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THE SCENARIO ANALYSIS PLATFORM AS A METHODOLOGICAL BASE OF THE NATIONAL FORESIGHT PROGRAM OF UKRAINE

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The outputs of technology foresight and conclusions drawn for different systems would principally differ. Each country, and in the first turn Ukraine, should independently sort out the problem of innovation development. Here the mathematical and software platform of scenario analysis and development of complex of activities on technology foresight in Ukraine are proposed. Organization of a complex of activities on technology foresight is given.

Let us consider two aspects of technology foresight — establishing the mathematical and software platform of scenario analysis and development of complex of activities on technology foresight in Ukraine.

Availability in Ukraine of powerful scientific schools in the field of mathematics, cybernetics and programming forms the basis for the first aspect. Therefore, Ukraine also could make its contribution to development of technology foresight.

The second part of the report will deal with organization of a complex of activities on technology foresight. In this respect Ukraine will need recommendations from other countries which have considerable experience in organization and conduction of such activities.

Challenges and threats of the modern world in which severe competition is dominating make it necessary to foresee on the objective basis at least indicative scenarios of future events. It is required for formulating rational and unmistakable strategy of development of any organized community (nation, country, institution or company).

It should be pointed out that today there are no universal and comprehensive solutions of future events foresight, there exist only attempts of constructing possible scenarios of these or those future events. But the principal difference lies in the fact that for solving these problems the methods used are qualitative, but not quantitative in their nature.

1. SCENARIO ANALYSIS PLATFORM

Today a number of qualitative analysis methods is known. These methods are used at certain stages of future events foresee. But none of them solves fully the defined problem. First of all, because foresight is the process of application of

certain methods in some sequence establishing the determined interrelations between them. The above-mentioned process can be formed with the help of more universal mathematical, logical and software platform named **scenario analysis platform** [1]**,** which is the complex of knowledge, mathematical, software and logical tools for determination of the sequence of their application, their interconnection and in general formation of the foresight process. This platform is methodological body of the National Foresight Program. It was worked out at the Institute for Applied System Analysis which belongs to the National Technical University of Ukraine «KPI».

The eight qualitative analysis methods are used in this platform for solving the foresight problems. Their comparative characteristics are given in Table 1.

Table 1. Comparative characteristics of quantitative analysis methods and conditions of their application

Methods	Conditions and peculiarities of application	
	Required conditions	**Requirement of powerful software facilities**
Method of scanning	1. Availability of expert groups in different fields of knowledge.	Requires network software and hardware for on-line operation
Brainstorm method	1. Availability of some expert groups in narrow fields of knowledge. 2. Applied at the first stage of scanning method.	Requires network software and hardware for on-line operation
Delphi method	1. Availability of an expert group in certain field of knowledge. 2. Easiness of collection, preparation and processing of information.	Requires network software and hardware for on-line operation
Method of cross impact	1. Used at the first stage of Delphi method. 2. Experts are to access simple and conditional probabilities of events and scenarios. 3. With the help of mathematical programming the computational values of possible events and scenarios probability are searched.	Requires powerful software facilities for programming complicated systems
Saaty method	1. Should be based on the Delphi method application, in case the possible scenarios cannot be verbally described. 2. Highly qualified experts in the field of network theory are required. 3. With the help of mathematical programming the computational values of possible scenarios probability are searched.	Requires application of powerful software for information processing in hierarchy networks.
Method of morphological analysis	1. Specialists in the field of the sets theory. 2. Calculation of possible scenarios searching for crossings of morphological spaces of characteristic parameters for investigated systems.	Requires application of powerful software
Method of scenarios writing	1. Requires system analysts of high qualification. 2. Based upon qualitative analysis methods, introduction of empirical assumptions and system construction of integral analysis.	Requires application of powerful software for imitation of scenarios modeling
Method of Bayes models	1. Requires analysts in the field of probability theory and random values. 2. To be used in addition to other qualitative analysis methods for checking the degree of confidence of the constructed possible scenarios.	Requires application of powerful software

It should be noted that in solving practical problems of foresight on the basis of Scenario Analysis Platform (SAP) the estimates are received, as a rule, by Internet in on-line mode.

In Scenario Analysis Platform the qualitative analysis methods are used at four different stages.

At the first stage (Fig. 1) for preliminary study of the foresight problem the methods of scanning and brainstorm are consistently used.

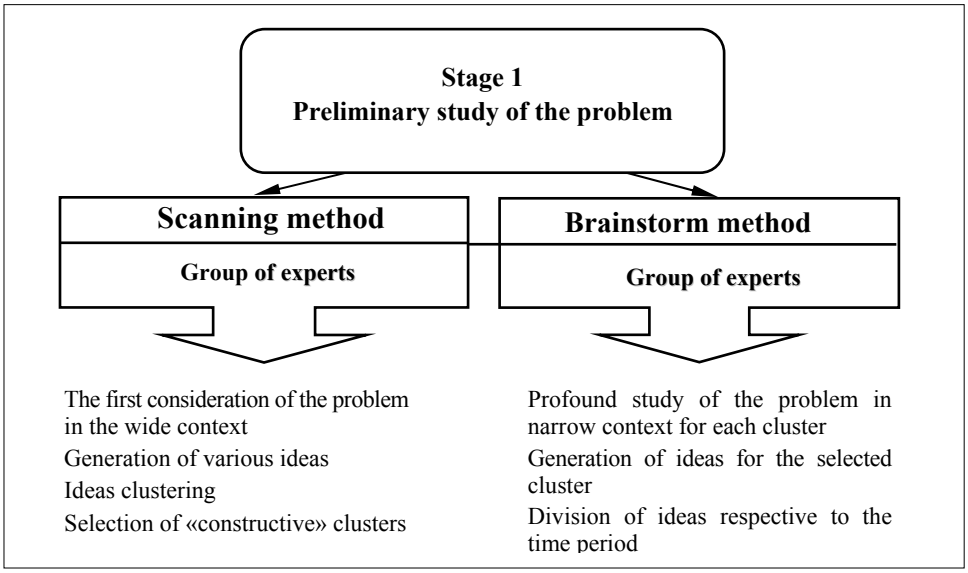

Fig. 1. Preliminary study of the problem

At the second stage (Fig. 2) for carrying out all-round qualitative analysis of the problem the most frequently used methods are Delphi, Saaty, Cross — Impact and Morphological Analysis. They may be used separately or as a combination of methods depending on the peculiarities of this problem.

