# History and Modern Landscape of Futures Studies

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## Abstract

The challenges that futures studies face are particularly complex, interconnected, and contradictory, and cannot be resolved using linear approaches. Prognostic science needs tools matching the new contextual complexity, which would allow one to capture a much wider range of driving forces, and their potential effects, in a non-linear perspective to improve the accuracy of forecasts and quality of strategies. Through a retrospective analysis of prognostic science and Foresight studies, this paper presents the prerequisites for enriching the relevant methodology with the concepts of complexity science. Relevant Foresight competences are identified. Case studies are presented, which can serve as practical guidelines to master the creative potential of complexity during particularly unstable periods. Special attention is paid to the emerging megatrend of the rising deglobalization, which can radically impact the implementation of previously developed strategies. The key conclusion from the presented analysis is that skilful handling of complexity opens up major opportunities for creative growth.

**Keywords:** corporate strategies; futures studies; Foresight; history of science; sustainable development; megatrends; science of complex systems; complexity; scenario planning; weak signals; uncertainty; competencies

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## Introduction

Futures studies require advanced competences, including the ability to go beyond the "limits of the known", take into account non-obvious driving forces, assess their combined effects, switch between different horizons. The growing complexity of modern socioeconomic and technological systems has become the new normal. The flow of "wicked" problems is growing exponentially: interconnected and inconsistent ones, which cannot be clearly defined and give rise to new challenges when one tries to apply fragmented solutions.[1] During periods of transformation, dealing with such multiple complexities creates the need to master new relevant approaches and tools borrowed from other fields, first of all, systems science. Turning to such assets allows one to capture a much wider range of factors, cause-and-effect relationships, and their potential impacts in a non-linear perspective. This, in turn, improves the ideas about the future and the accuracy of forecasts, and significantly reduces the "room for error" in decision-making. The problem is that adopting new concepts requires learning to see a broader picture of the world. One effective way to unlock the potential of and meet the growing demand for approaches enriched with advanced knowledge is to review the evolution of prognostic science, its current landscape, and examples of the practical application of tools borrowed from complexity science.

Accordingly, the objective of this study is to retrospectively review the development of futures research and analyze its "contact points" with complex systems science. The blended tools based on such relationships allow one to see complexity as a major source of transformational development potential, design next-generation strategies, and prepare more accurate forecasts.

The paper begins with an analysis of the prognostic science's evolution. The combination of retrospective and prospective views provides a better understanding of the sequential unfolding of complexity in civilizational development, and of its impact on prognostic science and Foresight studies. Next, a classification of Foresight generations is presented; the authors' contribution is in enriching it with theses from other sources, and with original observations. Also, we expand this classification by introducing a new Foresight generation and describe the relevant competences.

Finally, an attempt is made to assess the potential of complexity science techniques by presenting two case studies. One reflects the process of gradually "nurturing" an optimal strategy in a complex, turbulent, and uncertain environment. The other highlights a new major trend with transformational potential, which necessitates a revision of strategies developed in a relatively recent context characterized by greater stability and predictability.

## The Evolution of Futures Science

Attempts to "look into the future" began during the early stages of civilizational development. Philosophy made a significant contribution to futures science, since it focuses on the fluidity and irreversibility of time, the choice of paths, the connections between the past, present, and visions of the future, and so on. Attempts to try to influence the future were first recorded in the 13th century BC in China (Gidley, 2017). A major leap in this area was made in Ancient Greece (in the 7th-5th centuries BC), when the general shape of the (still relevant) Delphi method emerged. The first fundamental philosophical treatises on the topic under consideration appeared during the periods of the Renaissance and Enlightenment. In 1627, Francis Bacon, who laid the foundation for scientific empiricism, described a model which became prototype of the organizational structure of the present-day academies of sciences. Forty years after its publication, it became the basis for the creation of the British Academy of Sciences. As Denis Diderot noted, Bacon "wrote the history of what was to be learned" (Diderot, 1770). The co-founder of the British Academy, Samuel Hartlib, proposed an expanded scientific academy model, according to which scientists and the general public were involved in improving quality of life through the application of technology (the prototype of the modern Foresight community). In 1868 John Stuart Mill used the term "dystopia" for the first time in the British Parliament. A new literary genre with the same name subsequently developed, which has affected the thinking about the future and the creation of its visions. During the same time Auguste Comte and Herbert Spencer introduced into the scientific discourse the topic of social megatrends (McKinnon, 2010).

Futures studies became a scientific discipline in the 1970s, when Fred Polack coined the terms "prognostic science" and "image of the future" (Polack, 1972). Working with a single version of the future was envisaged initially: a linear projection of the past into the present and on into the future. But as the development context became more complex and change accelerated, the limitations of this approach became increasingly obvious. Attempts to anticipate future events largely turned out to be counterproductive.[2]

[1] The term "wicked problems" was originally suggested by Christorpher Churchman in the second half of the 1960s (Churchman, 1967).

