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SOCIAL SCIENCES IN FRONT OF THE PARADIGM OF SYSTEMS THINKING

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Abstract: The article analyzes the new challenges faced by the social sciences in an attempt to defend their right to provide adequate knowledge of their object of study, and what is more important, to formulate more accurate predictions about its behaviour and change. The increasingly explicit penetration of information technology in the deep structures of modern civilization creates a fundamentally new situation in the research of society as well. Separation of the different scientific fields becomes counterproductive and the current methodological arsenal shows more visible deficits. A new paradigm is being formed in which apparently will be implemented research of society in the future - the paradigm of systems thinking. It enables and requires adequate knowledge of complex objects like all objects of social sciences, to be organized so that their functioning as system dynamic integrity to come to the fore. Systems thinking is a common conceptual framework, a set of attitudes, knowledge, methods and tools, united by the idea that when a particular social area has to be explored, it is necessary to take account of the whole and to understand the processes by which the parts of reality are linked together.

Key words: social sciences, systems thinking, digitization, complex objects, system integrity.

Introduction

On November 5, 2008, at the height of the global financial crisis, during a visit to London School of Economics the Queen of UK asked an unexpected question: Why no one among so erudite and experienced British economists had succeeded to predict the crisis[1]. This question should not be perceived as common inquiry, which can be given a specific answer[2]. It concerns a funda-

[1] "If these things were so large, how come everyone missed them?"

[2] In fact, on 17 June 2009, on the second British academic forum dedicated to the discussion about the causes of the financial crisis, gathered to discuss teachers, business journalists, politicians and others tried to formulate such response. In a letter sent to the Queen among other things was said: "The mistake was the inability to discern how all this builds on a series of interconnected imbalances that were outside the jurisdiction of the institutions".

mental for social sciences problem, which undoubtedly is the economics.. To what extent the theoretical tools and conceptual framework in which they work are adequate to research of their subject - social structures and processes, which become more and more complex and mutually dependent? And why accumulated stresses and imbalances are not captured in time to prevent any crises and conflicts?

The question therefore arises, provided there are hundreds of different theories, conceptual systems and practically approbated social experiments at the moment, is there a new situation, non-problematized so far theoretical and empirical material that requires and allows to look in a new way to the subject of the social sciences? I believe the answer is positive and this is related to possibilities for uncovering the links and interdependencies of influences and mutual influences between different, sometimes distant at first glance, elements of the social whole. What allows these processes to be identified and analyzed is the imposition of a principally new, unknown before, way of functioning of society (and science). It is associated with the rising importance of information technologies that leads to unthinkable, four or five decades ago, shrinking of global distances to the size of one, though global "village" (in the words of M. McLuhan). This new situation allows inaccessible before connections, patterns and impacts to be identified and turned into the subject of scientific analysis.

1. Information and its transformative power

This text has no ambition to trace out the ford in the swamp of concepts, definitions and classifications of information and its powerful force, transforming modern societies. But we cannot carry on without making some preliminary comments and clarifications.

From a philosophical point of view, the concept of information (from the Latin verb informare – to give form to, to form an idea of) is currently regarded as the main category, along with being and thinking. But this is not indisputable, because it is difficult the hundreds of definitions of information to be brought under one common denominator which to present the specifics of this category. Moreover, unlike the vast majority of philosophical categories that have thousands of years of history, the term information, at least in the sense that is imparted in it now, is quite new. It is related to the famous article of Claude E. Shannon "Mathematical Theory of Communication" [**Shannon, 1948**: 379-423, 623-656]. So far, although the word was known, it was used in the sense of news or facts about something. Claude Shannon himself in his earlier works often resorts to another concept of information (intelligences).