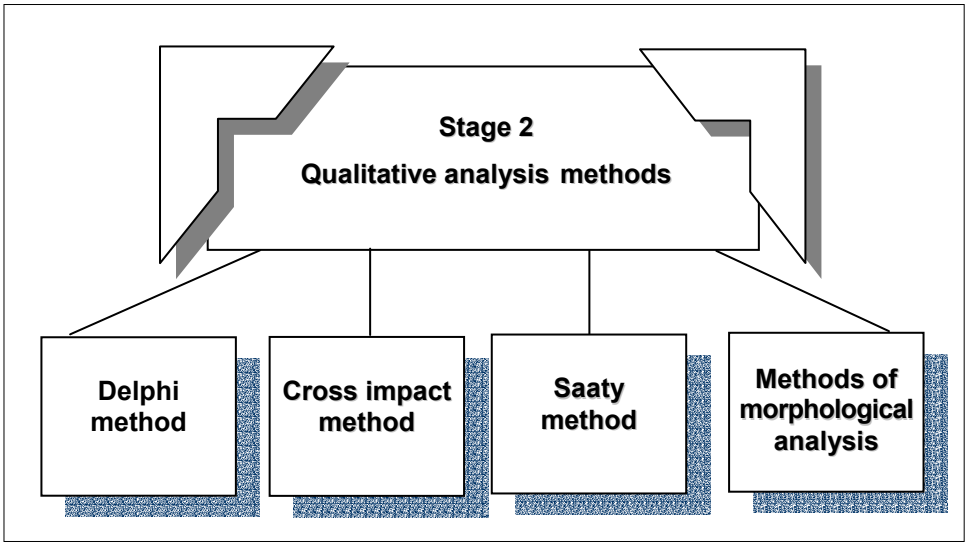

Fig. 2. Qualitative analyses of the problem

At the third stage (Fig. 3) empirical nine-step procedure of scenario construction [2] can be used.

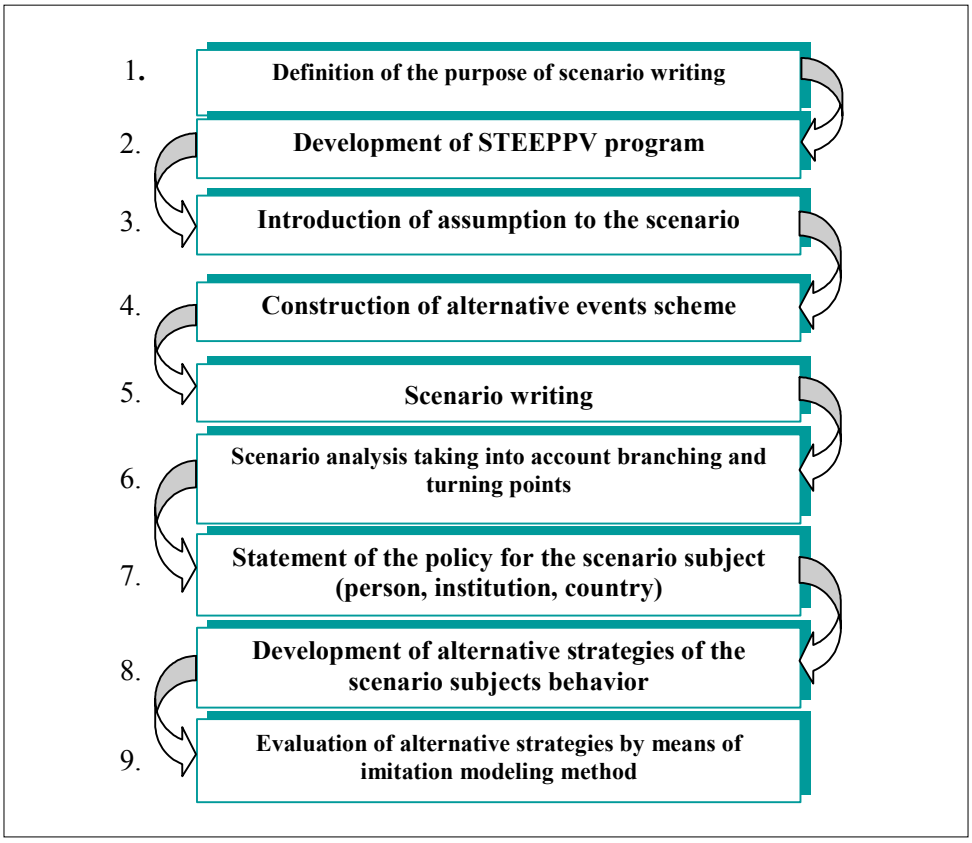

Fig. 3. Scenario writing (Dennis Loveridge)

And at the last **fourth stage** (Fig. 4) the scenarios are presented to a group of people who are to take strategic decisions and comprehensive analysis of these scenarios is carried out in accordance with the following procedure:

- determination of the confidence level of each scenario;
- estimation of scenarios probability;
- estimation of risks connected with each of the scenarios;
- selection of the most acceptable scenarios from the point of view of the above criteria.

