

System Theory Approach as a Basis of Strategic Management

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Abstract

The introductory article to the special issue “Strategic Management in the Context of Dynamic Complexity” substantiates the claim that models and representations of the theory of complex systems are becoming the most relevant science-based foundation that allows one to respond to the challenges of our time. The increasing complexity of social and economic development processes, accompanied by uncertainties, instabilities, unexpected turns, the digitalization

in the economy and the birth of Industry 4.0, the growing importance of network structures in business activity, and new environmental standards associated with the need to switch to circular processes in the economy - all these things require changes in the management strategies of firms and corporations. Unconditional advantages are received by those firms that embed the principles of systemic, holistic, and non-linear thinking into their business philosophy.

Keywords: non-linear dynamics; complex system; strategic management; scenario planning; foresight; digitalization; long-term strategies

Citation: Knyazeva H. (2020) System Theory Approach as a Basis of Strategic Management. *Foresight and STI Governance*, vol. 14, no 4, pp. 6–8. DOI: 10.17323/2500-2597.2020.4.6.8

An increasingly complex context and new development models require multi-level management systems of appropriate complexity. According to the Conant-Ashby principle, only under this condition will system regulators be sufficiently reliable. A variety of elements allows a complex dynamic system to remain stable, adaptable, and capable of multivariate development [Ashby, 1956]. The control systems must be sufficiently flexible, varied, and complex to not constrain the system and provide opportunities for its forward movement.

This special issue discusses important aspects of the complex self-developing systems theory which can enrich approaches to strategic management, foresight, and scenario planning to meet the current and emerging challenges.

The assumption that invested managerial efforts are directly proportionate to the results obtained (the linear management concept) in most cases is not confirmed by practice in the present-day context. The development of the economic, financial, business, and socio-

cultural spheres is becoming increasingly complicated and nonlinear, accompanied by uncertainty, the emergence of extraordinary phenomena, and the passage of special points - singularities, after which the development path radically changes. The trial and error or extrapolation methods (the empirical projection of the current state of affairs onwards) turn out to be not very effective in such situations. The theory of systems focused on understanding complex self-organizing structures and the laws of their evolution offers a new level of productivity.

Mathematical (game and graph theory, nonlinear programming, dynamic analysis, etc.) and computer science methods are actively applied in economic and social sciences. Mathematical tools are finding new applications not only in economics but also in sociology, history, social organization and management theory, and other domains. In addition to statistical descriptions or probabilistic assessment, they help to simulate and better understand complexly interconnected communication networks and their potential

effects [Mainzer, 2017]. Cliodynamics is actively used in historical analysis, which makes it possible to study retrospective processes in the scope of possible alternative scenarios for countries' and sectors' development based on the global system approach [Wallerstein, 2018].

The proliferation of information and digital technologies has led to the emergence of a new economic model, Industry 4.0. Its main aspects (cyber-physical systems, the Internet of Things, smart cities, smart infrastructure, etc.) can be viewed in terms of dynamic complexity as well. This principle also works well in another area currently seen as a priority: the extended environmental perspective which goes beyond the relationship between man and nature. The systems theory reveals the laws of coevolution: the sustainable, mutually consistent, and balanced development of the environment on a variety of scales. The transition to waste-free production and a circular economy is currently under way [Wiesmeth, 2020].

This process facilitated by the actively developing interdisciplinary research in network science previously associated with cybernetics, systems theory, and systems analysis [Barabási, 2014, 2018]. Network partnerships provide obvious advantages in organizing the economy and communities over the previous hierarchical structures, since they create a synergy potential by combining all kinds of participants' resources. The smart development model encompasses an increasingly wide range of areas including transport and urban infrastructure, healthcare, energy, and so on. Smart energy grids are designed for the use of renewable sources and the redistribution of energy across networks. Assessing complex socio-technological systems requires interdisciplinary approaches which merge natural science, technical, social, and humanitarian competencies. Scientific and technological progress should be considered in universal selectionism terms. The processes associated with Industry 4.0 are in many ways reminiscent of biological evolution: innovations play the role of mutations, markets prompt natural selection, while social institutions determine the development of trends, just as the ecological situation sets the vector for environmental and climatic changes. Uncertainty determines the variability of processes whose alternative development paths diverge farther and farther from one another the more remote the time horizon becomes. Different scenarios arise, which may significantly deviate from the basic one. The aforementioned processes are described in **Klaus Mainzer's** paper "Technology Foresight and Sustainable Innovative Development in the Complex Dynamic Systems View".

