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THE PROCESS OF SELECTION OF THE MAIN RESEARCH METHODS IN FORESIGHT FROM DIFFERENT PERSPECTIVES

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Abstract. When making research tasks in every field of science is essential to have the conviction that the selected research methods and procedures are reasonable applied, that is, one that effectively lead to the realization of the defined tasks. The set of methods that can be used in foresight projects (future studies) is very rich and, due to the dynamics of foresight, is still open. This article presents a synthetic set of guidelines for the choice of methods for exploring the future, paying attention to the very important fact that the rules of effective methodical conduction, due to its complexity, are often not clearly defined. Depending on the context, functions, stages, types, classes of foresight methods can be used in different ways, which also complicates the creation of optimum model. The article shows that this problem – under certain conditions – can be effectively minimized. The article analyzes the current (shown in the future science literature) approaches, principles, assumptions associated with the selection of foresight research methods.

Keywords: research method, context of foresight, future studies, stages of research.

JEL Classification: O20, O21, O32, O33.

1. Introduction

Nowadays, one of the most popular tools for planning, creation a vision, and management of strategic changes in both the global as well as local level, is foresight (Jemala 2010). Its idea is based on a systematic multi-dimensional creations long-term future (Gudanowska 2011).

Foresight is relatively difficult to clearly definable. In contrast to traditional forecasting, which often do fail to predict the future in turbulent times (Nazarko, Kononiuk 2013), it creates a platform for developing the science of the future. R. Slaughter defines foresight as a universal human ability that allows to think ahead, to model, create and respond to eventualities in the future. It is based on a extensive, integrated and complex system of thought, supporting human perception (Hideg 2007). This is all the

more valuable that as noted by Zavadskas and Turskis (Zavadskas, Turskis 2010), "in many real-world decisionproblems a decision-maker has a set of multiple conflicting objectives".

"Futures research aims at systematically exploring, predicting and/or explaining future developments with the means of different methods and techniques. Thus, it supports organizations (i.e. companies', regions, etc.) efforts to sense change and adapt or renew accordingly. In this context, the application of futures research methods can serve various goals such as testing strategies, or identifying new fields (i.e. business) or new policy issues" (Duin *et al.* 2014).

In the context of the article is subject, we can say that foresight using research methods (participative, transparent, forwardlooking) (Havas *et al*. 2010) derived from different fields of science, creates a platform for developing the science of the future. Due to the high complexity of foresight the process of selection of "appropriate methods" has many gaps, which according to the author can effectively supplement, which is proved in this article.

2. Assumptions concerning foresight research process

A set of methods that can be used in these programs is very extensive and because of the dynamics of foresight it is still open. The author has identified a rich list of 116 methods that can be used in foresigh programs (Magruk 2011).

Literature does not present simple rules concerning the choice of suitable methods for research. Depending on the function and context of foresight, methods can be used in different ways (Nazarko, Ejdys 2011) which complicates creation of an optimal workflow (UNIDO 2008).

Several years of direct observation and literature analysis helped the author of this article to identify several important conclusions and assumptions concerning foresight research process:

- the selection of foresight methods is a complex, multifactorial process, but often unsystematic and incoherent process based solely on intuition (Markley 1988), and sometimes also on inexperience and irresponsibility of practitioners and promoters (Popper 2008b);
- in foresight studies there is no single best method by which we can resolve the research problem (Slaughter 2004);
- foresight research methods are selected mainly on the basis of their internal attributes (eg. quantitative-qualitative) (Elena *et al.* 2008);
- there are many sources of literature on the use of various research methods, but relatively little has been written about their efficient selection (Elena *et al.* 2008);
- appearing in the literature analysis and typological classification is often not taken into account a wide range of foresight research methods. Only a few authors of

the study involved more than four classes/types. Additionally, in some cases, definition of typology is confused or equated with the definition of the classification. It is important, therefore, to find ways to facilitate the selection of research methods foresight.

