Iceland Liechtenstein Norway grants

Foresight methodology

focused on application in the context of the future labor market

Foresight-oriented IT system supporting higher education and career development (FORhesIT)
EOG/21/K4/W/0118

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Introduction

This methodology was developed as part of the *IT system supporting higher education and career development using the foresight methodology (FORhesIT)* project, implemented in the EDUCATION program, with the financial support of the European Economic Area funds for 2014-2021[1].

The FORhesIT project is a continuation and development of the work of the *Future Horizons* project carried out in 2018-2020 as part of the DIALOG programme of the Minister of Science and Higher Education. The experience gathered by the Team at that time allowed us to propose new solutions to improve the competitiveness and effectiveness of the career guidance system and career planning processes using foresight methods.

The presented methodology is the result of the intellectual work of IO1 of the FORhesIT project *(Foresight methodologyfor future-oriented labor market),* whose primary goal is to implement an IT tool CREATE THE FUTURE[2], supporting the process of creating professional development scenarios by students and university graduates. We hope that it will be a practical tool for career counsellors and academic teachers to conduct future-oriented workshops and a tool for individual use for the analysis of individual career paths and personal development of students and university graduates.

The foresight methodology has been adapted to 2 levels – individual and group use by advisors and academic teachers. The methodology for group and individual use **in the context of the future labour market** includes the implementation of stages I-III. The methodology for individual use **in the context of career development** includes the implementation of stages I to IV.

The first stage concerns the analysis of trends and identification of factors affecting the selected area of analysis (e.g. labour market) in the selected time perspective. These can be social, technological, economic, ecological, political, legal and values-related factors. It also allows you to assess these factors in terms of their importance and uncertainty. The second stage involves the development of four scenarios for the future labour market (or other area), and the third stage involves the analysis of strengths and weaknesses, opportunities and threats related to the implementation of the selected development scenario. The fourth stage is dedicated to the development of an action plan necessary to achieve a specific professional goal in a selected career development scenario.

[1] The FORhesIT project benefits from funding to the value of EUR 148,620.00 received in 85% from Iceland, Liechtenstein and Norway under the EEA Funds and 15% from the national budget (Project No: EOG/21/K4/W/0118).

[2] Forecast date for making the tool available to all interested parties: January 2024.

1. Methods and the process of their selection in foresight research

Foresight projects are carried out using a variety of methods. These methods are both typically scientific and heuristic, i.e. based on the intuition of experts and stakeholders[3]. The best-known classification of methods in the literature was developed by R. Popper. It is referred to as the methodological diamond of foresight (Fig. 1). It includes four dimensions[4]:

- creativity – methods focused on creative thinking;
- expertise – methods focused on the skills and knowledge of experts in a given field;
- interaction – methods aimed at acquiring new knowledge with the involvement of a wide range of stakeholders;
- evidence – methods aimed at understanding the current state of the research area.

Figure 1. Futures methodological diamond
Source: *Futures Diamond*, https://www.futuresdiamond.com/the-diamond [12.04.2022].

The studied phenomenon or research object can be characterized by numerical parameters thanks to the use of quantitative methods. Complex and difficult to quantify phenomena can

[3] A. Magruk, E. Jańczuk, *Typologia i klasyfikacja metod badawczych foresightu technologicznego* [in:] J. Czech-Rogosz (eds.), *Koniunktura gospodarcza a reakcje podmiotów gospodarujących*, Wydawnictwo Akademii Ekonomicznej, Katowice 2009, p. 382.
[4] *Futures Diamond*, https://www.futuresdiamond.com/the-diamond [12.04.2022].

be described using qualitative methods. Thanks to the use of indirect methods, it is possible to present complex phenomena. R. Popper points out that an effective research methodology can be designed by selecting methods from each vertex of the methodological foresight diamond[5].

The most comprehensive and multi-context classification of methods was developed by A. Magruk. He noted that the available classifications often do not take into account a number of foresight research methods[6]. Therefore, he developed a classification based on phenetic analysis, presenting a common meaning ground of methods from a specific group and using similar research tools (Tab. 1).

Tab. 1. Classification of the foresight research methods

Class	Methods	Features
Consultative	voting, polling, survey, interviews, expert panels, essays, conferences, workshops, citizen panels, brainstorming	collecting and analyzing (possible at every stage of the research) opinions of the widest possible group of stakeholders (experts) on the researched area and related factors, particularly important in the social context
Creative	wild cards, weak signals, mindmapping, lateral thinking, futures wheel, role play, business wargaming, synectics, speculative writing, visualization, metaphors, assumption reverse	based on creativity, spontaneity, flexibility – addressed to a wide range of people – system analysis, outlining the vision of the examined reality and at the same time capturing the related consequences, e.g. economic, social
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	based on creativity, heuristics and defining development visions, a group of formalized expert methods closely related to anticipating the future
Multicriterial	key technologies, source data analysis, migration analysis, shift-share analysis, factor analysis, correspondence analysis, cluster analysis, sensitivity analysis, priorization, SMART, PRIME, AHP	measurement of mutual relations between a large group of variables and criteria characterizing the tested objects as well as classification and selection of alternatives for action, with a large number of decision criteria
Radar	scientometrics, webometrics, patent analysis, bibliometrics, technological substitution, life cycle analysis, technology mapping, analog forecasting	monitoring, detecting and analysing important signals and resulting opportunities and threats regarding the latest research and technological discoveries, potential innovations that may be related to the tested object
Simulation	probabilistic trees, trend extrapolation, long-term analysis, time series analysis, stochastic forecasting, classification trees, modeling and simulation, systems dynamics, agent modeling	analytical, using expert knowledge, based on statistical inference, working in a virtual environment, using the properties of synthesis and modeling, forecasting and simulation methods

[5] R. Popper, M. Keenan, I. Miles, M. Butter, G. Sainz, *Global Foresight Outlook 2007*, The European Foresight Monitoring Network 2007, p. 20.
[6] A. Magruk, *Innovative classification of technology foresight methods*, „Technological and Economic Development of Economy" 2011, vol. 17(4), pp. 700-716.

Class	Methods	Features
Diagnostic	object simulation, force field analysis, Word Diamond, SWOT, word diamond, SWOT, STEEPVL, institutional analysis, DEGEST, Trial&Error, needs analysis, constraint management, problem management, ANKOT	qualitative and quantitative system and strategic identification, assessment of the current state of the tested object and management of the development of the tested object, possible problems, limitations and related risks, using, among others, solutions from other systems, objects
Analytical	future index status, stakeholder analysis, critical impact analysis, trend impact analysis, structural analysis, megatrend analysis, cross impact analysis, technology barometer, profit & loss analysis, technology scouting, technology watch, sustainability analysis, environment scanning, content analysis, root cause analysis and effects of defects, risk analysis, comparative analysis according to the pat tern	objective, indirectly referring to the future, research on development trends, driving forces, variants of change, the structure of the studied reality, society, as well as potential stakeholders
Survey	web research, desk research, technology assessment, social network analysis, literature review, retrospective analysis, macrohistory, back-view mirror analysis, experience-based future	time-consuming review and evaluation of data on past activities, results in the analysed research field, and spatio-temporal studies of social systems in the researched social area
Strategic	technology roadmapping, technology positioning, Delphi, scenarios, social impact assessment, strong portfolio modelling, technological scanning, multiple perspectives assessment, causal layered analysis, MANOA, action learning	evidence-based cognitive, insightful projection of studied complex objects into the future, planning, scenario building, solving complex decision problems and managing change

Source: own elaboration on the basis A. Magruk, Innovative classification …, op. cit., pp. 700-715; A. Magruk, Hybrydowa metodyka badawcza foresightu technologicznego, doctoral dissertation, Wydział Inżynierii Zarządzania, Politechnika Poznańska, Poznań 2012, pp. 12-13.

R. Popper points out that in the process of constructing the methodology of foresight research, the methods should be chosen flexibly and should be consistent with the purpose of the planned research[7]. The selection of research methods should definitely not be based on copying them from previous research[8]. Only a well-thought-out combination of methods can bring the desired result, including a properly conducted research process[9].

When choosing methods, it is important to keep the principle of triangulation. It consists of evaluating the studied phenomenon from different perspectives in order to better understand it[10]. The following types of triangulation should be highlighted[11]:

- data triangulation – includes the use of data from various sources, both secondary and primary, for research;

[7] R. Popper, *How are foresight methods selected?*, „Foresight" 2008, vol. 10(6), pp. 62-89.
[8] A. Eerola, I. Miles, *Methods and tools contributing to FTA: A knowledge-based perspective*, „Futures" 2011, vol. 43(3), pp. 265-278.
[9] M. Aaltonen, T.I. Sanders, *Identifying systems new initial conditions as influence points for the future*, "Foresight" 2006, vol. 8(3), pp. 28-35.
[10] K. Jonsen, K. A. Jehn, *Using triangulation to validate themes in qualitative studies*, „Qualitative Research in Organizations and Management: An International Journal" 2009, vol. 4(2), p. 125.
[11] A. Kononiuk, J. Nazarko, *Scenariusze w antycypowaniu i kształtowaniu przyszłości*, Wolters Kluwer SA, Warszawa 2014, p. 84.

- researchers triangulation – involving in the study the participation of many researchers representing various environments, e.g.: scientific, business, political, administration, business environment institutions, etc.;
- theoretical triangulation – involving the use of various theories to interpret the collected material;
- methodological triangulation – involving the use of many research methods to assess a specific phenomenon.

When selecting research methods, the following issues should be taken into account: the purpose of the research, available funds, duration and time horizon of the research, involvement and number of stakeholders, the possibility of making connections with other methods, and the competences and skills of the project team[12].

The selection of research methods was initially focused on three phases of foresight, defined as: pre-foresight, foresight and post-foresight[13]. With the development of interest in foresight, the research phases were refined and supplemented with further elements[14].

J. Nazarko distinguished 8 research phases of the foresight process: initial, scanning, recruitment, knowledge generation, anticipation, action, evaluation and renewa[15].

The initial phase involves defining the rationale, scope and objectives of the study. The available resources, duration and time horizon of the research are identified. Moreover, the factors influencing the research methodology are identified. The research methodology and research plan are also pre-defined. In this phase, methods belonging to the consultative, radar, analytical and survey classes are recommended[16].

The scanning phase involves the identification and analysis of trends and changes over time that may affect the future of the processes and facilities under study. In this phase, it is recommended to use methods belonging to the following classes: diagnostic, radar, survey and analytical[17].

