



From Data to Scenarios On the “Imaginative Coefficient” of Futurology

Abstract: This article reconstructs the historical circumstances that led to the emergence of futurology, as a distinct field of research, and of Herman Kahn’s scenario analysis, as an investigative tool alternative to trend analysis. Two main paradigms characterized prospective thinking up to the mid-20th century, a historico-literary one that emphasized the importance of imagination and artistic talent, and a technical-scientific one that favored the rigorous analysis of data and precision of forecasts. After the Second World War, these two paradigms found a virtuous synthesis in scenario analysis, a halfway approach between literary arts and science. The author argues that the use of imagination and creativity does not undermine the scientific status of futurology, just as it does not put in jeopardy that of other sciences. He also introduces the term imaginative coefficient to indicate a fundamental ingredient of prospective thinking and provides the theoretical basis of this concept.

Keywords: futurology, scenario analysis, possible worlds, trend analysis, imaginative coefficient, futures

*A dream will always triumph over reality,
once it is given the chance.*

– Stanisław Lem,
*The Futurological Congress*¹

Introduction

For several decades, futurology² has established itself as an important field of study, with the support of international scientific journals, popular magazines,

1. Stanisław Lem, *The Futurological Congress*, trans. Michael Kandel (San Diego: Harcourt Brace Jovanovich, 1985).

2. There is no consensus on the denomination of this field of study and its specialists. The discipline is indicated by various terms, such as “futures studies,” “futures analysis,” “futurology,”

research institutes, university courses, recognized experts, and even offices in the largest multinational corporations. No doubt, the prediction of future events is not a prerogative of futurology. It is one of the fundamental objectives both of science³ and ordinary knowledge.⁴ Predictions are formulated not only by astronomers, meteorologists, physicians, and economists, to name just a few categories of men of knowledge, but also by ordinary people in the course of daily life. If this is the case, why have some scholars felt the need to establish a discipline explicitly focused on the study of future events? Futurology differs from other disciplines in two main respects: (1) its scope is holistic; (2) its approach is strongly interdisciplinary in character. The second feature is a consequence of the first one. Futurology has a much broader scope than other prediction-oriented sciences. Futurologists wonder about the path and destiny of humanity as a whole. In the 19th century, such reflections were the preserve of philosophers of history, such as Georg Hegel and Karl Marx, or of classical sociologists, such as Auguste Comte and Herbert Spencer. At that time, specialization was not yet exaggerated. No one would have ever felt the necessity of asking Marx to clarify whether he was fundamentally a philosopher, a sociologist, a historian, a political scientist, or an economist. Philosophy and sociology were understood as supersciences, which incorporated many other domains of knowledge. In the 20th century, the philosophy of history left the scene, and sociology carved out its specific territory, different from that presided over by economists, political scientists, and historians. As a result of the specialization process, scientific journals have become increasingly reluctant to host holistic views of the past and the future. Therefore, the need arose to found a new all-encompassing discipline, with its own journals and conferences. German political scientist Ossip K. Flechtheim proposed calling it “futurology,” in an essay originally written in the mid-1940s and subsequently included in an anthology edited by Alvin Toffler.⁵

“futurism,” “futuristics,” etc. The practitioners are often called “futures analysts,” “futurologists,” and “futurists.” In the English language, the dominant denominations seem to be “futures studies” for the discipline and “futurists” for the experts. This vocabulary may however result in misunderstandings, as “Futures” is also a NASDAQ financial product, while “Futurism” has been an important cultural movement active at the beginning of the 20th century, especially in Italy and Russia. Although I am not a fundamentalist on this issue, here I adopt the terminology used by one of the leading exponents of this field of study, Polish writer Stanisław Lem, by calling “futurology” the discipline and “futurologists” the specialists of the sector.

3. John L. Casti, and Anders Karlqvist, eds., *Beyond Belief: Randomness, Prediction and Explanation in Science* (Boca Raton: CRC Press, 2018).

4. Jonathan A. Waskan, *Models and Cognition. Prediction and Explanation in Everyday Life and in Science* (Cambridge, MA: The MIT Press, 2006).

5. Ossip K. Flechtheim, “Futurology – The New Science of Probability?”, in *The Futurists*, ed. Alvin Toffler, 264–276 (New York: Random House, 1972).

