Epistemology of Strategic Forecast

Tadeusz Gospodarek

Wałbrzych School of Management and Entrepreneurship
ul. Wrocławska 10; 58-309 Wałbrzych, Poland
tadgospo@gmail.com

The paper presents the scientific concept of a strategic forecast based on the ordered structure of logically layered modeling structure, from the ontological layer, through the epistemological and methodological ones, to the semantic representation. Assumptions for the optimum construction of a strategic forecast are discussed, and from the rational probabilistic point of view, a scientific status of the forecast is confirmed. A definition of a scientific forecast is proposed, in which the ontology is the knowledge of the objective of the forecast. For this ontology, the ordered epistemology and methodology have to be defined, which allows the formation of an appropriate numerical representation at the semantic level of reasoning. Rules of reasonably grounded forecasting hypotheses, based on the current knowledge of the forecasting objective and applying a minimum probability of changes in time, have also been defined in the paper. Reference is made to the concept of forecasting truth as truth in the sense of Watkins' acceptable truth, in a given context and verifiable experimentally in future periods of time.

Introduction

Can a strategic forecast be understood as any scientific structure? Can any prognosis be recognized as a scientific issue as it is related to the uncertain knowledge of the future time? What conditions imposed by the philosophy of science would allow to classify the forecast as a category of a scientific problem? How to decide which forecast is better, one supported by the present-tense data, or that closer to a strategist's vision? May the usefulness of forecasts at the moment of their creation be the overriding criterion for the rationality of choice?

It is a set of questions to be addressed in forecasting issues from the position of management philosophy, especially the epistemology of management science. The answers stem from a philosophical stance assumed, such as the Popperian fundamentalist, Feyerabend's postmodernist or rational probabilist, as well as the established criteria of demarcation. Natural Sciences have developed a good paradigm for the construction of demarcation and methodology of scientific knowledge-building, known as the "scientific method"[1,2] . But are the strict rules of the scientific method, the good paradigm concept of Kuhn and Lakatos, or Popper's falsificationism fully acceptable in terms of forecasting, or the construction of a rational strategy? Experience shows that they are not[3]. However, in terms of probabilism[4,5], there is an option of accepting the knowledge expressed by means of verifiable hypotheses in future periods. Therefore, the most promising epistemological position for the construction of a scientific forecast seems to be the approach of a rational probabilist, for whom it can be a research object with the probability of success which is unidentified at a given moment but high in the future.

[1] Gauch, H. G., "Scientific method in practice", Cambridge University Press, Cambridge, (2003)
[2] Kuhn, T., „The Structure of Scientific Revolution", 2nd Ed., The University of Chicago Press, Chicago, (1970)
[3] Feyearabend P., „Against Method", Revised Ed., Verso, London - New York, (1988)
[4] Joyce, M. J., "A Nonpragmatic Vindication of Probabilism", Philosophy of Science 65 (1998): 575-603.
[5] Watkins J. W. N., „Science and Scepticism", Princeton University Press, Princeton, (1984)

Descriptions of the strategy presented in literature are generally inconsistent[6], which is primarily connected with the epistemological disorder in management theory. Determining the logical modeling of forecasts and strategies, resulting from the logic of scientific discovery and the structure of information processing by computer systems, is useful for utilitarians and practitioners, for whom theoretical aspects of philosophical consistency are hardly relevant. An engineer implementing the strategy expects a clear methodology and an easy semantic interpretation of forecasts. He is less interested in the epistemological correctness of the inference. Hence, the success of the strategic card concept[7] and the LFA logical matrix approach[8] in consulting practice far outweighs unformalized methodologies. In the end, the engineer begins to look for axiological confirmations of the chosen methodology of forecasting, by which time the correct epistemological approach becomes necessary.

> **Example 1:** There exist practical concepts of emerging strategies which are widely accepted and applied. Can such a self-consistent process of goal definition be regarded as scientific, or rather as an art of self-adapting the objective to the conditions of the micro-macro balance in time? On the other hand, a methodology of forecasting which is similar to the above-mentioned, based on the concept of real options[9], has a very good theoretical basis, drawn from operations research in relation to equity options[10]. Which methodology will thus be more reliable for the board taking a strategic decision?

Intuition suggests that the method of real options seems a better approach. The scientific justification of this hypothesis can be supported by epistemological analysis. But does it automatically mean that the forecast obtained by means of the real-options approach would be better? It is worth mentioning at this point that there is a similarity between the model of a scientific theory formulation and formulation of scientific forecasts, which justifies the adoption of similar attitudes to the choice of better forecasts, such as those characterized by the philosophy of science in relation to the selection of a better theory. The fact that all competing theories at the time of forecasting are equally uncertain and do not have a certain probability of being real, does not mean that there are no accepted methods for choosing the best of them and rejecting others. It may be assumed that the best ones are those that lead to an optimum way of achieving the goal[5]. Unfortunately, any experimental confirmation of such a choice is mostly limited to a case study and no universal experiment has been proposed that would allow a determination of base sentences for forecasting hypotheses, mainly probabilistic ones. The notion of general optimality of a forecast, not only as a function of variables but also expressing their psychological state and formulating axiological or optimization criteria, has not been defined either[5,11,12].

Therefore, a forecast regarded as a scientific problem and further on in this paper called a *scientific prognosis* understood as a cognitive structure, requires a strong epistemological support and, above all, ordering the model as a set of consecutive filters to be imposed on the generality of the wording (forecasting assumptions). In addition, this forecast should be characterized by a high utility value for the implementing engineer. Gospodarek has shown[13] that a forecast, which is a measurable problem, at least in the axiological sense, always has its numerical representation. This means that there exists a selecting demarcation border for it, as a measurable problem of management science[14].