The recruitment phase consists of identifying and inviting foresight project stakeholders and domain experts to the project. The project team/research panels are also identified during this phase. The recruitment phase uses methods from the consultative, analytical and survey classes[18].

The knowledge generation phase involves obtaining, processing, analysing and synthesising existing knowledge in order to generate new knowledge in the area of the study. This phase should ensure the identification and analysis of the key factors, trends and driving forces shaping phenomena in the area, and an understanding of the context created by

[12] R. Popper, *Foresight Methodology* [in:] L. Georghiou, J. Cassingena Harper, M. Keenan, I. Miles, R. Popper (eds.), *The Handbook of Technology Foresight: Concepts and Practice, Prime Series on Research and Innovation Policy*, Edward Elgar, Cheltenham, Northampton 2008, p. 80.
[13] B.R. Martin, J. Irvine, *Research Foresight: Priority–Setting in Science*, Pinter Publishers, London 1989, p. 35.
[14] D. Szpilko, *Foresight jako narzędzie doskonalenia zarządzania turystyką w regionie*, Oficyna Wydawnicza Politechniki Białostockiej, Białystok 2016, pp.172-173.
[15] J. Nazarko, *Regionalny foresight …*, op. cit., pp. 63-67.
[16] A. Magruk, *Hybrydowa …*, op. cit.; J. Nazarko, J. Ejdys (red.), *Metodologia i procedury badawcze w projekcie Foresight technologiczny «NT FOR Podlaskie 2020» Regionalna strategia rozwoju nanotechnologii*, Oficyna Wydawnicza Politechniki Białostockiej, Białystok 2011.
[17] Ibidem.
[18] Ibidem.

stakeholders for the research being conducted[19]. In this phase, it is recommended to use methods mainly from the following classes: creative, consultative, prescriptive, strategic, simulation, analytical and multicriterial[20].

The anticipation phase consists of predicting possible future states of the studied processes and objects. The result of this phase should be e.g.: alternative scenarios, recommendations/policies of economic, social, political, legal nature, established lists of priorities. Methods from the strategic, prescriptive, creative, simulation, consultative and multicriterial classes correspond primarily with this phase[21].

The action phase consists of transforming the results of the study from the anticipation phase into concrete practical action. Possible options, strategies and plans should be proposed at this stage, enabling the best possible course of action to be taken[22]. In this phase, it is advisable to use methods from the following classes: strategic, consultative, simulation, diagnostic, creative, prescriptive and analytical.

The evaluation phase is aimed at verifying the extent to which the actions identified in the previous phase have fulfilled the objectives[23]. It should provide reliable and useful information to support the decision-making process. This phase is also intended to assess the relevance of the actions identified and their validity[24]. Methods from the consultative, diagnostic, analytical and survey classes correspond primarily with this phase.

The resumption phase involves starting of work on reactivating the foresight cycle on the basis of the evaluation results from the previous phase. It should take place after a certain period of time (e.g. several years) after the completion of the current project. The main objective of this phase is to develop success factors on which the initial phase of the new research cycle can be based[25]. In the resumption phase, methods from the consultative and diagnostic class are mainly used.

The indicated research phases of the process are the basis for the methodology of designing hybrid systems developed by A. Magruk. It includes 4 stages[26]:

- determination of factors influencing foresight research methodology;
- selection of foresight research methods in accordance with the classification, research context and stages of the foresight process;
- selection of methodical hybrids;
- construction of a hybrid system.

The first stage is to determine the factors influencing the research methodology. Among the key factors determining the selection of specific research methods, the following can be distinguished: access to quantitative and qualitative data, methodological competences, key

[19] L. J. Krzyżanowski, *O podstawach kierowania organizacjami inaczej: paradygmaty, modele, metafory, filozofia, metodologia, dylematy, trendy,* PWN, Warszawa 1999, pp. 286-291.
[20] A. Magruk*, Hybrydowa metodyka…,* op. cit.; J. Nazarko, J. Ejdys (red.), *Metodologia i procedury…,* op. cit.
[21] Ibidem.
[22] J. Nazarko, *Regionalny foresight gospodarczy...*, op. cit., p. 66.
[23] Ibidem.
[24] J. Nazarko, J. Ejdys, A. Gudanowska, A. Kononiuk, A. Magruk, Ł. Nazarko, *Ekspertyza Badanie ewaluacyjne realizowanych w Polsce projektów foresight*, Białystok 2010, pp. 13-14.
[25] J. Nazarko, *Regionalny foresight gospodarczy...*, op. cit., p. 66.
[26] A. Magruk, *Referencyjna metodyka projektowania systemów hybrydowych w badaniach przyszłości*, „Zeszyty Naukowe Politechniki Śląskiej. Seria: Organizacja i Zarządzanie" 2014, nr 73, p. 388.

attributes of methods, the legitimacy of combination with other methods, as well as their cognitive nature[27].

The second stage involves the selection of research methods in accordance with the classification, research context and stages of the foresight process. The selection can be made from among the 10 classes of methods presented in Table 1. When designing the methodology, special attention should be paid to the strength of linking the 10 classes of methods with the 8 phases of foresight research implementation and their assignment to the research contexts: cognitive, social, technological and economic (Fig. 2)[28].

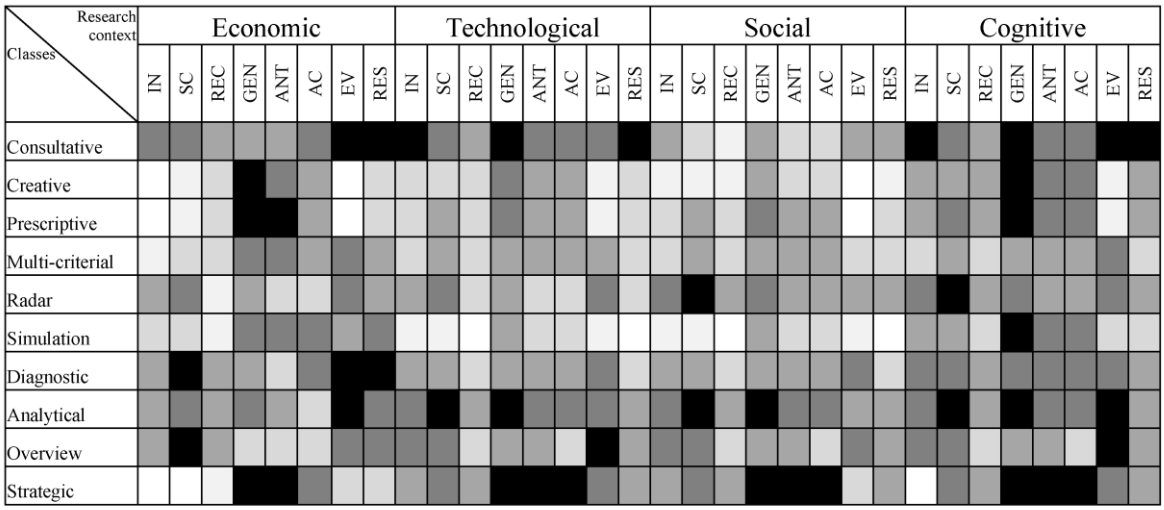


Figure 2. The strength of connecting a given class of methods at particular stages in the foresight process, in the context of the economic, social, technological and cognitive aspects
Source: J. Nazarko, Regionalny foresight ..., op. cit., p. 59.

In order to design the correct methodology to achieve the synergy effect, methods from different classes should be selected. Methods from only one class should not be used, as this may result in generating results in a similar way[29]. At the same time, care should be taken to ensure a strong reference to all research contexts (economic, social, cognitive), so as not to lead to domain domination by too strong reference to one of them[30].

The third stage is the selection of methodological hybrids. Hybrids have the structure:

- sequential – the output values from the first method are the input values in the second method. Its use is justified when the results of the method from one stage of foresight are input to the next stage;
- loosely coupled – information obtained from the application of specific methods is exchanged between individual methods, although each of them works separately;

[27] A. Magruk, *Kluczowe czynniki kształtujące metodykę badawczą projektów foresightowych*, „Przegląd Organizacji" 2013, no. 9, pp. 3-9.
[28] J. Nazarko, *Regionalny foresight …*, op. cit., p. 59.
[29] A. Magruk, *Referencyjna metodyka projektowania ...*, op. cit., p. 390.
[30] Ibidem, p. 395.

- nested – they are highly integrated. There is frequent interweaving and exchange of information between the methods used (multiple feedback). In this structure, the main and auxiliary methods can coexist, and the flow of information will take place in both directions;
- • operating on the principle of support – they are divided into basic and auxiliary methods. The secondary method (not always active) may use the same input as the primary method. In contrast, the results of the auxiliary method definitely need to be processed by the primary method[31].

The fourth stage consists in designing a hybrid system in which skillfully selected methods can achieve a synergistic effect[32].

The presented methodology of designing hybrid systems was used to develop research methodology for the implementation of the project „Foresight-oriented IT system supporting higher education and career development" (FORhesIT).

2. The characteristics of selected foresight methods

2.1. Trend analysis

The concept of a trend is often used in the social sciences, in particular in sociology, economics and management, but in each of these fields of science it is defined slightly differently. In the literature on sociology, a social trend is "a noticeable pattern of changes over time, illustrated by a social indicator or index"[33]. In economic science, a trend is defined as „a relatively benign and undirected pattern seen in data that arises from the accumulation of information over time. Many of the time series in economics and other social sciences show mild upward or downward trends"[34]. The PWN Dictionary of the Polish Language defines the concept of a trend quite generally as „a direction of development in some field existing at a given moment"[35]. An example of a trend that will significantly affect the labor market in the future may be: a change in wages in a specific sector of the economy, an increase in demand for employees with digital competences.

Megatrends can be defined as permanent economic, social, political and cultural trends, phenomena arising in the process of civilizational development of society, with various conditions affecting humanity beyond national borders and continents, covering the entire globe and conditioning the main directions and goals of the prospective development of humanity[36]. Global megatrends have an increasing, but difficult to predict, impact on our reality. The main trends and megatrends that currently and in the near future affect the development of society and the global economy include: urbanization, migration, aging of the

[31] Ibidem, pp. 391-392.
[32] Ibidem, p. 392.
[33] G. Marshall, *Dictionary of Sociology*, Wydawnictwo Oxford Paperbacks, Oxford 1998.
[34] G. González-River, *International Encyclopedia of the Social Sciences*, Wydawnictwo Macmillan, New York 2008.
[35] L. Drabik, A. Kubiak-Sokół, E. Sobol, *Słownik języka polskiego PWN*, Polskie Wydawnictwo Naukowe, Warszawa 2021.
[36] S. Marek, M. Białasiewicz (red.), *Podstawy nauki o organizacji. Przedsiębiorstwo jako organizacja gospodarcza*, Polskie Wydawnictwo Ekonomiczne, Warszawa 2011, p. 389.

population, globalization, circular economy, digitization and digital society, automation and robotization[37].