3. Aspects influencing the selection of the main foresight research methods – gneral view

In most cases (including foresight) some disciplines adopt common methodological assumptions, exploit of research results from related disciplines, and only in appropriate cases, develop a separate method only for the specific discipline (Chrisidu-Budnik *et al.* 2005).

The main purpose of foresight, which can be expressed as exploring the future through its targeted building, is carried out by using a variety of tools and research methods.

T. Kotarbiński pays particular attention to the systematic nature of the method and the need for its modification and adaptation to a situation or problem that is under consideration. According to the author of this article, in the case of foresight methods such features as repetition, regularity and adaptation to a given problem are of a special nature. Other important features of the research methods are: intelligibility, clarity, advisability, efficiency and reliability (Apanowicz 2003). In the case of foresight methods only clarity rule – that excludes the flexibility to use different ways and procedures – it is not always maintained. Some methods (for example, a scenario method, delphi, wild card, etc.), despite the well-established principles of application, allow for flexibility and modifications.

Very important feature of the foresight research method is the possibility of resorting to practical knowledge – based on experience and intuition of experts involved in the study.

M. Alexandrova, D. Marinova, D. Tchonkova, M. Keenan, R. Popper and A. Havas emphasized that the method of foresight (as in other research (Apanowicz 2000)) should always be selected after determining the aim of research, but never vice versa (Alexandrova *et al.* 2007; Popper 2008a, 2008b). Only after the identification of phenomena, questions and hypotheses, the relationship between them can proceed to the selection of methods, research tools, indicators (Nowak 2006).

For example, method-oriented communication and use informal sources of information are relevant when we examine the dynamic and rapidly changing areas. In addition, motivational and coordination function of these methods allow to overcome organizational barriers and personal (Reger 2001).

Linear presentation of the future, for instance, by extrapolating trends may be useful, only on restricted and solid conditions or in combination with a more dynamic methods. In foresight, there are methods that allow for ambiguity, and those that are sensitive to the initial or new conditions. The foresight nonlinear systems thinking is critical, because even a small event in one place can cause problems in another, because of the sensitivity of the system to new initial conditions. It is important to note that the use of models, research methods in new, unconventional way can become a source of innovation. According to M. Aaltonen and T. I. Sanders for the effective application of foresight research methods it is necessary to understand several guidelines (Aaltonen, Sanders 2006):

- in-depth understanding of research methods, which is the starting point for a successful foresight process;
- the use of a single method is the wrong approach; just thought a combination of different, even contradictory techniques can give proper results;
- mathematical and system engineering methods should be applied in the initial phases of research foresight. In fact, every foresight should be based on knowledge of the largest possible number of sources of information. Foresight projects should end by methods emphasizing the social context;
- major in research foresight is to treat the future as a factor having an impact on what is new, and not as a factor which is a continuation of the past.

Referring to the T. J. Gordon and J. C. Glenn (Gordon, Glenn 2004) research, below are presented some important rules that must be taken into account in studies of foresight:

- accuracy and precision are two distinct concepts. Quantitative forecasts can be very precise, but quite inaccurate. On the other hand, the forecast may be accurate, but imprecise;
- future relied only on research extrapolation will certainly be flawed;
- each typical forecasting is incomplete, because there will never be a complete understanding of all phenomena in the world. Many undiscovered phenomena is not based on precedents;
- due to the inaccuracy and incompleteness, the planning must be a dynamic process, based on ongoing scanning of new ideas, the development of new trends and opportunities for the future;
- the future depends on the opportunity; changes often irrelevant in the initial phase can turn into phenomena that dominate the tested field;
- many methods should be assisted by determination of the likelihood of future events;
- accurate forecasts of some complex and non-linear systems can be impossible.

M. Alexandrova, D. Marinova, D Tchonkova, M. Keenan, R. Popper and A. Havas formulated three important assumptions for to the selection of appropriate methods (Alexandrova *et al.* 2007):

- a list of methods that can be used in foresight research should be the fullest;
- have knowledge about the characteristics of each method, it is crucial to understand the features of each of them;

- one should set criteria that will allow the selection of appropriate methods and rejection of other techniques.