[6] de Wit, B., Meyer, R., "Strategy Synthesis: Resolving Strategy Paradoxes to Create Competitive Advantage (Concise Version)", 2nd Ed. Thomson Learning, London, (2005)
[7] Kaplan, R. S., Norton D. P., "The Execution Premium. Linking Strategy to Operations for Competitive Advantage", Harvard Business Press., Boston MA, (2008)
[8] Örtengrena, K., "Summary of the theory behind the LFA method"; Sida, Stockholm, 2004.
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[10] Hull, J. C., "Options, Futures, and Other Derivatives with Derivagem", 7th Ed., Prentice Hall, Upper Saddle River, 2008
[11] Simon H.A., "Administrative Behavior", Free Press, New York 1957.
[12] Kahneman, D., "Maps of bounded rationality: A perspective on intuitive judgment and choice", w T. Frangsmyr [red.], Les Prix Nobel 2002, Almquist & Wiksell International, Stockholm, 2003.
[13] Gospodarek T., „Modeling in Management Science Based on Research Programs and Representative Formalism", Economic University of Wroclaw, Wroclaw, 2009
[14] Gospodarek T., "Representative management' as a rational research program in Kuhn–Lakatos–Laudan sense", Int. J. Economics and Business Research, Vol. 1, No. 4, 409-421, 2009

Hence, it can be inferred that any quantifiable forecast is a model of semantic interoperability. Thus, a scientific forecast, as a measurable problem in management sciences, can be successfully subjected to the criterion of demarcation in terms of Popperian falsificationism[15], as well as recognized as an issue in terms of scientific probabilism. It means that it is possible to determine such a structure of the prognosis and such a formulation of its sentences that the forecast will be included in the range of the term *scientific problem* with its strict criterion of demarcation[15].

The aim of this paper is to point out the general methodology of research-supported forecasting which could be accepted both by the philosopher of management and the engineer who prepares the prognosis. For decision makers, this study indicates the most appropriate and scientifically aided practices for forecasting, allowing a selection the most reliable forecast. For management theory, the work introduces an arrangement of the forecasting model with a fixed measure, which always leads to the existence of a formal representation of forecasts (e.g. numerical algorithm). For the philosophy of management, it offers an approach to the prognosis issue from the rational probabilist point of view, as a defined ontology (of the intangible resource of knowledge) with the related epistemology.

To understand the logical structure of the scientific strategic forecast model, we will use the illustration (Fig. 1). It represents a set of logical layers of information processing which allows to define the forecast as a model of a given level of abstraction.

> **Example 2**. Any strategy, understood as an economic development model of micro or macro set in time, also representing a defined set of prognoses, can be built in a hierarchical order of conceptual inclusions from the most general – epistemologically-functional strategies (e.g. real options strategy), through the functionally-semantic strategy deriving from it (municipal development strategy according to the LFA methodology), to the operational strategy at the semantic-syntactic level (risk management strategy of Enterprise X). The strategy is an example of an ontology with defined epistemology, which is a future knowledge resource related to the subject.

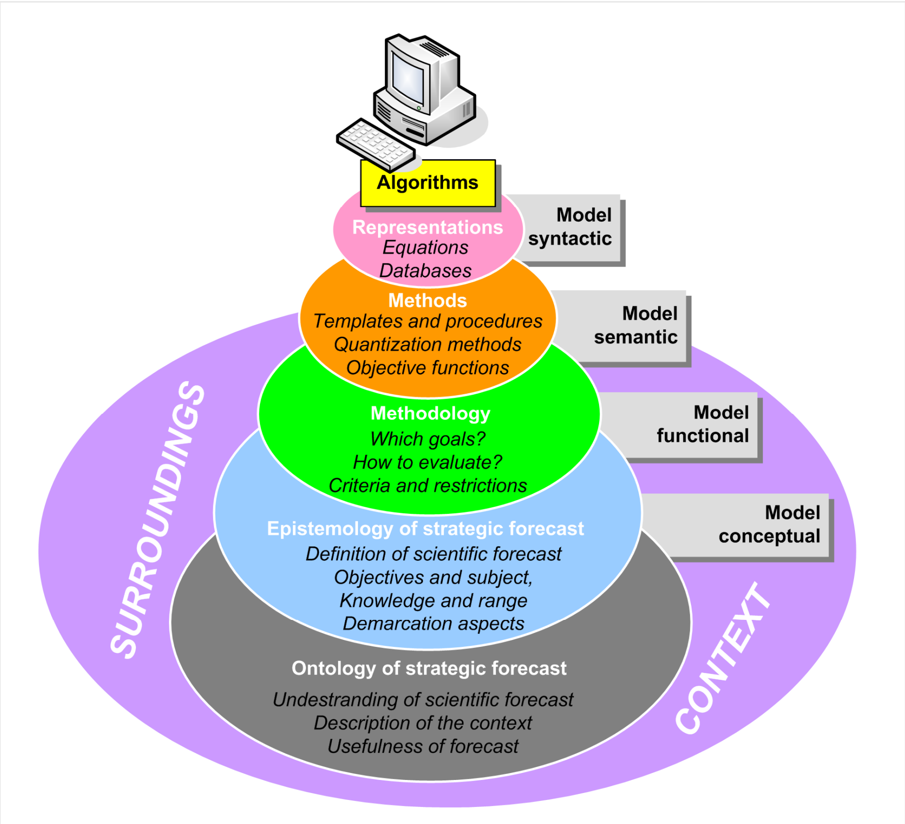

Fig. 1 Logical structure of a forecast with its final semantic representation [source: self creation]

[15] Popper, K. R., „Logic of Scientific Discovery", Routlege, London – New York, 2002

The above model corresponds to the numeric representation construction of the selected nonmathematic problem, which makes it similar to the reasoning for the construction of an in-formation system of the Web 2.0/3.0 type[16], thus drawing inspiration from the philosophy of the logical layers of information systems. On the other hand, it is a reflection of the concept of Watkins' logical levels of reasoning, resulting from Hume's skepticism[5].