Estimation of scenarios probability in Scenario Analysis Platform is done by means of the Bayes method which consists in determination of conditional probabilities of implementation of this or that scenario.

$$P^C\left(\frac{C_j}{\Pi_1,\ldots,\Pi_N}\right)=\frac{P^0(C_j)P^C\left(\frac{\Pi_1}{C_j}\right)P^C\left(\frac{\Pi_2}{C_j,\Pi_1}\right)\times\ldots\times P^C\left(\frac{\Pi_N}{C_j,\Pi_1,\ldots,\Pi_{N-1}}\right)}{\sum_{i=1}^{K=2^N}P^0(C_i)P^C\left(\frac{\Pi_1}{C_i}\right)P^C\left(\frac{\Pi_2}{C_i,\Pi_1}\right)\times\ldots\times P^C\left(\frac{\Pi_N}{C_i,\Pi_1,\ldots,\Pi_{N-1}}\right)}.$$

The method is applied in accordance with the corresponding algorithm at separate stages of which Delphi method, Bayes formula and powerful software for graphic presentation of the analysis results are used. After experts have analyzed the obtained results the final conclusions are made regarding the probability of the studied scenarios.

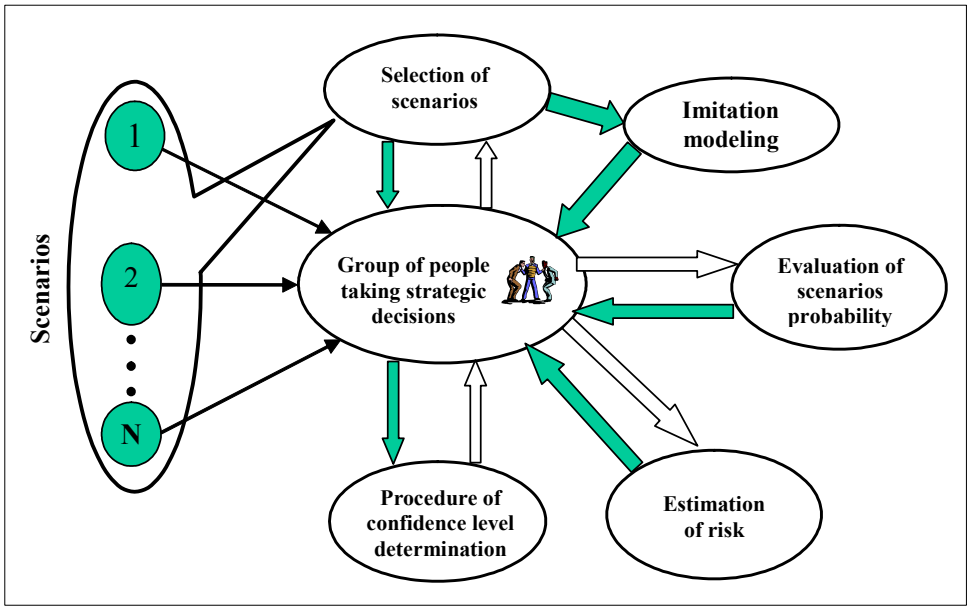

Fig. 4. Submission of scenarios to the group of People
Taking strategic decision

For all the above-indicated methods used in the course of scenario analysis the output data are the conclusions made by experts or analysts involved in solving the specific problems of technology foresight. Such conclusions are always made on the basis of **knowledge, experience, intuition and reason** of professionals in this or that field. Therefore, the results obtained by means of the considered methods are only approximations of what is going to take place in reality.

The typical foresight cycle in Scenario Analysis Platform is shown in Fig. 5.

The software used in this platform (Fig. 6) is the network information system of decision making for future scenarios construction. It includes the special mathematical apparatus which realizes the scenario analysis technology given above. A convenient and flexible user interface making it possible by Internet to involve experts and quickly obtain and process their decisions, organize communication, interaction and information exchange among them and the platform.

Based upon the chosen methods for the system development the main components are to be realized in Java language. Today Java-technologies are in development of corporate systems for decision making support, systems appropriate to the scale of transnational corporations, Internet-systems and systems working under heterogeneous medium conditions. This approach has a number of considerable advantages for development of distributed systems and Internet-systems: complete initially object-oriented component model which does not depend upon the computer architecture and the installed operational system, which makes it possible for any Internet user to use this system without thinking about hardware