[2] E.g. an in-depth analysis of more than 80 strategic failures conducted by US researchers in the mid-2000s showed that in 82% of cases, the failure was caused by the incorrect initial assumptions about the future. In other words, plans were made for scenarios which have never become reality (Finkelstein et al., 2009).

In parallel, systems science and its branches such as "complexity science" and "systems dynamics", which have been developing since the second half of the 20th century, have radically changed the understanding of, and approaches to, futures research. Previously, the future was perceived to be closed, pre-determined, and controlled. The new understanding reflected its true nature: openness, variability, the possibility of "adjusting" it in a desired way, and the dependence of the emerging picture upon the interplay of various competing driving forces (Miller, 2018; Patomyaki, 2006; Wilkinson, 2018). A holistic view highlights the long-term consequences of decisions, the complex web of cause-and-effect relationships, phased transitions, and other previously unrecognized phenomena, which radically affect the course of development (Miller, 2007; Heinonen, 2013).

In the early 1990s the term "Foresight" was introduced into the professional discourse to describe these shifts in prognostic science in an attempt to define its new dynamics. The most famous definition of this term was suggested by Ben Martin: "Foresight involves systemic attempts to assess the long-term prospects for science, technology, economy, and society, in order to identify strategic research areas and new technologies that can bring the greatest socio-economic benefits" (Martin, 1995). But even before the emergence of this concept, related ones, borrowed from other disciplines were incorporated into the domain of "working with the future". In the mid-1980s Robert Rosen proposed the notion of anticipatory systems to describe a kind of "radar" for looking "beyond the horizon" (they have been implicitly used throughout the history of civilization) (Rosen, 1985). It served as a basis for the emergence of derivative concepts such as anticipatory learning (Stevenson, 2002) and anticipatory governance. Though the latter term was coined only in 2009, the relevant practices have actually been applied in the scope of the Millennium project since the early 2000s (Guston, 2014). The number of publications on these topics is steadily growing.

As a result, prognostic science has accumulated a sufficient background to reach a new level and adopt anticipation principles. However, the term *anticipation science* itself was proposed only in the mid-2010s, in an attempt to organize and structure the aforementioned concepts (Poli, 2017).

In turn, futures research, including forecasting, anticipation, and Foresight, can be attributed to a broader field: the decision-making science (or, alternatively, the behavioral science). Representatives of this discipline initially proceeded from the assumption that decision-making is primarily based on reason and aims to obtain maximum possible benefits. However, their arguments were refuted by Herbert Simon, Daniel Kahneman, and Amos Tversky, who have proved that economic behavior frequently turns out to be rational only to a limited extent (Simon, 1957; Tversky, Kahneman, 1974; Kahneman et al., 1982). People may opt for a particular course, even if the consequences seem to be risky and unproductive, to pursue short-term (as opposed to long-term) interests due to numerous cognitive distortions (Kahneman, Tversky, 2000; Kahneman, 2011).

Thus, the area under consideration gradually incorporates new knowledge from other disciplines (cognitive sciences, complexity science, psychology, philosophy, sociology, anthropology, behavioral and affective sciences, network science). The extended toolset allows one to more accurately trace chains of upcoming events, at different time horizons. For example, cognitive science is currently exploring the underlying neural mechanisms affecting cognitive heuristics and biases, which improves future scenario building (Schirrmeister et al., 2020). Approaches are proposed which allow one to overcome limited rationality, embrace a wide variety of complex, non-obvious cause-and-effect relationships, and so on (McKiernan, 2017; Rhemann, 2019).