1. The forecast as an ontology

Can a prognosis be considered an ontology? Based on the considerations from the Stanford Encyclopedia of Philosophy[17], the defined knowledge resource related to the future behavior of a forecasting subject is equivalent to recognizing it as a non-physical being (ontology). It is of little importance whether the knowledge is certain or uncertain, true or not, probable or improbable. The set of information it consists of has not only a dimension, meaning and scope, but also features distinguishing this entity from others. An ontological description of the forecast is best realized in a comprehensible way through the phenomenological presentation of its macroscopic properties and answering the following questions:

- How do the properties of the forecast relate to it?
- Which features of the forecast distinguish it as an isolated entity?
- How can it be justified that the strategic forecast exists in time?
- When does the forecast cease to exist, as opposed to its changes over time?

Table 1 shows some ontological characteristics of the strategy.

Table 1 Ontological characteristics of scientific forecasts.

Properties of the scientific forecast referring to itself	Features of the forecast distinguishing it
1. defined subject of the forecast, 2. delimited time horizon, 3. specified merit range of the forecast, 4. existence of measure and measurement methods, 5. determined conditions of feasibility, 6. defined context, 7. existence of formal representation.	a) prediction of activity of the entity, b) optimizing use of resources, c) optimizing interactions, d) determining feasibility of achieving the aim, e) quantification of operation results, f) axiological assessment, g) assessment of decision-making.

The following designates justify the existence of an effective strategic forecast and adherence to the hypotheses in a given entity and period of time:

1. the existence of an economic micro-macro equilibrium in the longer run,
2. the achievement of indicator values by the subject, assumed in the forecast in a given time,
3. the optimization of resource usability warranting a stability of operation,
4. a high level of entrepreneurship and innovation
5. established lines of development and relations with the surroundings (network connections, GSC, etc.).

An important ontological issue is the distinction between the time when the strategic forecast ceases to exist (i.e. to operate in an acceptable way), and when we can only consider its changes. This could be approached in a formal way. If the assessment of results assumed and the implemented strategic fore-

[16] Mills Davies, Project 10X, http://www.slideshare.net/Mills/what-is-the-role-of-cloud-computing-web-20-and-web-30-semantic-technologies-in-the-coming-era-of-transparent-collaborative-connected-egovernance?type=powerpoint
[17] Hofweber T., "Logic and Ontology", The Stanford Encyclopedia of Philosophy (Spring 2009 Edition), E. N. Zalta (ed.), URL = <http://plato.stanford.edu/archives/spr2009/entries/logic-ontology/>

casts according with the principles of measurement and evaluation within the time schedule is not satisfactory, and the analysis of options for future periods shows that no further implementation of the strategy will improve the results or it creates the risk of loss, then the existing forecast should be discarded and a new one created.

> **Example 3:** Investment projects co-financed by the ERDF fund require proof of financial sustainability of the project, using the forecasts of development of the country or region in the reference period (15-30 years, depending on the type of investment). Such prognoses are created by the national statistical centers of the EU member states according to the rules introduced by the Eurostat and their use is mandatory in the feasibility study (a formal attachment to the application form). They generally assume the sustainable development and changes in stable macroeconomic parameters. But during the 2008-2010 crisis, all the indicators of economic growth, as well as interest rates, changed so drastically that it was necessary to develop new multi-annual forecasts as the adjustments of previous estimates and proposed scenarios were too drastic. Curiously enough, in 2008 it was required to file the applications with forecasts that ignored the emergence of the crisis observed around.

It is obvious that the outcome indicators of the forecasts and the assumed objective function are the basis for taking rational decisions. It is worth noting that the surroundings often force changes in the economic systems of a catastrophic character (e.g. rapid variations in consumer preferences or a technology replaced with another, more innovative technology). It should therefore be inferred that the main reason for the change of a strategic forecast is the emergence of a micro-macro inequilibrium.

Another question is the increased risk of implementing a strategic forecast resulting from trends in the surroundings. If the risk rises above the assumed estimation of the economic security of the subject, then the option to resign from the continuation of the strategy should be considered. This will have a particular impact on the decisions taken by entities that have an aversion to risk. In this case, despite the moderately good results of the measurements of the objective function, the strategy may be abandoned and replaced by another, less risky one. Whether it is a modification of the implemented strategic forecast or the end of its existence is not possible to determine a priori.

What may be inferred from the above considerations is that treating the forecast as an ontology introduces some rational methodological limitations to the strategies created on its basis and related to establishing the designates of its existence, conditions of its obsolescence and forecasting features for the subject. It is worth noting that the LFA procedure meets all the ontological requirements for the strategies created with it.

2. Epistemology of the strategic forecast

Since it has been assumed that the strategic forecast represents an ontology, a set of epistemological characteristics can be attributed to it. In particular, the following questions must be answered:

1. What is the forecast strategy as knowledge?
2. What is the definition of the forecast as an ontology?
3. What is the subject and object of the forecast?
4. What are the limits of forecasting cognition?
5. Which criterion of demarcation can be applied to the forecast?
6. How to access strategic knowledge?
7. What is the proper way of building strategies and forecasts?
8. How to build strategic hypotheses and the objective function?
9. Can the forecast be true in any sense?
10. Which criteria for axiological evaluation of the forecast are applicable?