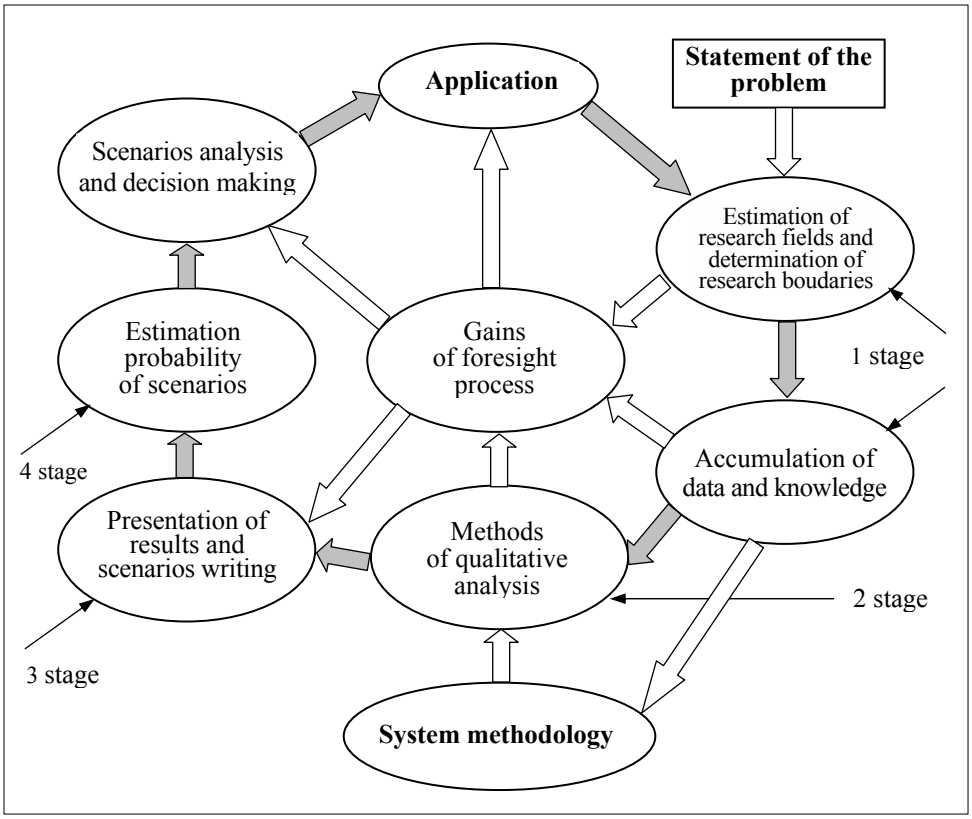

Fig. 5. Typical foresight SAP cycle

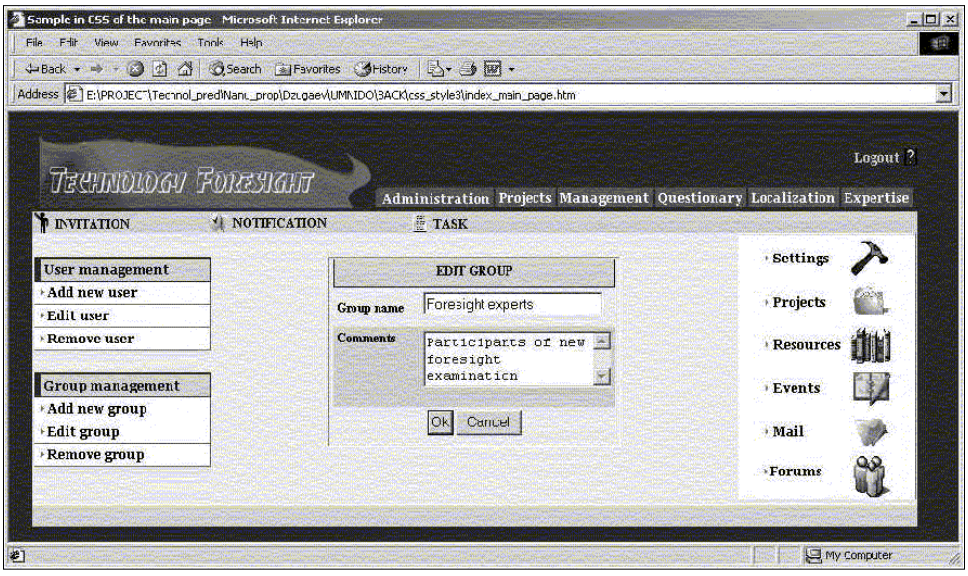

Fig. 6. Scenario analysis platform overview

compatibility. In the process of development a special attention is paid to further application of the system in Internet with the possibility of drawing experts from all over the world. Any Internet-oriented information system has to take into ac-

count the peculiarities of working with users who are far apart from each other. In particular, while conducting survey of experts living in different parts of the world, one should take into account the difference in time zones (the system must be accessible in on-line mode on the twenty-four hours basis), difference in the languages being used and also different level of experts' computer mastery. In connection with the above the functions of internationalization and multilingual support are provided. Application of the web-interface will allow remote users to use the software which is familiar to them.

The described information system of technology foresight is realized as a distributed cross-platform system built on the client-server architecture.

The component approach allows to present the system in the form of 3 levels hierarchy: as shown in Fig. 7.