The nonlinear thinking logic sees uncertainty as a potential strategic management asset. Like chance, it should not be interpreted only as a form of ignorance. Both these factors are natural properties of the majority of real-life processes and they cannot be completely eliminated. Accordingly, one should not as-

sume uncertainty can be overcome just by improving research tools and building development scenarios. However, a correlation between the degree of uncertainty and different futures described in scenarios can be established. **Andrzej Magruk's** paper "Uncertainties, Knowledge, and Futures in Foresight Studies — A Case of the Industry 4.0" presents various ways of efficiently handling the uncertain prospects common for those trying to reach a preferred future.

New knowledge created by "complexity science" changes the existing ideas about development processes accompanied by uncertainty, instability, and ambiguity. It allows one to see non-equilibrium in a new way: as a source of creative potential and as "enriched material" for designing alternative visions of the future. **Helena Knyazeva's** paper "Dynamic Complexity Management Strategies", shows how skillful complexity management based on holistic thinking helps actors painlessly survive crises, pass forks in the road, go through periods of turbulence, and reach the desired development paths, using the energy sector as an example.

Innovative circular production models are proliferating, focused on preserving the environment and based on higher environmental standards. Among the particularly important ones is the circular economy model which implies re-using products instead of recycling them through the application of new technologies and creative, ecological design. **Hans Wiesmeth's** article "Systemic Transformations for Businesses in the Context of the Transition to a Circular Economy" presents the basic trends in this area. The author describes less-than-obvious barriers hindering the proliferation of the new model, such as inertial linear production schemes which create "path dependencies" and limit development opportunities. The paper reveals complex multi-layered cause-and-effect relationships which complicate the transition to a waste-free economy driven by socially and environmentally responsible businesses.

The application of digital technologies increases uncertainty and complexity associated with the development of any sector. New standards are emerging, which require the production of personalized products (preferably using local production facilities) and their accelerated delivery. As a result, production networks become more complex, while the number of connections between their nodes increases. Various actors' relationships are becoming increasingly nonlinear. In some cases, synergies arise, in others, the connections weaken. Doing business under such circumstances requires flexible, context-dependent management and adequate strategies. The paper by **Marta Götz** and **Barbara Jankowska** "The Adoption of Industry 4.0 Technologies and Company Competitiveness: Case Studies from a Post-Transition Economy" shows how companies that have taken the digital economy path more rapidly than others are transforming their own and related industries. Harmonized, coordinated action taken by top managers jointly with IT department heads plays a significant role here, along with a focus

on holistic thinking which helps build an effective network of manufacturers, suppliers, other partners, and consumers. Such connections are also important for strengthening cooperation between universities and industrial companies, which creates the basis for translating new knowledge, that is, transforming it into technological innovations.

Business success increasingly depends upon building cooperation networks between enterprises, suppliers, and customers. The scope and duration of knowledge sharing partnerships (on a regular, systematic, or ad hoc basis) are determined by the specific market situation of a particular industry or enterprise. All network structures' links are interested in innovations, while their operations fit into the "open model". The publication by **Vitaliy Roud** and **Valeriya Vlasova** "Cooperative Strategies in the Age of Open Innovation: Choice of Partners, Geography, and Duration" stresses that open nonlinear networked cooperation promotes innovation both by individual nodes and by the network structure as a whole.

Following the example of medicine, all science (including university research) is switching to the translational principle which implies the accelerated conversion of knowledge into technological and other innovations. The "science-education-business" triangle is emerging, promoting mutually beneficial partnerships with synergistic potential. Businesses' and society's demand for knowledge generated over the course of university re-

search creates a feedback effect from the former, in the form of additional support for university research and educational programs. At the same time the implementation of science-based innovation by companies increases their competitiveness, which is demonstrated in the paper by **Selma Ottonicar**, **Paloma Arraiza**, and **Fabiano Armellini** "Opening Science and Innovation: Opportunities for Emerging Economies".

The network interaction model which became a feature of the modern context [*Castells*, 2015], is further developed in the article by **Vladimir Milovidov** "The Linked Prosperity Model as an Integrated Response to Corporate Management Challenges in a Network Society". Horizontal, decentralized connections between individuals and companies of different sizes are becoming no less important than hierarchical structures. Enterprises' integration into such an environment also has a network dimension. Their activities, including their environmental and social responsibility affect the future of the regions where they are based. In accordance with the principle of the system and its context impacting each other [*Casper*, 2019], the environment the company creates becomes the key factor for its own further development.

Thus, the studies presented in this special issue offered to the reader's attention illustrate the applicability of systemic, holistic, nonlinear, and network thinking principles as effective strategic management, foresight, and scenario planning tools.

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