Methodological Support for the Romanian Sustainable Development in a European Context

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Abstract

The complex transformations of the last three decades of socio-economic evolution, the confrontations with multiple economic, social, ecological, cultural, educational problems require today new approaches, visions, strategies and policies for sustainable development. Ensuring smart and inclusive growth, priorities are important at the global, regional, national and local levels. New theoretical and methodological approaches to economic activities at the microeconomic level / small and medium enterprises, large enterprises and corporations needed. In this article, we review the interdisciplinary approach on the law of entropy, the theory of value-entropy, the approach of the nature-society-man system in sustainable development. We propose the introduction of the "auto poetry" model that combines ideas of synergetic, evolutionary epistemology, constructivism and represents a theoretical basis for the study of processes at different levels of organization of nature and social life. The concept of autopoiesis acts as a natural scientific basis. Knowledge formed to adapt to the environment of existence, for an efficient implementation. The application of the auto poetry model consists in the permanent capacity of constant reproduction, in maintaining the autonomy in relation to the environment, and it develops inside the synergistic paradigm.

Keywords: sustainable development, sustainable development strategy, autopoiesis model.

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Introduction

With the transition of national economies to the knowledge economy in several states (information-innovative) development, it became obvious the need for new theories of development, appropriate to the essence of the processes taking place in society (Sarbu, et al., 2021). Each of the spheres of society (economic, social, environmental, etc.), being an open and complex dynamic system in any aspect and at any level of manifestation (global, national, regional, local), subject to a positive or negative impact of external factors and conditions) (Radulescu, et al., 2021). Therefore, we would like to mention the objectives of *the Romanian Sustainable Development Strategy: (1) No poverty. Eradicating poverty in all its forms and in any context. It is* proposed to reduce the number of citizens in severe and relative poverty in all dimensions, according to national definitions. Reducing the number of people living below the poverty line, stimulating participation in the labour market, developing the system of protection and social assistance. *(2) Zero hunger***.** Eradicating hunger, ensuring food security, improving nutrition and promoting sustainable agriculture. Development of a sustainable and competitive agro-food sector to improve the quality of life and ensure living conditions in rural areas

close to those in urban areas, promoting local and organic production, capitalizing on traditional and mountain products with added value. *(3) Health and well-being.* Ensuring healthy living and promoting well-being at any age. Reducing the maternal and infant mortality rate, reducing infectious and chronic diseases, preventing and treating substance abuse and mental illness. *(4) Quality education***.** Guaranteeing quality education, promoting lifelong learning opportunities for all. Access of all children to early education, fair and quality primary and secondary education. *(5) Gender equality.* Achieving gender equality and strengthening the role of women and girls in society. Preventing and combating violence against women and girls, in the public and private spheres, ensuring balanced and effective participation of women - equal opportunities for leadership at all levels of decision-making in political, economic and public life. *(6) Clean water and health.* Ensuring the availability and sustainable management of water and sanitation for all. Aligning Romania with EU requirements and standards on drinking water, wastewater, and waste management and increasing water efficiency in all sectors. *(7) Access to energy;* Ensuring everyone's access to energy at affordable, safe, sustainable and modern prices. To support consumers' long-term expectations, the energy sector needs to become economically robust, advanced, technologically flexible and less polluting. *(8) Decent work and economic growth.* Promoting sustained, open, sustainable economic growth, full and productive employment. *(9) Industry, innovation and infrastructure***.** Building resilient infrastructure, promoting sustainable industrialization and encouraging innovation. **(***10) Reduced inequalities***.** Reducing inequalities within and between countries. The strategy proposes reducing gaps, eliminating discrimination of any kind and policies for the progressive achievement of increased equality, in particular scales, wages, education and social protection. (*11) Sustainable cities and communities***.** Developing cities and human settlements so that they are open to all, safe, resilient and sustainable. *(12) Responsible consumption and production***.** Ensuring sustainable consumption and production models. Staged transition to a new development model by introducing elements of the circular economy, increasing resource productivity, reducing food and waste. (*13) Action in the field of climate change.* Take urgent action to combat climate change and its impact. *(14) Aquatic life.* Conservation and sustainable use of oceans, seas and marine resources for sustainable development. *(15) Earth life***.** Protecting, restoring and promoting the sustainable use of terrestrial ecosystems, sustainable forest management, combating desertification, halting and repairing soil degradation and halting biodiversity loss. (*16) Peace, justice and efficient institutions***.** Promoting peaceful and inclusive societies for sustainable development, access to justice for all and the creation of efficient, responsible and inclusive institutions at all levels. *(17) Partnerships to achieve the objectives***.** Consolidation of means, implementation and revitalization of global partnerships for sustainable development. *The 2030 Agenda for Sustainable Development* (Ministerul Afacerilor Externe, 2020) has brought a new vision not only in terms of the essence of the objectives set, namely their universal and interconnected nature, but also in terms of implementing the objectives and monitoring them, which is based on recognizing that the success of materialization depends not only on the state actor, but also on the other actors involved, up to the citizen.