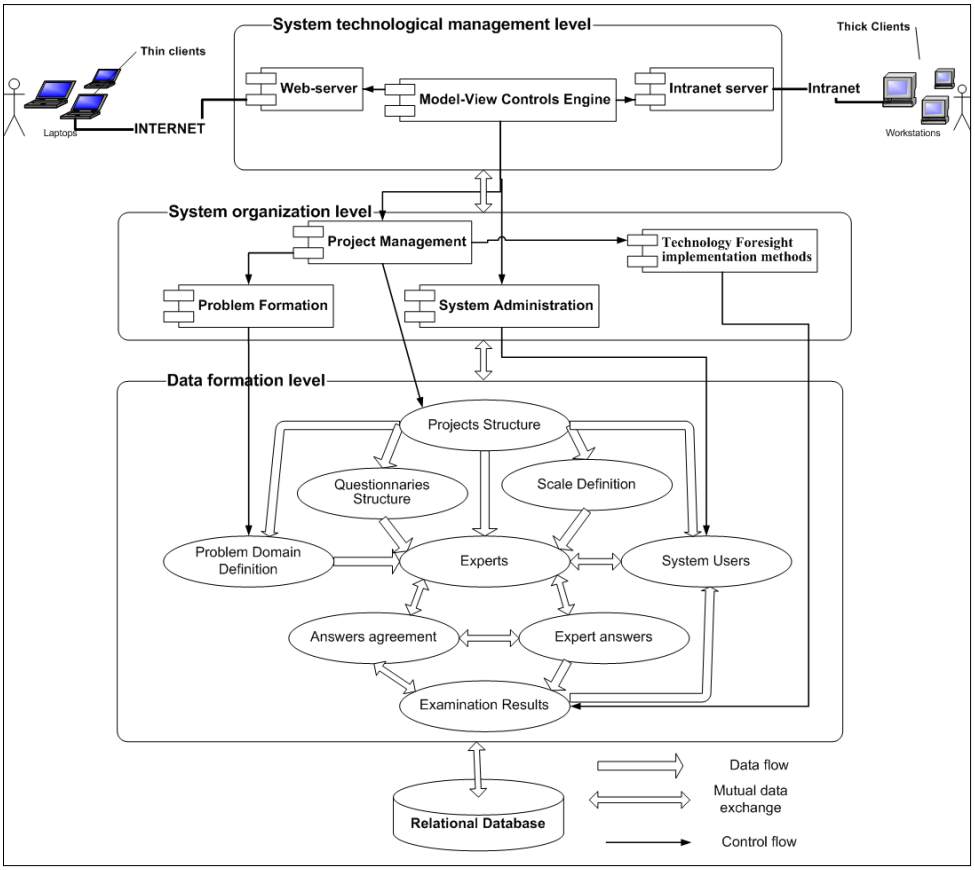

Fig. 7. Scenario Analysis Platform Architecture

System technological management level carries out a dialogue with the user. It comprises modules of system control and the modules of interaction with experts via Internet in on-line mode. The plotting module is provided for visual presentation of the expert examination results and other analytical information. And here the experts and remote users make use of the operational system and Internet browser familiar to them. The module of multilingual support will allow dynamically form the web-interface for remote users in the language preferable for them.

System organization level realizes the main algorithms of the system and is realized in a number of functionally independent sets of data processing methods.

- Contains the mechanisms of system administration, of projects and expertise control, descriptions of a problem domain, realization of technology foresight methods.
- Is responsible for users management, users access level to the system and projects management.
- Includes all the necessary procedures for expert examinations: definition and formalization of the problem in the object domain, invitation of experts and determination of their competence level, appointment and conduction of expert examination rounds, experts survey and processing of the received answers.
- Uses formalization of the problem, definition of the problem expertise, determination of questionnaires structure, scales construction, questionnaires generation in accordance with the assigned structure, assigning the objects of expert examination.
- Contains a set of mathematical methods of information processing based upon fuzzy logic.

Data formation level uses one of 12 relational systems of databases control most popular today and is based upon object-relational approach of data conversion, which allow taking into account the advantages of both object-oriented and relational approach. The main tasks of the storage sub-system are:

- storage of information about all users of the system and about experts who are involved in expert examination in on-line mode;
- storage of data for description of the objects under study;
- storage of hierarchy structure and the questionnaires content;
- storage of information about all stages of expert examinations conduction and their results;
- storage of experts' answers at all stages of expert examination and results of their processing;
- storage of the proximity measure of answers and the chosen scales of expert examination;
- storage of housekeeping information.

In addition, the apparatus of fuzzy sets are used in this project. It allows to embrace a wide class of expert reviews with fuzzy data, which ensures considerable flexibility of all methods of fuzzy information processing.

Now we consider an example of Delphi method realization based upon classic principles of expert examination organization proceeding from the modern requirements to the apparatus for solution of technology foresight system problems. Mathematical processing of expert data is carried out at higher community level as compared to problems of any particular expert examination, which allows the Delphi method procedure to work in any metric space irrespective of what type of data are presented in this space (Fig. 8)**.**

The peculiar feature of Delphi method presented in this development is high flexibility of individual and group analysis algorithms of expert information achieved by independent many-dimensional processing of expert data in regard of various properties of the object being examined.

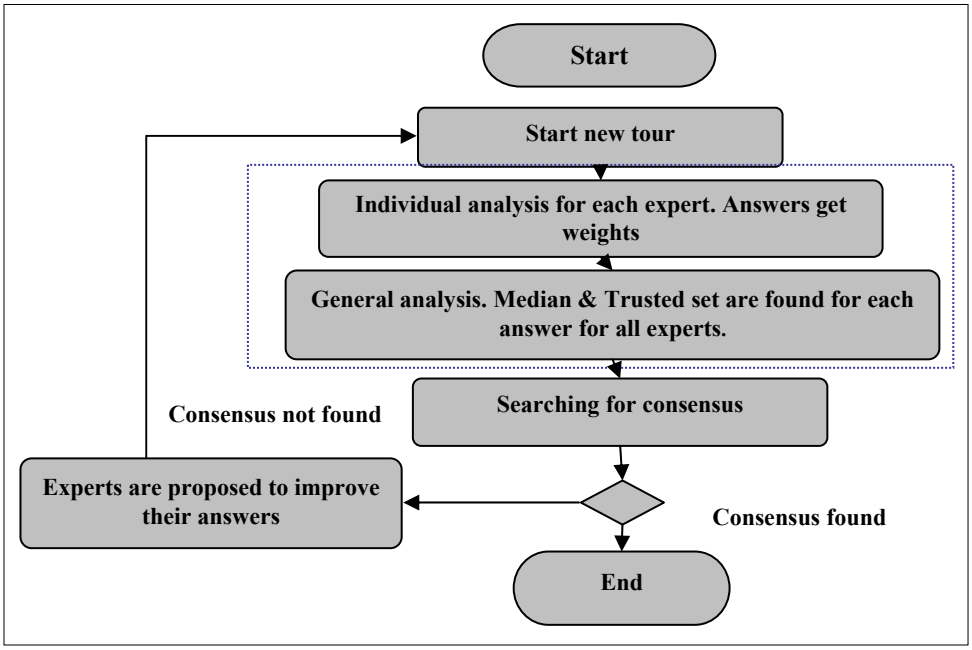

Fig. 8. The Delphi Method Procedure

Let us consider in more detail the procedure of the Delphi method realization by the example of analysis of the results obtained in the first round of expert examination, in which five experts give estimations, $\widetilde{Q}_j \quad j=\overline{1,5}$ of some property Q_j for object under study. These estimations include the quantitative and interval value of the studied properties and the level of the expert's confidence in his estimation (Table 2). At any stage of examination an expert may be suggested to argue his estimations. Since the procedure of group and individual analysis of expert estimations is many-dimensional, processing of the current property estimations goes independently of other characteristics under study.