Concerning the scientific status of the new discipline, Flechtheim states the following: “The present author having suggested the term ‘Futurology,’ prefers to leave it up to the reader to think of Futurology either as a science or as a ‘pre-scientific’ branch of knowledge. For much will depend upon our definition of the term ‘science.’ If we think of the term only in the original meaning of ‘exact science,’ futurology will, no doubt, not qualify as a science.” However, “if we [...] define science broadly as a system of organized knowledge concerning the facts of a particular subject, Futurology may pass as a science [...]”⁶

Having to specify which type of science it is, the German scholar adds that futurology “is closely related to history and could indeed be pictured as a projection of history into a new time dimension.” As regards the scope and methods of the field, he clarifies that “[f]uturology does not so much deal with a new and special segment of knowledge, but rather represents a new synthesis of varied materials.” He also specifies that the discipline “will avail itself of interpretation, generalization, and speculation to a considerably higher degree.” Flechtheim concludes that we may “think of Futurology as a division of sociology resembling that branch of sociology sometimes called ‘historical sociology.’”⁷ It is worth noting that historical sociology, by dealing with long-term societal transformations on a global scale, is the branch of the social sciences that maintains the closest connection with 19th-century classical sociology. It goes without saying that there is no obligation to self-identify as a futurologist to craft far-reaching speculations about the future of humanity.

As it deals with the future of the world as a whole, futurology cannot but have an inherently interdisciplinary character. Futurologists must take into account cultural trends, social transformations, scientific discoveries, and technological innovations, as well as significant changes in the environment and, therefore, in the physical and biological world. As Master’s degree programs in future studies are relatively new and rare, professional futurologists often had and have diverse academic and scientific backgrounds. Scholars from the so-called hard sciences (such as mathematicians, engineers, and natural scientists), the social sciences (such as sociologists, anthropologists, and economists), and the humanities (such as historians, philosophers, and literary writers) venture on the path of futurology bringing with them the legacy of their education. Furthermore, among social scientists, some feel closer to the natural sciences and some to the humanities. In other words, futurology is not exempt from the contrast between “the two cultures” already outlined by Charles Snow in his famous 1959 essay.⁸

6. Flechtheim, “Futurology – The New Science of Probability?”, 268.

7. Flechtheim, “Futurology – The New Science of Probability?”, 269.

8. Charles Snow, *The Two Cultures and the Scientific Revolution* (New York: Cambridge University Press, 1959).

Thus, on the whole, two main paradigms seem to characterize this field of study, a historico-literary one that emphasizes the importance of imagination and artistic talent, and a technical-scientific one that favors rigorous data analysis and precise forecasts. The former tends to stress that another world is *possible* and *preferable*. Those who take this perspective often follow a creative path based on an explicit axionormative orientation, to outline the features of an ideal society. The latter is instead based on the persuasion that another world is *necessary* or at least *probable*, regardless of our preferences about it. Those taking this second perspective tend to believe that the nature of things is at the basis of necessary changes and, therefore, favor an analytical-descriptive approach over the axionormative one.

In this article, I show how these two futurological paradigms have found a virtuous synthesis in “scenario analyses,” whose initiator is Herman Kahn. The issue of how and why futurology and scenario analysis emerged pertains to intellectual history, thus this article must primarily be understood as a contribution to this field of inquiry. To put it even more clearly, the goal of this article is not to craft a new type of scenario analysis or to show in detail how this approach works, but to reconstruct the historical circumstances of its emergence and illustrate how this approach is halfway between literary arts and science.

As both possible and probable futures cannot be observed, but only imagined, in the last section I discuss the issue of imagination in science. More precisely, I argue that the use of imagination does not undermine the scientific status of research, and I provide a theoretical basis for what I call the “imaginative coefficient” of futurology.

Herman Kahn’s Scenario Analysis

In the first half of the 20th century, visions of the future were mainly elaborated by writers⁹ or sociologists,¹⁰ the former mainly relying on imagination and the latter on trend analysis.¹¹ Scenario analysis emerges as an alternative methodological tool after the Second World War, in the frame of the Cold War. As we have seen, that was also the moment when Flechthelm coined the term futurology.

