such as the Team Science Toolkit, the Tools for Integration and Implementation Sciences, and td-net's toolbox for co-producing knowledge. These collections

showcase the diversity and plurality of tools and methods to be used in transdisciplinary projects. The practical use of methods is flexible and situational and requires know-how and skills in facilitation. Facilitation is a means to balance the different interests embedded in a transdisciplinary project. The level of facilitation needed is dependent on the complexity of the task, and it is associated with the backgrounds of the participants in the project. Facilitating is the skill required to create scaffolding, a structure, and a safe container where enough chaos can be brought in for co-creation to happen and new things to be born. (p. 106)

Lotrecchiano and Misra (2018) categorically stated the problems of interaction between specialists in transdisciplinary teams. They said:

One category of systems complexity pertains to the barriers to transdisciplinary integration arising from interpersonal interactions in transdisciplinary team-based contexts called interactive systems complexities. Interactive systems challenges to transdisciplinary integration include perceived inequitable contributions to the project, unbalanced problem ownership, discontinuous participation, fear of failure, variability in communication types and skills, overall lack of participant satisfaction with the project processes and outcomes, among others. Structural systems complexities, on the other hand, are barriers to transdisciplinary integration that arise from characteristics inherent to the makeup of teams. These include differences in foundational training among team members, diverse and changing career paths, geographic dispersion, a lack of awareness of the breadth and complexity of the problem, perceived insufficient legitimacy of a team to solve the problem, conflicting methodological standards, conflicting epistemological and ontological orientations, and differing levels of transdisciplinary orientation among team members. (pp. 52-53)

These objective and subjective difficulties hinder attempts to evaluate and compare different opinions and strands of transdisciplinarity. Nonetheless, the overview of the literature reviews focuses on the results of the primary generalization of the literature content, but not on the continuous quoting and discussions of its authors since it occurs in the traditional literature reviews. Through the results of rethinking and systematizing the literature review content, it was possible to draw a conclusion. Thus, the existing opinion about the transdisciplinarity was recorded in the scientific environments in the form of 39 stable stereotypes.

TRANSDISCIPLINARITY STEREOTYPES

The *stereotype* is a belief or idea of what a particular transdisciplinarity is. This evaluation prevails in the scientific and personal consciousness and forms the prejudiced attitude to the term. The use of stereotypes allows the human brain to save energy spent for mental activity. The stereotypes simplify an unordinary and fuzzy image of transdisciplinarity while trying to describe it in simple and common expressions for the authors of the articles and literature reviews. In terms of certain articles, the stereotypes of transdisciplinarity appear to be convincing. However, it should be noted that authors of some stereotypes use their own perception of transdisciplinarity, and the content turns out to be far from its prime cause and initial ideas. Probably, this circumstance is one of the main reasons that some researchers consider transdisciplinarity to be a marginal direction of contemporary science. However, during qualitative content analysis, it was observed if a major part of stereotypes recorded any certain property, parameter, or characteristics of transdisciplinarity. Thus, the detected stereotypes were classified into 11 groups (A-K) (Table 1).

Table 1. Distribution of Stereotypes by Similar Content

GROUP OF STEREOTYPES	CONTENT OF STEREOTYPES
A) Main prime causes of transdisciplinarity (6):	<ul style="list-style-type: none"> - Desire to have a global approach to the control of social and economic development of the modern society tending to globalization; - Desire to solve the problem for stable development of the modern society; - Desire to overcome division of the scientific disciplines and disciplinary knowledge; - Desire to integrate worldviews of the academic and systems approaches; - Desire to integrate knowledge of science and practice; - Desire to generalize mythological, religious, philosophical, and scientific worldviews.
B) Main initial ideas of transdisciplinarity (2):	<ul style="list-style-type: none"> - Transdisciplinarity of higher education as a meta-discipline (systems transdisciplinarity) provides training for students in the systems transdisciplinary method to solve complex problems in modern society; - Transdisciplinarity of scientific research as a special type of transdisciplinary research allows scientists and specialists to form unique methods to solve certain complex scientific problem.
C) Meanings of “transdisciplinarity” definition (5):	<ul style="list-style-type: none"> - Declaration stating and protecting the equal rights of famous and little-known scientists, great and little science disciplines, as well as cultures and religions, in research of the outside world; - High level of education, versatility, and generality of knowledge of a certain person; - Rule of the outside world research; - Principle of scientific knowledge organization that provides great opportunities of interaction for many disciplines when solving the complex scientific problems; - Type of systems approach developed within the limits of forming meta-discipline “system transdisciplinarity”.

GROUP OF STEREOTYPES	CONTENT OF STEREOTYPES
D) Transdisciplinarity forms (3):	<ul style="list-style-type: none"> - Theoretical form relating to research of the proper transdisciplinarity and its methodology; - Phenomenological form being capable of connecting theoretical principles with observed experimental data when forecasting further results; - Experimental form being capable of ensuring that the level of the experiment procedure reproduction and the results is being acceptable by the scientific society.
E) Transdisciplinarity kinds (5):	<ul style="list-style-type: none"> - Transdisciplinarity-0 uses the illustrative potential of the artistic metaphor and figurative language as a basis; - Transdisciplinarity-1 designates formal interconnection of several disciplines during transdisciplinary research; - Transdisciplinarity-2 designate internal connection of the disciplinary knowledge with the personal experience of the researcher; - Transdisciplinarity-3 is associated with the use of the general metaphors having fundamental cognitive meaning; - Transdisciplinarity-4 is associated with forming meta-discipline (systems transdisciplinarity) on the basis of which there is a special world view (transdisciplinary reality) and transdisciplinary methodology of its research.
F) Transdisciplinarity types (2):	<ul style="list-style-type: none"> - Transdisciplinarity of ideal type (Mode 1) supposing creation of general cognitive-epistemological structure, by means of which an attempt to combine all disciplinary languages and specific types of causality is made; - Transdisciplinarity of real type (Mode 2) supposing the cooperation of science, practice, and society (combining of scientific and empirical knowledge).