Review of the scientific literature

In the European context of sustainable development the concept of sustainable development in the European Union was introduced in the Enlarged Europe Strategy 2006 (Anon, 2019). The purpose of Romania's first sustainable development strategy in 1999 (Gladwin, et al., 1995) was to promote the continuous improvement and conservation of the well-being of the population, in correlation with the requirements of a sensitive use of natural resources and the conservation of the ecosystem. Bartelmus, (1999) argues: “Sustainable development is the globally adopted paradigm for integrating environmental and development policies. A controversial debate between "environmentalists" and "environmental economists" has led to a confusing proliferation of indicators and policy advice on sustainable development. Modern management theory is limited by a fractured epistemology author, Thomas (1995) that separates humanity from nature and truth from morality. Reintegration is necessary for organizational science to support ecologically and socially sustainable development. The author presents requirements for such a development and rejects the paradigms of conventional technocentrism and antithetical ecocentrism for reasons of incongruity. Dobrovolska (2018) in her research: “Reveals the peculiarities of modelling the paradigm of sustainable development since the

publication of the first studies on the impact of human activity on the environment to date." The author identified three main stages of development, focusing on key objectives and tasks, through an analysis of the main documents governing activities in this field. Šlaus and Garry (2011) in "Human Capital and Sustainability" are of the opinion: "a study of sustainability must consider the role of all forms of capital - natural, biological, social, technological, financial, cultural - and complex ways in which they interact. All forms of capital derive their value, utility and application from human mental awareness, creativity and social innovation. This makes human capital, including social capital, the central determinant of resource productivity and sustainability." This article examines the links between population, economic development, employment, education, health, social equity, cultural values, energy intensity and sustainability in the context of evolving human consciousness. According to Harrington (2016) "Sustainability" and "sustainable development" have become important concepts and objectives for science and society. Sustainability, connected to long-term desirable conditions, an activity applied to geography and other fields. However, the integrative statement of the essential concepts on which sustainability studies and applications are built is missing. The author discusses ideas, theoretical concepts, including the importance of choice, place, scale, systems, limits, change, connected concepts, and the identity of "sustainability". According to Spangenberg (2005): "Any society described will comprise four economic, social, environmental and institutional dimensions. Each of them is a complex, dynamic entity, which self-organizes and evolves in itself, making the coupled system one of extraordinary complexity. For the sustainability of the system, the four subsystems must maintain their capacity to survive and evolve, while the interconnections of the subsystems must allow for permanent co-evolution." Solving the problem of "adequate level of complexity" for analysis, studies, descriptions and modelling is a necessary precondition for proper analysis and to avoid wrong predictions. Kuhlman and Farrington (2010) consider that: "Sustainability as a policy concept has its origins in the 1987 Brundtland Report. That document was concerned with the tension between humanity's aspirations for a better life on the one hand, and the limitations imposed by nature on the other. The paper supports this change in the sense that: (a) it hides the real contradiction between the goals of well-being for all and the conservation of the environment; (b) risks of diminishing the importance of the size of the environment; and (c) separates social aspects from economic aspects, which are, in fact, the same. ***Instead of the concept of stability, the concept of stationarity could be used.*** In the study "Studies of economic theory and modelling". Verger, (2013) argues that: "Industrial ecology and stationary economy can be combined in the notion of cycles: thus industries could operate in an almost closed loop if the theory of industrial ecology was followed to the end, and the economy in its more general form would not disturb the great natural and ecological cycles that allow it to subsist in terms of the stationary economy, on the contrary, it would fit perfectly into it." Seele and Lock (2017) are stating: "When in 2015, 193 countries agreed on 17 sustainable development goals, the delegations of the nations signed a challenging agenda to pass this planet on to future generations in the next 15 years. Efforts for sustainability have not yet led to greater sustainability or less unsustainability. Despite many efforts in developing and developing countries, none of the United Nations Member States has yet achieved all the goals (GeSI, 2016)." Strange and Bayley (2008) argue that: "Local initiatives have been successfully taken to raise public awareness of the importance of their participation in waste reduction, urban renewal and other projects. The authors considered that the implementation of the principles of sustainable development was by no means simple. The key question remains whether we have made enough progress - or taken the warnings seriously enough - to properly understand and address the most important and urgent issues. There is strong evidence that the climate is changing, and forecasts indicate a proliferation of extreme events that could have catastrophic consequences for the systems on which life is built and for human societies". Seghezzo (2009) states: "Sustainability is usually seen as a guide for developing economic and social policies in balance with ecological conditions. More than two decades after the World Commission on Environment and Development (WCED) defined "sustainable development" and put the concept of sustainability on the global agenda, the concrete meaning of these terms and their suitability for specific cases remains challenged. A new conceptual framework is needed to address sustainability issues. The limitations of the WCED definition could be mitigated if viability is seen as the conceptual framework within which territorial, temporal and personal aspects of development can be openly discussed. Sustainability could be better understood in terms of "Place", "Permanence" and "People". The place contains the three dimensions of space, Permanence is the fourth dimension of time, and the category of People represents a fifth human dimension". Soyer, Ozgit and Rjoub (2020) assume that economic growth contributes to