To understand why and how Shannon reaches the current sense of information, one should bear in mind that he worked at Bell Lab, divisions of AT & T on the problem of separation, the separation of those electromagnetic impulses that made some sense to the perceiver, who differentiated them from the rest representing electromagnetic "noise". In his attempt to "reset" the information, he came upon the idea of unit information, so-called **Bit** (short for **bi**nary digi**t** – binary unit). But though this article is considered a landmark, mostly with ideas for using statistical methods as a means of studying the information and formulation of the Law of Gaussian channel capacity, that which profoundly changes the meaning of the concept of information is the introduction of quantitative criterion, i.e., the difference between the known, the familiar, the trivial and the new, unknown until now. This means that a single bit may carry information comprised in a range from zero to the immensely important, depending on that who perceives it. According to the definition of Shannon, information are only those data, intelligences, signals, which eliminate or minimize to the least possible level or amount existing before their adoption uncertainty. In other words, the information is to eliminate uncertainty as a result of the adoption of certain signal or intelligence.

Of course, Shannon is not concerned with the content side of the messages. The focus of his researches is on the likelihood of appearance of a signal. Any signal at one time or another may appear, but the smaller the probability is, the rare or unexpected is its appearance, the amount of information that brings is greater. The significance of this idea is that it leads to understanding the relative nature of the information and its fundamental role in the system entities for which exchange of information, data, and signals is crucial. These systemic formations could not function, and often could not survive without a continuous exchange of data and signals not only between subsystems included in them, but also between them and the environment. Such a system is society as well.

Acceptance of the idea, a direct consequence of understanding the difference between meaningful information and information noise, that the public whole is extremely dependent on the quantity, quality and speed of information exchange between its different components and between the components included in these units have important consequences. They suggest that, albeit it is debatable whether societies organized around communication and information technologies have enough differences to be classified into a new historical stage, the societies possess some previously unknown properties and characteristics after all. These new features stem from opportunities for more rapid, efficient and accessible technical information processing, which gives grounds to speak about the emergence of a new quality of organization, the formation of communities and social movements. With the caveat that we will use a broader understanding of the concept, we can designate this new public-quality **digitization** of social processes.

Usually, with the concept digital world is marked virtual reality generated by electronic games. This is a narrower understanding of part of the changes brought by digital technology, and here it will not be discussed. **Digitization is the process in which more and more in public life are entwined communication technologies, involving the possibility of using digital encoding of the data arrays, the latter to be easily and with minimal costs and losses classified, processed, stored and used.**

This allows not only to be revealed new, previously unknown sides of reality, not only for the formation of new industries and opportunities, but also much more complete and most importantly systematic knowledge. And this applies not only to the natural sciences.

When we talk about the importance of digitization as a means of increasing and expanding research capacity in the social sciences, we can highlight some ideas or achievements. The first is the famous article of Vannevar Bush (1890-1974) "As We May Think", published soon after the end of World War II (1945). In it Vinegar Bush, who is considered the father of the idea of hypertext, presents his vision of the possibilities of machine processing of information. He depicts a view of a reality in which people are able, using encoders, quickly and easiliy "to multiply, divide and add temporary storage of some results, separate them for future processing and to record them" [**Bush, 1945**]. Particularly interesting are his insights on the technology for processing of unthinkable in an earlier period volumes of information and detection of relationships between different datasets. According to him, the devices for converting into binary code submissions from scientist's data will be able to detect links with other data, as when dialing a phone number set connects us with specific subscriber among the thousands of owners of phones. The practical implementation of this idea makes available not only the accumulation of information and knowledge of the reality in volumes unthinkable before, but forms the possibility of creating links, comparison and juxtaposition of objects and areas which at first glance have little in common.

To explain his idea of hypertext, Vannevar Bush departs from a description of the way the human brain works – by creating a web of connections involving various sections and cells. He imagines that the relationship between the two documents stored in the machine, for example, may become available at any time, because the machine does not know the problem of forgetting. Then the user of one document can reach and use other documents whenever he wants. This will create a completely new form of encyclopedia of knowledge that will keep many similar connections. This would facilitate the work of each expert in whatever field of science he works. Even it will occur, believes Bush, a new profession of creators of virtual trails (trail blazers), who will build useful links between different data.