Trend analysis is particularly important in the context of high uncertainty and volatility of the environment that affect modern society and economy. Understanding the mechanisms of the functioning of trends can be an important element in the process of better preparation for future phenomena, as well as predicting the future. In terms of futures studies, the most important aspect of trend analysis is the ability to explore the future based on undermining one's own and obvious assumptions and critically assess emerging trends and signals of change[38].

Trend analysis includes the following steps:

1. Observing the environment – the knowledge about the trends directly shaping the researched area should be checked and updated, as well as those that may indirectly affect it. Regularities and changes in the researched area, as well as in the wider social, technological and economic macro-environment, should be taken into account.
2. Search for additional information – the observed trends should be subjected to critical verification using additional sources of information: whether the observed changes signal the development of a significant trend, what factors shape the trend and whether they are related to other phenomena. The source of additional information collected in the verification process may be in particular: industry magazines and newspapers, statistical data (GUS, Eurostat), market research, conversations with specialists in specific fields and experts, statistics of page views.
3. Identifying regularities – at this stage of the analysis, it is necessary to verify how the identified trends develop and what type of trend is presented (seed, growth, mature, declining trends) and whether similar changes have been observed in the past. Point out the similarities and differences between the present and the past.
4. Exploring the future – based on the collected data, an attempt to explore the future can be made. The following may be used in particular to formulate variants of trend development:

    - trend extrapolation;
    - looking for analogies – verifying how the factors responsible for the trend may change, specifying the conditions under which they will change and what it will mean;
    - looking for discontinuities – checking what may cause a given trend to reverse, collapse or intensify and what will be the consequences.

    Attention should be paid to any signals and factors of change that may affect the maintenance or change of identified trends. It is worth observing these elements in order to react early to changes in the future.

5. Controlling the change – it is recommended to search for information over time and check whether any of the defined changes that may affect the course of trends are

[37] *Wzrost Populacji Świata i Jego Konsekwencje [MEGATRENDY 2050]*, Polskie Towarzystwo Studiów nad Przyszłością, https://ptsp.pl/wzrost-populacji-swiata-i-jego-konsekwencje-megatrendy-2050/ [19.06.2022]; *Cyfryzacja i Automatyzacja Pracy [MEGATRENDY 2050]*, Polskie Towarzystwo Studiów nad Przyszłością, https://ptsp.pl/automatyzacja-pracy-megatrendy/ [19.06.2022].
[38] A. Gudanowska, A. Kononiuk, A. Magruk, A. Pająk, E. Rollnik-Sadowska, A. Sacio-Szymańska, *Doradca zawodowy projektantem przyszłości. Zastosowanie studiów nad przyszłością w doradztwie zawodowym*, https://horyzontyprzyszlosci.itee.radom.pl [17.06.2022].

actually being implemented. It should be verified whether this will have a direct or indirect impact on the study area.

Examples of good practice in applying trend analysis in foresight projects include:

- „Horizons of the Future", a project implemented under the program of the Minister of Science and Higher Education under the name „DIALOG" in 2018-2020[39];
- „The reasons for the diversification of poviat labor markets in the Podlaskie Voivodship", a project commissioned by the Voivodeship Labor Office in Białystok [40];
- „Mazowieckie Center of Economic Information. Regional economic foresight" (MCIG), a project implemented by the Association of Employers of Warsaw and Mazovia co-financed by the European Union under Sub-measure 8.1.2 of the Human Capital Operational Program [41];
- „NT FOR Podlaskie". Regional strategy for the development of nanotechnology, a project implemented under the Operational Program Innovative Economy Project, 2007-2013, Priority I. Action 1.1. Action 1.1.1[42];
- Economic foresight study on industrial trends and the research needed to support the competiveness of European industry around 2025[43].

2.2. STEEPVL method

The STEEPVL analysis is an expert method for identifying social (S), technological (T), economic (E), ecological (E), political (P), related to values (V) and legal (L) factors that affect the development of a given research area[44]. It is an extension of the analysis:

- PEST taking into account political, economic, social and technological factors;
- STEEP including social, technological, economic, environmental or ecological and political factors [45];
- STEEPV – STEEP analysis enriched with value factors analysis [46].

Extending the PEST analysis area to seven dimensions of STEEPVL allows for more accurate identification of development factors of the analyzed area that could be omitted in

[39] A. Gudanowska, A. Kononiuk, A. Magruk, A. Pająk, E. Rollnik-Sadowska, A. Sacio-Szymańska, *Doradca zawodowy*..., op. cit.
[40] *Przyczyny zróżnicowania powiatowych rynków pracy w województwie podlaskim*, http://wupbialystok.praca.gov.pl/documents/102984/5933864/Przyczyny%20zroznicowania%20powiatowych%20rynk%C3%B3w%20pracy%20wojew%C3%B3dztwa%20podlaskiego/53493f56-ca7b-4481-b3b1-8cc03ab7eea0?t=1513583916205 [28.06.2022].
[41] J. Nazarko, *Regionalny foresight* ..., op. cit.
[42] Nazarko J., Ejdys J. (red.), *NT FOR Podlaskie. Regionalna strategia rozwoju nanotechnologii,* https://depot.ceon.pl/bitstream/handle/123456789/7512/Uwarunkowania_rozwoju_nanotechnologii_w_wojew%C3%B3dztwie_podlaskim_Wyniki_analiz_STEEPVL_i_SWOT.pdf?sequence=1&isAllowed=y [29.06.2022].
[43] *Economic foresight study on industrial trends and the research needed to support the competiveness of European industry around 2025*, Fraunhofer Society with participating institutes, European Union 2012, http://ec.europa.eu/research/industrial_technologies/pdf/economic-foresight-on-rd_en.pdf [30.06.2022].
[44] G. Ringland, *UNIDO Technology Foresight for Practitioners. A Specialised Course on Scenario Building*, 5-8 November 2007, Prague; D. Szpilko, *Foresight as a Tool for the Planning and Implementation of Visions for Smart City Development*, „Energies" 2020, vol. 13, p. 10; J. Ejdys, A. Gudanowska, K. Halicka, A. Kononiuk, A. Magruk, J. Nazarko, Ł. Nazarko, D. Szpilko, U. Widelska, *Foresight in Higher Education Institutions: Evidence from Poland*, „Foresight and STI Governance", 2019, vol. 13, p. 77.
[45] A. Kononiuk, *Analiza STEEPVL na przykładzie projektu Foresight technologiczny. "NT FOR Podlaskie 2020" Regionalna strategia rozwoju nanotechnologii*, „Ekonomia i Zarządzanie" 2010, vol. 2(4), pp. 105-106.
[46] D. Loveridge, *The STEEPV acronym and process - a clarification*, Ideas in Progress, Paper Number 29, The University of Manchester, PREST Policy Research in Engineering, Science and Technology, Manchester 2002, p. 2, https://php.portals.mbs.ac.uk/Portals/49/docs/dloveridge/steepv_wp29.PDF [16.04.2022].

the case of traditional PEST analysis[47]. The STEEPVL analysis is primarily used to identify the potential driving forces of the scenarios. It also allows you to capture an unprecedented event that can cause trends to break down[48]. The results of the method can be a valuable input material for other analyses, such as a SWOT analysis, in order to facilitate the identification of opportunities and threats [49].

The limitations of using the STEEPVL method are:

- labor consumption in identifying factors for analysis based on many literature items;
- in many cases, the need to involve a number of experts to conduct the study;
- difficulty in engaging respondents with an extensive list of factors in 7 thematic groups;
- a possible large discrepancy of opinion on the assessed factors.

When carrying out research using the STEEPVL analysis, supporting methods are used, including: analysis of existing sources, an expert panel and surveys.

The method of examining existing sources, also known as desk research, is used to make an initial characterization of a research problem on the basis of already existing information[50]. It consists in searching, collecting and analyzing knowledge on a specific topic. This knowledge can be obtained from the following sources: compact publications, magazines, reports, expert opinions, bulletins, databases, catalogues, publications posted on websites. The acquired knowledge should definitely be verified by the researcher in terms of credibility and reliability. The advantages of the method include: relatively short research time, low cost and avoiding the time-consuming and cost-intensive process of data production. The disadvantages include limited access to data and their obsolescence[51].

The idea of the brainstorming method manifests itself in generating new ideas, based on associations, by arousing creativity in team members[52]. It is used to collect as many ideas as possible to solve a specific problem in a short time[53]. Brainstorming is a key component in foresight research. Its use can take the form of free discussion[54]. Work using this method can proceed in the following stages[55]:

- Stage I – a research problem is formulated and activities related to the organization of the meeting are carried out;
- Stage II – during the meeting, participants are presented with a research problem, and then ideas are collected on the basis of associations (without subjecting them to

[47] G. Ringland, *UNIDO Technology* ..., op. cit.; D. Szpilko, E. Glińska, J. Szydło, *STEEPVL and Structural Analysis as a Tools Supporting Identification of the Driving Forces of City Development*, „European Research Studies Journal", 2020, vol. 23, p. 342.
[48] S. Mendonça, M.P. e Cunha, J. Kaivo-oja, F. Ruff, *Wild cards, weak signals and organisational improvisation*, „Futures" 2004, vol. 36(2), pp. 206-207.
[49] J. Nazarko, Z. Kędzior (red.), *Uwarunkowania rozwoju nanotechnologii w województwie podlaskim. Wyniki analiz STEEPVL i SWOT*, Oficyna Wydawnicza Politechniki Białostockiej, Białystok 2010, p. 11.
[50] J. Nazarko, *Regionalny foresight* ..., op. cit., p. 38.
[51] *Innowacyjny model współpracy dla instytucji pomocy społecznej i rynku pracy*, Raport Diagnostyczny, BD CENTER, Rzeszów 2011, p. 8, http://www.wspolpraca.bdcenter.pl/images/pliki/RAPORT%20DIAGNOST CZNY.pdf [14.05.2022].
[52] Z. Martyniak, *Wstęp do inwentyki*, Akademia Ekonomiczna w Krakowie, Kraków 1997, p. 39.
[53] K. Borodako, *Foresight w zarządzaniu strategicznym*, Wydawnictwo C.H. Beck, Warszawa 2009, p. 86.
[54] R. Popper, *Foresight Methodology*, [in:] L. Georghiou, J. Cassingena Harper, M. Keenan, I. Miles, R. Popper, *The Handbook of Technology Foresight: Concepts and Practice, Prime Series on Research and Innovation Policy*, Edward Elgar, Cheltenham, Northampton 2008, pp. 47-48.
[55] *Narzędzia i strategie trenerskie w sytuacjach trudnych. Burza mózgów*, Helsińska Fundacja Praw Człowieka, http://www.hfhr.org.pl/wezkurs/e-podrecznik/index.php?option=com_content&view=article&id=225%3Aza lacznik-69&catid=19%3A051-metody-pracy-edukacyjnej&Itemid=98 [25.02.2022].

criticism). The quality of the proposals is not important, but generating the largest number of them.
- Stage III – includes discussion and evaluation of ideas and their grouping.