human development and social well-being by increasing employment, purchasing power and production. Sustainable development is a multi-faceted concept that could be defined in many ways. According to Jackson, the philosophy of the root and the social basis for sustainable economies differ greatly from the basis of current conventional economies. The former have various meanings (Ministerul Afacerilor Externe, 2020). Among the different perceptions of sustainable development, some consider it a possible radical philosophy to reshape the growth process and as a new concept of framing (Anon, 2012). On the contrary, other perspectives consider it to be key to making greater progress in collective social equity and also in environmental protection.

Yesterday's economists, but also today's economists are concerned with the interdisciplinary approach. As early as 1880, in SA Podolinsky's work "Human Labor and Its Relation to the Distribution of Energy" (1991), he developed the concept of social energy, the role of human labour in retention, accumulation, protection against dispersal, theft and transformation of the forms of solar energy needed to meet people's needs. Based on the concept of social energy, improvements were made in the twentieth century, including Vernadsky's teachings on the relationship of solar energy with living matter, with a great scientific influence on thinking and technology. Professor Georgescu Roegen, (1996) Romanian economist considered the founder of the school of bioeconomics, which is that production as a transformation of a constant supply of materials and energy must be subject to the law of entropy, which applies to all closed systems: entropy or the amount of inaccessible matter and energy tends to increase continuously, while the amount of available matter and energy tends to decrease continuously. Among the Romanian economists of the Romanian school, a passionate successor of the development of that school is Professor Bran (2003) with the development of the entropy value theory. In the author's opinion "Since value is the object of work of financial distribution we cannot be indifferent to the correct nature of economic theory that specifies what is and by what mechanism is obtained and managed value in the current economy" The author considers that the theory of value based on low entropy (TVE) recognizes as an objective foundation for all processes engaged in obtaining and managing value the most general laws of nature, ***the law of conservation of matter*** and ***the law of entropy.*** **The new approach of the nature-society-man system in the context of sustainable development.** In order to understand Kuznetsov, et al. (n.d.) it is necessary to mention the elements of originality1. Identified the unanswered questions that made it impossible to close the gaps in the relationship between philosophy, mathematics, natural sciences, engineering and the humanities - between scientific and theoretical knowledge and the ability to use them correctly in the practice of developing management in nature - society - man; 2. Identified the "basic" questions, the answers to which allow, for a "legitimate reason to sew together" fragmented and disparate knowledge into a single structure of the world, allowing them to be deliberately recomposed into an integrated model Development. 3. He provided the answer to these questions in a way that shows the way to unification - a synthesis of disproportionate and therefore seemingly disparate ideas and theories between the natural sciences, engineering and the humanities. 4. Starting from the scientific and theoretical logic of thinking, perceptions that can be discovered in the new laws of nature, he managed the specific design of the system, managing the development of the system, at any level of the system nature - society - man, to transform the impossible in the possible. Iliescu (2016) states that: "The general purpose of this article is to highlight the fact that behind the sociological discourse are different formal logical substrates. One of these is given by the relations of order. It is about inferences based on these relationships. One of the specific purposes was to produce these inferences. They capture as many fragments of social reality as possible in a double aspect: static and dynamic. Another purpose was to compare the variable, understood as in the syntactic sense of the predicate logic with the sociological variable. Maturana and Varela (1980): 'the term "autopoiesis", the concept has become a paradigm, by moving to many other realms of science and by how fruitful it has proved to be. Moving from biology to cybernetics, from systems theory to social function theory, from ontology to art, "autopoiesis" has become more than just a heuristic tool; it has become a way of understanding and explaining phenomena without resorting to other layers of interpretation: a tout court paradigm".