Bush reaches to the insight that if we thus streamlining the records of the past, we will be able to more thoroughly analyze and our present. Ever-increasingly complex civilization that we have created needs mechanisms for data processing. And they no longer fit in the limited human memory. So if you have the opportunity to restore what the human brain, obeying the physiological laws, mind, we will be much fuller and more satisfying to focus on the subject, which examine or study which examine or study at the moment.

Vannevar Bush examines the science of his time in terms of more effective communication between people, allowing them not only more reliable to store ideas, but also to develop and amend them in such a way that they are an organic part of the development of society and not something independent of it. The more specialized knowledge is accumulated, the more efforts and more time will be required to maintain connections between different areas of science. Traditional methods for recording and disclosure of research results, says V. Bush, are outdated and inadequate to emerging problems. He gives an example with the laws of Gregor Mendel in the field of genetics, which remained unnoticed at first, then were lost and finally were discovered again. This happened because the publication of the results of those trials has proved inaccessible to people who could have understood and appreciated them. According to

V. Bush, such losses of knowledge will be repeated and will become more common if the plotting of science and the lack of opportunity for effective liaison between disciplines and branches of knowledge continue. The solution to this problem, according to him, consists in the use of technological innovations for storing and processing information (in his time these are photographing, filming, television, scanning, microfilming, data compression and so on).

Scientists of the future, says V. Bush, will not be tied to certain workplace. They will carry out their studies while maintaining constant communication with their colleagues to share and comment on experimental data, hypotheses, theories and ideas using a variety of communication channels.

V. Bush emphasized that the scientist is not the only one who collects and classifies data and uses logical methods for their processing. Essentially the processing of these data is no different from the actions of symbols and methods used by mathematicians. But every time you apply symbolic logic, these actions can be performed by a machine. Namely formal logic is the instrument by which the machine can replace the man if he asks it a right question, programs it in a certain way.

This idea of Bush has linked to another theory, which has important practical implications. One of its authors is the English mathematician Alan Turing (1912-1954). This is the theory of the possibility of any data, intelligences or signals can be digitally encoded and processed by the same device. There is no need to exist a separate telegraph or telephone transmission of text or voice messages, radio – for broadcasting of sound signals, or television – for video. All of them can be encoded, processed, transmitted and decoded by a device that performs any of these actions depending on a way it will be programmed. This now do personal computers.

Indeed, we should admit that A. Turing himself did not formulate its conclusions precisely this way. His contribution to the philosophical understanding of the opportunities of formalized system is connected to the insoluble second problem of David Hilbert. At the second mathematical congress in Paris in 1900 D. Hilbert presents a list of 23 outstanding at that time mathematical problems and defined them as targets on which to focus mathematicians in the 20th century. The second of them is connected with logical foundations of mathematics and to whether mathematics is complete, whether it is self-consistent system and whether it is solvable. Negative response to the first two questions gives Kurt Friedrich Gödel, proving his famous incompleteness theorem in 1931, but the contribution to solve the third issue is largely of A. Turing. This response is associated with the ability to know in advance whether a class of problems is solvable, even before they are resolved. Put another way, this question is if there is common path, algorithm, that ensures that we will know whether a task is solvable or not before we set specific values of the variables in it and we have come to a particular decision. The problem is further complicated by another paradox - it turns out that there is a class of problems for which the attempt to prove that they are solvable leads to a negative answer, but that does not mean that they have no solution. If we get to prove that they are not solvable, we again come to the wrong answer because it does not guarantee that they have no solution. In essence, the question is as mathematical as it is philosophical. It turns out that despite all its slenderness and logic, mathematics faces unsolvable logical problem - to prove its own axioms (basic statements).

More curious is that while working on this mathematical problem, outlined in the published in 1936 paper "On Computable Numbers, with an Application to the Entscheidungsproblem", 24-year-old A. Turing reached the idea that it is possible to create a calculation model in which each procedure, each algorithm can be represented as a sequence of elementary steps and in a way to be performed by a mechanical device, without human intervention. Later this abstract model is called the "Turing machine". Through it are set the limits of computation, which means that if a task be translated into machine language and be specified algorithm on which to proceed, the machine after a period of time long enough to make all the calculations, but still limited, will be able to cope alone.