Survey research is a well-known and often used method of foresight research. Most surveys are based on questionnaires, currently mostly online[56]. The quality of survey results depends on the size of the sample[57]. Among the survey techniques, the following should be distinguished: direct individual questionnaire interview (*Paper & Pen Personal Interview – PAPI*), computer-assisted interview via a website (*Computer Assisted Web Interview – CAWI*), computer-assisted telephone interview (*Computer Assisted Telephone Interview – CATI*) a self-filled paper questionnaire (*Personal Self-Administered Questionnaire – PSAQ*). Among the advantages of conducting surveys, the simplicity of their form and the ability to easily and fairly quickly reach the respondents should be pointed out. The main disadvantage is the inability to deepen the researched problem, due to the rigidly defined set of questions in the survey[58].

Examples of good practice in using STEEPVL analysis in foresight projects include:

- „Digital Foresight 2035. 12 Scenarios for Poland", a project implemented by the Polish Economic Institute[59];
- „Scenarios for the development of small towns", a project implemented by the Polish Economic Institute[60];
- „Horizons of the Future", a project implemented under the program of the Minister of Science and Higher Education under the name „DIALOG" in 2018-2020[61];
- „The reasons for the diversification of poviat labor markets in the Podlaskie Voivodship", a project commissioned by the Voivodeship Labor Office in Białystok[62];
- „Mazowieckie Center of Economic Information. Regional economic foresight" (MCIG), a project implemented by the Association of Employers of Warsaw and Mazovia co-financed by the European Union under Sub-measure 8.1.2 of the Human Capital Operational Program[63];
- „NT FOR Podlaskie". Regional strategy for the development of nanotechnology, a project implemented under the Operational Program Innovative Economy Project, 2007-2013, Priority I. Action 1.1. Action 1.1.1[64].

2.3. SWOT Analysis

SWOT analysis is a technique of organizing and verifying information, the purpose of which is to identify the strengths and weaknesses as well as opportunities and threats of any entity

[56] R. Popper, *33 Foresight Methods – Expert Panels*, https://rafaelpopper.wordpress.com/foresight-methods/# Expert-Panels [08.03.2022].
[57] E. Babbie, *Badania społeczne w praktyce*, Wydawnictwo Naukowe PWN, Warszawa 2004, p. 301.
[58] Ibidem, pp. 301-302.
[59] *Foresight cyfrowy 2035. 12 scenariuszy dla Polski*, https://pie.net.pl/wp-content/uploads/2021/05/PIE-Raport_Foresight_cyfrowy.pdf [25.06.2022].
[60] *Scenariusze rozwoju małych miast*, https://pie.net.pl/wp-content/uploads/2019/12/PIE-Raport_scenariusze_male.pdf [25.06.2022].
[61] *Horyzonty przyszłości*, https://horyzontyprzyszlosci.itee.radom.pl/wp-content/uploads/2021/02/HP_podrecznik_A4_calosc.pdf [25.06.2022].
[62] *Przyczyny zróżnicowania powiatowych …*, op. cit.
[63] J. Nazarko, *Regionalny foresight ...*, op. cit.
[64] Nazarko J., Ejdys J. (red.), *NT FOR Podlaskie…,* op. cit.

or phenomenon. The name of the method is an acronym of English words: strengths, weaknesses, opportunities (potential opportunities or existing in the environment) and threats (probable or existing threats in the environment). It is one of the basic methods of strategic analysis of a company, organization (or any event in their activity), although the object of analysis can also be, for example, a university, project, investment, student or employee. Thus, a SWOT analysis can be carried out for both professional and personal purposes.

The purpose of conducting an organization's SWOT analysis is to search, collect and organize data on determinants, and present them in a clear and legible form. To make this possible, the procedure begins with the identification of the most important and mutually exclusive factors affecting the object under analysis. Then, the identified conditions should be classified into groups forming a matrix consisting of four fields that include the following factors[65]:

- strengths, ie features of the examined object, constituting its asset (internal determinants);
- weaknesses, ie features of the analyzed object, constituting its defects and limitations (internal determinants);
- opportunities, ie features of the environment affecting the tested object, enabling the achievement of the assumed goal (external factors);
- threats, ie external conditions hindering the operation of the analyzed facility, constituting a barrier to achieving the assumed goal.

The main stages of the analysis are presented in the figure 3.

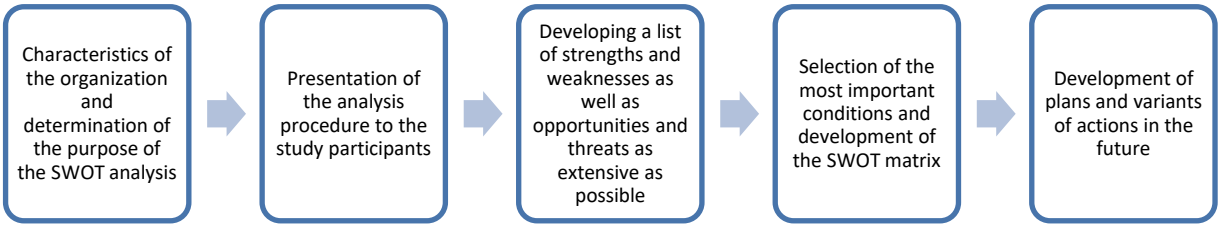


Figure 3. Basic stages of SWOT analysis
Source: own elaboration on the basis Chermack T.J., Kasshanna B.K., 2007, *The Use and Misuse of SWOT Analysis and Implications for HRD Professionals*, "Human Resource Development International" 2007, vol. 10, no. 4; M. Nowicki, Analiza SWOT, [in:] *Kompendium metod i technik zarządzania. Technika i ćwiczenia*, Wydawnictwo Oficyna a Wolters Kluwer Business, Warszawa 2015, pp. 325-354.

In practice, this analysis consists in identifying four groups of factors relating to the considered entity or phenomenon, determining their impact on the development of the entity in the future and their proper use in order to introduce improvements or even radical changes[66]. However, it is difficult to take into account uncertain or bilateral factors, i.e. factors that can be considered both a strength and a weakness at the same time[67]. The limitations of using the SWOT analysis are also related to the following aspects[68]:

- general perspective of the analyses;

[65] M. Nowicki, *Analiza SWOT*, [in:] *Kompendium metod i technik zarządzania. Technika i ćwiczenia*, Wydawnictwo Oficyna a Wolters Kluwer Business, Warszawa 2015, pp. 325-354.
[66] ISO, https://www.iso.org.pl/uslugi-zarzadzania/wdrazanie-systemow/zarzadzanie-strategiczne/analiza-swot/ [8.09.2022].
[67] Queensland Government, https://www.business.qld.gov.au/starting-business/planning/market-customer-research/swot-analysis/benefits-limitations [28.08.2022].
[68] E. Gürel, M. Tat, *SWOT analysis: a theoretical review*, "Journal of International Social Research" 2017, vol. 10, p. 51.

- many factors are identifiable but not prioritized or targeted in detail;
- solutions to problems are not provided or alternative decisions are indicated;
- it is possible to generate too many ideas and therefore it is difficult to choose the best one;
- it is possible to generate a lot of information, but not all of it is useful.

SWOT analysis is also used in foresight projects, in which it can be treated as an analytical tool for categorizing important factors determining the development of various entities or phenomena (organisations, enterprises, industries or a region or country), facilitating the determination of the desired and most important directions of action. In this sense, this analysis is a good starting point for discussing current and future challenges and the right way to map key success factors[69]. Examples of good practice in applying SWOT analysis in foresight projects are, among others:

- „National Foresight Program – implementation of results" – synthesis of NPF results in terms of fields, scenarios and SWOT analysis, project implemented by the Białystok University of Technology[70];
- „National Foresight Program – implementation of results" – synthesis of NPF results in terms of fields, scenarios and SWOT analysis, project implemented by the Białystok University of Technology[71];
- "ERA-LEARN 2020 – Strengthening joint programming in Europe" – SWOT analysis of alignment modalities, a project implemented by the University of Manchester[72];
- "The T&T Foresight Project", NIHERST, Sector Foresight Project: TOURISM, a project implemented by the Ministry of Education in Trinidad[73].

The SWOT analysis is also a summary and a starting point for developing a strategy for operating on the labor marke[74]. Increasingly, this method is also used for personal/professional/employee/people analysis, and can even be treated as a tool to help achieve a state of personal well-being[75]. A SWOT analysis of one's own professional career can make pupils, students or professionally active people aware of the situation in which they find themselves. In addition, it creates the opportunity to make plans or dreams come true, helps to set directions for action and teaches to see opportunities in terms of one's own development. It is a tool that can be successfully used in the future in private and professional life. It gives you the opportunity to independently choose your professional career and take responsibility for your life choices[76].