GROUP OF STEREOTYPES	CONTENT OF STEREOTYPES
G) Institutional statuses of transdisciplinarity (4):	<ul style="list-style-type: none"> - Transdisciplinary approaches as a method for implementation of trends to integrate and generalize disciplinary, interdisciplinary, and multidisciplinary knowledge and models of the object; - Transdisciplinary processes as a method of combining “theoretical severity” of the scientific knowledge and “empirical wisdom” of practical knowledge about the real world; - Transdisciplinary research as a method for creation of different disciplines of new conceptual, theoretical, and methodological innovations to solve the complex scientific problems by researchers; - Transdisciplinary metadiscipline as a way to coordinate knowledge of the unconditional, intuitive, speculative, and empirical types of knowledge.
H) Trends for transdisciplinarity activity (5):	<ul style="list-style-type: none"> - First trend (slogan “Integration”) is a modern version of systematic integration and synthesis of disciplinary knowledge; - Second trend (slogan “Unity”) is a modern version of unification and generalization of disciplinary knowledge and existing world views; - Third trend (slogan “Transgression”) is a modern version of attempts to overcome the borders of academic and unacademic knowledge, borders of class, gender, race, ethnic and other identities, etc.; - Forth trend (slogan “Holism”) is a modern attempt to move beyond the disciplinary views formulating the integral image, pattern or model of the research object; - Fifth trend (slogan “Problem Solving”) is focusing on wicked problem solving in the modern society.

GROUP OF STEREOTYPES	CONTENT OF STEREOTYPES
I) Potential states of transdisciplinarity (2):	<ul style="list-style-type: none"> - “Weak” transdisciplinarity is associated with transdisciplinary approach in the classification of the academic scientific approaches. This approach is based on the natural-science world view and supposes search of unique methods to solve the complex problems of science; - “Strong” transdisciplinarity is associated with systems transdisciplinary approach in classification of the systems approaches. This approach is based on the philosophic picture of a single world (unicentrism) and uses a universal systems methodology to solve the wicked problems in the modern society.
J) Consistency of transdisciplinarity to the scientific method (2):	<ul style="list-style-type: none"> - Consistency to academic (classical) approaches in their classification; - Consistency to systems approaches in their classification.
K) Associative relation determined as the transdisciplinarity (3)	<ul style="list-style-type: none"> - The transdisciplinarity as an association with some “crossing plays” being capable of describing homogeneity for theoretic activity in different areas of science and engineering independent from the field, where this activity is performed and formulated only in the mathematical language; - The transdisciplinarity as an association with original theoretic concepts, which are outside the scope of one research area only; - The transdisciplinarity as intellectual sophistication associating with the common to humanity culture.

Rethinking of stereotypes in their group combination in terms of the prime cause and two initial ideas allowed us to form the generalized definition of transdisciplinarity:

Transdisciplinarity is a method of the intellectual activity intensification in the area of interdisciplinary interactions contributing to maximum broadening of the scientific worldview horizon.

Such a definition of transdisciplinarity supposes availability of the tools that ensure broadening of the scientific worldview horizon. The role of such tools in the area of interdisciplinary interactions is played by the transdisciplinary and systems transdisciplinary approaches. Considering the generalized definition of transdisciplinarity, the definition of the transdisciplinary approach will be as follows:

Transdisciplinary approach is a method of broadening the scientific worldview horizon in terms of a natural-science worldview by the implementation of integrative trends of disciplinary, interdisciplinary, and multi-disciplinary knowledge and models of the object.

In the classification of the academic scientific approaches, the transdisciplinary approach allows maximum integration and synthesis of disciplinary knowledge by the idealized object model. The idealized object is an imagine structure of a real object, which is provided with all possible (real and unreal) properties during mental experiments. The idealized object is used as a basis to construct theories, which allows the description of reality laws (Subbotin, 2010).

In turn, the definition of the systems transdisciplinary approach will be as follows:

Systems transdisciplinary approach is a method of broadening the scientific worldview horizon within the limits of the philosophic picture of a single world by simulation of the object in the form of the transdisciplinary system by allowing the use of the systems transdisciplinary methodology for its research.

In the classification of the systems approaches, the systems transdisciplinary approach allows maximum unification and generalization of disciplinary knowledge within the limits of the transdisciplinary system. The transdisciplinary system is an imagine structure of general order conditioning unity of proper space, information, and time of each object, as well as the proper environment, which elements are these objects (Mokiy & Lukyanova, 2021). The systems transdisciplinary models of spatial (Mokiy, 2020), informational (Mokiy, 2021a), and temporal (Mokiy, 2021b) unit of the order provide the object with certain strict properties. Initially, it also determines the basic parameters for these properties, their values, nature, and intensity of their interaction in the object.

CONSISTENCY OF THE TRANSDISCIPLINARY APPROACHES WITH ACADEMIC AND SYSTEMS SCIENTIFIC APPROACHES

For demonstration of consistency of the transdisciplinary approaches with academic and system scientific approaches, C.F. Gauss random variables normal distribution was used. The normal distribution law is known as C. F. Gauss random value distribution law (Prokhorov, 2020). Distribution of random values is showed by the Gaussian curve (Gaussian). A part of median (Gaussian centre) is executed by some average value of the researched parameter. As a result, the Gaussian can show, for example, distribution of shell burst around the target aim point on “short-long” principle; distribution of blood pressure values in the group of people that do not achieve or exceed averaged value of 120/80 mmHg; distribution of height values for these people that do not achieve or exceed the average value of 175 cm, etc. However, for the scientific approaches, there are no such evaluation parameters as “short-long” to the essence of the research object. Thus, the law of normal distribution for scientific approaches differs from distribution of shell bursts around target aim point. In this case, axes of Gaussian will not have numeric (quantitative) but logic (qualitative) characteristics.

In the classification of academic and systems approaches, the continuity is associated with a sequential broadening of the scientific worldview horizon. Thus, it is important to exactly visualize what the stereotype “broadening of the scientific worldview horizon” means. Sight sense of amphibians, for example, frog, is organized so that it sufficiently recognizes moving objects and actively responds to them. It sees and responds to the flag, which is moved by the wind. However, if the wind goes down, then for the frog the flag turns out to be a fuzzy grey spot on the fuzzy grey background of the environment (Zhdanova, 2018). As a result, a frog can start moving in order to broaden the worldview horizon. During motion, all stationary objects start moving in relation to the frog and it can see and distinguish them! The views of the disciplinary specialist also have specific features. In reality, the eyes of the disciplinary specialist can see a bent spoon in a glass of water (see Figure 1a), which is actually a straight one (see Figure 1b).