Paper Body

According to Romania's Sustainable Development Strategy 2030, Romania is gradually adapting to a new Development Paradigm, in a defined period of globalization, increasing inequalities and increasing environmental degradation. Romania's Sustainable Development Strategy takes on the challenge and tries to help Romania travel in its transition to a more sustainable future (Profiroiu, et al., 2020). Based on the principles of the 2030 Agenda for Sustainable Development, this transition will be made as a member of a prosperous and revitalized European Union. In the field of employment we have the evolution (Bodislav et al., 2020). In 2017, according to the National Institute of Statistics (Anon, 2012) and Eurostat, the employed population was 8,670,556 people. The employment rate for the population aged 20-64 was 68.8%, of which 77.3% for men and 60.2% for women. The elderly between 55-64 years old registered an employment rate of 44.5%. The unemployment rate was 4.9%. Romania registered an employment rate among people with higher education, for the 15-64 age group, with approximately 4 percentage points higher than the EU average, respectively 87.9% compared to 84.0%. Industrial activities in Romania have been concentrated in recent years in the low-tech and medium-tech sectors (Angheluta, et al., 2019). Technological changes lead to long-term economic growth,(OECD, 1998) (Goos, et al., 2019) productivity and improved living standards. New ideas, new products and new production techniques involve the process of "creative destruction". Newly implemented technologies are destroying jobs in some industries, primarily low-skilled jobs, creating new jobs with new knowledge and skills (Ioniţă, et al., 2009). Evolutionarily, the process has led to job creation, as new industries replace the old industry, workers adapt their skills to change and expand demand (Burlacu, et al., 2019). Technological changes, in conjunction with the ongoing restructuring in OECD economies, lead some to associate technology with unemployment and social suffering (Radulescu, et al., 2020). The impact of Technologies on employment at the economic level is positive provided that the mechanisms for transforming technology into jobs are not affected by deficiencies in training and innovation systems and rigidities in product, labour and financial markets (Profiroiu, et al., 2020). Economic activity becomes fundamentally knowledge-based: jobs are shifting from low-skilled to highly skilled workers; productivity and employment growth depend on the conditions for the economic dissemination of new products and processes. Labour market reforms, combined with measures that foster improvement and lifelong learning, contribute to the further development of innovation, facilitate the use of advanced technologies and allow for technical change in translation into more jobs. Large-scale policy reforms are needed Improving the contribution of technology to growth and productivity, while implementing the conditions to translate its potential into higher incomes and jobs, requires the implementation of large-scale and coherent policy reforms. In most OECD countries, current policies in this area focus too much on developing new technologies in the low-tech part of the sector's production and too little to promote technology innovation and diffusion throughout the economy. Therefore, in the table below we show the evolution, regarding employment in technology and knowledge-intensive sectors by NUTS 2 regions in EU member countries.

Table no. 1. Employment in technology and knowledge-intensive sectors by NUTS 2 regions (from 2008 onwards, NACE Rev. 2) - High-technology sectors (high-technology manufacturing and knowledge-intensive high-technology services)

(Thousand) Total

GEO/TIME	2015	2016	2017	2018	2019
European Union - 27 countries (from 2020)	7,276.50	7,424.20	7,614.90	7,872.80	8,192.20
European Union - 28 countries (2013-2020)	8,765.70	8,930.50	9,160.90	9,426.60	9,844.30
European Union - 15 countries (1995-2004)	7,194.90	7,326.20	7,490.60	7,658.70	8,027.00
Euro area - 19 countries (from 2015)	5,584.30	5,702.10	5,840.70	5,990.50	6,254.50
Belgium	198.6	196.7	211.3	230.5	245.1
Bulgaria	112.8	116.1	114.8	122.6	127.7
Czechia	229.2	242	243.6	261.9	257.7
Denmark	154.5	154	143.5	146.8	157.3