9. The following are a few examples: Herbert George Wells, *Anticipations* (London: Chapman & Hall, 1902); Aldous Huxley, *Brave New World* (London: Chatto & Windus, 1932); George Orwell, *Nineteen Eighty-Four* (London: Secker & Warburg, 1949); Ray Bradbury, *Fahrenheit 451* (New York: Ballantine Books, 1953).

10. William Fielding Ogburn, *Social Change: With Respect to Culture and Original Nature* (New York: Huebsch, 1923).

11. It is worth noticing that there is more than trend analysis in forecasting. For instance, Marxist predictions of a socialist revolution are to some extent based on the assumption that once reached a certain threshold, quantitative changes trigger qualitative transformations.

One of the most visible trends of the period was the arms race between the two great powers, the USA and the Soviet Union. However, the future of humanity could not be predicted based on trend analysis alone. Since decision-making power was concentrated in a few hands, the story could take different directions also depending on the psychological characteristics of the men in the control room. In moments of crisis, single leaders or small elites decide for everybody. This is true in communist or fascist regimes as well as in large representative democracies – even if, in the latter, public opinion is supposed to have a greater role. Both the president of the United States and the secretary of the Communist Party leading the USSR could have pressed the button and started a thermonuclear war, depending on their definition of the situation and the convictions and persuasiveness of the small group of advisers surrounding them.

To account for this uncertain situation, while working at the RAND Corporation in the 1950s, Herman Kahn introduced the term scenarios into futurology as a way of imagining a variety of possible futures. Based on this approach, in the book *On Thermonuclear War*, published in 1960, Kahn renounces making a precise forecast and rather explores alternative worlds, that is, different paths that lead to alternative results.¹² Kahn argues that there is often a reluctance to think about certain scenarios, for moral reasons. Still, nothing guarantees that the leaders who are entitled to decide for everybody will embrace this morality. With the formula “thinking the unthinkable,” Kahn invites futurologists to be open-minded and take into account also the futures they would never want to see.

If one is sufficiently honest and open-minded, one must recognize that there are many possible scenarios, such as the continuation of the arms race, unilateral disarmament, peace, escalation, de-escalation, deterrence, the balance of terror, preemptive attack, war (regional, global, conventional, thermonuclear), partial or total victory, partial or total defeat, and, eventually, nuclear holocaust and the extinction of humanity.

Mathematician and physicist by training, Kahn wrote several articles to refine the method of scenario analysis. He argued that it is necessary to develop sufficiently structured analytical models, but, at the same time, he insisted that it is equally important to recognize the role of imagination, inventiveness, and creativity. This deliberate normative ambivalence serves to overcome two typical problems of the field.

The first typical problem is blurring the line between the normative and the descriptive. The following are Kahn’s words:

12. Herman Kahn, *On Thermonuclear War* (Princeton, NY: Princeton University Press, 1960).

Unfortunately, the field of future studies is thick with normative forecasting masquerading as descriptive. Many prognostications of many distinguished American thinkers are statements of what the author wants to happen, not necessarily, what he thinks will happen, and frequently they are a bald pitch for some express policy or program. If done openly and honestly this is a perfectly valid method of political advocacy, with many honorable precedents but it tells us very little about what the future will be, except insofar as it is influenced by the ideas and desires of important men today.¹³

The second typical problem is that “most of the world’s business is conducted on the basis of surprise-free projections.”¹⁴ This is a mistake because “the enhanced importance of unlikely events is a novel and most significant element in our age of technology; and to plan prudently means increasingly to extend the boundaries of plausibility.”¹⁵

So, what is the solution? Mixing the two approaches, the two paradigms, by coupling trend analysis with imagination and creativity, as “prediction about future possibilities depends upon an understanding of the present and past, and it also involves the making of imaginative and analytical leaps as well as extrapolations.”¹⁶ A futurologist should not be afraid to play with ideas, contemplating also what may seem absurd. Indeed, “the analyst, being less responsible for immediate decisions than the government official, but more responsible for ‘stretching the imagination,’ should, on occasion, be more willing to seriously consider the unlikely and the bizarre, or spend more energy in re-examining and reinterpreting the old and familiar.”¹⁷