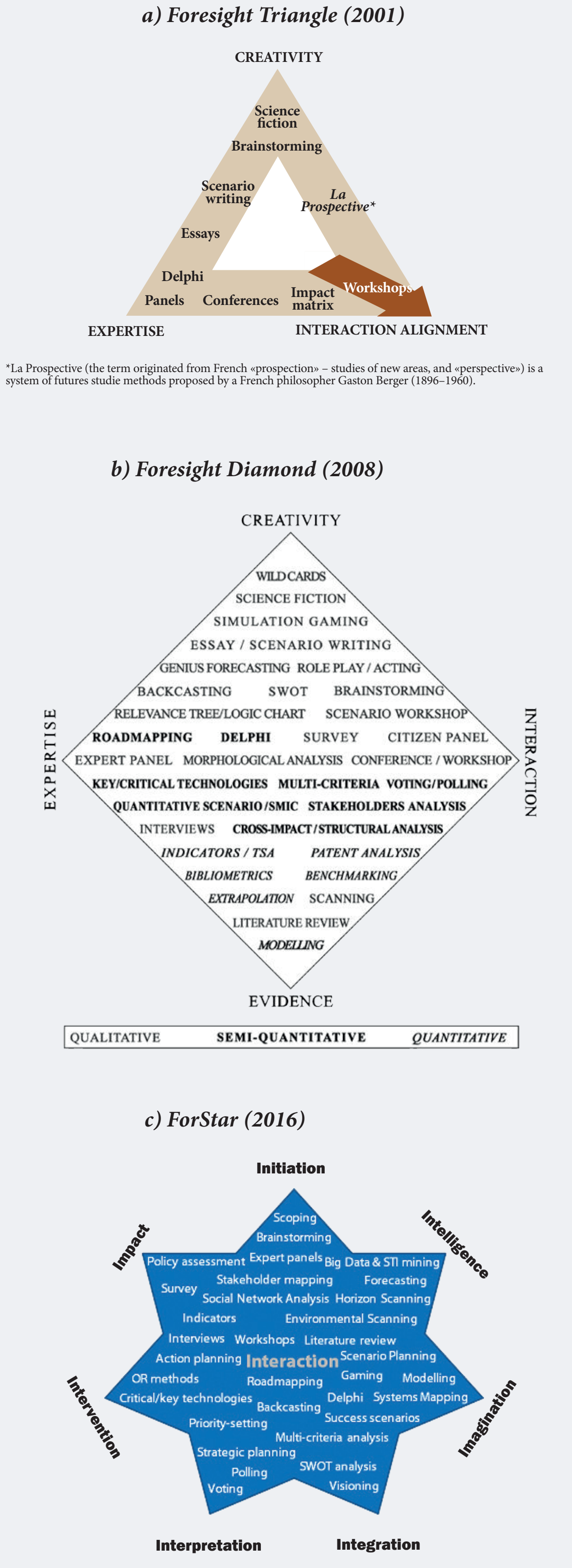
## Transformations of Foresight Methods

As the context changed, so did the nature and content of Foresight studies: the approaches became more diverse and multidimensional, and their classification became more complex. Figure 1 shows the evolution of classification models developed at different times by experts from the Manchester Institute of Innovation Research (UK): Luke Georghiou, Rafael Popper, Ozcan Saritas, and Dennis Loveridge as well as Alexander Sokolov and others from the Higher School of Economics Institute of Statistical Studies and Economics of Knowledge (Georghiou et al., 2008; Saritas et al., 2022; Saritas, Smith, 2011; Butter et al., 2008; Sokolov, 2007). These models provide guidelines for combining methods to match the goals and objectives of Foresight initiatives.

At different times, it was possible to more clearly anticipate forthcoming events due to the emergence of new layers of hard-to-access, difficult-to-perceive information and tacit knowledge, which contributed to the transformation of Foresight and its conceptual foundations.

This transformation stemmed from the previous practices of Foresight itself, other research areas, more general social changes, and the changing understanding of the links between science, technology, innovation, and economic development. As a result, the Foresight methodological basis was expanded and updated. A chain of generations was identified in the development of Foresight studies, reflecting their increasingly diverse objectives: from regularly reviewing the goals and practices of current activities to developing long-term strategies (Yuan et al., 2010).

**Figure 1. Evolution of Classification Models of Foresight Methods**




*La Prospective (the term originated from French «prospection» – studies of new areas, and «perspective») is a system of futures studie methods proposed by a French philosopher Gaston Berger (1896–1960).

*Note:* Different versions of the presented models exist.

*Note:* adapted by the authors from (Loveridge, 2001; Sokolov, 2007; Popper, 2008; Miles et al., 2016).

Researchers from the Danish Technical University led by Allan Dahl Andersen proposed a classification comprising five generations of Foresight studies. We adopted it as a basis for describing Foresight's evolution in line with the objectives of this paper. We advance our Danish colleagues' work by describing each generation in more detail, and adding a new, sixth generation whose contours began to emerge in the mid-2010s, after the publication of the original study (Andersen, 2012).

***First Generation (1950-60).*** The prerequisites for its emergence appeared after World War II, when some of the basic methods were proposed such as Delphi and scenarios. In Europe and North America experts in natural sciences and engineering disciplines implemented technological forecasting projects. The dominant attitude was that the future and innovation can be accurately predicted. Assessing the likelihood of future events became popular: it was considered uncomplicated due to the increasing availability of ever larger amounts of data and the development of advanced predictive models. This process did not require one to rethink the established ideas about development trends and prospects. As the amount of available data increased, the image of the expected future became sharper, while specific details in the form of "unlikely" events were considered minor and ignored. The reductionist approach did not allow for predicting  the chains of major crises (the oil crisis of the 1970s, the financial crisis of 2008, etc.), which came as surprise factors (Wilkinson, 2018). The risks of relying exclusively on quantitative methods became increasingly apparent. In an effort to compensate for the latter's drawbacks, experts in the US and France in parallel began to develop new approaches to reducing uncertainty (Masini, 1993; Bell, 1997).