[69] J. Nazarko, J. Ejdys, K. Halicka, A. Magruk, Ł. Nazarko, A. Skorek, *Application of Enhanced SWOT Analysis in the Future-oriented Public Management of Technology*, "Procedia Engineering" 2017, vol. 182, pp. 482-490.
[70] J. Nazarko, J. Ejdys, K. Halicka, A. Kononiuk, A. Olszewska, U. Glińska, A.E. Gudanowska, E. Krawczyk-Dembicka, N. Brzostowski, Ł. Nazarko, Ł. Prusiel, *Synteza rezultatów NPF w zakresie pól, scenariuszy oraz analizy SWOT. Narodowy Program Foresight – Wdrożenie wyników*, Białystok 2013.
[71] Narodowy Program Foresight, https://ntfp2020.pb.edu.pl/ [28.08.2022].
[72] *SWOT analysis on alignment modalities*, The University of Manchester, United Kingdom 2017, ERA-LEARN%20Del%204.4_SWOT%20alignment_FINAL.pdf [7.09.2022].
[73] NIHERST, https://www.niherst.gov.tt/resources/publications/tourism-sector-chpt2.pdf [8.09.2022].
[74] H. Sobocka-Szczapa, *Analiza SWOT w strategicznej ocenie lokalnego rynku pracy m. st. Warszawy*, Instytut Pracy i Spraw Socjalnych, 2015.
[75] E. Pluchevskaya, *Application of the SWOT-analysis as an evaluation tool to achieve state of personal well-being*, III International Scientific Symposium on Lifelong Wellbeing in the World, 2017.
[76] M. Ciesielka*, Osobista analiza SWOT narzędziem motywowania i planowania wyborów edukacyjno-zawodowych młodzieży*, „Edukacja – Technika – Informatyka" 2019, no. 4(30).

2.4. Scenario method

Scenario method is the logical and formal construction of alternative visions of the desired future based on the involvement of heterogeneous (diverse) groups of experts, taking into account a thorough knowledge and understanding of the factors determining the studied phenomenon and enabling rational decisions about the future[77].

The construction of scenarios is both a way of exploring the future and a field of application of knowledge gained in earlier stages of the foresight process, as well as a tool for supporting strategic decisions, presenting possible choices and their potential consequences.

Considering the variety of techniques for building development scenarios, it is recommended for organisations to elaborate the development scenarios as a result of an expert scenario workshop. An exemplary method used for scenario building is based on scenario axes[78]. At the beginning, it includes two factors that emerge as a result of step one e.g. the STEEPVL analysis[79]. The choice of factors is determined by the criterion of importance and uncertainty. The identified factors are plotted on two axes. Thus, a matrix is formed, in which the upper right field is given a positive colour, while the lower left field is given a negative colour. The other two boxes take the positive and negative values of the first or second factor respectively. In result, four scenarios are created, which represent different perspectives of future of the study area development. The alternative future states developed on the scenario axis technique should form a coherent, reliable image of events development (Fig. 4).

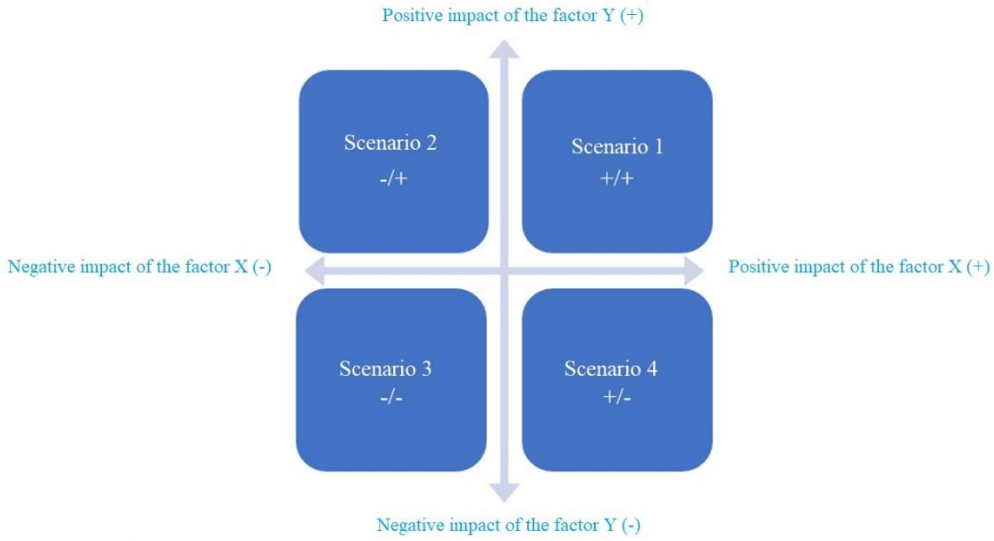


Figure 4. Distribution of scenarios based on key factors X and Y
Source: own study.

[77] A. Kononiuk, *Metoda scenariuszowa w antycypowaniu przyszłości* (na przykładzie Narodowego Programu Foresight „Polska 2020"), Uniwersytet Warszawski, Warszawa 2011, p. 314.
[78] S.A. Klooster, M.B.A. Asselt, *Practising the scenario-axes technique*, „Futures" 2006, vol. 38, pp. 15-30.
[79] J. Ejdys, Ł. Nazarko, *Foresight gospodarczy – instrumentem orientacji na przyszłość*, [w:] J. Lichtarski, S. Nowosielski, G. Osbert-Pociecha, E. Tabaszewska-Zajberts (eds.), *Nowe kierunki w zarządzaniu przedsiębiorstwem –wiodące orientacje*, „Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu", 2014, no. 340, pp. 651-664; J. Winkowska, D. Szpilko, *Methodology for Integration of Smart City Dimensions in the Socialised Process of Creating City Development*, „European Research Studies Journal" 2020, vol. 23, p. 534.

The advantage of this method is that an infinite number of potential future options (scenarios) can be built, from which a number of manageable options can be selected in a specific time frame. On the other hand, its main disadvantage is the difficulty in transforming the developed scenarios into concrete decisions and actions, especially if they are very general[80].

Among examples of good practices in the scenario method in foresight projects are among others:

- „Digital Foresight 2035. 12 scenarios for Poland" project carried out by the Polish Economic Institute[81];
- „Foresight on competencies of the future" project implemented by the Polish Economic Institute[82];
- „Scenarios for small town development" project implemented by the Polish Economic Institute[83];
- „Horizons of the Future" project implemented within the framework of „DIALOGUE" programme of the Minister of Science and Higher Education in 2018-2020[84];
- „Causes of differentiation of district labour markets in Podlaskie Voivodeship" project commissioned by the Voivodeship Labour Office in Bialystok[85];
- „Mazovian Centre for Economic Information. Regional Economic Foresight" (MCIG) project implemented by the Union of Employers of Warsaw and Mazovia co-financed by European Union funds under sub-action 8.1.2 of Human Capital Operational Programme[86];
- „FUTURES – Future laboratories for professional and personal development" project funded by Erasmus+ programme, contractors: Middlesex University, FORTH, Valuedo, Hanze University, Bialystok University of Technology and Lukasiewicz Research Network –Institute for Sustainable Technologies [87];
- „beFORE – Becoming Future-Oriented Entrepreneurs in universities and companies" project funded by Erasmus+ programme, contractors: Łukasiewicz Research Network –Institute for Sustainable Technologies, Bialystok University of Technology, University of Pisa, Mondragon University – Faculty of Business Studies, Free University Berlin – FuturInstitute, Valuedo, 4CF, Errequadro, Prospektiker i Aveniture[88].

2.5. Technology roadmapping

Technology roadmapping (TRM) method is a comprehensive approach to strategic planning, which integrate science and technology into business practice and identify opportunities in

[80] K. Borodako, *Foresight w turystyce. Bariery wykorzystania i rozwoju*, Wydawnictwo C.H. Beck, Warszawa 2011, p. 86.
[81] *Foresight cyfrowy 2035…*, op. cit.
[82] *Foresight kompetencji przyszłości* , https://pie.net.pl/wp-content/uploads/2022/05/Foresight-kompe...20.07.2022-kopia.pdf [24.06.2022].
[83] *Scenariusze rozwoju małych miast*, op. cit.
[84] *Horyzonty przyszłości*, op. cit.
[85] *Przyczyny zróżnicowania powiatowych …*, op. cit.
[86] J. Nazarko, *Regionalny foresight ...*, op. cit.
[87] *FUTURES – Future laboratories for professional and personal development*, https://futuresproject.pb.edu.pl/download/ [21.06.2022].
[88] *beFORE - Becoming Future-Oriented Entrepreneurs in universities and companies*, http://futureoriented.eu/ [20.06.2022].

the development of new technologies[89]. On a corporate level, the method allows to visualise the future, within a defined time horizon, taking into account all relevant business aspects[90]. The final roadmap enables the research team to know and understand the company goals and how to achieve the[91] (fig. 5).

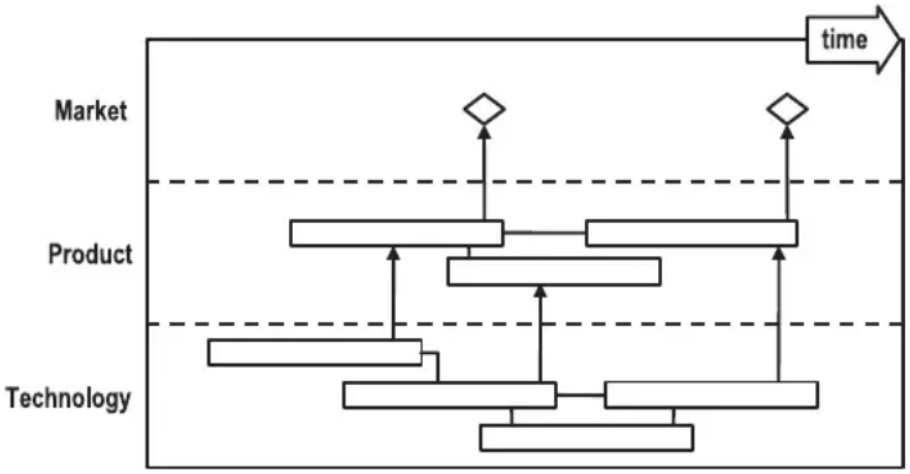


Figure 5. Example of a roadmap
Source: R. Phaal, C.J.P. Farrukh, D.R. Probert, Technology roadmapping – A planning framework for evolution and revolution, „Technological Forecasting and Social Change" 2004, vol. 71, p. 10.

A properly executed roadmap is a document presenting several layers with different levels of detail, as well as a tool to support the development process[92]. Considering the construction of a roadmap, visualisations can be created in the context of: strategic planning, long-term planning, product, opportunity, knowledge capital, programme, process or integration[93].

The term *roadmapping* is not only important in terms of technology[94]. It can also be applied to career path planning. Roadmapping, including analysis, visualisation and development planning, is otherwise a work plan, a precise description of activities in an appropriate order[95]. The construction of roadmap is linked to fundamental questions that arise in any strategic context: Where are we going? Where are we now? How can we get there? Why do we need to act? What should we do? How will we do it? Till when? The general character of this approach indicates the flexibility of the whole process, which can be adapted to a wide range of objectives and contexts[96].