Universal Turing machine represents a single device that performs various actions if it has a corresponding program for each particular case. Turing not only formulates and proves another mathematical theory which quickly finds technological realization and becomes a practical solution to the important problem of processing large datasets. His idea has deeper philosophical roots - it provides mathematical and logical arguments for the hypothesis that **the world is much more integrated and interconnected than the sciences of 18 and 19 century imagined, and that those interconnections and dependencies can be identified, studied, machined and used.**

The importance of the theory of A. Turing is in problematization of similarity and difference between human and computational machine (computer). On this problem is dedicated the published in 1950 in the scientific journal "Mind" article "Computing Machinery and Intelligence" [**Turing, 1950**]. After the death of Turing, the article is reprinted in Volume 4 of "The World of Mathematics" by James R. Newman entitled "Can the Machine think?" [**The World of Mathematics..., 1956**]. It is significant that in his article when he thinks how to define what a machine is, Turing uses to reference the digital computing machine ("electronic computer" or "digital computer"). Obviously, this feature is essential for him when the thinks about the thought experiment, called the "imitation game". Through this test, according to A. Turing, it can be identified alterity between a "thinking" machine and a man. In addition to describing in detail the principle of the algorithm (programming), i. e. how by using preset commands can accurately be identified specific series of actions (calculations), the English mathematician also formulates the problem of defining intelligence (natural and artificial).

In the cited article, reflecting on the process of "learning" how to think he highlights three essential points: the initial (at birth) state of mind, subsequent education (or training), and individual experience (which can be defined as education or training). Reflecting on the machinery to be taught to think like a man, the English mathematician brings different arguments about how to understand the intellect and thinking. His conclusion is rather phenomenological – for a digital computer can be inferred that it thinks if it is able to deceive, that it is a person in more than 30% of cases when it is subjected to the so called "Turing test".

The fact that until now this test is not passed by any machine suggests that there is no matter how "smart" become modern computers, they probably have a fundamental difference from human quality that sets the physical limits of their "intelligence." It is the lack of bio-social component. This component allows people to make meaningful distinctions between successful and unsuccessful attempts to learn in the course of individual successes and mistakes, putting them in a much broader, supra-individual context. But there is no way in advance to be prepared the program (or algorithm) that allow to determine what links, comparisons and relationships between objects undetermined number will be important for future events so as to ensure the success and adequacy of thinking in the future. The determination of each one of them is inseparable from the complex; ambiguous systems built unity of a living organism and environment in which it exists. Unity, behind which stays the ongoing millions of years evolutionary history.

Hubert L. Dreyfus calls this starting premise, from which departs human intelligence, "background knowledge". It is obvious, implicit, including an undetermined number of facts which are shared by human beings thanks to the fact that they all have bodies [**Dreyfus, 2009**]. Exactly this limited set of basic prerequisites of thinking, each element of which does not need to be specifically defined, because it is implied by its very factual physicality of human individuals, is at least for the time being untranslatable into machine language.

To all this should be added the unique experience that not only makes the individual unique, but is both a precondition and a result of the inclusion in the social whole. This complex of features is impossible to be played by a device, there is no matter how perfect it is, if it does not have a bio-social quality, definitively determining the human individual.

The third key idea is the technological feasibility of a global infrastructure that is able not only to transmit but also to store and provide fast and at very low cost information of any kind. It is connected with the name of the English physicist and computer programmer Timothy John Berners-Lee. In 1989, 34-year-old at the time Berners-Lee was appointed as informatist at CERN (Conseil Européen pour la Recherche Nucléaire), which collided with a annoying problem. When scientists working there had to share with each other documents connected with their research activity, they must have them organized and formatted so that they are compatible with the base computer system to CERN.