This is quite simple to say but difficult to implement. One cannot suddenly decide to be open-minded. This requires a profound psychological transformation. A “backward-looking futurologist” is an oxymoron. Dogmatism, bigotry, and intolerance are not just major impediments to performing scenario analysis. In a rapidly changing world, they render impossible even trend analysis. This is because “even those aspects of the future which are relatively accessible to the imagination – more or less simple projections of present trends – may still be ignored because an individual’s view of the future is necessarily conditioned by

13. Herman Kahn, *The Essential Herman Kahn. In Defense of Thinking* (Plymouth: Lexington Books, 2009), 224.

14. Kahn, *The Essential Herman Kahn*, 176.

15. Kahn, *The Essential Herman Kahn*, 182.

16. Kahn, *The Essential Herman Kahn*, 182.

17. Kahn, *The Essential Herman Kahn*, 182.

emotional and intellectual biases.”¹⁸ This problem adds to the circumstance that “the future is uncertain in a statistical or probabilistic sense.”¹⁹

Making scenario analysis the goal of futurology takes all these problems to the surface and offers a valid solution. Let us see how.

Modes of Scenario Analysis

There is no predefined number of scenarios but there is general agreement that the number should not be excessive. If there are too many scenarios, the reader cannot memorize them, compare them, and focus on the fundamental critical uncertainties. Furthermore, it makes it almost impossible to formulate strategies and action plans. Therefore, many studies focus on solely four scenarios. This seems to be the standard number.

As we said, one performs scenario analysis by combining knowledge of the current state of affairs and trends with assumptions about future developments. However, this can be done in several ways based on different analytical models. For instance, a futurologist may decide or be asked to explore four alternative scenarios, namely the most optimistic, the most pessimistic, the most likely, and a less likely but still possible one, which we call the Alpha, Beta, Gamma, and Delta worlds (see Figure 1).

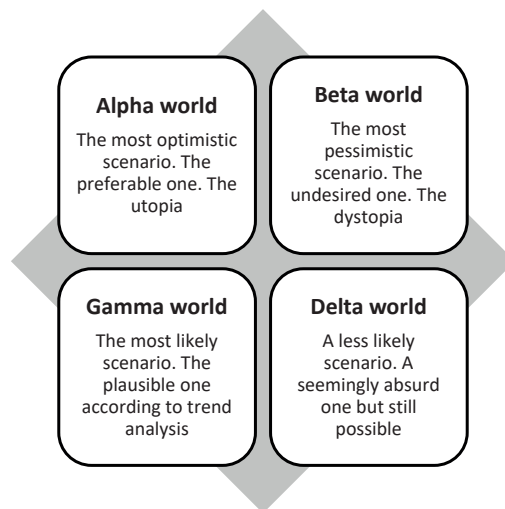


Figure 1. *Expectations-based four scenarios diagram* (author’s work)

18. Kahn, *The Essential Herman Kahn*, 182.

19. Kahn, *The Essential Herman Kahn*, 182.

As one can see, if clients assign this task to analysts, the chance for the latter of smuggling their preferences into supposedly value-free predictions is strongly reduced. To avoid wishful thinking, the model explicitly asks to distinguish the optimistic scenario from the likely one. As optimists are forced to contemplate a cloudy sky, pessimists have to take into account the possibility of a sunny sky. Similarly, unconventional thinkers are asked to contemplate the hypothesis that nothing weird will happen, while conventional thinkers are invited to reflect on absurd scenarios.

By engaging in scenario analysis, a futurologist with a background in economics would not just tell us that the economy will necessarily go this or that way. In a critical situation, a scenario analyst working with this model would take into account four alternative worlds, such as the following: (1) Growth (the most optimistic one); (2) Recession (the most pessimistic one); (3) Stagnation (the most likely one according to trend analysis); (4) State bankruptcy (a seemingly absurd but still possible outcome). The possible worlds would be different in the presence of uncertainties related to exceptional events such as pandemics, wars, natural catastrophes, famine, etc. If the trend or the current state of affairs is very critical, a state default could become the most likely scenario, and growth would just be an absurd but still possible outcome.