[89] T.U. Daim, T. Oliver, *Implementing technology roadmap proc ess in the energy services sector: A case study of a government agency*, „Technological Forecasting & Social Change" 2008, vol. 75.
[90] K. Czaplicka-Kolarz (eds.), *Scenariusze rozwoju technologicznego kompleksu paliwowo-energetycznego dla zapewnienia bezpieczeństwa energetycznego kraju. Cz.1 Studium gospodarki paliwami i energią dla celów opracowania foresightu energetycznego dla Polski na lata 2005–2030*, Główny Instytut Górnictwa, Katowice 2007.
[91] A. Gudanowska, *Roadmapping jako narzędzie wspomagające zarządzanie rozwojem regionu*, „Zarządzanie i Finanse" 2012, no. 2.
[92] J. Nazarko, J. Ejdys, A. Gudanowska, A. Kononiuk, A. Magruk, Ł. Nazarko, *Badanie ewaluacyjne …*, op. cit..
[93] J. Nazarko, J. Ejdys, A. Gudanowska, K. Halicka, A. Kononiuk, A. Magruk, Ł. Nazarko, *Roadmapping in Regional Technology Foresight: A Contribution to Nanotechnology Development Strategy*, „IEEE Transactions on Engineering Management" 2022, vol. 69, no. 1, pp.179-194.
[94] A. Kononiuk, A. Gudanowska (red.), *Kierunki rozwoju nanotechnologii w województwie podlaskim*. Mapy. Marszruty. Trendy, Oficyna Politechniki Białostockiej, Białystok 2013.
[95] A. Pająk, A. Gudanowska (eds.), *Doradca zawodowy projektantem przyszłości: zastosowanie studiów nad przyszłością w doradztwie zawodowym*, Sieć Badawcza Łukasiewicz - Instytut Technologii Eksploatacji, Radom 2021.
[96] R. Phaal, C.J.P. Farrukh, D.R. Probert, *Technology roadmapping – A planning framework for evolution and revolution*, „Technological Forecasting and Social Change" 2004, vol. 71, pp. 5-26.

Preparing a roadmap allows to visualise the setting goal and shows how to get there from where you are. Two essential and related functions of roadmaps in foresight studies can be distinguished[97]:

- roadmaps are usually presented in graphical form, where the „nodes" (past, present or future states of studied object development) are connected to each other according to the criterion of causality or co-occurrence over time;
- graphic representations are very practical tool, as they outline what steps need to be taken and support the identification of future options. Therefore, the roadmaps also have a planning function.

The result of this method is a time chart consisting of several layers, which usually cover different perspectives. A roadmap is a visualisation of the implementation of planned strategies. It transforms the formulated objectives and strategies into concrete actions, enriching them with specific dates, linking them to important moments in time, often indicating the key functions of these actions and their interconnections.

The undoubted advantage of this method is the possibility to indicate the normative direction of development in the context of the key resources required for this development, which in effect allows to make recommendations for development, investment and financial allocation decisions. It should be emphasised that an image is much quicker assimilated by the human eye than a comprehensive text. In a synthetic way, it can present the development direction of particular market, its sector, a specific professional group or one's own career path. In the last mentioned area of application, it allows to define an action plan that will lead to the realisation of the defined vision. The main disadvantage of this method is the difficulty in objective assessment of resources that later are transformed into effective action. In addition, external conditions may cause a redefinition of layers or resources modification.

When carrying out research using the technology roadmapping method, a backcasting is used. Backcasting is a method of analysing alternative futures. It focuses on how the desired future might be achieved. The method is distinguished by an inverted logic of inference. It starts by defining a vision of the future that is desired to be achieved, then step-by-step backcasting all the way to the present day. The target horizon usually extends up to 50 years into the future. The method is most often used to create prescriptive scenarios and determine their feasibility and possible consequences[98].

Among examples of good practice in the application of roadmapping method in foresight projects are among others:

- „Horizons of the Future" project implemented within the framework of the programme of the Minister of Science and Higher Education called „DIALOGUE" in 2018-2020[99];
- „FUTURES – Future laboratories for professional and personal development" project funded by Erasmus+ programme, contractors: Middlesex University, FORTH,

[97] A. Pająk, A. Gudanowska (eds.), *Doradca zawodowy projektantem przyszłości: zastosowanie studiów nad przyszłością w doradztwie zawodowym*, Sieć Badawcza Łukasiewicz - Instytut Technologii Eksploatacji, Radom 2021.
[98] Foresight Platform, http://foresight-platform.eu/community/forlearn/how-to-do-foresight/methods/roadmap/backcasting/ [20.03.2023].
[99] *Horyzonty przyszłości*, op. cit.

Valuedo, Hanze University, Bialystok University of Technology and Lukasiewicz Research Network –Institute for Sustainable Technologies [100];

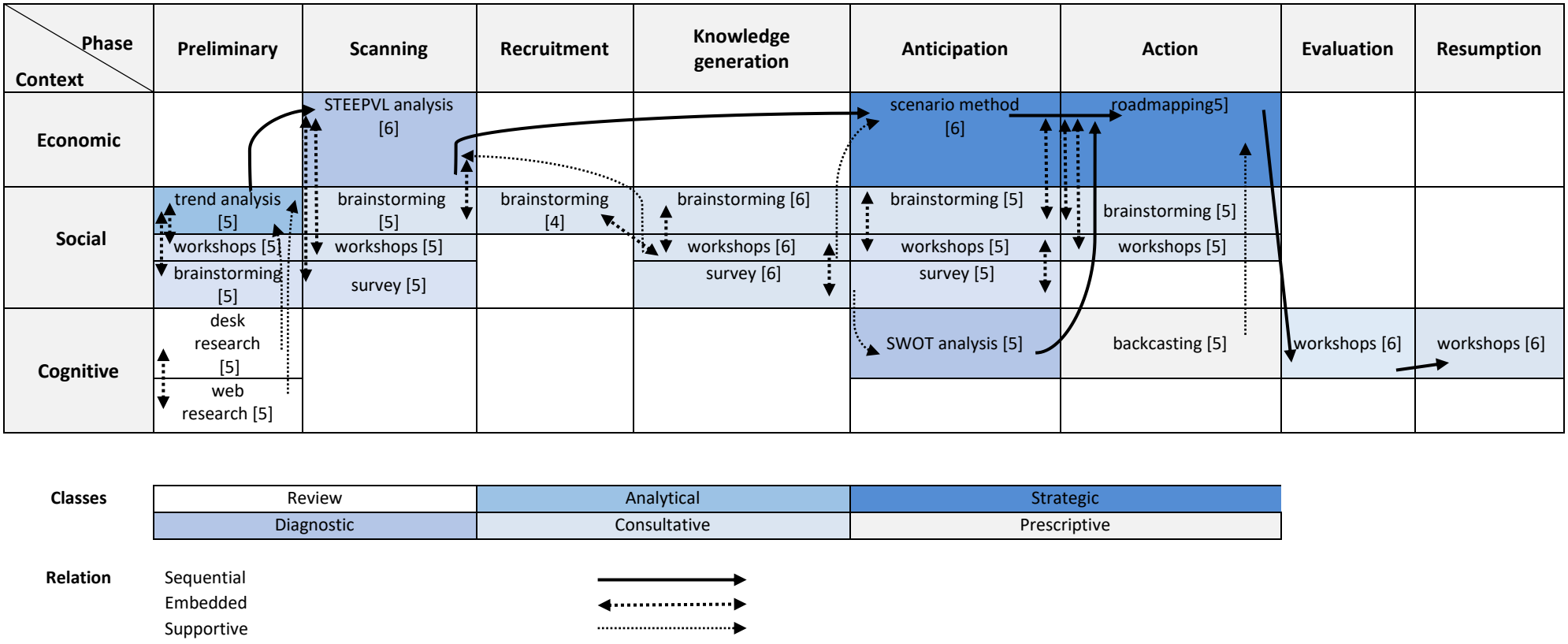
- „beFORE – Becoming Future-Oriented Entrepreneurs in universities and companies" project funded by Erasmus+ programme, contractors: Łukasiewicz Research Network–Institute for Sustainable Technologies, Bialystok University of Technology, University of Pisa, Mondragon University – Faculty of Business Studies, Free University Berlin – FuturInstitute, Valuedo, 4CF, Errequadro, Prospektiker i Aveniture[101].

3. Foresight methodology to apply in the context of the future labour market (or other area)

The research methodology was constructed to plan and implement a vision for the development of specific research area with reference to three key areas: the stages of the foresight process, the research context and the classification of methods. The selected methods belong to six different classes and relate to three contexts (economic, social and cognitive), so that they remain complementary. Three types of hybrids are also used in the methodology: sequential, embedded and supportive.

The methods were chosen to keep the balance between reference to the contexts associated with the research area and the eight phases of foresight. The cognitive context was ensured by the methods: desk research, web research, SWOT analysis, backcasting and workshops. The social context was expressed through: trend analysis, surveys, brainstorming, workshops. The economic context is linked to the STEEPVL analysis, scenario method and roadmaps
(Fig. 6).

[100] *FUTURES – Future laboratories …*, op. cit.
[101] *beFORE - Becoming …*, op. cit.



Strength of relation: 1 – zero or very low, 2 – low, 3 – medium, 4 – high, 5 – strong, 6 – very strong

Figure 6. Foresight methodology to apply in the context of the future labour market (or other area)
Source: own study.

The trend analysis carried out on the basis of desk research and web research allows to gather the necessary theoretical knowledge about the conditions of study area development. It can also be carried out in the form of workshop using brainstorming (preliminary phase). Within the framework of sequential hybrids, the trend analysis is the introduction to the brainstorming workshop and the survey research (scanning phase) in the form of STEEPVL analysis. STEEPVL analysis is primarily a tool to facilitate the identification of driving forces for the future scenarios of study area. The workshop method combined with surveys and brainstorming in embedded hybrid (knowledge generation phase) within the framework of supportive hybrid provides input to the scenario method (anticipation phase). Workshop method is also a part of another supportive hybrid, providing also information to SWOT analysis. Scenario method indicating the assumptions and conditions for the construction of future vision, provides input to the roadmapping of analysed area. Also, the backcasting method within the framework of supportive hybrid provides input to the roadmapping of analysed area (action phase). The last two phases of the process – evaluation and resumption – should be initiated at a certain interval in order to compare how the study area might develop differently with time and changes in the environment. The sequential hybrid in this case is based on an evaluation workshop.