***Second Generation (1970s).*** The World Future Studies Federation (WFSF) was established. The accelerated social and technological change created an interest in megatrends and in possible "future shocks" (Naisbitt, 1982; Toffler, 1970). The future began to be perceived as less predictable, and open to design. As a result, the circle of Foresight project participants became wider at the expense of the business community. A search for the right balance between innovation potential and a broader context has begun (taking into account environmental, social, and ethical issues, corporate responsibility, and technology supply and demand). The general contours of technology policy emerged. Analyzing market failures came to the fore. Attempts to calculate specific risks gave way to studying uncertainty (as an immeasurable concept, which still must be taken into account) and businesses' ability to make use of the emerging opportunities. Since the 1980s the number of Foresight projects increased gradually, but in the 1990s it exploded (Andersen, 2012).

***Third Generation (1980s-1990s).*** The analysis of market failures – gaps market mechanisms do not fill – has been replaced by studying the qualitative development of innovation systems in general. The creation of innovations began to be seen as a chain of integrated, interactive, and parallel processes, complex and non-linear. The circle of stakeholders expanded, who now saw Foresight not as a product (a one-time initiative culminating in the preparation of a report), but as an ongoing process (Cariola, Rolfo, 2004). Technology policy has been supplemented with an innovative one. A market of international "producers" of global future scenarios has emerged. Various players (multinational companies, national governments, intergovernmental organizations, international agencies, regional authorities, universities, professional networks, R&D organizations, transition research laboratories) started to establish partnerships, while at the same competing for leadership in setting the global science policy agenda.[3] The international expert community became interdisciplinary in nature, and requirements for Foresight competences became more stringent. The larger the problem, the wider the range of factors that must be addressed, and the more complex the knots of cause-and-effect relationships that need to be untangled. As a consequence, the increased cognitive load reduced the ability to perceive and take into account multiple and diverse driving forces (Ram, Montibeller, 2013), creating the need for an in-depth study of the cerebral mechanisms (Schirrmeister et al., 2020). Demand emerged for research in topics such as heuristics and overcoming bias in building future scenarios (Schoemaker, 1993; Ahvenharju et al., 2018, 2021; Rowland, Spaniol, 2021). Experts in cognitive sciences began to be involved in Foresight projects.

***Fourth and Fifth Generations (2000s-2010s).*** The semantic diversity of Foresight studies increased; the approach began to be perceived as a distributed process. In addition to science and technology, industrial, regional, educational, infrastructure, corporate, and competency-based issues were explored. Foresight initiatives were implemented. Approaches to dealing with uncertainty were reconsidered yet again: integrated models and narratives replaced probabilistic forecasting (Alcamo, 2008). However, the more advanced big data processing and complex modeling capabilities still did not help one to obtain a more holistic picture of forthcoming events.

Gradually an understanding arose that relying on quantitative methods increases the risk of slipping into backward-looking policies and makes one less prepared for the future (Mangalagiu et al., 2011). Despite its certain usefulness, retrospective analysis unsupported by other tools cannot be seen as a reliable source of information for decision-making. The most important knowledge about the future lies in its differences from the past. However, the more difficult-to-manage the system under study is, the harder it is to assess its future prospects without considering the past. This observation helps to explain why numerous trend-based forecasts failed, among other things, to predict the 2008 global financial crisis (Wilkinson, 2018). The Foresight methodology continued to evolve from the supply to the demand side, making the process more complex. The scenario planning method was widely adopted. While scenarios also rely on quantitative data, their purpose is not to extrapolate the past into the future, but to challenge ideas about dominant trends. Scenarios depict multiple alternatives, highlight the relationships between different, often difficult to compare problems, while solutions are chosen on the basis of a comprehensive analysis (Wilkinson, 2018).

***Sixth Generation (2015 – present).*** A series of unpredictable global crises (financial, economic, pandemic, etc.) increases the need for new tools and approaches to working with the future. The UN has set the Sustainable Development Goals agenda (SDGs).[4] New platforms to facilitate flexible network collaboration have emerged. Events previously considered isolated began to be seen holistically and interconnectedly. Scenario planning received new meaning: as a strategy testing technique, allowing one to see the consequences without the need to immediately make decisions. The "safe space" concept has been proposed to describe this approach, along with reframing which involved adjusting perceptions, increasing the emphasis on dealing with complexity, and broadening the coverage of diversity (Ramirez, Wilkinson, 2016).[5] Also, scenario building is now supported by big data and artificial intelligence technologies. Scenario elements (building blocks) are prepared using ChatGPT and then fleshed out and adjusted by experts, which saves time (Kishi-

[3] These include the OECD, IMF, World Bank, UN, European Commission, G20, World Economic Forum, Big Cities networks, foundations, international non-governmental structures, and regional organizations. New global participant networks, inter-organizational initiatives, cross-sector partnerships, and global change labs are also involved in shaping the global agenda.