In general meaning, the choice of methods should be subordinated primarily to issues of the study. It is harmful phenomena when methods dominate over the research issue (Nowak 2006). According to J. Apanowicz, research methods should be properly "tailored" to the specific nature of the object of study, the characteristics and complexity of the phenomenon and its diagnostic features (Apanowicz 2000).

4. Typology and classification of research foresight methods

This section has been made to systematize the typology and classification of research foresight methods. According to the author this brief characteristics, on the one hand complements descriptions in the previous section, as well as synthesizes guidelines for building effective research foresight methodologies.

Table 1 shows a summary list of the existing typologies and classifications of method used in future studies.

J. C. Glenn, T. J. Gordon are one of the first authors who have made a thorough analysis of methods used in the future studies (Gordon, Glenn 2004).

The UNIDO handbook characterizes two classifications. First, by I. Miles and M. Keenan, includes 13 methods and 4 classes (Cariola 2007; UNIDO 2008). The second classification of G. May includes 40 methods and is divided into 3 classes: I. Foreseeing: II. Managing and III. Creating. The starting point in the foreseeing is the present (or past), which takes anticipation of a possible or probable future (UNIDO 2008). The methods of management group are focused on management of changes and strategic crisis. These methods are often based on the identification of new peripheral trends, weak signals or tsunami of change (May 2009). Creating is based on the normative methods and assumes that the future does not exist, but can be invented and developed (UNIDO 2008).

In addition, in the UNIDO handbook we can find two types of methods - focusing on the product and focus on the process. The first group of methods allows generate of formal results as e.g. scenarios, key technologies, etc. Methods focused on the process allows to look at the foresight problem in several stages, facilitating the continuation of the program after its finish and creation of sustainable networks between participants of foresight studies (UNIDO 2008).

M. Aaltonen, T. I. Sanders, referring to the research of J. C. Glenn and T. J. Gordon created a typology consisting of 29 methods in four areas as combination of four dimensions called perspectives: mathematical, social, engineering and system. Methods of engineering and system groups are used for a long time, with a strong grounding for example in strategic management. Mathematical methods based on complex adaptive systems are still not very common in future studies. Together with the methods

Table 1. Typologies and classifications of research foresight methods in foresight literature (source: created by the author)