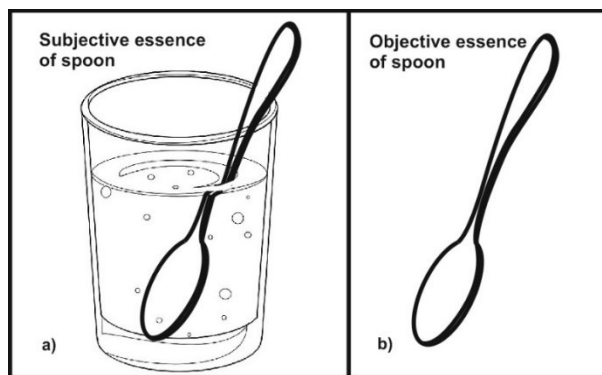


Figure 1. Image of Straight Spoon in a Glass of Water

If the disciplinary specialist does not have the possibility to remove the spoon from the glass or does not actually know what it is, then the specialist will research and describe what is seen – the bent spoon.

However, if the spoon has a real bend copying its supposed bend (Figure 2b), then in reality the eyes of the disciplinary specialist see the straight spoon in the glass of water (see Figure 2a). As a result, the specialist will research and describe the bent spoon as a straight spoon.

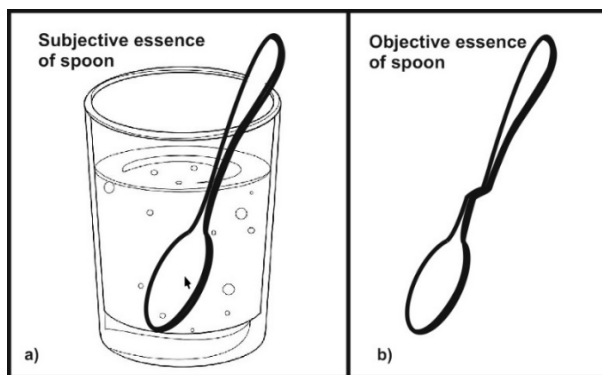


Figure 2. Image of Bent Spoon in a Glass of Water

This example results in asking the following question: What are actually the objects and subjects of public (social) sciences that the specialists see in reality? Are these bent spoons, which are actually straight ones, or are these straight spoons, which are actually bent ones? In this case, it is reasonable to ask another question: What form of social relations (subjective or objective) do economists, sociologists, politicians, and managers use for development of new model of the world social and economic order and control of the local and global processes of the social and economic development? In order to answer these questions, it is necessary to exclude the objects of public (social) sciences from the natural environment, such as the spoon from the glass of water, and see what they are in reality. Without unambiguous answers to these questions, it is impossible to analyze the risk from the implementation of a new model of the world social and economic order. Thus, the specialists of the public (social) sciences should pay attention to the systems transdisciplinary approach, which allows the distinguishing of the objective essence of the objects, subjects, and their interactions without breaking their connection with the environment.

However, the desire of the disciplinary specialist to achieve maximum scientific worldview horizon is similar to the desire of a smoker to give up smoking. Theoretically it is possible, but practically it is difficult. As a result, this makes the specialist leave the area of psychological comfort that is formed by the disciplinary worldview. In reality, this desire obtains noticeable support if the smoker sees an X-ray image of their lungs. Possibly, the Gaussian pattern, which demonstrates consistency of the

transdisciplinary approaches with the academic and systems approaches, will help the disciplinary specialist. Thus, such Gaussian can be seen in Figure 3 below.

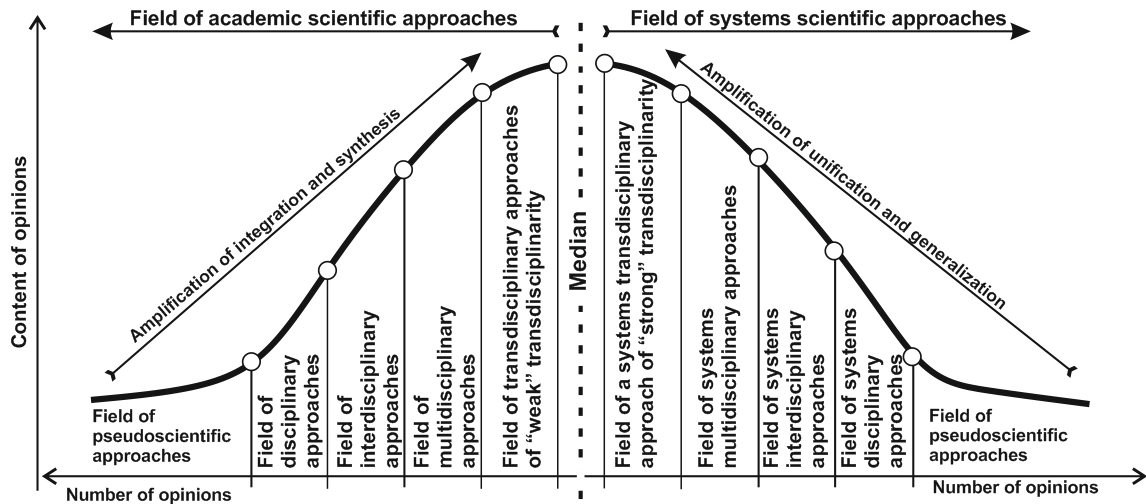


Figure 3. Illustration of the conceptual analysis of transdisciplinary approaches in the environment of academic and systems approaches (Gaussian model)

In this case, the median divides the Gaussian into two halves. These halves (areas) are characterized by similar structure of classification for the academic and systems approaches.