Germany (until 1990 former territory of the FRG)	1,627.70	1,670.40	1,703.70	1,738.20	1,762.00
Ireland	171	179.8	183.3	181.3	187.5
Greece	85.7	90.4	93.8	105.6	116
Spain	656	656.6	706.2	699	732.2
France	1,061.90	1,065.80	1,078.10	1,105.20	1,181.60
Croatia	51.9	57.6	57.1	66.9	70.2
Italy	767.5	779.5	774.5	812.7	854.4
Cyprus	10.5	10.7	11.7	12.8	11.8
Latvija	29.5	27.9	31.8	31.9	29.8
Lithuania	30.6	33.3	33.4	40.1	44.1
Luxembourg	10.1	9.3	10.4	11.9	12.5
Hungary	196.9	223.1	211.7	233.6	257.1
Malta	11.7	12.7	12.6	12.9	14.6
Netherlands	306	335	326.8	339.3	368.9
Austria	165.7	182.5	186	179.1	171.8
Poland	487	466.8	494.1	524.9	543.2
Portugal	123	125.2	134.1	143.2	154.8
Romania	224.4	225.7	256.8	259.8	249.6
Slovenia	54.3	50.3	54.5	53.7	56.1
Slovakia	99.2	103.3	111.8	110.6	117.2
Sweden	235.5	236.8	252.7	265.9	275
Iceland	11.1	11.2	10.4	10	10.3
Norway	106.8	103.8	107.2	111.7	114.8
Switzerland	263.3	278.3	291.6	294.3	306.7
United Kingdom	1,489.20	1,506.20	1,545.90	1,553.80	1,652.10

Source: Eurostat

From this table we notice that in Romania in 2015 in the Hi-tech sector 224.4 thousand people were employed, and in 2019 it increased to 249.6. In the North-West Region from 30.8 thousand employees there was a decrease to 29.4 thousand employees, in the Central Region from 26.4 thousand a decrease to 19.3 thousand employees.

Table no. 2. Employment in technology and knowledge intensive sectors by NUTS 2 and regions (since 2008, NACE Rev. 2) - High-tech sectors (high-tech manufacturing and knowledge-intensive high-tech services)

(Thousands) Total

GEO/TIME	**2015**	**2016**	**2017**	**2018**	**2019**
Romania	224.4	225.7	256.8	259.8	249.6
Macro region one	57.3	54.7	56.9	52.4	48.7
Northwest	30.8	30.1	29.9	31.3	29.4
Centre	26.4	24.7	27	21.1	19.3

Macro region two	30.2	30.5	26.5	27.4	30.6
NORTH EAST	21.3	20.7	15.8	18.1	22.9
South East	8.9	9.8	10.7	9.2	7.7
Macro region three	94.7	96.3	123.6	124.2	121.4
South - Muntenia	12.4	12.6	15.4	14.6	14
Bucharest - Ilfov	82.3	83.7	108.1	109.6	107.4
Macro region four	42.3	44.3	49.8	55.8	48.9
Southwest Oltenia	8.7	:	6.6	8.9	:
West	33.6	38.3	43.2	47	42.7

Source: Eurostat

The impact of technological innovation on the future of work. New digital technologies are becoming more widespread in the economy (Commission of the European Communities, 2006). Thanks to digitization, cars are becoming more and more capable of performing tasks that only people could do before. A key finding is that so far recent technological changes have had little effect on aggregate jobs, but lead to significant job restructuring. This involves three key challenges for European labour markets: **first,** digitalisation induces changes in skills requirements, and the fate of workers in changing labour markets depends crucially on their ability to keep up with change. **Second,** digitalization is not a purely technological process, but requires a process that accompanies organizational change. **Third,** digitalization comes with an increase in the share of alternative work arrangements, due to more outsourcing, standardization, fragmentation and online platforms. These alternative working arrangements involve both new opportunities and challenges.