2.1 What is the strategic forecast from the philosophy science point of view?

A strategy, understood as **an ontology that is a resource of particular knowledge**, always carries a significant packet of knowledge related to the subject, context, economic processes, etc. Strategic knowledge is founded on the methodologies of social sciences, computer science, economics, and at the same time based on the methodology of quantification borrowed from operations research, statistics, mathematical methods of physics, etc. It is therefore an interdisciplinary topic of the theory of probability, as well as practical applications supporting decision-making processes, and may be experimentally confirmed in the future if implemented in practice. It appears advisable to set its positioning among the fundamental issues of management science.

The unresolved demarcation problem is a reference of strategic forecast to the future, although for its formulation sentences of the current and past time are used. Therefore, any base opinions relating to forecast hypotheses are always uncertain and thus approximating them to the truth may be at most probable and experimentally verifiable after some time. This uncertainty increases in the course of time and depends on the level of generality of the forecast. Nevertheless, we may recognize forecasts as sources of strategic information and knowledge of the subject interacting with the surroundings and its development over time. What is the truth in relation to the forecast? This issue will be explained later on in this paper.

But how to define a forecast? In the light of the arguments presented above, it may be stated that no definition in available literature includes all its ontological characteristics. Let us therefore propose the following definition of a strategic forecast:

A strategic forecast is the resource of knowledge about the subject, which is an ontology with the set of features 1-7 and functionality described as a-g presented in Table 1.

This definition includes all possible definitions previously presented in literature, additionally locating the strategy as an information resource with a particular functionality, enabling a predition of the subject's possible future behaviors. This information resource can be logically changed and modified in time by recursive actions during the implementation of the strategy. It takes place in strategic management according to emerging strategies or the real options concept, and when optimization is based on the Bellman principle[18].

2.2 The entity of the strategic forecast

The subject of the forecast can be: an organization, a collection of organizations, any set of resources interacting with the surroundings, an economic sector, etc. But is it a sufficient determination of the entity? After all, organizations are not isolated objects. No one who prepares a forecast attempts any such simplifications, leaving the relationship, interactions and structures (e.g. networks, enterprises or supply chains) out of strategic inference items. Thus, a complete description of entity forecasts at a given moment of time using a finite set of variables x (t) does not seem probable. It therefore seems advisable to introduce the concept of "economic system" as a generalized entity of the strategic forecast, used in a context wide enough to include any process possible to occur in the real world. This means that the formulation of forecasts as resources of knowledge may be applied to any organizations, groups of organizations, industries, parts of organizations (e.g. marketing) which are collections of resources interacting with the surroundings. Thus, for further discussion, *the strategic forecast will be understood as a resource of strategic knowledge, for a defined economic system*.

2.3 Subject of strategic forecasts

The subjects of forecasts are possible descriptions of the system in the future referring to the maximum usability of the strategic information resource in a given economic system. It is silently assumed that *the formulated strategic forecast is created in good faith to obtain accurate information about the state of the system after time t, based on the best available current and past knowledge for the formulation of hypotheses*. Then the received forecast is, in the probabilistic sense, a quasi-formal and consistent but incomplete description of the given aspect of development in time. Assuming an idealization of that description to a finite number of variables x_1 (t), x_2 (t), ..., x_n (t), which will act as quantifiers of the strategic forecast, automatically the aspect of the uncertainty of forecasting at the level of current knowledge about the system in the form of *ceteris paribus* is introduced, whose values

[18] Bellman, R.E., "Dynamic Programming", Princeton Univ. Press, Princeton, New Jersey, 1957

in the best case may be simulated with some stochastic methods (e.g. using the Brownian motion model) [19].

While methods for estimating strategic indicators are known, the general principles of the selection of strategic variables to describe the state of the system and quantify the forecast do not exist. There are no restrictions in this matter, and both the use of the principles of behavioral economics[20], or subjective choices with bounded rationality[11] are available. Hence, introducing subjectivism in the description of the state of the system and strategic measurements justifies the elimination of accurate quantification, replacing it with precise estimations of the uncertainty of the prognosis. This causes that the verification of prognostic hypotheses after time t, using strict Boolean criteria, is not adequate. Therefore, fuzzy logic and conditional probability are essential methods of verifying strategic hypotheses[21]. The conditional probability of obtaining a given value of forecast quantifiers should be assumed as rational switches between options.

When deciding to forecast the development of a system in time by a finite number of variables, one must have a sufficiently large and structured knowledge of the system from the internal observer's point of view, which is usually a serious problem for any board of any organization. For practical reasons, and initially assumed uncertainty of the future description, prognostic variables may be taken as one-dimensional (scalars), for example: the size of capital, stock quantity, market share, etc. The values of these variables in future periods will be the hypothesis under investigation in subsequent intervals. And if it is so, then the subjects of forecasts are also methods for evaluating the accuracy and reliability of forecasts, as well as conditions affecting the uncertainty of inference. In other words, the estimation of uncertainty is one of the key aspects in strategic forecasts.

When strategic variables are determined, what becomes the fundamental subject of the forecast is the objective function and its optimization. Unfortunately, the inadequacy of mathematical models of economic forecasting is widely known and we should rather not expect any significant improvement in this question soon. This conclusion comes from observations of real economic systems, where in most processes involving these systems, the change of the state is not only a function of the parameters of the current state but requires the simultaneous inclusion of some values from the past. Thus, the development of the system in time can not be described as a simple system of differential equations but it requires sophisticated methods of subtract-differential equations, which can rarely be reduced to the simplified forms of recursive algorithms. Thus, the subject of the forecast is also a quantitative description, consisting of the objective function and methods of control systems, capable of maintaining the required values at the time of this function, using e.g. feedback (information delays on the description of the state at any given time t) or optional choices. This function need not be continuous, especially linear, which further complicates the formal description.