AREA OF ACADEMIC APPROACHES

The area of academic approaches is located on the left side of the median. This area is formed with five types of approaches in the direction from pseudoscientific approaches to transdisciplinary ones. The total priority of disciplinary knowledge and disciplinary methodologies in this area does not allow the transdisciplinary approach to form any general theoretical structures. In such a form the transdisciplinary approach calls for greater reflectivity, particularly to humility, openness for interaction with other methodologies and practices, and readiness to give place to other approaches if they are more proper for modern challenges. Such a transdisciplinarity plays a part of weak transdisciplinarity, and its methodology essentially is similar to the methodology and multidisciplinary scientific research (Max-Neef, 2005). However, a weak transdisciplinarity has strong properties. These properties are formed as a result of disciplinary knowledge integration and synthesis. Synthesis is a procedure of combining of the appropriate features, properties, and relations distinguished during analysis into a complex whole. Integration is a method used for maximum filling of the obvious model of the idealized object with the knowledge of complementary disciplines. Generally, this knowledge has already been systematized in their disciplines. Within the limits of their own disciplines for knowledge within the standard quantitative and qualitative characteristics, their numerical or logical values are determined. However, the disciplinary knowledge remains indifferent (insensible) in its classifications. They remain indifferent to the process of integration in the integral model of the idealized object (simply stated, they and their numeric values represent only what they present). Thus, the disciplinary specialists often have to make a conclusion and describe the results of interdisciplinary, multi-disciplinary and transdisciplinary research, based on compromise searching. Its search of compromises results in three negative consequences:

- **Ambiguousness of Methodological Assurance.** Each research of the complex object or solving of the complex scientific problem needs creation of a unique method. The content of the unique method cannot be predicted, as it is newly formed every time during cooperation of participants from a temporary team. The temporary team of disciplinary specialists is broken apart and a unique method is lost. It should be noted that the unique method

requires a unique way for risk analysis due to implementation of the object research results or problem solving. Nonetheless, the proper creation of such analysis ways is a complex scientific problem.

- **Elitism.** Forming of the unique method is available for the specialists who have formed a scientific world view. On the other hand, it is unavailable for the students who are in process of scientific world view forming and training of the scientific method essence. Thus, the rules to form the unique methods cannot be taught in universities.
- **High probability of self-reference disciplinary traps.** Self-reference occurs in the cases when some notion refers to itself. For example, it involves a case when the disciplinary specialists have to prove the obvious sense of the straight spoon only on the basis that it is perceived as the straight spoon. But earlier it was shown how false its obvious essence could be.

AREA OF SYSTEMS APPROACHES

The area of systems approaches is located from the right side of the median in Figure 3. Moreover, this area is formed with five types of approaches in the direction from pseudoscientific systems approaches to systems transdisciplinary ones. Contrary to the transdisciplinary approach in classification of the academic approaches, which use the obvious (subjective) sense of the model for the idealized object, the systems transdisciplinary approach uses the objective essence of the object representing it in the form of the transdisciplinary system (Mokiy, 2019b). The availability of special philosophic substantiation (unicentrism) and the appropriate universal methodology provides the features of strong transdisciplinarity for the systems transdisciplinary approach. The systems approaches of the Gaussian right area are characterized with increase of disciplinary knowledge unification and generalization degree.

Unification is a process for bringing the disciplinary knowledge and/or their disciplinary classifications to a uniform systems transdisciplinary classification. In other words, the existing classifications of disciplinary knowledge are specified within the limits of isomorphic systems transdisciplinary models for space, time, and information units of the order, which conditions a unity of the world and each object and process. After unification, the disciplinary knowledge becomes an active part of the systems transdisciplinary solution for acute problems of the modern society, as well as in solving complex scientific problems. Thus, the specialists can forecast change of quantitative and qualitative characteristics of the certain object even concerning condition of the objects, which were located within one area (Mokiy, 2019c).

Generalization is a method of ordered filling of the systems transdisciplinary models of the order units with the required and sufficient disciplinary knowledge, which describes the objective essence of the object or problem. It should be noted that the systems transdisciplinary unification and generalization do not break the disciplinary classifications of knowledge and do not cancel their disciplinary criteria, indices, and parameters. It helps in interpreting these criteria, indices, and parameters in terms of the order conditioning of a unity of the environment, as well as the objects and processes, which are its elements. Moreover, relevance, reliability, scientific severity, and efficiency of the disciplinary tools and methods used for the process of systems transdisciplinary research are retained.

The systems transdisciplinary unification and generalization of the disciplinary knowledge results in six positive consequences:

- allows excluding the practice of compromise search between the disciplinary specialists;
- allows the specialists of the transdisciplinary team to focus on their professional competences, but not the compromise search, particularly by providing the required volume of disciplinary information, organize and perform the required experiments, and control and comment on the process of disciplinary knowledge generalization in the direction of wicked problem solving;

- contributes to substantiation for selection of the disciplinary specialists in the temporary teams, as well as the disciplinary knowledge, which will be used in the systems transdisciplinary research;
- contributes to the use of the universal research method and universal method of risk analysis due to research results implementation. Also, the rules for the use of the universal method of research and risk analysis can be studied in the universities;
- reduces the part of facilitators in the transdisciplinary teams of the disciplinary specialists. As a result, the management (coordination) of the disciplinary knowledge and not the disciplinary specialists are performed;
- avoiding dead end with self-reference, as the specialists of the transdisciplinary team use the objective and uniquely determined philosophic, conceptual, and methodological categories by excluding the use of the corrupted or incorrect research object pattern and solved problem.

DISCUSSION

In June 2020, the Organization for Economic Co-operation and Development (OECD) published the policy document “Solving social problems through transdisciplinary research” (Global science forum, 2020). Recall that the OECD is an organization that in 1968 and 1970 organized two international conferences. During these conferences, the root cause and two initial ideas of transdisciplinarity were formulated.

Having studied the OECD document, it was concluded that, by 2020, the OECD had completely exhausted the possibilities of the additional initial idea of transdisciplinarity, which was formulated by J. Piaget and who also implemented various transdisciplinary approaches. Hoping to solve complex social problems, experts from the OECD did not pay attention to the objective and subjective difficulties that accompany transdisciplinary research and transdisciplinary teams. This circumstance inevitably endowed the program document with obvious advantages and hidden disadvantages, which reduce the effectiveness of solving complex social problems.

The obvious advantages of the document include clarity of presentation of materials, a systematic presentation of projects that are defined as transdisciplinary projects, and the formation of concluding comments describing the conditions under which such transdisciplinary research can be successful.