Another simple but effective way to conduct scenario analysis is to select two business-critical uncertainties and use them to create a scenario matrix. The main steps are the following. First, one has to map underlying trends and driving forces such as industrial, economic, political, technological, legal, and social trends. Then, one has to assess the extent to which these trends affect the issues under investigation. Finally, one has to find key uncertainties and evaluate the presence of relationships between driving forces. This will help focus on some possible scenarios and rule out inappropriate ones.²⁰ The scenario matrix approach based on two critical uncertainties provides four distinct worlds to explore (see Figure 2).

For instance, if an epidemic breaks out, by observing the trend and using imagination, we may detect the presence of two main uncertainties: (1) Will the epidemic evolve into a pandemic?; (2) Will the medical community be able to provide an effective remedy? The combination of these two uncertainties gives way to four alternative worlds. The Alpha world is the best possible scenario – one in which the epidemic does not evolve into a pandemic and, just in case, the medical community possesses an effective remedy. The Beta and the Gamma worlds are two intermediate scenarios. In the former, the epidemic hits an isolated community but there is no remedy for it, while in the latter a pandemic breaks

20. Bertrand K. Hassani, *Scenario Analysis in Risk Management. Theory and Practice in Finance* (Berlin: Springer Nature, 2016), 3.

out but physicians dispose of an effective medicament. The Delta world is the worst-case scenario, that is, a pandemic with no working remedy available. One may take into account three uncertainties instead of four, for instance, by asking if the disease is highly or slightly lethal. In this case, one would have to design nine alternative worlds.

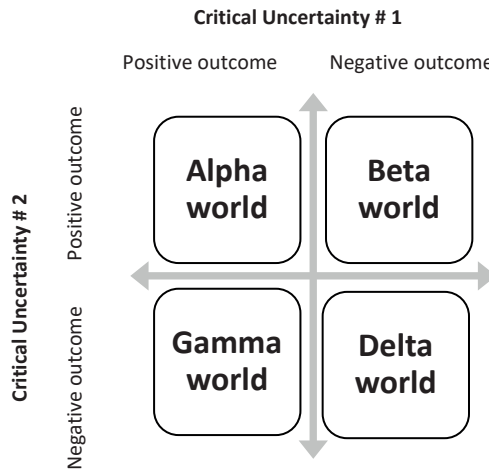


Figure 2. *Uncertainties-based four scenarios diagram* (author’s work)

The ultimate goal is to transform the results of the scenario analysis into key management actions to prevent, control, or mitigate risks. Having more scenarios in mind, actors would not elaborate only on a plan of action A, but also on plans B, C, and D, being able to face different possible challenges and change the strategy in progress.

It must be indeed clear that “even if used as an existence theorem, specific scenarios, war games or other artificial devices normally cannot and should not be used to ‘prove’ anything. They are literary and pedagogical tools rather than instruments of rigorous analysis, are useful to stimulate, illustrate, and teach, to provide both preciseness and richness to communication, and to check details.”²¹

The words “literary” and “pedagogical” should not pass unnoticed. Unlike forecasts based on trend analysis, which impose patterns extrapolated from the past and projected into the future, scenarios are plausible and relevant “stories” that concern the strategic thinking process more than the concrete formulation of a specific strategic plan. Writing stories implies not only imagination but also

21. Kahn, *The Essential Herman Kahn*, 195.

literary talent.²² The stories must be well-written, convincing, and perhaps even entertaining, to attract the attention of publishers, editors, reviewers, peers, clients, political authorities, students, and readers in general. As is well known, half of the scientific literature passes completely unnoticed. It is neither read nor quoted. And, again, literary talent is not a skill one just decides to have. Improving one's writing skills is especially difficult due to the fact that the *lingua franca* of science is English, that is, a foreign language for most researchers. French, German, or Chinese futurologists who would write inspiring and entertaining scenario analyses in their native language, must struggle to render complex ideas into English.

This cannot however be an alibi, especially if we consider that the inventor of scenario analysis did not shine for stylistic skills. The editors of the anthology *The Essential Herman Kahn*, Paul Dragos Aligica and Kenneth R. Weinstein, though considering Kahn "one of the world's most creative and best minds," cannot but underline that the study and systematization of his work were made difficult by "the prolixity and complexity of some of his writings."²³ This is to say that, although difficult to achieve *in practice*, literary skill remains an essential *ideal* component of scenario analysis.