Finally, the subjects of strategic forecasts are also the criteria and axiological assessment methods, especially from an external observer's point of view. The claims of a good or bad prognosis, rational, flexible forecasts, etc, belong to the category of qualitative descriptions of valuation on any conventional scale[22]. Hence it is necessary to define not only the scale but also the qualitative categorization thresholds. We should not ignore the aspect of the subjectivity of evaluation and time variability, not only of the strategy but also the axiological criteria. What is regarded as beneficial today may not necessarily be beneficial in the future. Thus, the variability of the assessment criteria along time are also an important aspect of strategic forecasts, which introduces additional *ceteris paribus* into the reasoning.

To sum up, the subject of strategic forecasting is not only the easy prediction of changes in value during the time of selected parameters describing the system, but the whole process consisting of variables describing the system choice, the formulation of the objective function, optimization and evaluation methods, and axiological assessment.

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[19] Dixit A., Pindyck R., "Investment Under Uncertainty". Princeton University Press., Princeton, NJ., 1994,

[20] Rabin M., "Psychology and Economics". Journal of Economic Literature (American Economic Association) (1), 1988, 11–46.

[21] Talbott, W., "Bayesian Epistemology", The Stanford Encyclopedia of Philosophy (Fall 2008 Edition), Edward N. Zalta (ed.), URL = <http://plato.stanford.edu/archives/fall2008/entries/epistemology-bayesian/>.

[22] Stevens S.S., "On the theory of scales of measurement". Science 103, (1946), 677–680.

2.4 The ranges of prognostic cognition

The boundaries of prognostic cognition are the most important factors of the forecast structure as an ontology with defined epistemology. They essentially concern all the areas of operation of a system or organization, consisting of objectives of the strategic forecast. What should be pointed out here is the essence of the restrictions imposed by the surroundings on the forecast, which is a finite set of hypotheses, a set of basic sentences of the current time (PEST analysis, SWOT, etc.). It is therefore bounded, being a set of finite elements. So, the question arises whether the limitations of the information resource for the construction of hypotheses cancels the validity of the forecast as an ontology. Can we state any hypotheses based on such uncertain knowledge? The scope of the existing and introduced restrictions makes the forecast usable for specific stakeholders, as well as offering expertise in the range of *a priori* fixed usability. Thus, a strategic forecast is not a universal outlook, which does not mean that it is unfounded or can be placed outside the borders of the demarcation of science. Therefore, the constraints arising from incomplete knowledge of the system are decisive in the usefulness of the information to support decisions in describing the state of the system and determining the extent to which deliberately introduced *ceteris paribus* will influence the uncertainty of the objective function in the future, when experimental verification is possible. At this point, the limits of knowledge should be complemented by the estimates of the limits of forecasts and criteria for selecting suitable options in the self-correction process.

Regardless of the presented aspects, we must also consider the scope of strategic hypotheses which are verifiable in the future set of sentences. The larger the scope of hypotheses, the wider the range of strategic knowledge. The more sentences constituting the criteria of feasibility, the more justified the inference. The better methods of quantification, the more accurate the process of adapting strategic forecasts to the variability of restrictions in time.

Concluding, the limit of strategic cognition is the probabilistic information of the introduced hypotheses together with the conditions limiting the scope of the matter. Within the limits of strategic knowledge there are also rules for the creation of measurement and scale of assessment, methods and techniques of the quantification and description of the system's development in time (the objective function and equation of the state).

2.5 The demarcation criteria

An important epistemological aspect to the scientific forecast is the border of demarcation. It sets the conditions for recognition of the strategic forecast as scientifically justified and rational, as opposed to metaphysical predictions or a set of sentences without a fixed logical value. Demarcation also requires the determination of appropriate methods for measuring the results of the forecast or of its axiological assessment.

> **Example 4:** Let us use the paradox of blue emeralds as an illustration of an inappropriately raised problem. Consider the following hypothesis H1: ”all emeralds are green until 2011, then they will change to blue”, then hypothesis H2: "all emeralds until 2012 are green, then they will change to blue", etc. As a result, we have an infinite number of generalizing sentences, which may appear experimentally falsifiable, but in future periods. What is more, each next sentence shifts the falsification horizon ad continuum. The paradox is in fact a wrongly base-embedded hypothesis which does not take into account the chemical properties of the crystal as a main generator of the stone’s color. In addition, the inference uses the principle of induction inappropriately. Thus falsifying the forecasting sentence is too broad a criterion to accept the rationality of the hypothesis.

The above problem applies in no lesser degree to sentences formulated in strategic forecasting. Scientific forecasting formulates sentences relating to the future, fully empirically falsifiable, as long as the result can be measured, weighed or counted, which in accordance to the logic of scientific discovery can then be regarded as the scientific view (not necessarily true). In this way, an experimental falsification of the hypothesis of a 100%-increase in a company’s revenue in 2010 is simple – it is sufficient to show that after 31 December 2010, under the ex-post accounting entries, the result is different from the assumed one. In this way the prediction phrase, acting as a hypothesis, will be falsified. But to put forward **a reasonable hypothesis** concerning the 100%-increase, it is necessary to verify its feasibility, e.g. taking into account the current economic results, market trends, state of resources and context. And this is exactly the cognitive scope of the forecast. *The more reasonable sentences, verifiable experimentally by monitoring the assumed set of quantifiers in time are available, the greater the scope of information about the organization is included in the strategic forecast*. And the smaller the uncertainty of the prognosis becomes. Let us call such sentences **"the good heuristics of forecasts**." It is of little importance which school of strategy gives the rational prognostic sentence or puts the probabilistic hypothesis. What is important is that either it is falsifiable in a finite time, or not. It is either a reasonable hypothesis, supported by a feasibility study best available for a strategist's current information and simulations, or it remains metaphysical fiction, which does not necessarily mean an automatic disqualification of the practical success of hypotheses with a lower degree of current-time data support. However, forecasts which are self-adjustable in time or based on intuition will not be considered scientific strategies in the context of this work, in spite of their possible practical success in the future.