Authors	[T]-TYPOLOGY [C]-CLASSIFICATION: NAMES OF TYPES/ CLASSES (references)
T. J. Gordon, J. C. Glenn	[T]: 1) Collect judgments Genius, 2) Forecast time series, and other quantitative measures, 3) Understand the linkages between events, trends, and actions, 4) Determine a course of action in the presence of uncertainty, 5) Portray alternate plausible futures, 6) Reach an understanding if the future is improving 7) Track changes and assumptions, 8) Determine system stability, 9) Quantitative, 10) Qualitative, 11) Normative, 12) Exploratory (Gordon, Glenn 2004)
I. Miles, M. Keenan	[C]: 1) Identifying Issues, 2) Extrapolative Approaches, 3) Creative Approaches, 4) Prioritization (UNIDO 2008)
G. May	[C]: I. Foreseeing: 1) Prediction; 2) Extrapolation; 3) Analytical forecasting; II. Managing: 1) Judgemental; 2) Forecasting; 3) Management), III. Creating: 1) Policy-making; 2) Speculation; 3) Imaging (UNIDO 2008)
UNIDO	[T]: 1) Concentration on product, 2) Concentration on process (UNIDO 2008)
M. Aaltonen, T. I.Sanders	[T]: 1) Mathematical, 2) Social, 3) Engineering, 4) System (Aaltonen, Sanders 2006)
O. Saritas	[T]: 1) Understanding, 2) Synthesis&Model, 3) Analysis&Selection, 4) Transformation, 5) Action (Elena *et. al.* 2008)
I. Miles, R. Popper	[T]: 1) Pre-foresight, 2) Recruitment, 3) Generation, 4) Action, 5) Reneewal (Popper 2008b)
R. Popper	[C]: 1) Quantitative, 2) Semi- Quantitative, 3) Qualitative (Popper 2008b)
R. Popper, D. Loveridge	[T]: 1) Creativity, 2) Interaction, 3) Evidence, 4) Expertise (Popper 2008b)
R. Popper	[C]: 1) Bottom-up, 2) Top-down (Popper 2008b)
EUFORIA project	[T]: 1) Based on virtual environment, 2) Based on real environment, 3) Soft (qualitative), 4) Hard (quantitative), 5) Based on expert judgements, 6) Analytical, 7) Bottom-up, 8) Top-down (Popper, Korte 2004)
R. Slaughter	[C]: 1) Input methods, 2) Analytic methods, 3) Paradigmatic methods, 4) Iterative and exploratory methods (Slaughter 1997)
K. Borodako	[C]: 1) Strategic, 2) Forecasting, 3) Futuristic (Borodako 2009)
FOREN	[C]: 1) Methods that are based on eliciting expert knowledge to develop long-term strategies, 2) Quantitative methods that make use of statistics and other data, 3) Methods to identify key points of action todetermine planning strategies (Miles, Keenan 2001)
F.Tilley i T. Fuller, S. Inayatullah	[C]: 1) Predictive, 2) Cultural, 3) Critical (Tilley, Fuller 2000)
K. Cuhls, K. Blind, H. Grupp	[C]: 1) Cognitive, 2) Statistical and econometric, 3) Structural and causal (Cuhls et al. 2002)
A. L. Porter	[T]: 1) Creativity, 2) Descriptive and matrices, 3) Statistical, 4) Expert opinion, 5) Monitoring and intelligence, 6) Modeling and simulation, 7) Scenarios, 8) Trend analyses, 9) Valuing/decision/economic, 10) Hard (quantitative), 11) Soft (qualitative), 12) Exploratory, 13) Normative, 14)Roadmapping, 15) Combinations (Porter 2010)
J. Voros	[C]: 1) Evolutionary, 2) Revolutionary (Voros 2006)
A. Magruk (Magruk 2011)	[C]: 1) consultative, 2) creative, 3) prescriptive, 4) multicriterial, 5) radar, 6) simulation, 7) diagnostic, 8) analytical, 9) survey, 10) strategic

emphasizing the social aspect create a complementary picture of the emerging future (Aaltonen, Sanders 2006).

O. Saritas divided 32 foresight research methods into five types according to key stages of systemic foresight: understanding, synthesis and model, analysis and selection, transformation, actions (Elena *et al.* 2008).

R. Popper and I. Miles made the typological distribution foresight research methods in-debt criterion, which are the stages of foresight: pre-foresight, recruitment, generation, action, reneewal. Another, well known among practitioners of foresight, the R. Popper's typological distribution of methods (relating to the classification of quantitative, indirect and qualitative methods) is foresight diamond, comprising four dimensions: creativity, interaction, evidence, expertise (Popper 2008b). According to R. Popper, proper design of foresight research methodology should include the use of at least one method of each dimension of diamond (Popper 2008a). According to the author of this article, R. Popper's approach is correct, but incomplete. Many methods are not clearly assigned to specific poles of the diamond. This fact can create big problems – especially for new practitioners of foresight – in the process of construction of research methodology.

Another classification is composed of two groups: bottom-up and top-down. Practitioners emphasize the importance of foresight methods from the bottom-up group, based on the participation of a wide range of stakeholders (not only expert) with different backgrounds. In this approach, the prevailing view that more important than the final results are research process, social participation and debate. In a study of top-down central role is played by the experts. Most results (both fragmentary as well as the final) are based on their opinions (Popper 2008b).

International project EUFORIA let distinguish 4 original types of methods. Methods based on the virtual environment used digital tools (eg. Internet network) are recommended in case of complicated calculations and the need for systemic look at the issue. Methods based on the work in a real environment, force personal contact of foresight stakeholders, which affects the speed-up the final results. Methods based on the intuition of experts (heuristic) generate original ideas and solutions. Analytical methods use of readily available knowledge as evidence, statistics, analysis, allowing appoint vision and development priorities (Popper, Korte 2004).