Table 2. Developing of fuzzy estimation $\widetilde{Q}_j$.

Level p	Quantitative description	Qualitative description	Confidence estimation μ_{jp}
1	extremely low	[0,00÷0,10]	0,01
2	very low	[0,10÷0,25]	0,30
3	low	[0,25÷0,40]	0,50
4	medium	[0,40÷0,60]	0,80
5	high	[0,60÷0,75]	0,40
6	very high	[0,75÷0,90]	0,20
7	extremely high	[0,90÷1,00]	0,01

The estimation $\widetilde{Q}_j$ given by an expert is processed through construction of the membership function for the fuzzy value $\mu_j(x)$ at discrete levels $\langle x, \mu_{jp}(x)\rangle$, as shown on Fig. 9 for the first expert.

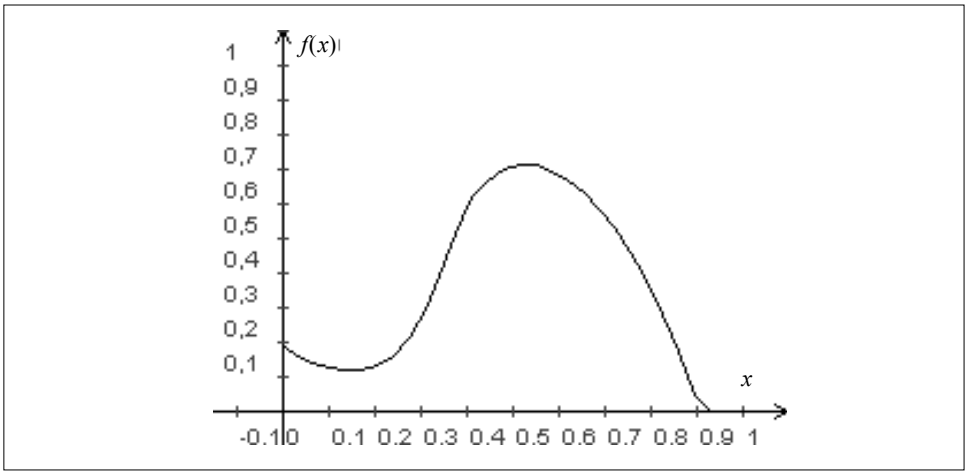

Fig. 9. Estimation of the first expert (trusted).

To determine two main characteristics of the obtained set of expert estimations of each property of the studied object (medium *M* and confidence set *T*) on fuzzy values the L_1 metrics is introduced by:

$$\rho(\mu_1, \mu_2) = \int_0^1 |\mu_1(x) - \mu_2(x)| dx .$$

With the above metrics the medium estimation *M* is determined by

$$M = \widetilde{Q}_j^* = \arg \min_{j=\overline{1,5}} \left(\sum_{q=1}^{5} \rho(\widetilde{Q}_j, \widetilde{Q}_q) \right)$$

and can be found from the distance matrix $\mathbf{D} = \{\rho(\mu_p, \mu_q)\}$, $p, q = \overline{1, 5}$

Distance matrix

0,000000	0,149286	0,093881	0,142629	0,245376
0,149286	0,000000	0,107801	0,158109	0,334713
0,093881	0,107801	0,000000	0,101319	0,248917
0,142629	0,158109	0,101319	0,000000	0,279179
0,245376	0,334713	0,248917	0,279179	0,000000

Estimation divergences

0,631172	0,749909	0,551918	0,681235	1,108184

as estimation with minimal row sum. With the other four fuzzy estimations shown on Fig, 10 and corresponding row sums shown on Fig. 11, medium is the estimation of third expert.