The hidden shortcomings of the document include the drafters’ lack of theoretical knowledge of the document about the types, forms, types of transdisciplinarity and the lack of ideas about the identification features of multidisciplinary and transdisciplinary research. The drafters of the document got out of this situation very simply. They compiled their own glossary (Global science forum, 2020, p. 79). In this glossary, they used one of many possible definitions of transdisciplinarity and transdisciplinary research. Then, the drafters of the document selected projects that fit this definition, designating them as transdisciplinary research. As a consequence, the paper has a perfectly legitimate presentation of 28 projects (p. 41), a highly problematic introductory theoretical part (p. 15), and even more problematic concluding comments (p. 69).

The problem with the introductory part is that its iconography (p. 15) demonstrates the equality of all disciplines and their knowledge. At the same time, it does not explain the principles on which it is supposed to carry out the interaction of disciplinary worldviews, methodologies, and languages. Furthermore, there is no justification for the generalization of disciplinary knowledge, as well as the language in which the results of transdisciplinary research should be presented.

The paradox of the final comments is that these comments are, in fact, a description of the factors that hinder the development of transdisciplinarity and transdisciplinary research. For example, the authors of the document state (p. 69):

- Whilst policy makers and other actors can provide mandates and incentives for transdisciplinary research, their impact will be limited without the support of the academic community and its representative associations.

In this comment, the compilers of the document do not take into account the main purpose of the academy, which is to preserve the disciplinary worldview, to accumulate and preserve disciplinary knowledge, and to protect disciplinary boundaries. Transdisciplinarity aims to transcend these boundaries. It is for this reason that the academy opposes transdisciplinarity. Therefore, until transdisciplinarity turns into an independent scientific discipline with its own boundaries, which the academy will have to protect, it will fundamentally not enjoy the support of the academic community.

- Universities and public research institutions are the principle organisations through which transdisciplinary research is carried out, and their long-term strategic commitment and support is essential if TDR is to be expanded to the scale that is necessary to address complex societal challenges.

In this comment, the drafters of the document do not take into account the fact that the main task of universities is to form a disciplinary scientific worldview in students, to teach them the skills of practical disciplinary activity, limited to the competencies of bachelor's and master's programs. Consequently, the expansion of transdisciplinary research to the extent necessary to solve complex social problems will be blocked by the goals of higher education, the disciplinary structure of universities, and the disciplinary worldview of the organizers of higher education.

All this leads to the conclusion that such policy documents of the OECD do not contribute to the formation of a policy of using transdisciplinary research to solve complex social problems. However, they contribute to the improvement of the policy of using interdisciplinary and multidisciplinary research in solving low-threshold and medium-threshold social problems, as well as the development of appropriate interdisciplinary and multidisciplinary approaches.

Recall that each transdisciplinary (applied) research needs the formation of a unique method and methodology. Applied research is original investigation intended to acquire new knowledge but directed towards a specific, practical aim or objective (including a client-driven purpose). Applied research is original research carried out to gain new knowledge but aimed at achieving a specific practical goal or goal (Research, n. d.). On this occasion, E. Morin (1999) wrote that, in fact, it is multidisciplinary and transdisciplinary complexes that play a fruitful role in the history of science; it is worth remembering the key concepts that are involved here, namely, cooperation, more precisely, a joint project. There is no single method for collaborative projects; what is needed is rather the ability to identify and combine methods that best support the current work (Kasa & Pohl, 2019).

What will happen if transdisciplinary (applied) research is used to solve the problem of the sustainable development of society? It is known that sustainable development has three components: social, economic, and environmental (Cristian et al., 2015). Therefore, the study of each component of sustainable development will require the formation of a unique team of disciplinary specialists and the creation of a unique transdisciplinary method. In this case, the question arises on the methodology and language of which discipline should be used to obtain and describe the solutions to this complex multifactorial problem - economics, ecology, sociology? There is no answer to this question.

Despite such shortcomings, the transdisciplinary approach (see Figure 3), which is formed by the additional initial idea of transdisciplinarity, is better known in science and education. This happened due to the imposition of the subjective desire of practitioners to eliminate the separation of disciplinary approaches on the objective desire of scientists to synthesize and integrate disciplinary knowledge, which characterizes the current stage of development of science. This overlap contributed to the transformation of interdisciplinary and multidisciplinary research into a special form of transdisciplinary (applied) research. A distinctive feature of the transdisciplinary approach is that

each unique method is based on the experience of facilitation, consensus, and compromise of disciplinary specialists – members of the transdisciplinary team. Therefore, the effectiveness of transdisciplinary (applied) research significantly limits the objective and subjective interpersonal, worldview, psychological and methodological and other problems of interdisciplinary interaction (Lotrecchiano & Misra, 2018). In this case, the solution to the problem of interaction between disciplinary specialists depends to a greater extent on the practical experience of the facilitators. As a result, many problems of modern society, which are waiting for their solution and in which social and political aspects are manifested, are declared as ‘wicked’ problems. It should be noted that such problems are excluded from the list of problems that could be solved by science (Rittel & Webber, 1973). Thus, it can be stated that the transdisciplinary approach associated with transdisciplinary (applied) research allows solving well-structured scientific problems that involve knowledge of complementary disciplines.

In contrast to the transdisciplinary approach, the systems transdisciplinary approach (see Figure 3) initially develops the prime cause and the main initial idea of transdisciplinarity, which was formulated by E. Jantsch (1968, 1970, 1972). Recall that this idea involved the creation of a universal global approach based on systems thinking, a systematic approach, and the potential of disciplinary science. This approach should ensure long-term planning, forecasting, and management of the global (sustainable) development of modern society. In this case, the study of each component of the sustainable development of society, as well as the unification and generalization of the results of these studies, will be carried out using the universal methodology of the systems transdisciplinary approach. To achieve this goal, effective management and coordination of disciplinary knowledge is carried out using transdisciplinary models of spatial, temporal, and informational units of order. In this case, disciplinary specialists in transdisciplinary teams do not need to seek consensus and compromise. Their participation is reduced to a traditional professional activity – to analyze a given amount of disciplinary knowledge using strict disciplinary methods. Specialists-generalists, carriers of the methodology of systems transdisciplinary methodology, at the final stage unify and generalize the results, form the final conclusions of the study, describe them in a language understandable to disciplinary specialists, administrative workers and politicians, and analyze the risk associated with the implementation of the results of systems transdisciplinary research. In this role, a systems transdisciplinary approach allows solving high-threshold problems, which, as a rule, are poorly structured problems of science and society.