The following sentence may be a conclusion of the above discussion: *A rational forecast is one which, with a given set of certificates in current time U, is a set of hypotheses H, for which we can conclude in the best-conceived manner that they are true and verifiable experimentally after a finite time t, and at the same time will be best correlated with the set of these certificates.* This assumes the condition of a minimum of necessary changes of the prognosis after time t in order to be experimentally verifiable. And that, in principle, should provide a rational demarcation border for the scientific strategy, corresponding to the criterion of rational demarcation derived from the philosophy of science[23].

2.6 Strategic truth

Can the strategic forecast be recognized as true? Can strategy as knowledge be treated as the truth? We may say that not all information is knowledge, not all knowledge is wisdom, and not all wisdom is the truth. So, what is the essence of prognostic truth?

As previously shown, the more verifiable hypotheses of current time form the basis of strategic forecasting, and the more certificates of future events can be presented in relation to the strategic hypotheses, the more probable is their utility and expected values of the objective function quantifiers. Therefore*, meta-analyses, leading to probabilistically acceptable hypotheses of the* ***present time****, can be considered elements of good heuristics of scientific forecasts*. But is it sufficient to consider this heuristics closer to the truth? The model of future behavior of the forecast entity is verifiable after time t constitutes the forecast horizon. After time t, the observer may measure a predicate representing a measure of scientific prognoses, and falsify or accept the reasoning and hypotheses formed in the past as confirmed knowledge. This is consistent with the paradigm of modeling[24] and allows to determine the level of prediction reliability. The forecast may therefore reach the acceptable level of truth after time t. Unfortunately, at time t_0 of its formulation, we had to deal with World A, and at the time of the measurement – with another World B. Hence the axiological evaluation of the measured results taking the context into account limits the concept of prognostic truth to the level of **probable truth** in the pragmatic sense. This eliminates the possibility of considering a certain truth predicate as a requisite belonging to even the best scientific forecast. It does not exclude optimizing the conditional truth and in this way achieving a highly probable truth (i.e. acceptable truth). Such an optimized conditional truth may be regarded as **possible truth** in the given context and time. Starting from the initially assumed position of a philosophically reasoning, rational probabilist, we may accept the following statements legitimizing the possible truth of strategic forecasts.

A scientific forecast approximates the proven truth about state X of the system after time t, and the set of hypotheses {S} at the time of its formulation t_0 *is a set of highly probable truths which are verifiable by a set of certificates {E} available at time* t_0 *and after time t, where the*

[23] Laudan L., „The Demise of Demarcation Problem" [in] „Physics, Philosophy and Psychoanalysis. Essays in Honor of Adolf Grunbaum", R.S. Cohen [Ed]., D. Reidel Publishers Company, Dordrecht, 1983

[24] Hertz H., "Principles of Mechanics". (1894) [tr.] D. E. Jones and J. T. Walley. New York: Dover, 1956.

system of hypotheses {S} is a system of conditional and possible truths if:

a. *it is internally consistent,*
b. *remains in agreement with non-empty set {E} of certificates available at time t_0 and t, and is weakly variable in time,*
c. *there are no known conflicts within set {S}, and between a given S and related certificate E at the time of formulating strategy t_0.*

Such a limited system of good predictive heuristics can be considered the possible and acceptable truth. Any other interpretation of truth requires a full epistemological analysis and the adoption of a relevant inference position and definition of truth.

3 Methodology

It is one thing to define strategic forecasts, and quite another to have a method by which under favorable conditions it will be possible to construct objectively the best prognosis. Finding the optimal concept of a strategic forecast is the crucial question in the methodology of strategy formation. Proceeding from the scientific strategic forecast concept presented above as a knowledge resource with an established epistemology, the methodology brings additional know-how, which is in this case the best solution and will provide a way for the strategist to select the best practices. *Epistemology states that the best methodological solution exists and it is the one with the highest probability of obtaining the assumed result*. It does not state how to achieve it, though. Hence, the methodology is crucial in creating a model of the scientific forecast at the conceptual level, because only at this level of abstraction, on the borderline of the layers of logical reasoning of methodology, can we consider a physical occurrence of ontology known as the scientific strategic forecast.

Since any model of forecasts at the methodological level refers to the concept (ontological model), therefore it does not require any quantification features, but it can determine the direction of searching the objective function, which should be a necessary procedure in the construction of any scientific forecasts. Observations of the implemented models of strategies and the described case studies indicate that the principles of a good scientific forecast should neither be too rigid nor too epistemologically dogmatic in the methodological sense.

A scientific forecast at the methodology level is a model related to a particular subject for future strategic actions, which becomes an **acceptable model for knowledge transfer** to that entity. Thus, in addition to the logical design of know-how, methodology should develop an effective transfer of knowledge, taking into account the information context. This aspect explains the existence of a number of strategic schools which, in relation to a particular case, are to ensure an easy absorption and fitting future interaction to the context (surroundings) and specific objective, in particular to ensure that the implementing engineer has clear and acceptable measurement tools, assessment tools, as well as an axiological and experimental verification at the operational level.

3.1 The measurement and the objective function

Once we know how to form criteria and are aware of the principles of the construction of measurement, the methodology should answer the question: how to measure? It also refers directly to the rational method of formulating objectives. In general, it is clear that the strategic objective of the scientific prognosis should:

1. be consistent,
2. be impartial in relation to the measure and measurement,
3. be possible to achieve,
4. give optimization guidance in choosing the best solutions,
5. contain ideas of the pursuit of the truth about the state of the system in future periods.