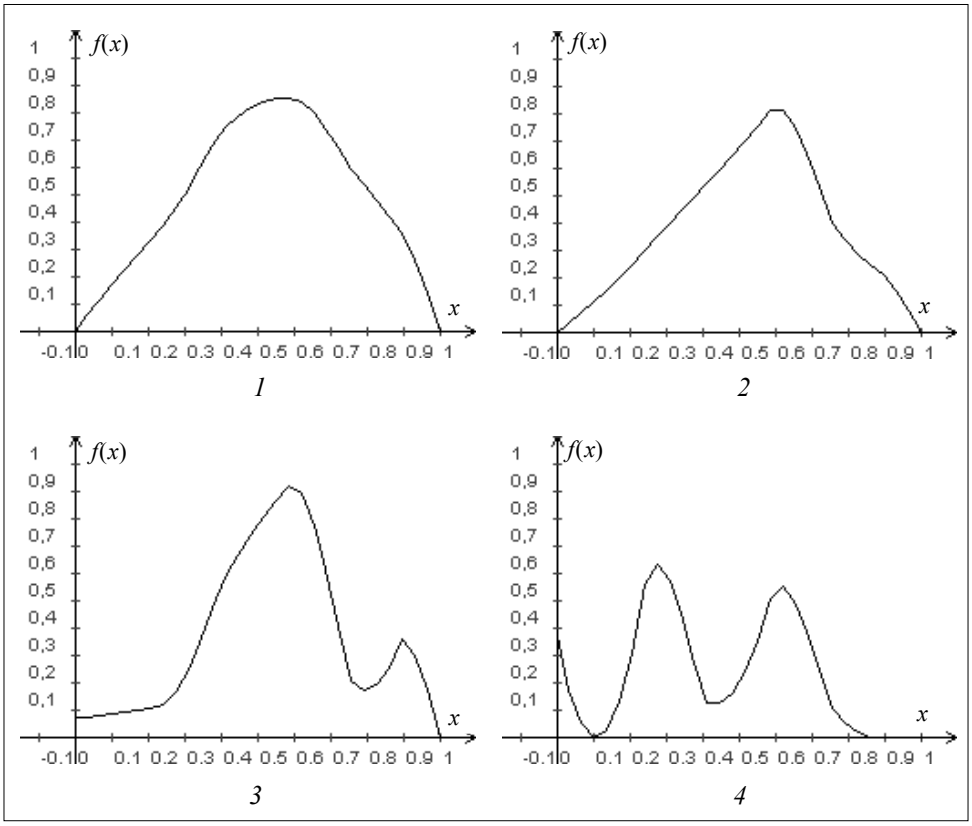

Fig. 10. Estimation of the experts
1 — Estimation of the second expert (not trusted)
2 — Estimation of the third expert (medium)
3 — Estimation of the fourth expert (trusted)
4 — Estimation of the fifth expert (not trusted)

At the first round of the expert examination the confidence set T is determined as half of the estimations less distant from the medium estimation. Confidence set can be found using divergence vector $\mathbf{d}^M = \left\{\rho_j\left(\widetilde{Q}_p, M\right)\right\},\ p = \overline{1,5}$

Estimation divergences

0,093881	0,107801	0,000000	0,101319	0,248917

that is shown on Fig. 12. It is now clear, that the estimations of first and fourth experts are hitting confidence set as the two less distant from the medium estimation. The important characteristic of the confidence set T used in the course of analysis of the next round of expert examination is the radius of the confidence set R^T determined as

$$R^T = \max_{\widetilde{Q} \in T} \left(\rho_j\left(\widetilde{Q}, M\right)\right)$$

where M is the estimate which has become the medium. In our example, $R^T = 0{,}1013$.

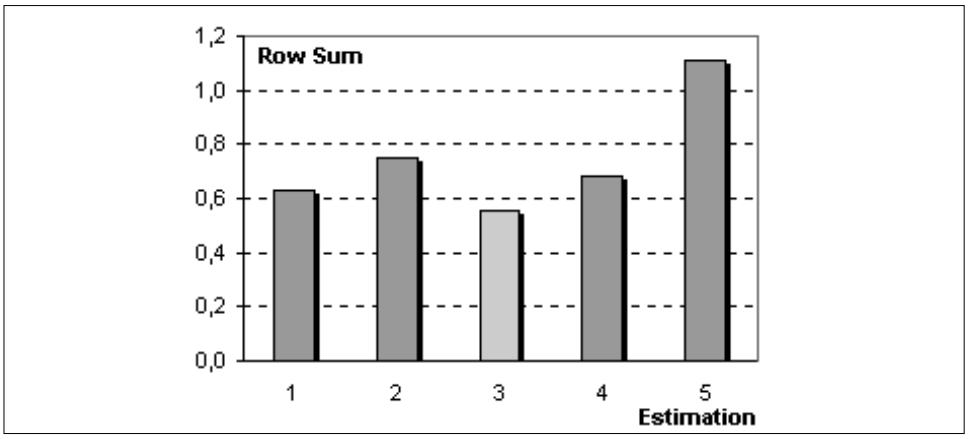

Fig.11. Row sums for estimations

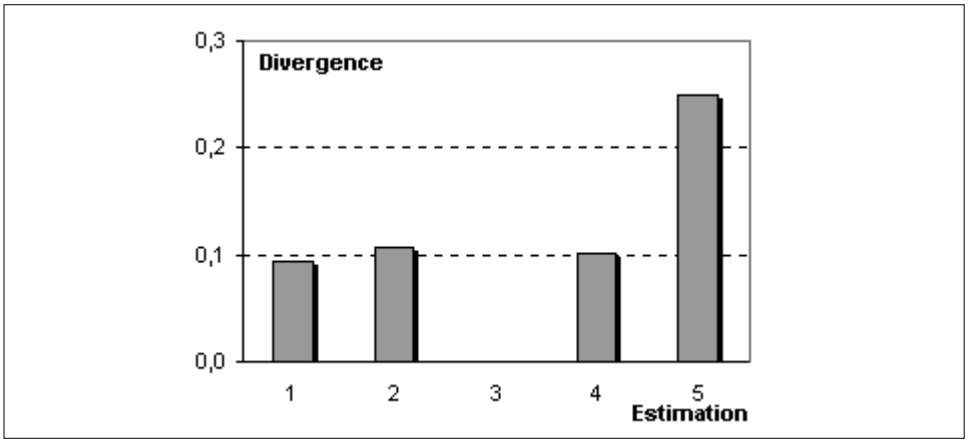

Fig.12. Estimations divergence

At the next rounds of the expert examination the experts are informed about the results of the previous rounds including the fact of each expert's estimation hitting or not hitting the confidence set. After that "the dissidents" are asked to reconsider their estimations and, in case of refusal, to give their arguments. The experts whose estimations hit the confidence set also may change their opinion. After receiving new estimations the medium estimation and confidence set are determined again, and for forming the confidence set, it is not the number of the estimates hitting it is fixed, but the radius R^T at the previous round level.

If in the obtained confidence set more expert estimates got in it than in the previous round, then there is the convergence of the experts' opinion. In case if convergence is also observed he subsequent rounds of expert examination, the expert estimation of the studied object properties is considered completed. The main criterion of completion of estimation of the studied object properties is when the number of expert estimates of each property of the studied object a priori assigned in per cent number hits the confidence set. The data of the confidence set for each property of the studied object is used for formation of the most agreed results of the expert examination.