R. Slaughter made a classification of twelve methods due to the 4 functions. Input methods accumulate the knowledge needed in the organization of the entire research process. Analytical methods are the main in the research process and are often used in combination with other methods. Paradigmatic methods are those that treat studied objects in a systemic way using a holistic vision of the world. Iterative methods allow for substantive determining the future and development of strategies (Slaughter 1997)

K. Borodako (using research of F. Tilley and T. Fuller) distinguishes three groups: strategic methods (which create scenarios), forecasting methods (extrapolating future) and a futuristic methods (based on the narrative of alternative futures) (Borodako 2009).

F. Tilley and T. Fuller identify three classes of foresight methods: predictive, cultural, critical. The first group is identical to the explorative methods. The aim of cultural method is understanding (insight) of research problem and the treatment of language and cultural aspects as important in the process of creation of reality. The aim of the critical methods is to find ways of uniting sophisticated analyses (Tilley, Fuller 2000).

K. Cuhls, K. Blind, H. Grupp distinguished 3 classes of foresight 30 research methods: cognitive (large and small scale), statistical and econometric (extrapolative, econometric, facilitating decision making), structural and causal (scenario, simulation, evaluation) (Cuhls *et al.* 2002).

According to A. L. Porter creative methods allow to generate of novel approaches. The descriptive and matrix approach facilitates the interpretation of the examined information. Monitoring and intelligence methods outline and profiles the available information. Scenario methods combine multi-shots in order to build alternative futures. Methods of time trends analysis are used to projection into the future. Valuing/decision/economic methods support estimation of certain activities (for example political). Roadmapping methods inform and assist the planning of development of science and technology. Combined methods integrate various research tools in order to develop the perspective of a better future (Porter 2010).

Among the prospective methods, J. Voros distinguishes two classes of methods. In the evolutionary methods starting point is the present time, which occurs relatively stable, predictable and reliable development. Revolutionary methods focus on a distant, hard predictable future, based on emergency events, not necessarily connected with the present. These methods are often characterized by sudden, a different point of view (Voros 2006).

Despite the fact that some typological and classification approaches are very popular in literature, in the opinion of the author of this article, they have many limitations. The new classification (Table 2) of A. Magruk (Magruk 2011) takes into account all the characteristics of existing typologies and classifications enriching them many other features. The homogeneous distribution to 10 separate classes appears to be more complete, so that the selection of methods seems to be easier.

5. Selection of foresight research methods according to the context of research, stages and the author's classification

In present chapter author of the article referred to a study JW Creswell (for F. Boardman), the investigator combining quantitative and qualitative methods, which states that in the process of combination of research methods answer the following key questions (Boardman 2012):

– In what order the collected qualitative and quantitative data will be implemented to research?

– What relative priority will be given to the collection and analysis of qualitative and quantitative data?
– At what stage of the project qualitative and quantitative data will be integrated?

The first question can strictly refer to the stages of the foresight process. The author has analyzed the potential application of the methods of the class (Table 2) of selected research phase of foresight. The second question is related to the selected contexts foresight studies. In this case, these are the contexts of technological, social, and cognitive (Nazarko 2013). Priorities are reflected by the strength of ties methods with particular contexts (Table 3). The third question corresponds directly with the stages of research foresight and indirectly from the author's classes.

Determined research context of and the selection of appropriate methods are highly interdependent of each other. They also have a direct relationship with the stages of foresight process.