[4] The Sustainable Development Goals are a set of 17 interrelated programme goals that imply finding comprehensive responses to global challenges, such as protecting the environment, improving the quality of life, achieving balanced economic development and resource consumption, combating climate change, etc. (https://sdgs.un.org/goals, accessed on 17.11.2023).

[5] An alternative three-generation Foresight classification proposed by the Hague Center for Strategic Studies (HCSS) is also worth mentioning (De Spiegeleire et al., 2016). In the scope of Foresight 1.0 (1950s-70s), experts built limited sets of future scenarios. The improved version, Foresight 2.0 (1980s-2010s) became interactive in nature, with interdisciplinary teams occasionally involved in the process. Foresight 3.0 (the term was proposed in 2016) is based on blending quantitative and qualitative tools.

ta et al., 2023). As a consequence, the coverage of complexity and the range of perspectives to consider future options increased with each new generation (Rowe and Wright, 2011; Schatzmann et al., 2013).

***Competences Required for Sixth-Generation Foresight Studies***

The new type of competences is focused on working with socioeconomic systems, based on understanding their complex nature, adaptability, interdependence, and unpredictable behavior. This topic has been actively discussed in recent years. From a comprehensive review of such skills and abilities presented in (Ahvenharju et al., 2018), the following should be noted:

- critical revision of established mental models and world views;
- switching between different levels of analysis: micro (cognitive system), meso (company, sector, etc.), and macro (global);
- extending the cognitive coverage of diverse driving forces;
- abandoning "simple solutions" and simplified polar thinking in "yes/no" or "optimism/pessimism" terms, etc.
- correctly interpreting events and processes, identifying turning points in a sufficiently early manner;
- taking into account the complex interweaving of deep cause-and-effect relationships and self-organizing processes;
- building transformational potential required for sustainable development;
- mastering the decomposition method, which allows one to study complex systems at a basic level without disrupting the relationships between their elements;
- managing the "limits to growth"; etc.

The success in acquiring the above competences depends on a number of mental and personal traits, which can be adjusted. These include individual perceptions of the current situation and the dynamics of change (Lombardo, 2016). In stable times, the future is perceived as a continuation of the past, which creates the illusion of "boundless stability"; mental models lose reflexivity, flexibility, and the ability to respond to emerging events (De Jouvenel, 1967). During periods of radical change, views of the future change also. The future is perceived to unfold nonlinearly and becomes unconnected to the past (Bell, 1997). Another relevant skill is being able to create a perspective, set time horizons, and comprehensively assess the available and potential resources needed for development (Baumeister, Vohs, 2016).

## The Creative Potential of Complexity

The complex systems science takes futures research to a qualitatively new level, offering a comprehensive "lens" to holistically perceive reality and solve complex problems (Wilkinson, Kupers, 2013). It also helps one understand the sustainable development dynamics and identify emerging opportunities in a tangled, chaotic, and turbulent environment.

Dynamic organizations use complexity and turbulence as resources and as a basis for building adequate strategies. Any organization is a part of a socioeconomic system with adaptive potential, capable of maintaining dynamic equilibrium by constantly balancing between relatively unstable states. Maintaining such fluid balance in the course of development is considered to be a close-to-optimal state. Innovative transformations, new conflicts and interactions, the growing circle of actors, and other factors knock the system out of a relatively stable position and provoke a constant search for a new, balanced path. As a consequence, the system suddenly and abruptly changes its state; multiple bifurcation points appear, along with new driving forces which follow unexpected trajectories. Trying to define sustainable development, people often talk about resilience, i.e., following a flexible, supple strategic course, when possible deviations from the main direction do not undermine the progress, but open up internal opportunities to regenerate and carry on. Sustainable development can be seen as self-sustaining.