The lack of awareness of the systems transdisciplinary approach is due to several fundamental circumstances:

- Firstly, the philosophical and conceptual substantiation of a systems transdisciplinary approach implies the substantiation of certain objective laws of the socio-economic development of society. Knowledge of objective laws presupposes their unconditional and unambiguous implementation by states and society as a whole. However, the subjectively interpreted laws of social development and the subjective goals and objectives of modern politics may not correspond to each other. Politics are actions or activities related to the attainment and use of power in a country or society (Collins Dictionary, 2022). It is known that these actions and activities in different countries have subjective goals and objectives, the content of which differs significantly for internal and external use. Therefore, the massive use of a systematic transdisciplinary approach is limited by the fear of the leaders of economically developed states that the real possibility of organizing long-term planning, forecasting, and managing the development of society will lead to an inevitable change in the world socio-economic order. The new model of the world socio-economic order will be focused on achieving long-term goals of sustainable development, and not on achieving short-term goals and short-term political and economic benefits.
- Secondly, the possibilities of a systems transdisciplinary approach, as a global approach, are able to substantiate the principles of a new model of the world socio-economic order,

mechanisms for its implementation in intrastate and interstate relations, mechanisms of state and global security, mechanisms of non-forced coercion of states and state unions to a peaceful existence, etc. In other words, we are talking about the possibility of developing systems transdisciplinary technologies for long-term planning, forecasting, and managing the sustainable socio-economic development of society. The creation of technologies is exactly what the disciplinary approach and transdisciplinary (applied) research lack.

- Thirdly, the global approach cannot exist without its carriers. The role of such carriers is played by specialist generalists. Specialists-generalists are not born. Like any other specialists, generalists must receive the appropriate education and competencies at universities in special departments. To create such departments, the global approach must be a scientific discipline – a systems transdisciplinarity. In our opinion, the introduction of systems transdisciplinarity into the various department in universities will largely contribute to the completion process of the transformation of second-generation universities into third-generation universities.

CONCLUSION

T. Kuhn (1962) stated in his famous book “The Structure of Scientific Revolutions” that almost always people who successfully provided the fundamental development of a new paradigm, based on which the global approaches were constructed, were either very young or beginners in this area. Thus, important significance is attached to partial reforming of the disciplinary structure of the universities by allowing the creation of the Systems transdisciplinary departments and the Centers of systems transdisciplinary retraining of disciplinary specialists. Moreover, T. Kuhn warned that the change of tools in science was a last extreme measure, which was taken only in case of actual necessity. Significance of social and economic and social and political crises of modern society consists particularly in that they speak about the relevance of such tools change. The priority in such a shift belongs to transdisciplinary approaches and a systematic transdisciplinary approach.

Given the above, it can be concluded that transdisciplinarity is not a marginal trend in modern science and education. Transdisciplinarity is a method of the intellectual activity intensification in the area of inter-disciplinary interactions contributing to maximum broadening of the scientific worldview horizon. The transdisciplinary approach and the systematic transdisciplinary approach serve as tools to expand the horizon of the scientific worldview.

Considering the above information, it can be concluded that the transdisciplinary approach and the systems transdisciplinary approach have a different initial idea, different philosophical, conceptual, and methodological foundations, as well as different research potential. Based on recommendations, the organizers of higher education, who are currently discussing the problem of reforming the disciplinary structure of the university, should pay attention to the differences between the transdisciplinary and systems transdisciplinary approaches. In this case, they should take timely actions to accurately determine the goals of such reform and start moving within the optimal calendar timeframe towards achieving these goals (Mokiy, 2019c).

The customers and sponsoring organizations trying to obtain the solution form the problem of long-range forecasting, planning, and control of the global and regional social and economic development of the society, should pay attention to these differences. Thus, to solve such problems, firstly it is necessary to involve the teams of specialists who have skills in knowledge of the systems transdisciplinary approach and who are able to conduct a risk analysis of the proposed solution.

REFERENCES

- Academia. Scientific social network. (n.d.). *Transdisciplinarity*. <https://www.academia.edu/Documents/in/Transdisciplinarity>
- Academy of Transdisciplinary Learning and Advanced Studies. (n.d.). *Books*. <https://theatlas.org/index.php/about-atlas-3/honoring-dr-john-warfield-4>