This process impeded research, losing a precious time and moreover required additional computer and software skills that not everyone possessed. In March 1989, Berners-Lee prepared and transmitted to his supervisor at the time (Mike Sendall) project to build a system of information management at CERN, the idea of containing so called **hyperlink**. The next year T. J. Berners-Lee and his software team prepared programme enabling including in a file references ("links") to other files that contain data or information related to the content of the first file. So the scientists at CERN were able to put their files containing results, technical parameters or practical solutions 'online' on so called server, from where then anyone could through the respective link to reach them and to use them for their goals. Created for the purpose machine language called "hypertext transfer protocol" (http), is the technical solution of the idea of hypertext spoken more than four decades earlier by Vannevar Bush. Meanwhile, Bush's ideas were further developed by Ted Nelson and Douglas Engelbart, but exactly T. J. Berners-Lee and his colleagues at CERN managed to develop a technical solution allowing files to be published online and through hypertext links (hypertext links) to cross from one electronic document to another.

T. J. Berners-Lee is also the author of the software for the first Web server and the first Web browser, the program that allows access and open files uploading to the server, as well as the standards of URL (Uniform Resource Locator), of HTML (Hyper Text Markup Language) and World Wide Web[3]. The most curious thing is that in 1993 T. J. Berners-Lee and his colleagues decided to provide the system to create hyperlinks to navigate between pages and other documents located anywhere on the web totally free to anyone who wishes to use it. In practice, this is the real start of a mass influx of Internet use in public, and perhaps a new type of economy called freeconomy [**Anderson, 2009**].

Once the ideas and theories about the possibility of heterogeneous arrays of information and knowledge to be connected find their technical verification and implementation, to almost all areas of human activity are revealed new, hitherto unsuspected horizons. At the beginning of the second chapter of "The Rise of the Network Society" (1996) Manuel Castells writes: "New information technologies, by transforming the processes of information processing, act upon all domains of human activity, and make it possible to establish endless connections between different domains, as well as between elements and agents of such activities. A networked, deeply interdependent economy emerges that becomes increasingly able to apply its progress in technology, knowledge, and management to technology, knowledge, and management themselves" [**Castells, 2010**]. This situation, which currently seems most apparently transform its economy, and alerts to a new round of problems - this diversity of relationships and influences, the possibility to accumulate and securely store large amounts of information, to obtain data and information on the different and distant from one another areas (geographically, thematically or structurally), to process this information and make findings and conclusions, unattainable at the previous analogue stage. This not only creates the prerequisites, but forms a new type of integrated knowledge horizons of reality, including studying, understanding and forecasting of social processes.

Of course, there may be pointed out also other changes that are much more visible and often mentioned. These include the exponential growth in the amount of information of any kind that circulates in modern society, the increasing speed of its exchange and processing, repeated lowering of economic costs for transmission, the formation of new levers to exercise power and resistance to it, virtualization of social reality and much more. All of them, although

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[3] Technology **World Wide Web** and its basic principles of operation have been described at the end of April 1991 in the world's first website (Info.cern.ch,). There was uploaded a guidance for installation and setup of web browsers and servers as well. Interestingly, the information about it as the first ever hyperlink has been published by Tim Berners-Lee in newsgroup *alt. hypertext* as short message on 6th August.

they are significant and easy to justify using empirical data, are phenomena, manifestations of much deeper mechanisms of working of reality. To some of these mechanisms modern scientific knowledge is able to reach, for others it has a separate intuitive insights and hypotheses, and to third ones, such as the opportunities and limits of forecasting future events, it is still in the field of speculations.

Under these conditions it seems imperative to ask ourselves how our cognitive paradigm, on which current scientific knowledge is based, is adequate and complete.

2. The paradigm of systemic thinking

When you mention the term "paradigm", the most direct association is with the name of Thomas S. Kuhn, although after his conception was published and became popular, the term began to be used in a variety of meanings and contexts. In this case, it is most logical to stick to the original meaning of the word paradigm as a common conceptual framework setting out the methodology and standards of research [**Kuhn, 1970**]. Paradigm is a model, a pattern, a way of thinking. It is a summarized result of a relatively high degree of accumulation of observations and theoretical constructs and landmarks path of scientific research for a relatively longer period of time.