The adoption of these principles will guarantee that the engineer implementing a strategy will receive a useful tool for steering the system, with the highest possible degree of confirmation in the future. Thus, formulating the goal, the methodology is to provide tools for an optimized selection of a forecast type and to identify the best methodological practices for its implementation in a particular case. When formulating the strategic hypotheses, we should use the ones which are more confirmable than those of a weak factual basis of the current time. At this point, the following rationale may support the issue:

1. **Historical foundation**. In the past, well-confirmed hypotheses were a better basis for making rational decisions in practice, resulting in a greater proportion of the achievement of good results in forecasts than in the case of weakly confirmed hypotheses.
2. **The principle of rational choice**. From among the many possible ones, the procedure to choose should assume a successful outcome which requires minor adjustments to the strategy in the future.
3. **The principle of confirmation**. Only those hypotheses which are possible to confirm experimentally with an appropriately high probability in the future are regarded a rational choice.

In this way, the question of "blue emeralds" outlined above cannot reasonably be regarded as a problem of good heuristics and prediction of the future.

Methodology not only defines how to form a forecast, but it also describes the best practices, i.e. how to apply it. It offers procedures, standards, benchmarks, analytical and computational methods. A strategic forecaster receives a template of the model of the prognosis as an ordered scope of knowledge, allowing for a presentation of results of the analysis, methods of quantification and graphic elements. A number of books and papers dealing with this issue have been written[6,7]. However, they all stem from the methodological approach to management and are not based on the philosophy of science in laying the foundations of strategic forecasts. Does this mean that the existing methods of forecasting are wrong? Not necessarily, but from the perspective of rational probabilism they are hypotheses with a lower level of confirmation than those based on a rigid logical frame, such as the LFA[8].

Example 5: The LFA procedure consists of nine steps outlined below. Project planning (i.e. creation of forecasts, strategies, feasibility studies, etc.) must refer to each of them. In addition, during the whole life cycle of the project, all the nine steps may be updated, mostly by successive approximations. Hence, the LFA method is not a linear process. If the project is already at the implementation stage, the LFA method can still be used, but some of the steps may lose their importance then.

1. Analysis of the context of the project,
2. Analysis of the participants in the process
3. Analysis of the problems to solve
4. Analysis of the objectives of the project
5. Actions leading to implementation
6. Resources available in the process
7. Outcome indicators and quantifiers
8. Risk analysis and risk management
9. External conditions and constraints

The LFA method is not focused on actions that we perform and the resources necessary for their implementation. Its procedures begin with finding an answer to the question what we want to achieve through the implementation of the project. Thus, LFA is object-oriented and based on problems necessary to solve by means of operational activities (projects). This is the best example of a methodology in building a structured document or forecast. It is therefore not surprising that the LFA method is *de facto* a standard procedure in planning and designing documentation relating to the financing of investment projects under the EU Structural Funds.

The methodology introduces not only formal procedures, but above all the methods adopted from other fields of knowledge to strategic forecasting, e.g. strategic analyses like SWOT and PEST, measurement methods such as the multi-criteria analysis, methods of metric spaces, simulation and optimization formalisms, e.g. the calculus of variations, linear programming, the Monte Carlo method[25], etc.

The methodology allows to build a semantic representation of strategic objectives, represented by the objective function. It does not matter if the objective function was the set of scalar quantifiers to achieve, or any function of many variables, or a linear operator in the vector space – the methodology makes it possible to interpret the obtained result or measurement values. An example of this issue is economic growth, measured by the change in EBITDA[26] along time. It is well known how to count the EBITDA, how to interpret its calculated value. What is more, this indicator is so embedded in economic research that it does not seem to go out of use even in the medium range of strategic planning. Similarly, one can consider the use of a standard presentation of the strategy in the form of Ansoff's matrix[27].

Information about available methods of measurement are the feedback for methodology level of strategic modeling, introducing appropriate restrictions, formal or technical feasibility and quantification of the objective function, which consequently allows to create a better semantic representation of the strategic goal. The task of the methodology at this point is identifying the best objective function, corresponding to the concepts included in the existing recommendations. This function must by definition lead to a measurable effect, otherwise the concept of measurement is not feasible.

In conclusion, methodology is the most important part in creating a physical image of scientific forecasts. It provides a template of practical procedures, supported by the epistemological approach and best practices. An engineer creating a commissioned prognostic document does not necessarily carry out epistemological analyses. Using well-defined know-how at the methodical level, he will receive both a good model for a particular real system, as well as a good template. Such a procedure can be observed while creating strategic forecasts of sustainable development, as recommended by the UE.

4.2 Quantification in the strategic forecast

One of the most important aspects in forecast methodology is the strategic issue of the way to calculate the objective function. The problem which is directly related to it is the quantification of results and measure of interactions. Contrary to the methodological aspects, where the model of strategic forecast concerns the ontological or at most functional level of abstraction, at the level of methodology we deal with the construction of a semantic model and numerical representation. The results of the implementation of strategic forecasts are usually observable changes that can be measured or quantified. These changes can be divided into:

- results related to the subject of the forecast,
- interactions associated with changes in the surroundings.