Table 2. Classification of technology foresight research methods (source: created by the author)

Innovative classes	Methods belonging to each class
CONSULTATIVE	Voting, Polling, Survey, Interviews, Expert Panels, Essays, Conferences, Workshops, Citizen Panels, Brainstorming
CREATIVE	Wild Cards, Weak Signals, Mindmap., Lateral Thinking, Futures Wheel, Role Play, Business Wargaming, Synectics, Speculative Writing, Visualization, Metaphors, Assumption Reversal
PRESCRIPTIVE	Relevance Trees, Morphological Analysis, Rich Pictures, Divergence Mapping, Coates and Jarratt, Future Mapping, Backcasting, SRI Matrix, Science Fiction Analysis, Incasting, Genius Forecasting, Futures Biographies, TRIZ, Future History, Alternative History
MULTICRITERIAL	Key Technologies, Source Data Analysis, Migration Anal., Shift-Share Anal., DEA, Factor Anal., Correspondence Anal., Cluster Anal., Sensitivity Anal., AHP, Input-Output Anal., Priorization, SMART, PRIME, MCDM
RADAR	Scientometrics, Webometrics, Patent Analysis, Bibliometrics, Technological Substitution, S-Curve Anal Technology Mapping, Analogies
SIMULATION	Probability Trees, Trend Extrapolation, Long Wave Anal., Indicators, Stochastic Forecast, Classification Trees, Modeling and Simulation, System Dynamics, Agent Modeling
DIAGNOSTIC	Object Simulation, Force Field Anal., Word Diamond, SWOT, STEEPVL, Institutional Anal., DEGEST, Trial&Error, Requirement Anal., Theory of Constraint, Issue Management, ANKOT
ANALYTICAL	SOFI, Stakeholder Anal., Cross-Impact Anal., Trend Impact Anal., Structural Anal., Megatrend Anal., Critical Influence Anal., Tech. Barometer, Cost-Benefit Anal., Technology Scouting, Technology Watch, Sustainability Anal., Environmental Scanning, Content Analysis, FMEA, Risk Anal., Benchmarking
SURVEY	Web Research, Desk Research, Tech. Assessment, Social Network Anal., Literature Review, Retrospective Anal., Macrohistory, Back-View Mirror Anal
STRATEGIC	Technology Roadmapping, Tech. Positioning, Delphi, Scenarios, Social Impact Assessment, RPM, Technological Scanning, Multiple Perspectives Assessment, Causal Layered Analysis, MANOA, Action Learning

Table 3. The strength of relationship of classes with 3 contexts (source: created by the author)

CLASSES OF METHODS	CONTEXTS: TECHNOLOGICAL	SOCIAL	COGNITIVE
CONSULTATIVE	●	●●●	●●●
CREATIVE	●	●●	●●●
PRESCRIPTIVE	●●	●●	●●●
MULTICRITERIAL	●●	●●	●●
RADAR	●●●	●●	●●●
SIMULATION	●	●	●●●
DIAGNOSTIC	●●	●●	●●●
ANALYTICAL	●●●	●●●	●●●
SURVEY	●●	●●	●●
STRATEGIC	●●●	●●●	●●●

Power relation with classes and contexts
● - low or zero ●● - averge ●●● - very high

Methods relating to the technological sphere analyze in a strong degree of technological aspect. Using them can be implemented the following functions (Phaal *et al.* 2004): identification of key technologies, assessment of risks and opportunities of technology, analysis of technology in relation to the competition; vision for future, technology trends, identification, observation and analysis of new technologies, monitoring technology and the results of previous studies, identification of actions to be taken in order to develop the technology.

Methods referring to the social context are methods: testing (monitoring) social needs, analyzing expectations (and their dynamics) of different groups of potential customers, examining the structure of social change to enable active participation in creating a vision for the development of wide or narrow groups, examining the factors affecting social development, affecting the social networking (Borup *et al.* 2006; Martin 2010).

Cognitive aspect, referring both to the restorative and creative process. Especially in the context of technological development can be effectively implemented through the answers to the most important questions related to the management of technology: For what? What? How to? When? Who? What is the base/base? How to choose a course of action? How to do it? (Phaal *et al.* 2004).

The main criterion for determining the strength of the links of the method of the specific context of a set of individual characteristics associated with each method (Magruk 2011).