The Imaginative Coefficient of Futurology

The one fact that imagination is indicated as a fundamental component of scenario analysis led some scientists to the conclusion that futurology is not a genuine scientific discipline, but rather a pseudoscience. In this section, I will refute this assumption and argue that scenario analysis can acquire greater theoretical awareness through the concept of "imaginative coefficient."

Outstanding philosophers of science such as Karl Popper²⁴ and Gaston Bachelard²⁵ convincingly demonstrated that imagination is an essential ingredient of scientific research.²⁶ Since the human being is fallible and finite, and since scientists are human beings until proven otherwise, every universal statement is built on a logical leap. We always start from local observations and experiences, limited in time and space, to arrive at universal conclusions, supposedly valid in every place and at every time. The existence of universal laws itself, rather than

22. This is true for the scientific literature in general. Cf. John Kirkman. *Good Style. Writing for Science and Technology* (London and New York: Routledge, 2005).

23. Paul D. Aligica and Kenneth R. Weinstein, "Introduction," in Herman Kahn, *The Essential Herman Kahn. In Defense of Thinking* (Plymouth: Lexington Books, 2009).

24. Karl Popper, *Logic of Scientific Discovery* (Routledge: London and New York, 2005), 452.

25. Gaston Bachelard, *The Psychoanalysis of Fire* (Routledge & Kegan Paul: London, 1964), 110.

26. Dennis L. Sepper, *Understanding Imagination. The Reason of Images* (Dordrecht: Springer, 2013).

mere chaos, is an indemonstrable metaphysical postulate. Furthermore, in the microphysical realm, some phenomena are not directly accessible to our senses. To represent them we must necessarily put our imagination into play. But it would be wrong to think that where we rely on observation we are right and where we pivot on imagination we fail. Imagination can pave the way to truth, just as observations can be fallacious. Both the scientific theories we have rejected as false and those we consider provisionally true rest on a mixture of metaphysical postulates, observations, experiments, reasoning, intuition, and imagination.

It would also be wrong to assume that this representation of science is proper only for philosophers. Scientists directly involved in research, at least those not following the positivist paradigm, have also well-understood the role of imagination in science²⁷ and science education.²⁸ I will exemplify this by picking some fragments from an essay by Dutch chemist Jacobus van't Hoff. His essay is a response to Herbert Kolbe who, in a series of articles characterized by aggressive and vulgar language, had accused several respectable colleagues of being pseudoscientists producing only junk, failures of the human mind, hallucinations, imaginative nonsense devoid of any factual reality, natural philosophy instead of exact science, and dressing their philosophy "in modern fashion and rouged freshly like a whore whom one tries to smuggle into good society where she does not belong."²⁹ His corrosive criticism was directed above all towards theories such as August Kekulé's structure of benzene, van't Hoff's theory on the origin of chirality, and Adolf von Baeyer's reforms of nomenclature.

Kolbe, although arrogantly claiming to know better than anybody else what genuine science is, could not foresee that he was slandering as pseudoscientists three scholars destined to be rewarded with the most prestigious scientific honors. Kekulé, despite making no secret of having discovered the ring shape of the benzene molecule thanks to a reverie (he had a daydream of the Uroboros, the snake that eats its own tail), was assigned the Copley Medal, the oldest honor of the Royal Society. Both van't Hoff and Baeyer won the Nobel Prize in Chemistry, respectively in 1901 and 1905.

Van't Hoff replied in a far more delicate manner. In his essay *Imagination in Science*, he defines "imagination as the ability to visualize any object with all its properties."³⁰ The mechanism underlying scientific discovery is based on two phases: observation and imagination. "By means of the first, [...] one tries to obtain

27. Jacobus Henricus van't Hoff, *Imagination in Science* (Berlin and Heidelberg: Springer, 1967).

28. Yannis Hadzigeorgiou, *Imaginative Science Education. The Central Role of Imagination in Science Education* (Berlin: Springer Nature, 2016).