The possibility of delineating the objective function for quantification purposes is associated with the model of deterministic description of the present and future of the state of the system, which by definition cannot be accepted as an appropriate approach to forecasting because the simplification is too drastic. If we assumed a fully deterministic model of the forecasts, then writing the strategy would be pointless as the observer *a priori* knows its results after some time. Also, the full stochastic nature of the forecasting phenomenon does not make sense strategically, because nothing will be possible to predict after time t. Hence, any metaphorical approaches, referring to stochastic events (chaos, disaster, etc.) are not taken into account when creating a scientific forecast, remaining outside the line of demarcation. The probabilistic approach, however, allows for reasoning by analogy, which encourages the search for models of behavior derived from natural sciences – mathematics and IT[28] – expanding computing possibilities and quantification. However, any analogy is based on the proven similarity of

[25] Anderson D.R., Sweeney D.J., Williams T.A., "An Introduction to Management Science. Quantitative Approaches to Decision Making", 6th Edition, West Publishing Company, St. Paul, 1991.
[26] Earn Before Income Tax, Depreciation and Amortization.
[27] Ansoff, I. H., "Critical Evaluations in Business and Management", Edited by J. Wood; M. C. Wood, Taylor & Francis, London, 2007
[28] Gospodarek T., „Physicalistic Reasoning in Management Science", Acta Physica Polonica A, vol. 117 No. 4, 333-343, 2010.

selected features between the entities, and the reasoning applies to hypotheses regarding the absence of a specific predicate in one of the analogues, while it occurs in the second. Yet, proponents of bold strategic hypotheses usually fail to examine these facts. Therefore, the strict epistemology of a scientific strategy allows to take into consideration some defects of inference at the conceptual level with positive effects at the semantic level.

Example 6: It is a common practice in creating strategic forecasts to quantify the outcome and long-term impact by means of established indicators. It is particularly well exposed in all the strategies suggested by the European Commission for the regional development programs supported by EU funds, particularly the ERDF. Some simple indicators that are possible to measure are chosen as quantifiers, e.g. the number of newly created jobs, the number of visitors, the number of people with access to running water, etc. It is a good idea to have a look at the way such indicators are designed, known as the SMART method[29]:

- Specific (concrete) – isn't the goal too generally formulated?
- Measurable – is it possible to measure the quantifiers?
- Achievable – is the goal possible to reach?
- Realistic – is the objective achievable within the prescribed period?
- Timed (time restricted) – is the objective defined in time?

A certain epistemological order and the principle of confirmation are features of the above-presented set of quantifiers, as well as a will to acquire the truth which is possible to achieve within the time of measurement. That is the essence of quantification, which has a very strong philosophical support.

4.3 Axiological evaluation of the prognosis

What does the term "a good prognosis" mean? The way this concept is understood will be different for various stakeholders, namely:

- from the perspective of an internal observer (entity-related observer), a good forecast is the forecast confirmed experimentally in the largest possible percentage, and which has not required any significant changes in time,
- for an external observer belonging to the context, a good forecast for the company is a forecast which allows to perceive changes in the surroundings resulting from its implementation, e.g. achieving a better market position, a spectacular success in innovation, new products or services, increasing the volume of exchanges, etc.,
- for a supervisor or neutral observer, a good strategic forecast is one which allows to achieve the highest possible probabilistic truth. A scientific forecasts based on good heuristics described earlier fits this criterion best.

There are no universal quantifiers for an axiological evaluation of strategic forecasts.

The construction of a scale, or more properly – setting the good/bad switch point – is not easy to establish if the criteria for rationality must be held, and in addition they may vary over time. Methodologically, the most useful method of obtaining axiological thresholds is the multi-criteria analysis offering the vector approach to measurement definition. Then the problem is reduced to determining the assessment categories changing the measure vector and weighting the significance for each category. However, a less advanced measure with a higher level of subjectivity may be used, especially in the case of conceptual-level prognoses with a lower importance of quantification.

5 Conclusions

Concluding this work, it is worth mentioning that there are many possible ways to determine the strategic forecast by the philosophy of science, resulting from the application of different epistemological positions, and all of them may be perfectly correct. The rational probabilist position assumed here allows to define a scientific strategic forecasts as a fixed scope of probable knowledge of

[29] Miller, Arthur F. & Cunningham, James A "How to avoid costly job mismatches" Management Review, Nov 1981, Volume 70 Issue 11.

the future time about the entity with an established epistemology. Hence the final shape of the physical representation of the forecast is the semantic model supported by reasoning at the level of numeric and syntactical interoperationability. This means that it is impossible to create physically a numerical representation of the forecast at the methodological or ontological level of reasoning, where one can only receive the conceptual framework.

The scientific strategic forecast approximates the proven truth about the state of a subjective system after time t, and the set of hypotheses at time t_0 of the formulation of the forecast is always a set of highly probable truths verifiable by a set of data available at this moment, which are validated certificates. The axiological assessment of the forecast is always measurable by the methods defined at the methodological layer of the model.

All the "schools of strategy" described in literature are related to a methodological layer of the discussed model, regardless of the epistemological base. They can offer a complete scientific forecast, as long as the principles of good heuristics in formulating hypotheses and a suitable measure as well as the objective function are defined. The introduced simplifications of the subject system description by a finite number of variables do not decrease the value of the cognitive predictions. A condition is replacing the requirement of obtaining a certain knowledge in favour of probable. Estimating the *ceteris paribus* remains the most important problem.

Choosing possible scientific criteria, it is important to follow the criterion of the most probable and confirmed hypotheses and a minimum probability of changes of the prognosis after time t. This means the choice of the most accurate forecast for a given case. Hence it is so important to choose easily measurable time-dependent predicates of the prognosis, where the "SMART" method is a good example. This affects the shape of the objective function and its semantic and syntactic representations.

Although when applying the epistemological criteria, the emerging strategy does not fit the categories of a scientific forecast, while the real options approach does, this does not mean that creating a strategic forecast for a given case, the time self-consistent approach may be neglected, as it does not meet the predictability of the objective function. It is not stated anywhere, and neither is it in this paper, that the only scientific approach is an accurate forecast. It is only better justified for time $t_{0,}$ with the future still remaining uncertain. The approach presented in this paper epistemologically organizes a certain area of knowledge and allows to create projections based on the best current knowledge available, the choice of better heuristics and measurement methods. It also shows the most rational choice as a general principle.

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