The **paradigm of systems thinking** is a conceptual framework, a complex of attitudes, knowledge, methods and tools, united by the idea that adequate knowledge of complex objects like all objects of social sciences, require that they be considered in their dynamic integrity. This paradigm is based on the whole system of research methods and in this sense may be determined also as a synthetic theoretical approach. To a great extent systematic thinking is constructivist in nature, as is modelled not by specify prelimiarily set and axiomatically adopted basic principles but is dependent on the subject and must include a preliminary analytical stage. Its main feature is that it allows the researcher, in the words of Robert B. Reich, "... of seeing the hole, and of understanding the processes by which parts of reality are linked together... What looks like a simple problem susceptible to a standard solution may turn out to be a symptom of a more fundamental problem, sure to pop up elsewhere in a different form [**Reich, 2011**]. Unfortunately, R. B. Reich did not elaborate in detail these principles. It is possible that the deficiencies of the social sciences, especially their inability to provide satisfactory solutions for the projected social processes, to be due to their penchant for restrictive procedures subjected to strict formal logic. Many of the failures of economics, sociology, political science, the legal theory, and many other public courses are due to fear of criticism in any possible anti-scientism. But social reality apparently doesn't succumb to sufficiently depth knowledge only through formal-logical Enlightenment tools, although they have undeniable place in it.

At present, the greatest amount of articles on the issue of systematic thinking is in the fields of education and management. This seems logical, since in both areas success is linked to the ability to perceive and act in a dynamic and rapidly changing environment in which the system entities prevail. In his presentation on "The International Conference on Thinking" Breakthroughs 2001" Gary Bartlett determined systematic thinking more as a clarification of how the elements of the system entities operate in their interaction within the whole after we have studied and examined them individually. Thus, in systems thinking methods of analysis and synthesis are given in unity, but leading eventually is study of how the objects change depending on the dynamics of the system connections and relationships, which are included [**Bartlett, 2015**].

According to Sara Ross, discussions about what is a systemic thinking began in the mid 20th century and are closely related to the conception and development of systems theory, as they are subjectively and logically closely related [**Ross, 2010**]. In essence, the research methods, fairly close to the meaning that is given to the concept now, were used before, albeit under another name.

Robert Louis Flood and Ewart R. Carson identify four stages in the formation and development of this research paradigm [**Flood & Carson, 1993**]. The first stage involves the awareness of the fact that between apparently separate things exist relations and connections, leading to divert attention to the research study precisely on these connections. The focus moves from the study of the nature of the systems to their behaviour and change.

The second stage comprises the tendency to formalization of research procedures, which makes the system theory applicable in other scientific fields. It turned out that was especially productive into computer and information sciences, ecology, economics, geography, etc., and it forms a multidisciplinary nature of systemic thinking.

The third stage is marked by the gradual expansion of the scope of systems thinking to solve various practical problems, especially in the field of management.

And the fourth stage is –further application and refinement of projections of applied systems thinking to solve the very real problems associated with complex natural, technological and social phenomena. In the early 21st century, many of the political and civilizational issues (such as ethnic conflicts) have proved intractable, without using the tools of systems thinking.

Frequently mentioned name in the context of systemic thinking is that of Peter Senge. In his most famous book "The Fifth Discipline: The Art and Practice of the Learning Organization" (1990) he gives the following definition of systemic thinking: "Systems thinking is a discipline for seeing wholes. It is a framework for seeing interrelationships rather than things, for seeing patterns of change rather than static "snapshots". It is a set of general principles—distilled over the course of the twentieth century, spanning fields as diverse as the physical and social sciences, engineering, and management". [**Senge, 2004**].

Systems thinking as a research paradigm should not be perceived just as banal as to define and study the relations and interactions between conventionally separate elements of a whole. It certainly incorporates a similar approach. The accent is put on the overall pre-disposition to seek purposefully those links and relationships, influences and contexts of the studied objects and to remember that the behavior of complex systems is determined by the system structures formed in them or with their participation. But this is not enough.

Systemic thinking, if we continue the reasoning of Robert B. Reich, cited above, is the attitude to transmit observations, dependencies, findings from one area and checking their application and productivity in other areas of knowledge.