Foresight methods can be used in different phases of the research process. Referring to research R. Popper (Popper 2008a) (which presented an analysis of the usefulness of selected methods in different stages of foresight), author calculated the potential use of 116 methods in each of, identified by author, eight stages of foresight in the relation to the author's classification (Table 4). On the basis of this analysis has been made of the

Table 4. The strength of relationship of classes with steges of foresight process (source: created by the author)

		FORESIGHT STAGES							
		PRE	SCN	REC	GEN	PLN	ACG	EVL	REN
CLASSES OF METHODS	CONSULTATIVE	●●●●	●●●	●●●	●●●●	●●●	●●●	●●●	●●●●
	CREATIVE	●●	●●	●●	●●●●	●●●	●●●	●	●●
	PRESCRIPTIVE	●●●	●●●	●●	●●●●	●●●	●●●	●	●●
	MULTICRITERIAL	●●	●●●	●●	●●●	●●●	●●●	●●	●●
	RADAR	●●●	●●●●	●●	●●●	●●	●●	●●●	●●
	SIMULATION	●●	●●	●	●●●●	●●●	●●●	●●	●
	DIAGNOSTIC	●●●	●●●	●●	●●●	●●●	●●●	●●●●	●●
	ANALYTICAL	●●●	●●●●	●●	●●●●	●●●	●●●	●●●●	●●
	SURVEY	●●●●	●●●●	●●	●●●	●●●	●●	●●●	●●●
	STRATEGIC	●●●	●●●	●●	●●●●	●●●●	●●●●	●	●●

STAGES:
PRE – PRELIMINARY **SCN** – SCANNING **REC** – RECRUITMENT **GEN** – MAIN
PLN – PLANNING **ACG** – ACTING **EVL** – EVALUATIVE **REN** - RESUMING

Power relation with classes and stages
● - low or zero ●● - averge ●●● - high ●●●● - very high

synthetic measurement (using a weighted average) potential for the application of each class in each stage of the foresight research.

Author's study allowed to synthetic location of each class on specific thematic map that refers to the stages of foresight studies as well as three contexts: technological, social and cognitive (Fig. 1). This schematic approach, although simplistic, provides good basis for the implementation of the main goal of article, namely the development of methodology of designing hybrid systems integrating synergistic research methods, and thus to improve the methodological aspects of foresight.

Based on author's analysis we can draw general conclusion that each class creates a group of substitute methods to each other and complementary to the methods of other classes. Using the methods only form one class can lead to a situation in which the method will share related information resources, as well as to generate results in a similar way, without thereby affecting the desired synergy effect. The most favorable situation for foresight research methodology is selection of methods in each stage from the various classes with high-potential applications, with balanced reference to three contexts. In the opposite situation may occur the situation that each context will be stressed too weak. Or one context will be exposed too much in relation to the other, which involves a risk of domination by any discipline.

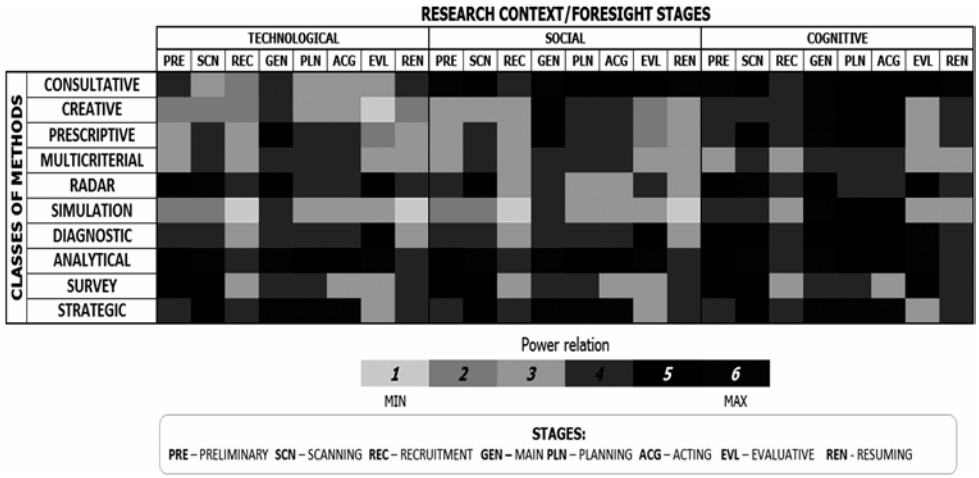

Fig. 1. The strength of relationship of classes with stages of the foresight process in 3 contexts (source: created by the author)