The presented methodology has been developed on the basis of good practices and examples of labour market-related foresight projects available in the literature, as well as the authors' personal experience gained during the implementation of foresight projects.

4. Operationalisation of a foresight research methodology to apply in the context of the future labour market (or other area)

The foresight methodology has been adapted to 2 levels – individual and group application conducted by counsellors and academics. The proposed foresight methodology is quite universal and has potential to be applied also to other parts of socio-economic area than only labour market. Methodology for group and individual application in the context of future labour market (or other area) includes the implementation of stages I-III. The methodology for individual application in the context of participant's career development includes the implementation of stages I-IV (Fig. 7).

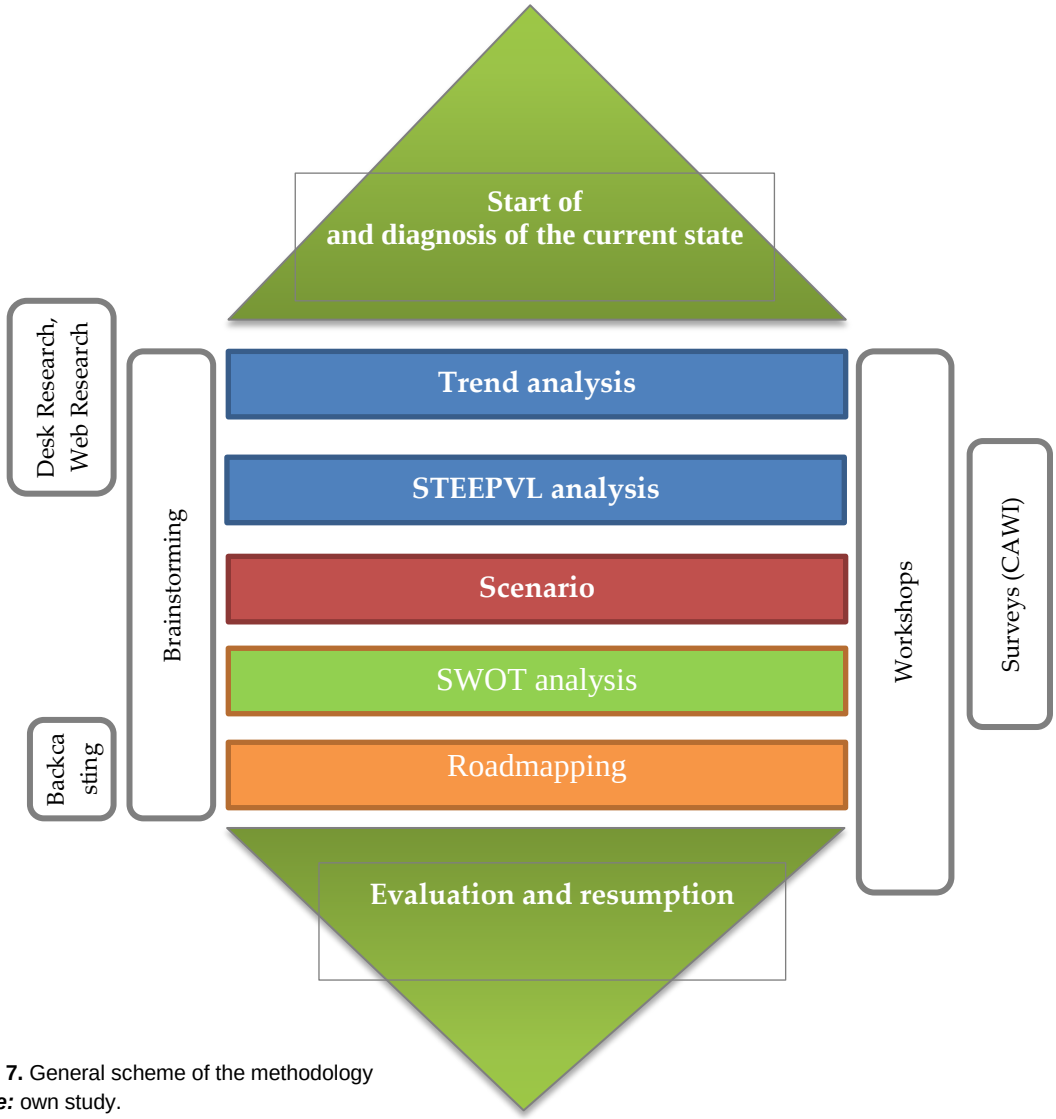


Figure 7. General scheme of the methodology
Source: own study.

The methodology consists of four stages:

- Stage I – Objective: to gather the necessary knowledge on the trends and conditions of the future labour market (or other area[102]), identification and classification of factors influencing the development of future labour market (or other area)
  - main methods: trend analysis, STEEPVL analysis;
  - supporting methods: desk research, web research, brainstorming, surveys, workshops.
- Stage II – Objective: to develop possible future scenarios of labour market (or other area)
  - main methods: scenario method;
  - supporting methods: brainstorming, workshops, survey method.

[102] The phrase "other area" in the following section also includes career development.

- Stage III – Objective: to identify the factors (strengths and weaknesses, opportunities and threats) associated with the implementation of selected future labour market scenario (or other area) / to identify the factors (strengths and weaknesses) associated with the implementation of user's chosen career scenario
  - main method: SWOT analysis;
  - supporting methods: brainstorming, workshops, survey method.
- Stage IV – Objective: to develop a plan of actions necessary to be implemented in order to achieve a specific career scenario
  - main method: roadmapping;
  - supporting methods: brainstorming, backcasting, workshops.

The structural and methodological complexity of the research process required to operationalise the research methodology in order to plan its particular elements.

4.1. Operationalisation of stage I

The diagram of the operationalisation of stage I in the research process is presented in Figure 8, including 3 tasks in accordance to the particular research methods.

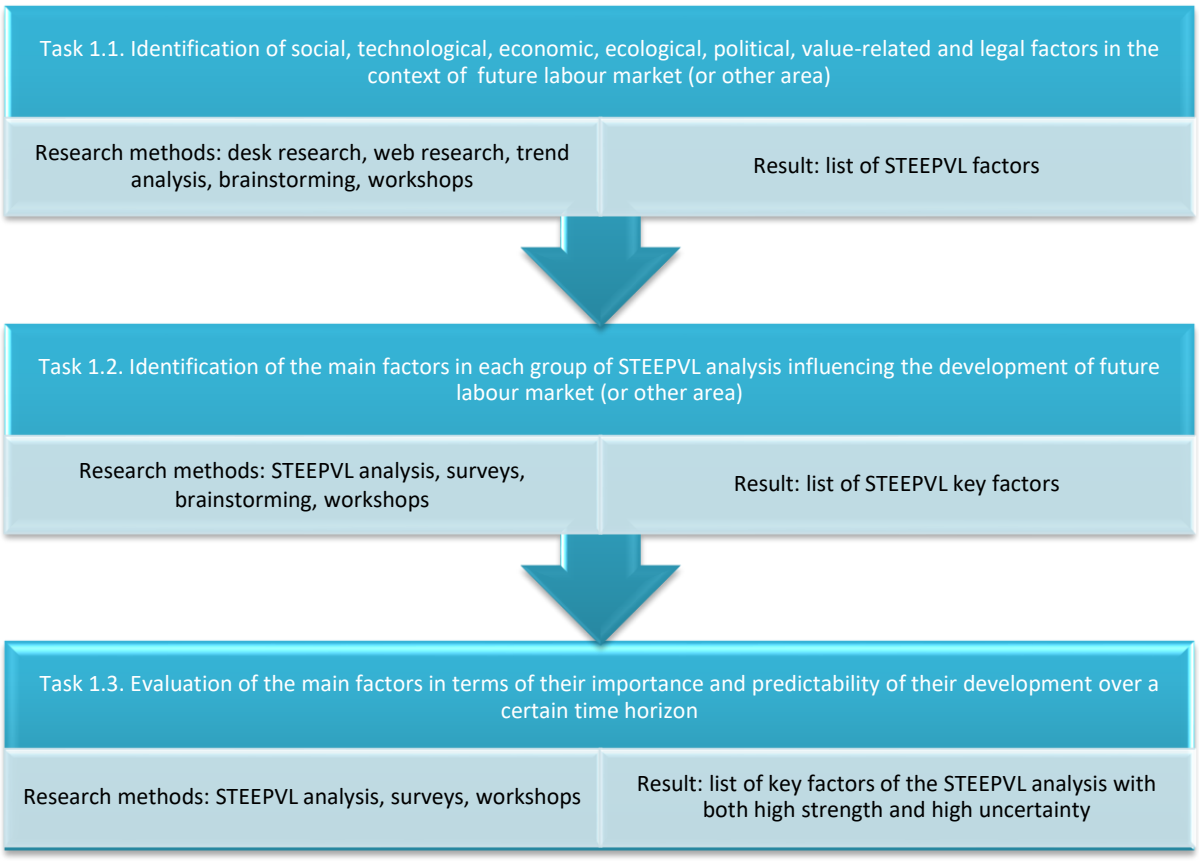


Figure 8. Diagram of the operationalisation of stage I in the research methodology
Source: own study.

Within task 1.1, a participant or a group of participants will identify the determinants of the development of future labour market (or other area) based on desk research, web research and trend analysis. The outcome of this task will be a set of identified factors classified within seven areas of STEEPVL analysis: social (S), technological (T), economic (E), ecological (E), political (P), value-related (V) and legal (L).

The aim of the activities undertaken as part of Task 1.2 is to identify the main factors in each group of STEEPVL analysis factors. Their selection should be made by a participant or a group of participants, using Computer-Assisted Web Interview (CAWI) technique, by indicating three most important factors in each group. The outcome of this task is a list of the main factors in STEEPVL analysis.

During Task 1.3, the list of main factors in STEEPVL analysis should be assessed in terms of their importance and predictability in terms of the development of future labour market (or other area). The assessment should be made taking into account a specific time perspective. In case of foresight studies, it is usually set at 10-20 years, although longer periods up to 30-40 years also occur. The assessment shall be made using a 7-point Likert scale and a research form of CAWI technique. This approach primarily serves to identify the most relevant factors that are potential driving forces of scenarios.

4.2. Operationalisation of stage II

The diagram of the operationalisation of stage II in the research process is presented in Figure 9, including 3 tasks in accordance to the particular research methods.