Reality is always complexly multivariant with a colossal potential for the emergence of new states, even if it is not perceived as such. Considering that all processes are in constant motion and restructuring, in the logic of complex systems, creating new and reformatting old paths does not seem to be something destructive. For example, it is hard to predict the behavior of global supply chains. Adding resources to any segment of the chain will not necessarily increase the supply at the point in space and time where it is most needed. Sustainability is created by continuous, flexible adjustment of the collaboration network by constantly coordinating and reviewing partners' cooperation. Like any complex system, international networks are nonlinear in the sense that the effect rarely turns out to be proportional to the cause (Sterman, 2012). In some cases, even significant external impact does not affect the system state, while seemingly minor processes lead to radical changes in individual subsystems or in the system as a whole. Because of the complex interactions between participants in a socioeconomic system, individual actors' actions, even positively motivated, often lead to unintended counter-productive results (Merton, 1936). Vision horizons, breaking points, and the scale of change must be taken into account. What is barely (if at all) noticeable over short periods of time can become critical in the long term (Sterman, 2012). Projecting the complexity science principles into management practices becomes a source of valuable ideas for developing transformational strategies.

## Case Studies

Let us move on to the practical aspects of applying systems science principles in order to identify long-term trends and patterns for subsequent strategy development.

### *Danone*

The case of the French company Danone inspires one to reconsider the classic approach to strategy building based on the belief that planning and implementation times can be precisely controlled and that a road map can serve as a guiding document. From complexity science's point of view, this logic does not take into account important factors such as the complex interweaving of cause-and-effect relationships, random coincidences, path dependence, and self-organizing processes, which significantly affect the organization's development. Meanwhile taken together, these factors can be used as a resource to achieve self-sustaining sustainable growth. This requires constant flexible improvization, adaptation, and regular strategy adjustment. It is dynamics that make possible the strategy's gradually moving toward "perfection", despite the periodic impact of random events and path dependence (which gradually minimize). It took time to realize that a successful strategy emerges through a combination of planned steps and adequate responses to the changing external situation. In the 1980s-1990s the prevailing view was that the optimal strategy depends solely on the existing context and careful planning (Lawless, Finch, 1989; Marlin et al., 1994; Hrebiniak, Joyce, 1985). Only since the 2000s have arguments pointing out the fact that the strategic vector equally depends on the ability to take into account self-organization and correctly interpret combinations of circumstances been broadly accepted (De Rond, Thietart, 2007; MacKay, Chia, 2023). Through flexible adjustments, strategic steps over time can be integrated into the ordered configuration of a self-organizing process.

The Danone case presents a rare opportunity to trace a long chain of steps (taken over more than 40 years, in 1966-2008, and comprising over 500 strategic events[6]) using advanced quantitative methods (Thietart, 2016). Five phases can be identified in the process of the company strategy "maturing", with structural breaks between them (phase transitions). Some of these phases appear to be stable, others turbulent, and still others combine different types of system dynamics (from path dependence to emergent self-organization).

Phase 1, a calm one (1966-1969), is characterized by consistent decisions: mergers with dynamic players, adaptive internal reorganization, investing in the target industry (the glass business). In phase 2, which was highly turbulent (1970-1987), the consistency was lost: the strategy was adjusted, promising companies operating in a different sector (the food industry) were "spontaneously" bought, while the glass business (until recently considered to be the company's core one) was sold. This period is also called "random drifting". During the moderately turbulent third phase (1987-1997) strategic consistency returns: the company adapts to the new industry, partnerships are established, and investments made to accomplish the fundamental goal of becoming an industry leader. In the calmer fourth phase (1997-2004), the financial strategy was adjusted. The focus has definitely shifted to the new area: food production. The investment portfolio was structured and diversified. In the stable fifth phase (2004-2008), the sequence of strategic events becomes longer: the updating of financial strategies was followed by the restructuring of the investment portfolio, new mergers and acquisitions, and new partnership alliances. Danone has reached the elusive point of achieving self-sustaining growth.

Thus, it turns out that the more stable the development phase is, the more consistent strategic steps become. In the first phase two cycles of strategic events were identified, in the third three were identified, in the fourth four, and in the fifth eight. Only in the second, highly turbulent phase no clear connection was established between the steps taken, when the strategy was changed most radically.

The sequence of actions taken by the management serve as strategy "building blocks". The more there are of them, the faster self-organizing processes emerge. Flexibly balancing management control and self-organization, Danone has gradually moved into a zone of new stability, manifested in the growing number of strategic cycles in each subsequent development phase (from zero in phase 2 to eight in phase 5).

The first and last phases were the most ordered ones. The first phase was dominated by path dependence: the company growth was determined by the past. The second one was the most turbulent, but in the third and fourth phases, the turbulence decreased to average. There were periods of active search, research, and complex experimenting in new business areas between the first and fifth phases. However, Danone's behavior was never chaotic, though from the outside it might appear that the company grew "randomly", following no strategy at all.