- Alvargonzalez, D. (2011). Multidisciplinarity, interdisciplinarity, transdisciplinarity, and the sciences. *International Studies in the Philosophy of Science*, 25(4), 387-403. <https://doi.org/10.1080/02698595.2011.623366>
- Apostel, L. (1972). *Terminology and concepts. Interdisciplinarity: Problems of teaching and research in universities*. OECD Publ., 79-81. https://archive.org/details/ERIC_ED061895/page/n3/mode/2up
- Baptista, B. V., & Rojas-Castro, S. (2019) Transdisciplinary institutionalization in higher education: A two-level analysis. *Studies in Higher Education*, 45(6), 1075-1092. <https://doi.org/10.1080/03075079.2019.1593347>
- Bergmann, M., & Jahn, T. (2019). Transdisciplinarity as critical transdisciplinarity. *International Transdisciplinarity Conference 2019: Joining Forces for Change* [Abstract booklet,], Gothenburg, Sweden 10 – 13 September 2019, 161. <https://council.science/events/international-transdisciplinarity-conference-2019-joining-forces-for-change/>
- Bernstein, J. H. (2015). Transdisciplinarity: A review of its origins, development, and current issues. *Journal of Research Practice*, 11(1), Article R1. <http://jrp.icaap.org/index.php/jrp/article/view/510/412>
- Brandt, P., Ernst, A., Gralla, F., Luederitz, C., Lang, D. J., Newig, J., Reinert, F. Abson, D. J., & Wehrden, H. (2013). A review of transdisciplinary research in sustainability science. *Ecological Economics*, 92(C), 1-15. <https://doi.org/10.1016/j.ecolecon.2013.04.008>
- Braun, V., & Clarke, V. (2008). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101. <https://doi.org/10.1191/1478088706qp063oa>
- Brenner, J. E. (2014). Systems and information: Transdisciplinary study. In B. Nicolescu & A. Ertas (Eds.), *Transdisciplinary education, philosophy, & applications*, (pp. 1-31). Lubbock, TX. The Academy of transdisciplinary learning & Advanced studies the ATLAS. http://www.theatlas.org/in-dex.php?option=com_phoca-download&view=category&id=1:books&Itemid=93
- Collection of articles (2015). *Transdisciplinarity in philosophy and science: Approaches, problems, prospects*. In V. Bazhanov & R.W. Scholz (Eds.), Russian Academy of Sciences, Institute of Philosophy RAS. Moscow, Navigator Publ. https://www.researchgate.net/publication/281407924_Transdisciplinarity_in_philosophy_and_science_Approaches_problems_prospects
- Collins Dictionary. (2022, January 17). Politics. In *Collins English Dictionary*. <https://www.collinsdictionary.com/dictionary/english/politics>
- Creswell, J. W. (2014). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. Pearson. <https://www.worldcat.org/title/educational-research-planning-conducting-and-evaluating-quantitative-and-qualitative-research/oclc/859836343>
- Cristian, D., Luminita, D., Gogan, M., Artene, A., & Duran, V. (2015). The components of sustainable development - A possible approach. *Procedia Economics and Finance*, 26, 806-811. [https://doi.org/10.1016/S2212-5671\(15\)00849-7](https://doi.org/10.1016/S2212-5671(15)00849-7)
- Darbellay, F. (2015, January). Rethinking inter- and transdisciplinarity: Undisciplined knowledge and the emergence of a new thought style. *Futures*, 65, 163-174. <https://doi.org/10.1016/j.futures.2014.10.009>
- Gill, M. J. (2014). The possibilities of phenomenology for organizational research. *Organizational Research Methods*, 17(2), 118–137. <https://doi.org/10.1177/1094428113518348>
- Global science forum. (2020). Addressing societal challenges using transdisciplinary research. *Directorate for science, technology and innovation, Organization for Economic Co-operation and Development*. OECD Publ., 9-69. [https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DSTI/STP/GSF\(2020\)4/FI-NAL&docLanguage=En](https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DSTI/STP/GSF(2020)4/FI-NAL&docLanguage=En)
- Jantsch, E. (1969). Perspectives of planning. *Proceedings of the OECD working symposium on long-range forecasting and planning*. Bellagio, Italy, (27th October – 2nd November 1968). Paris, OECO Publ., 7-8. <https://eric.ed.gov/?id=ED044791>
- Jantsch, E. (1970). Inter- and transdisciplinary university: A systems approach to education and innovation. *Policy Sciences*, 1, 403-428. <https://doi.org/10.1007/BF00145222>

- Jantsch, E. (1972). Towards interdisciplinarity and transdisciplinarity in education and innovation. *Interdisciplinarity: Problems of teaching and research in universities*. OECD Publ., 99, 105-106. https://archive.org/details/tails/ERIC_ED061895/page/n101
- Jahn, T., Bergmann, M., & Keil, F. (2012, July). Transdisciplinarity: Between mainstreaming and marginalization, *Ecological Economics*, 79, 1-10, <https://doi.org/10.1016/j.ecolecon.2012.04.017>
- Kasa, S., & Pohl, C. (2019). Methods for transdisciplinarity and how to use them. *International Transdisciplinarity Conference 2019: Joining Forces for Change* [Abstract booklet.], Gothenburg, Sweden 10 – 13 September 2019, 106. <https://council.science/events/international-transdisciplinarity-conference-2019-joining-forces-for-change/>
- Kiyshenko, L. P., & Moiseev, I. I. (2009) *Философия трандисциплинарности* [Philosophy of transdisciplinarity]. Russian Academy of Sciences, Institute of philosophy RAS. Moscow, Institute of philosophy. <https://iph-ras.ru/uplfile/root/biblio/2009/Kiyashenko.pdf>
- Kuhn, T. S. (1962). *The structure of scientific revolutions*. University of Chicago Press. <https://archive.org/details/tails/ThomasS.KuhnTheStructureOfScientificRevolutions/mode/2up>
- Lawrence, R. J. (2015). Advances in transdisciplinarity: Epistemologies, methodologies and processes. *Futures*, 65, 1–9. <https://doi.org/10.1016/j.futures.2014.11.007>
- Lotrecchiano, G. R., & Misra, S. (2018). Transdisciplinary knowledge producing teams: Toward a complex systems perspective. *Informing Science: the International Journal of an Emerging Transdiscipline*, 21, 52-53. <https://doi.org/10.28945/4086>
- Markus, A. (2013) Transdisciplinary research (Transdisciplinarity). *Encyclopedia of creativity, invention, innovation and entrepreneurship*, 1819-1828. https://www.researchgate.net/publication/281903139_Transdisciplinary_Research_Transdisciplinarity
- Max-Neef, M. (2005. April). Foundations of transdisciplinarity. *Ecological Economics*, 53(1), 5-16. <https://doi.org/10.1016/j.ecolecon.2005.01.014>
- McGregor, S. L. T. (2014) Transdisciplinarity and conceptual change, *World Futures*, 70 (3-4), 200-232. <https://doi.org/10.1080/02604027.2014.934635>
- Mobjörk, M. (2010). Consulting versus participatory transdisciplinarity: A refined classification of transdisciplinary research. *Futures*, 42(8), 866-873. <https://doi.org/10.1016/j.futures.2010.03.003>
- Mokiy, V. S. (2019a). International standard of transdisciplinary education and transdisciplinary competence. *Informing Science: the International Journal of an Emerging Transdiscipline*, 22, 73-90. <https://doi.org/10.28945/4480>
- Mokiy, V. S. (2019b). Systems transdisciplinary approach in the general classification of scientific approaches. *European Scientific Journal*, 15(19), 247-258. <https://doi.org/10.19044/esj.2019.v15n19p247>
- Mokiy, V. S. (2019c). Training generalists in higher education: Its theoretical basis and prospects. *Informing Science: the International Journal of an Emerging Transdiscipline*, 22, 55-72. <https://doi.org/10.28945/4431>
- Mokiy, V. S. (2020). Information on the space. Systems transdisciplinary aspect. *European Scientific Journal*, 16(29), 26. <https://doi.org/10.19044/esj.2020.v16n29p26>
- Mokiy, V. S. (2021a). Information on the information. Systems transdisciplinary aspect. *Universum: Social sciences*, 1-2. [https://7universum.com/pdf/social/1-2\(71\)%20\[18.02.2021\]/Mokiy1.pdf](https://7universum.com/pdf/social/1-2(71)%20[18.02.2021]/Mokiy1.pdf)
- Mokiy, V. S. (2021b). Information on the time. Systems transdisciplinary aspect. *Universum: Social sciences*, 1-2. [https://7universum.com/pdf/social/1-2\(71\)%20\[18.02.2021\]/Mokiy.pdf](https://7universum.com/pdf/social/1-2(71)%20[18.02.2021]/Mokiy.pdf)
- Mokiy, V. S., & Lukyanova, T. A. (2021). *Методология научных исследований. Трансдисциплинарные подходы и методы* [Methodology of scientific research. Transdisciplinary approaches and methods]. Moscow. Urait Publ., p. 65. <https://urait.ru/book/metodologiya-nauchnyh-issledovaniy-transdisciplinarnye-podhody-i-metody-467229>
- Mokiy, V. S., & Lukyanova, T. A. (2022). Development of interdisciplinarity and transdisciplinarity in modern Russian science and higher education. In B. V. Baptista & J. T. Klein (Eds). *Institutionalizing interdisciplinarity and transdisciplinarity. Collaboration across cultures and communities* (pp. 124-138). Routledge, Taylor & Francis.