29. Cf. van't Hoff, *Imagination in Science*, 6.

30. Van't Hoff, *Imagination in Science*, 8.

accurate knowledge of our environment forthwith. By means of the second, the causal connection in it is investigated.”³¹

To show that this is not just his speculation, the Dutch chemist conducts a sort of historico-sociological investigation. It examines two hundred biographies, chosen at random, of eminent scientists and shows that many of them have artistic, poetic, and literary backgrounds. This information is crucial because van’t Hoff considers “artistic inclinations a healthy expression of imagination.”³²

Among the two hundred scientists chosen at random, fifty-two, namely, 26% of the sample, are also distinguished poets and writers.³³ Van’t Hoff points out that these protagonists of the history of science had both a healthy and a sick imagination, and the latter sometimes bordered on superstition. However, despite the dangers, good science cannot dispense with imagination. To support this thesis, the Dutch chemist cites a passage in which the founding father of paleontology, Georges Cuvier, compares the contributions to chemistry by Luis Nicolas Vauquelin and Humphry Davy, the discoverer of Sodium, Potassium, Calcium, Boron, Magnesium, Barium, and Strontium. Here is the passage:

Notwithstanding his innumerable investigations and in spite of the important and noteworthy observations with which VAUQUELIN enlarged the stock of scientific knowledge, he cannot be considered as of the same caliber as DAVY. The former put his name in the paragraphs; the latter in the titles of each chapter. In a completely unpretentious manner, the former observed with a lantern the smallest obscurities and penetrated into the darkest nooks; the latter ascended like an eagle and illuminated the large realm of physics and chemistry with a shining beacon.³⁴

Van’t Hoff closes the essay by saying that these words describe “what research is without imagination, and what it can be if one uses it in an admissible manner.”³⁵

This is all the more true if we enter the field of sociology. The idea that we can move from observation to general laws and from the latter to forecasts was certainly more fashionable in 19th-century sociology than in 20th-century one.

31. Van’t Hoff, *Imagination in Science*, 8.

32. Van’t Hoff, *Imagination in Science*, 12.

33. The names are the following: Ampere, Bailly, Bonafous, Borda, Boyle, Cassini, de la Condamine, Copernicus, Davy, Delessert, Dupasquier, Descartes, Ebn-Jounis, Faraday, Flamsteed, Galilei, Gesner, Goethe, Halle, von Haller, Halley, Haüy, the two Herschels, Ingen-Houss, Kant, Kepler, von Kobell, Lacedepe, Lagny, Lalande, Leibniz, Lemery, Leonardo Da Vinci, Linnaeus, Malus, Miller, Newton, Palissy, Pascal, Poisson, Ramond, Rousseau, Rumford, Schleiden, Scilla, Schopenhauer, Smithson, Tennant, Tycho-Brahe, Volta, Voltaire, and Watt.

34. Cf. van’t Hoff, *Imagination in Science*, 18.

35. Van’t Hoff, *Imagination in Science*, 18.

However, with the possibility of collecting an enormous mass of data and information on human beings thanks to digitization, this idea has resurfaced. Not a few futurologists think that thanks to Big Data and algorithms, implemented in sufficiently sophisticated pieces of software, accurate predictions on human behavior can be made. This approach, which appears to be in continuity with the positivist paradigm, though addressing the problem in an updated form, has called into question the scenario analysis approach. The dream of being able to accurately predict a single future is back in vogue, implicitly or explicitly leveraging a supposed deterministic structure of the world.

This is a legitimate approach if conceived as one among others. It could however become an epistemological obstacle if adopted in an exclusive fashion. Indeed, it seems to me that those who venture in this direction do not take into consideration the lessons of the above-mentioned philosophers of science and natural scientists. Even less do they take into account the theoretical lessons of an eminent Polish sociologist, Florian Znaniecki, who between the two world wars opened our eyes to the “humanistic coefficient” of the social sciences.³⁶ In his book *The Method of Sociology*, Znaniecki points out that “the data of the cultural student are always ‘somebody’s,’ never ‘nobody’s’ data. This essential character of cultural data we call the *humanistic coefficient*, because such data, as objects of the student’s theoretic reflection, already belong to somebody else’s active experience and are such as this active experience makes them.”³⁷