During the second phase Danone made an unsuccessful attempt to take over a major competitor, but

[6] These strategic events include the first major business deal, joining an alliance, launching a new market product, etc. Based on the collected data, Thietart (2016) defined six categories of events related to strategic action and the external shocks category.

it did not affect the chosen strategic vector, despite creating certain chaotic dynamics and losing control over the growth processes. Typically, numerous unforeseen events tend to occur at this stage, but in Danone's case there were a few of them. In times of turbulence, the company management was unable to control the timing of achieving the "preferred future", so "manual control" had to be eased in favor of "serendipity". Danone combined complex restructuring of its core glass manufacturing business with diversifying into other industries. During phases 1, and especially 3 and 4, searching for new opportunities was followed by rapid growth: major initiatives alternated with smaller ones. The process was always driven by a clear goal: in phase 1 it was achieving a leading position in the glass industry, and in phases 3 and 4 - in the food sector. When a chain of subtle strategic moves reached a certain threshold, self-organization arose, followed by a phase transition to higher, more complex development levels. During the periods of implementing "minor" actions the company acquired new capabilities and knowledge and adapted to the new developments, carefully managing its strategy.

After 35 years of transformation, adaptation, and coping with uncertainty, maximum stability was achieved during the latest phase. Danone focused on its core business. The strategy has reached "full perfection" and was generally brought under control. Moreover, Danone was never fully "path dependent" – a feat achieved by very few companies. Excessive commitment to a particular course does not leave room for flexible adjustment and adaptation, so a risk of being "stuck in a rut" arises (Burgelmann, 2002). Constantly balancing in a state of dynamic equilibrium allowed the company to discover new growth sources and development paths. Plus, Danone has also mastered another elusive skill: gradually reducing the effect of random factors (from phase 2 to phase 5).

The phenomenon of self-organizing processes is difficult to understand because, at first glance, it appears to conflict with the management goals and functions. Tight managerial control undermines self-organization, which has enormous potential to create radically new opportunities.

Thus, human effort only creates preconditions for self-organizing growth, but the latter's actual emergence depends on other factors. In the case of Danone, self-organizing processes arose in the second phase and then consistently strengthened until the last, fifth one.

Reaching dynamic stability (sustainable development) can take many years, going through alternating periods of turbulence and order. Such a nonlinear path requires experimentation, improvisation, and strategy adjustment. Systems science knowledge allows for guiding strategy through difficult "rapids" into a zone where turbulence gradually reduces, along with the effects of the past and of random events. At a certain point the company reaches a state of fluid equilibrium, with self-organizing processes and strategic action coming into agreement. Danone dynamically grew in calm and turbulent periods alike due to three factors: setting major strategic goals, being ambidextrous (balancing between searching for new opportunities and using existing ones), and proactive (regularly monitoring and correctly identifying emerging opportunities). In a turbulent situation, the strategy and the timing of making and implementing strategic decisions are determined by self-organizing processes, while cautious, soft managerial interventions facilitate the strategy's "maturing to perfection". The sequences of micro-steps which served as fertile ground for the maturing of Danone's macro-decisions helped to softly and carefully supervise strategy implementation, without undue acceleration. Such tactics allowed for successfully moving on from searching for opportunities to experimenting and mastering their potential.

### *Deglobalization*

The second case concerns the process of deglobalization and long-term corporate strategies developed during the relatively recent period of predictability. Deglobalization has significant transformational potential: for establishing cross-border technological alliances, international division of labor, etc. Discussions about the possible advent of deglobalization began as early as during the 2008-2009 financial crisis and became more active after 2018. Until that time globalization was perceived to be irreversible, which was manifested in the growing number of studies on global megatrends, global risks, and global scenarios. The view of the world as a single integrated, closely connected structure dominated all Foresight studies and forecasts. However, since 2012 a slowdown in the globalization has become apparent. Due to the growing confrontation of countries not sharing the same political and economic principles, the ties between the elements of the global system have begun to weaken. Since 2019 this process has sharply increased, with businesses facing greater turbulence and uncertainty (Petricevic, Teece, 2019; Teece, 2022).

This trend is currently being addressed by various think tanks specializing in systemic futures research. We will mention two such studies: by the US Institute for Research on World-Systems (IROWS) (Chase-Dunn et al., 2022) and the Hague Centre for Strategic Studies (HCSS, the Netherlands) (Teer et al., 2023).