- Montuori, A. (2013). Complexity and transdisciplinarity: Reflections on theory and practice. *World Futures*, 69(4-6), 200-230. <https://doi.org/10.1080/02604027.2013.803349>
- Morin, E. (1999). La Tête bien faite. Repenser la réforme, réformer la pensée [Reform of thinking. Rethinking reform, reforming thinking]. *Editions du Seuil*, 136.
- Osborne P. (2015). Problematizing disciplinarity, transdisciplinary problematics. *Theory, Culture & Society*, 32(5-6), 3-35. <https://doi.org/10.1177/0263276415592245>
- Pasquier, F., & Nicolescu, B. (2019). To be or not to be transdisciplinary. That is the new question. So, how to be transdisciplinary? In B. Nicolescu, R. T. Yeh. & A. Ertas (Eds.), *Being transdisciplinary*. (pp. 7-16). Academy of Transdisciplinary Learning & Advanced Studies (ATLAS). <http://www.theatlas.org/index.php/about-atlas-3/honoring-dr-john-warfield-4?download=100:being-transdisciplinary>
- Piaget, J. (1972). The epistemology of interdisciplinary relationships. *Interdisciplinarity: Problems of teaching and research in universities*. OECD Publ. https://archive.org/de-tails/ERIC_ED061895/page/n135
- Prokhorov, Y. V. (2020). Normal distribution. *Encyclopedia of mathematics*. http://encyclopediaofmath.org/index.php?title=Normal_distribution&oldid=48011
- Research. (n. d). Definition of research. department of education and training. *Western Sydney University*. https://www.westernsydney.edu.au/research/researchers/preparing_a_grant_application/dest_definition_of_research
- Researchgate. Scientific social network. (n.d.). *Transdisciplinarity*. <https://www.researchgate.net/search.Search.html?type=publication&query=transdisciplinarity>
- Rigolot, C. (2020). Transdisciplinarity as a discipline and a way of being: Complementarities and creative tensions. *Humanities and Social Sciences Communications*, 7, 100. <https://doi.org/10.1057/s41599-020-00598-5>
- Rimondi, G., & Veronese, M. (2018). Defining the dialogue between sciences: A view on transdisciplinary perspective in the human sciences. *Informing Science: the International Journal of an Emerging Transdiscipline*, 21, 255-268. <https://doi.org/10.28945/4115>
- Rittel, H., & Webber, M. (1973). Dilemmas in a general theory of planning. *Policy Sciences*, 4, 155-169. <https://link.springer.com/article/10.1007/BF01405730>
- Scholar. Scientific social network. (n.d.). *Transdisciplinarity theory*. https://scholar.google.com/scholar?hl=ru&as_sdt=0%2C5&q=transdisciplinarity+theory&oi=
- Scholz, R. W., & Steiner, G. (2015a). Transdisciplinarity at the crossroads. *Sustainability Science*, 10, 521-526. <https://doi.org/10.1007/s11625-015-0338-0>
- Scholz, R. W., & Steiner, G. (2015b). The real type and ideal type of transdisciplinary processes: part I – Theoretical foundations. *Sustainability Science*, 10, 527–544. <https://doi.org/10.1007/s11625-015-0326-4>
- Subbotin, A. L. (2010). Идеализированный объект [An idealized object]. *New philosophical encyclopedia*. In 4 volumes. Institute of Philosophy RAS, National Social Science Foundation. Internet version of the publication. Moscow, Though Publ. <https://iphlib.ru/library/collection/newphilenc/document/HASHc976c6614a176c0458b2c9?p.s=TextQuery>
- Td-net. Network for transdisciplinary research. (n.d.). *Publications of td-net or in collaboration with td-net*. <http://www.transdisciplinarity.ch/en/td-net/Publikationen/Publikationen-td-net.html>
- Thompson, J. K. (2013, June). The transdisciplinary moment(um) *Integral Review*, 9(2), 189-199. https://integral-review.org/issues/vol_9_no_2_jun_2013_full_issue.pdf
- Thompson, J. K. (2014, November). Discourses of transdisciplinarity: Looking back to the future. *Futures*, 63, 68-74. <https://doi.org/10.1016/j.futures.2014.08.008>
- Zhdanova, T. D. (2018). *Зрение земноводных* [Vision of amphibians]. Natural science. Educational portal. <https://www.portal-slovo.ru/impressionism/36372.php>

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