Referring to Figure 1, it can be concluded that it is particularly inappropriate to use methods only from consultative class due to very strong connection in social and cognitive contexts, through which there is a risk of insufficient emphasis technological sphere. A similar situation, with the possibility of dominance of subject in the cognitive context, can occur when we use in the main stage, most methods only from one class: creative, normative, multicriterial or simulation.

6. Theoretical effective selection of foresight methods

In order to verify the process of selection of appropriate foresight methods below is shown an example of obtaining a synergistic effect. For this purpose, was used as one hypothetical example (Fig. 2) illustrates the effective selection method that is based on strong appeal to the stages and the three main contexts of foresight.

Model preserves the balance between contexts: technological, social and cognitive. Methods belong to different classes, so that they remain complementary character. Synergistic effect may manifest itself as follows: 1) The relation among the first three methods is the subject of exchanging opinions (based on literature and patent review) by vide range of stakeholders at conferences/workshops; 2) Using next three methods we can create visionary image of the future, which is divided into fragments, which are more specific and easier to interpret. Evaluative i resuming stages it is difficult to analyze in the context of synergism due to their several years distance from fundamental research.

During designing the research methodology of foresight, it is important to remember that there are many ways of combining of research methods. For example, all possible combinations of six methods (it is the average number of methods used in global foresight projects) from the set of 33 methods is 1,107,568, the number of permutations in the

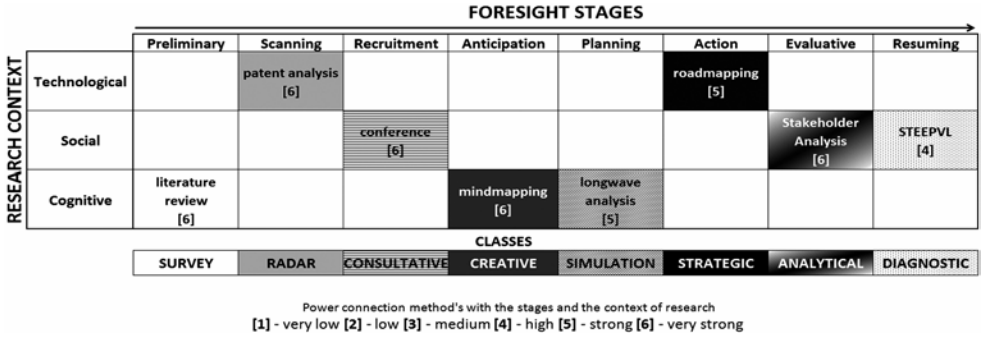

Fig. 2. An example of an effective selection of foresight research methods
(source: created by the author)

six methods is 720, so that all possible connections is about 800 million. Combining six methods (out of 116 methods identified by the author of this article) it will be received over 3 billion calls, which makes it impossible to determine one of the best combinations.

7. Conclusions

In author' opinion selection of adequate objective foresight research methods, eg. on the basis of the appropriate classification may affect, among other things, the following aspects identified by M. M. Aaltonen and T. I. Sanders (UNIDO 2008):

- make the foresight process more systematic;
- increase the intelligibility of the input materials and the results of the foresight process;
- create forums for interaction and communication between the actors of the system;
- assist in the visualization of the possible and/or desired future.

According to the author selected research methods should complement each other, so that their use in various stages of foresight gave the best results. A feature of these methods, depending on the competence of methodical foresight practicioners should both also be ease to implementation and the give ability to fully solve the research problem.

The analysis made in this article highlights the fact that the use of methods from only one group can deplete foresight study, because not have equal relevance of all aspects. According to the author the ability of classification of foresight methods may assist them in the design of a complementary selection, without limiting the flexibility of foresight.

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