In 2022, HCSS experts prepared two scenarios for European countries until 2032 based on Foresight studies' results, reflecting the possible consequences of deglobalization: “Chinese embargo on the supply of critical raw materials to EU countries” and “Naval blockade of Taiwan by China”. The probability of their implementation was estimated at over 50%, due to the growing macrotrend of renewed competition between major powers possessing significant economic, technological, and military might. Protectionist measures in favor of local producers, trade barriers, and intellectual property protection are being stepped up. The most worrying factor is reduced global flows of raw materials, goods, and technologies for vital industries. The exchange of these resources, which form the basis of the international trading system, faces serious risks. Recent geopolitical upheavals have significantly accelerated this process. Countries – major energy consumers - have become dependent on the emerging centers of power in the Asia-Pacific region. High turbulence is noted there, which could disrupt the supply of strategic raw materials from China and of semiconductors from Taiwan – resources crucial for the energy transition, digitalization, and the operations of basic sectors including medicine, defense and security, sustainable mobility, and ICT. In response to the arising challenges, some countries started to build up an internal supply of resources to become autonomous. The globalized world based on cost optimization principles is being replaced by one where security of supply comes to the fore. According to HCSS experts, the unfolding process may span over the next decade, and beyond. Despite all efforts to become independent from Asian resources, the need for them will remain in place at least until 2032, according to Dutch experts.

Their US colleagues from the Institute for Research on World-Systems (IROWS) were more optimistic. They see globalization as a cyclical process, which over the previous two centuries has repeatedly displayed rises, plateaus, and declines. According to IROWS experts, there are no grounds yet to speak about a definite shift towards deglobalization, since the current processes are diverse in nature, unfold at different speeds, and have multidirectional vectors in different dimensions. More accurate conclusions about the trend under consideration and a better forecast of its further development can be made no earlier than in 2028.

The US experts base their arguments on the results of a longitudinal study of the growth and decline in global trade over the abovementioned period. Globalization is not just a cycle, but an upward trend, because the stages of its partial decline are followed by the waves of stronger recovery. When the globalization level remains more or less stable, a plateau appears. In 2008 the world entered into a new deglobalization phase due to the contradictions in economic systems, trade conflicts, political disagreements, and so on. This phase is the third since the 19th century. The preceding wave of globalization arose in the late 1990s and peaked twice, in 2000 and 2007, thanks to digitalization and the relocation of production to countries with lower labor costs. In the recent past, major declines in economic activity after the acute phases of the financial and pandemic crises have been followed by periods of partial economic recovery and renewed growth. Currently, multipolarity is increasing, while the ties between countries are weakening. Noting the similarities between the most recent and earlier deglobalization periods, the authors suggest that if globalization processes have not reversed, they at least have reached a plateau. Previous deglobalization stages lasted over 20 years each, while only 15 years have passed since the 2008 recession. For this reason, more accurate conclusions about the deglobalization trend can be made only in five years. The globalization/deglobalization cycles according to IROWS are presented in Table 1.

Table 1. **Globalization and Deglobalisation Cycles: 1830 – Present**

| Period | Beginning | End | Duration |
|---|---|---|---|
| Plateau 1 | ? | 1848 | ? |
| Globalization wave 1 | 1849 | 1878 | 29 |
| Deglobalization wave 1 | 1879 | 1901 | 22 |
| Globalization wave 2 | 1902 | 1920 | 18 |
| Deglobalization wave 2 | 1921 | 1944 | 23 |
| Globalization wave 3 | 1945 | 1980 | 35 |
| Plateau 2 | 1981 | 1993 | 12 |
| Globalization wave 4 | 1994 | 2008 | 14 |
| Plateau 3, or Deglobalization wave 3? | 2009 | ? | ? |

*Note:* Question marks reflect uncertainty regarding the beginning or end of the relevant period and, accordingly, its duration.

*Source:* composed by the authors based on (Chase-Dunn et al., 2022).

## Conclusions

Futures studies face challenges characterized by interconnectedness and inconsistency; these challenges cannot be dealt with using linear approaches, which leads to increased complexity in a variety of fields. Prognostic science requires tools matching the new contextual complexity, allowing one to capture a much wider range of driving forces and their potential effects in a nonlinear perspective, significantly reducing the "room for error" in decision making.

This paper offers a retrospective overview of the evolution of approaches to futures studies. Prerequisites for enriching these approaches with the advances in complexity science are outlined, which convey a promising thesis: complexity has significant potential for development, which can be revealed through a skillful treatment of the former. The points of contact between prognostic science and complex systems science are shown, along with their effects on strategy development and implementation.

Six generations of Foresight studies are described, with an emphasis on the latest one and on the relevant competences. A number of practical cases were studied to demonstrate the scope for applying complex systems science knowledge to scenario building. The case of Danone illustrates how such tools helped to transform corporate strategy and helped the company reach self-sustaining growth through stages of turbulence and uncertainty. This case can be seen as a manual for making use of new opportunities and flexibly adapting a company during particularly volatile periods.

The emerging megatrend of growing deglobalization was also addressed, which can radically affect the implementation of strategies developed in previous years. The views of two different scientific schools exploring the prospects of complex transformational processes were described.

The presented review can serve as a starting point for discussions about the latest trends in the field of Foresight methodology, the challenges of adapting it to an increasingly complex context, and building relevant competences for working with multiple futures.

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