Systemic thinking is also an alternative thinking, as far as it involves the examination of a different, sometimes complementary one to another, and sometimes competing, systematic theoretical reconstructions of the same object studied. In this sense, it is not absolute, model, thinking-print, but rather malleable and relative.

A crucial component of systems thinking is its tracing the studied object back. Unlike most private-scientific methods, it requires to take account of changes of the object in time. Its explanatory capabilities are closely dependent on this sense of accumulated from systemic entities experience and skills to overcome past crises.

Systemic thinking is also based on the principle position that variability of social processes is woven into the very system of social relations between individuals, system which is society. This means that there are many mismatching, sometimes complementary, sometimes competing event trajectories which in separate sections can be very similar, they even can form identical models (historical attractors), but each of them has also its own unique characteristics.

The conclusion from this statement is that the paradigm of systems thinking is new, still incompletely built a conceptual framework for the study of society. It is a pattern of thinking and research that has the potential to transform various social disciplines into much better developed and promising research areas. And this includes not only the ability to go deep and to explain adequately the subject of the research, but also to form a toolbox for sound and realistic prognoses.

REFERENCES

Anderson, Chris. 2009. *Free (The Future of a Radical Price).* NY: Hyperion.

Bartlett, Gary. *Systemic Thinking (a simple thinking technique for gaining systemic (situation-wide) focus*. Presented by G. Bartlett at The International Conference on Thinking "BREAKTHROUGHS 2001", Final Draft, Available from: http://www.probsolv.com/systemic_thinking/Systemic%20Thinking.pdf [Accessed: April, 01. 2015].

Bush, Vannevar. 1945. *As We May Think*. July 1, 1945. The Atlantic. Reprinted in Life magazine, September, 10, 1945.

Castells, Manuel. 2010. *The Rise of the Network Society: The Information Age: Economy, Society, and Culture*. Chichester, West Sussex, United Kingdom: John Wiley & Sons Ltd, The Atrium, Southern Gate, 2nd Revised edition, 2010, p. 78.

Dreyfus, Hubert L. 2009. *On the Internet.* 2nd edition, London, NY: Routledge, 2009, p. 17.

Flood, R. L., & Carson, E. R. 1993. *Dealing with complexity: An introduction to the theory and application of systems science.* NY: Springer, 1993, 2nd ed., pp. 4-6.

Kuhn, Thomas S. 1970. *The Structure of Scientific Revolution***.** 2nd Edition, The University of Chicago, 1970, p. 10. (Available from: http://web.a.ebscohost.com/ehost/ebookviewer/ebook?sid=70ae6241-3e2d-4e9a-9fab-2b6b2f0a9949%40sessionmgr4004&vid=0&hid=4206&format=EK, [Accessed: 01, 2015]).

Reich, **Robert B. 2011.** *The Work of Nation: Preparing Ourselves for 21st Century Capitalism.* Penguin Random House LLC (Vintage), 2011.
(Available from: http://web.a.ebscohost.com/ehost/ebookviewer/ebook?sid=70ae6241-3e2d-4e9a-9fab-2b6b2f0a9949%40sessionmgr4004&vid=0&hid=4206&format=EK, [Accessed: 05, 2015]).
Ross, S. 2010. Systems Thinking. – In: *Political and Civic Leadership*. Thousand Oaks, CA: SAGE Publications, 2010, p. 906.
Senge, **P. M. 2004.** *The Fifth Discipline*. NY: DOUBLEDAY – a division of Bantam Doubleday Dell Publishing Group, Inc., 2004, p. 53.
Shannon, Claude, E. 1948. Mathematical Theory of Communication. – *The Bell System Technical Journal*, Vol. 27, July, October, 1948, pp. 379-423, 623-656.
The World of Mathematics. A small library... with commentaries and notes by James R. Newma,. vol. 4, NY: Simon & Schuster, 1956, pp. 2099-2123.
Turing, Alan. 1950. Computing Machinery and Intelligence. – *Mind*, vol. 59, 1950, pp. 433-460.

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