There follows a warning to sociologists with a positivist orientation who would like to transfer the methods of the natural sciences *sic et simpliciter* into the realm of the social sciences: “If the humanistic coefficient were withdrawn and the scientist attempted to study the cultural system as he studies a natural system, i.e. as if it existed independently of human experience and activity, the system would disappear and in its stead he would find a disjointed mass of natural things and processes, without any similarity to the reality he started to investigate.”³⁸

Following Znaniecki, many scholars have recognized that the social and human sciences need specific research techniques to access cultural phenomena. It is not enough to observe and describe social phenomena. One must also interpret, comprehend, and understand the human subjects under examination. To this end, it is necessary to interact and communicate with them, whenever possible, by using techniques such as interviews or questionnaires.

36. On this topic, a comprehensive work in Polish is the following: Lech Witkowski, *Uroszczenia i transaktywność w humanistyce. Florian Znaniecki: dziedzictwo idei i jego pęknięcia* (Kraków: Impuls, 2022). See especially pages 588–590 and 621–628.

37. Florian Znaniecki, *The Method of Sociology* (New York: Rinehart & Company, 1934), 37.

38. Znaniecki, *The Method of Sociology*, 37.

Still, it is worth emphasizing that Znaniecki also insists on the need to use imagination, to enter the heads of social actors. He noticed that:

Vicarious experience is active personal experience. In it the agent reproduces formally and functionally somebody else's activity. But, whereas the original agent really modifies the values included in the system, the reproducing agent modifies them only "in imagination," that is, acts as if his task were to build a copy of the system in an ideal world instead of reconstructing it in that concrete reality in which his own original activities go on.³⁹

To give an example, the priest who officiates a religious ceremony pronounces certain words, makes certain gestures, handles the instruments of worship, invokes divinity, and invites the flock of the faithful to pray with him. The religious studies scholars do not repeat the ritual concretely, nor do they limit themselves to observing and describing it. They rather try to understand the ritual by ideally identifying with the officiant. In other words, the social scientist "identifies himself as agent with the priest, but does not try really to influence the objects of the priest's action, though he recreates in imagination the results of this activity as he thinks these results appear to the priest."⁴⁰

We can therefore conclude that Znaniecki's "humanistic coefficient" assumes and includes what I would call an "imaginative coefficient."

Conclusions

Firstly, I have reconstructed the historical circumstances that led to the emergence of futurology, as a distinct field of research, and of Kahn's scenario analysis, as an investigative tool alternative to trend analysis. Secondly, I have shown that imagination is a necessary ingredient of scenario analysis, which is an approach halfway between literary arts and science. Thirdly, I have argued that the use of imagination does not undermine the scientific status of futurology, just as it does not put in jeopardy that of other sciences. Finally, I have shown how Popper's and Bachelard's fallibilist approach, van't Hoff's theory of imagination, and Znaniecki's humanistic coefficient provide the theoretical foundations of what I have here meant, synthetically, with the term imaginative coefficient.

Any attempt to dispense with the imaginative coefficient, in the hope of reaching exact predictions, collides with long-standing theoretical problems. Big data, algorithms, and pieces of specialized software can give new impetus

39. Znaniecki, *The Method of Sociology*, 167–168.

40. Znaniecki, *The Method of Sociology*, 168.

to trend analysis and other forms of forecast. Currently, futurologists working in big tech corporations can make use of a widespread collection of information on billions of individuals (although collected by ethically questionable methods). Knowing the ideas, habits, and preferences of billions of individuals can allow data owners to predict and influence their behavior. However, especially in times of crisis, individuals or groups can abruptly abandon ideas, habits, and preferences, making it difficult to predict their behavior. Furthermore, the concentration of power in a few hands, typical of both great nations (geopolitical empires) and large multinational investment funds (financial empires), sometimes, makes the will of the masses scarcely relevant for the future course of history. In the presence of uncertainties, analysts may be tempted to assume that the elites or the masses would act exactly as they would. Predicting the future on this basis would be shortsighted. Scenario analysis remains a valid and useful tool because it requires the analysts to put themselves in the shoes of others and imagine decisions and behaviors that are very distant from their own. Big data and algorithms can still be useful to craft the most likely scenario, as far as we do not forget that the latter is just one of the possible alternative worlds.

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