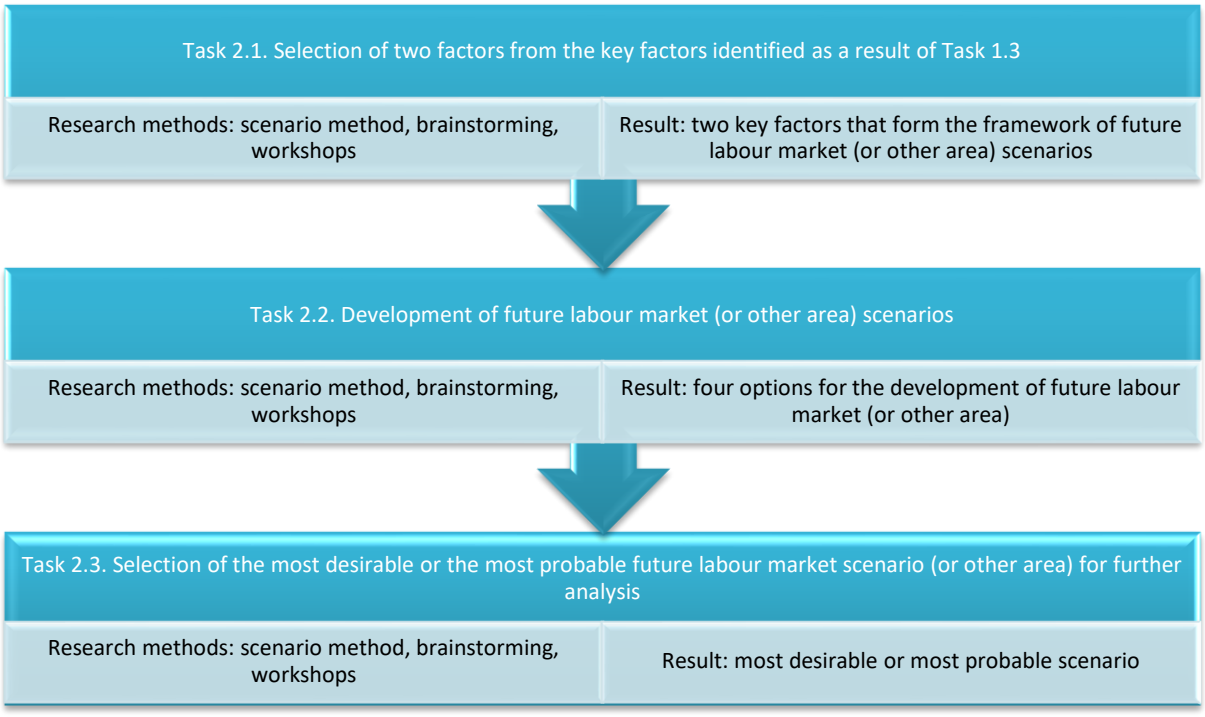


Figure 9. Diagram of the operationalisation of stage II in the research methodology
Source: own study.

Task 2.1 involves selecting two factors from the key factors identified as a result of Task 1.3 from the first stage of the research process. The selection is made by a participant or a group of participants using the CAWI technique.

Task 2.2 includes development scenarios for future labour market (or other area). Scenarios will be built on the basis of the two key factors selected in Task 2.1. By assigning the highest values to these factors, four scenarios of future labour market (or other area) development are identified. Within the framework of this task, a participant or a group of participants focus on naming and selecting the graphical characteristics of the individual scenarios. In addition, descriptive characteristics of 4 scenarios of future labour market (or other area) development can also be drawn up.

During task 2.3, a participant or group of participants select the most desirable or most likely future labour market (or other area) scenario for further analysis. It is also possible to select any other scenario for further analysis.

4.3. Operationalisation of stage III

The diagram of the operationalisation of stage III in the research process is presented in Figure 10, including 3 tasks in accordance to the particular research methods.

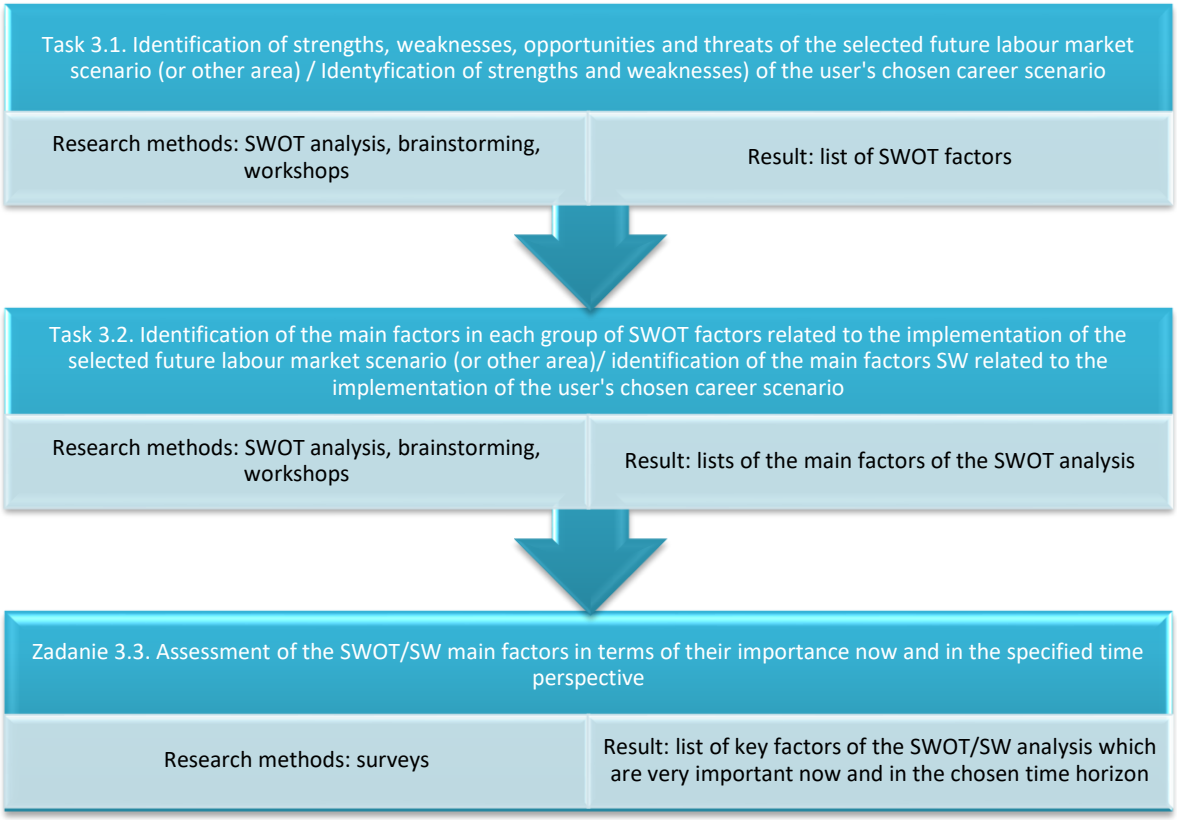


Figure 10. Diagram of the operationalisation of stage III in the research methodology
Source: own study.

As part of Task 3.1, a participant in the study or a group of participants will identify the strengths (S), weaknesses (W), opportunities (O) and threats (T) associated with the realisation of selected in Stage II future labour market scenario (or other area). The outcome

of the task will be a set of identified factors within four areas of SWOT analysis. In case of career development, provision is made for the identification of strengths (S) and weaknesses (W) associated with the user's chosen career development scenario.

The aim of the activities undertaken within Task 3.2 is to select the main factors in each of the identified groups of SWOT/SW analysis factors. Their selection should be made by a research participant or a group of participants, using an electronic form (CAWI), by indicating a specific number of factors (e.g. from 2 to 20 in total in a specific group of factors).

During Task 3.3, the list of main factors of SWOT/SW analysis should be assessed in terms of their importance now (in the current year) and in a defined time perspective (e.g. 2040). The assessment will be made using a 7-point Likert scale via the CAWI form. This approach primarily serves to identify SWOT key factors necessarily related to the implementation of the selected future labour market scenario (or other area) or SW key factors related to the implementation of the user's chosen career scenario.

4.4. Operationalisation of stage IV

The diagram of the operationalisation of stage IV in the research process is presented in Figure 11.

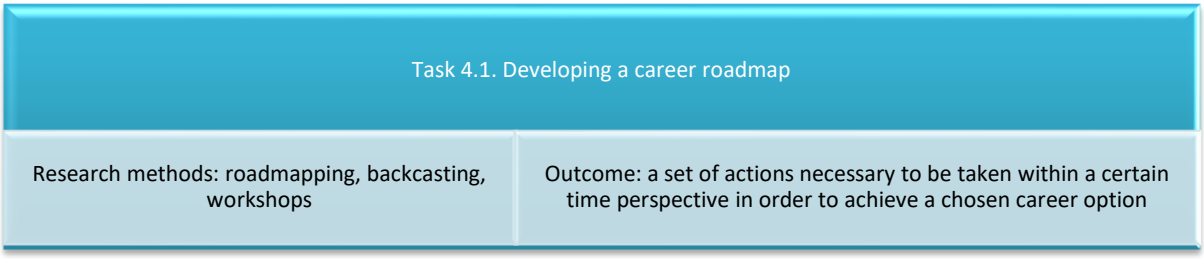


Figure 11. Diagram of the operationalisation of stage IV in the research methodology
Source: own study.

Task 4.1 aims to identify the necessary operational activities that should be carried out by a participant in order to achieve the chosen career option. Actions should be planned in accordance to different time perspectives. An example of a career roadmap for individual work is presented in Figure 12.

Layers	Time horizon			
	e.g. 2022-2025	…….	……	…….
Knowledge, skills, qualifications				
Expected net salary (per month)				
Job/Position				
Actions to be taken (courses, training)				

Professional objective in scenario X

Figure 12. The basic concept of a career roadmap
Source: own study.

The baseline career roadmap consists of four layers: knowledge, skills, qualifications, expected net salary (per month), position and activities to be undertaken (courses, training). The career roadmap refers to a time horizon and shows how a participant's career should develop over specific time intervals. The roadmap determines a kind of plan including the activities related to knowledge, skills, qualifications, which a user has to undertake in order to achieve the expected salary and occupy the expected job position. The roadmap allows to monitor the level of goals achievement over a certain time horizon.

A backcasting method will also be used. The user will start by defining a professional objective. Then, step by step, he or she will go backwards all the way to the present day, defining an action plan to achieve the objective.

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Figures

Tables