Methodology

The autopoiesis model. The sufficient predicates of self-poetry. Autopoiesis literally means self-production and expresses the dialectical connection between the structure and function of a complex system. The term was coined by Chilean scientists Francisco Varela and his principal colleague and Professor Umberto Maturana in 1973. “An autopoietic machine is a machine organized (defined as a unit) as a network of processes for producing components that 1) through interactions and their transformations are continuously regenerated and implemented by a network of processes that produce them, and 2) form it as a concrete unit in the space in which they (components) exist, defining the properties of the topological area of their implementation as such a network. An autopoietic system (machine) is fundamentally different from an allopoietic system (machine), such as an automobile factory, which uses raw materials (components that come from outside) to build organized structures that are something other than itself. An autopoietic system is built on the principle of self-attribution, cyclical organization, it occurs by itself. ***Theoretical models of organizational autonomy in biology*** Authors Maturana H.R., Varela F.J. [24] claim: “Autonomy is a Greek word meaning "self-law", self-foundation (" self-grounding "), self-construction, self-closure. In mythological consciousness, similar properties have been demonstrated by deities and divine creatures. All the above does not diminish the great methodological value of autopoiesis and other purely materialistic mechanistic concepts of biological autonomy in cybernetics, systems theory, cognitology, psychology, sociology and biology, as a critical theory that gave impetus to the development of a new paradigm. **1. Bootstrap in chemistry.** Chemist George Câmpis developed a systemic concept similar to autopoiesis. He called its component - system (component - system) or system of self-modification. **2. Second-order cybernetics and "own behaviour"** In accordance with the principle of structural determination, the reaction of each autopoietic system or, in general, closed organizationally to external influences is determined by its internal structure. **3. The epistemology of constructivism and bootstrap - a model of knowledge representation** Traditional Artificial Intelligence (GOFAI - "Old - Fashion Artificial Intelligence") is based on an epistemology of correspondence or correspondence that sees knowledge as a simple reflection or "reflection" of the outside world. **4. The concept of self-organization critique.** *Fractals*

are widespread in nature and demonstrate large-scale invariance, "self-resemblance." In biology, self-similar patterns are observed at different spatial scales. But fractals are also temporary: fluctuations of a similar type can be observed at different time scales. These are heart rhythms, epidemics on small islands, the reproduction of bird populations or paleontological records of fossils **5. Mathematics and bootstrap systems** In general, none of the theorists who developed bootstrap systems - F. Varela, R. Rosen and J. Campis proposed a formal apparatus, sufficiently complete and rigorous. R. Rosen realized that the classical set theory is not applicable to the description of such systems and recommended the use of the apparatus of category theory, convenient for constructing organized relationship structures (morphisms) in a recursive way. Attempts to describe the Rosen system (M - R) and autopoetry in the language of category theory have already been undertaken. **6. *Bootstrap in ecology and the theory of evolution*** Symbiotic relationships in the ecosystem and in the biosphere as a whole are global in nature. Moreover, relationships that, from a superficial point of view, appear to be antagonistic or competitive, in the broader context of a community or biocenosis, often prove to be symbiotic. Moreover, trophic relationships are far from basic. Symbiotic complexes in nature are semi-closed organizations, sympoietic systems with positive feedback. **7. Biosphere.** Various approaches to the systemic representation of the biosphere have been critically analyzed. It is concluded that the still popular view of the biosphere as a classical autopoietic system is not justified and, in principle, unconstructive. However, the biosphere can be attributed to bootstrap systems.

Conclusions

Rapid economic development and rising consumption levels have a serious impact on the natural environment, which can only be partially mitigated by technological solutions. Sustainable development seems to be a contradiction in terms, a paradox, which can only be fully resolved by the evolution of a higher level of human consciousness.

These challenges require appropriate policy responses at European, national and regional level, which must be implemented for education and training policies, active labor market policies, budgetary and fiscal policies and policies in the field of technological development.

Linking sustainable development with digital technologies in the form of e-health services, robotics or emission reduction solutions could help individuals, organizations and nations achieve a more sustainable planet in the light of sustainable development goals. The self-modification system is simply a collection of components that can transform each other and together form larger components.

It is assumed that each conceptual object (symbol) in the cognitive model of the subject corresponds to a physical object in the environment. The structure of the model can be considered an image, a map or a homomorphic coding of the structure of external reality. Such an epistemology of "reflection - correspondence" leads to a practical and conceptual problem, which is known as "symbol grounding": how are the symbols "rooted", the model elements in the external reality they intend to reflect? The problem cannot be solved with the model alone. This results from the principle of "linguistic complementarity", which generalizes classical epistemological restrictions.

Because fractals are associated with extensive correlations, they also reflect certain characteristics of the organization and evolution of living systems. A common feature of systems that demonstrate resemblance is the presence of large-scale functions (also known as power laws).

In the traditions of the last two or three decades, multi-level symbiotic relationships are often called bootstrapping. Such systems can have internal stability and, at the same time, are often vulnerable to specific external influences that violate the symbiotic balance.

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