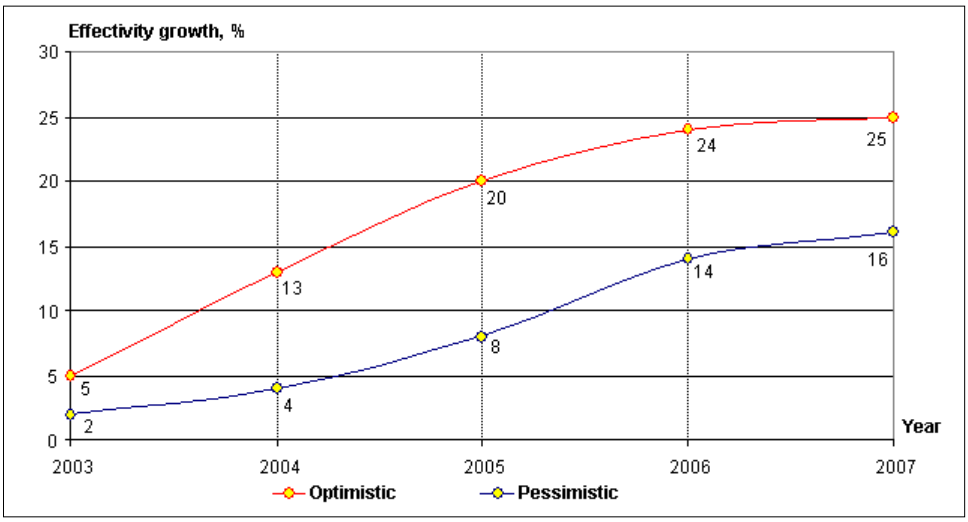

Fig. 13. Optimistic and Pessimistic Estimates

The highest and lowest estimates of the studied object properties form the sets of optimistic and pessimistic estimates, respectively (Fig. 13). These estimates are used accordingly for optimistic and pessimistic scenarios of development by the suggested algorithm. On completion of all necessary rounds of expert examination, when all experts have reached consensus, the resulting decision is taken which is proposed to a group of decision-makers in the form of a conception or strategy of development.

2. THE COMPLEX OF ACTIVITIES ON TECHNOLOGY FORESIGHT IN UKRAINE

Now let us consider **principles of technology foresight activities in Ukraine.**

Proceeding from the strategic plans of Ukraine's development till 2010 the only possible way of its revival is identification of priority industries and a set of so-called "breakthrough" technologies on which organizational, financial, scientific and industrial resources of the country should be concentrated and, as a result, to enter the world markets with a group of competitive products and technologies.

At present Ukraine is to find the answers to the following questions: what group of "export" products may bring success to Ukraine, what technologies are to be developed or bought for this purpose, what industries should be regarded as priority and, at last, what political, economic, organizational and other measures are to be undertaken. If we assume that accurate and objective answers to these questions are obtained, then a more complicated task will be set — that of taking and consistent implementation of the corresponding strategic decisions.

To know how to act, first of all, it is necessary to take into account the experience gained by the advanced countries of the world in which at the national level the problems of strategic planning of their development are being successfully solved and the plans are implemented.

Economic analysis of the priorities of technological development shows that application of new technologies can be characterized by several criteria.

Based on these criteria, one can present a list of the most advanced, in technological respect, sectors of industry depending on volumes of introduction of crucial technologies (the ordering of sectors corresponds to introduction amounts) (Table 3).

Table 3. Groups of most advanced sectors of industry

Index	Branch of industry
Volume of budget financing of the industries in concern with development of promising technologies and priority lines of scientific-technical development	Aviation Road construction and public construction Metal structures and wareMicrobiology Shipbuilding Machine-building (without electro-engineering) Apparatus production Coal. Fuel Electro-engineering
Volume of innovation costs	Power engineering, thermal power plants Shipbuilding Coal. Printing. Aviation Light industry Chemical and pharmaceutical industry Color metallurgy Electro-engineering
Introduction of new technological processes	Shipbuilding Automobile. Flour-milling Aviation Electro-engineering Machines and tools Tractors and agricultural machinery Apparatus production Production of household appliances and machines Production of plumbing and gas equipment and articles.
Manufacture of new products	Road construction and public construction Color metallurgy Automobile Flour-milling Repair of machinery and equipment Shipbuilding Light industry Machine-building (without electro-engineering) Machines and tools Printing
Specific volume of innovation costs in concern with introduction of new technological processes	Power-engineering, thermal powers plants Printing Light industry Wood-processing and paper industry Glass and porcelain industry Color metallurgy Chemical and oil-chemical Chemical-pharmaceutical Fuel Food industry
Specific volume of innovation costs in concern with mastering of new products	Fuel Shipbuilding Aviation Chemical-pharmaceutical Printing Electro-engineering Food industry Production of household appliances and machines Light industry Chemical and oil-chemical

These criteria were also prescribed on the basis of the National Technology Foresight program which was adopted by the Government of Ukraine in December of 2001 [3].

The program deals with the complex of technology foresight works at the governmental level.

The most significant elements of these activities are the following:

- Adoption of the state and national technology foresight program, as it has been done in the countries of "the big seven", European Union and a number of other countries which are following the intensive development road. Such program has been launched in Ukraine. We are to start its implementation.
- At the state level the steering committee on technology foresight is to be set up which should consist of representatives of supreme governmental bodies in charge of economic and industrial development of the country, authorized representatives of such major ministries as the Ministry of Economy and European Integration, Ministry of Finance, Ministry of Industrial Policy, Ministry of Education and Science, scientists of related profile, leading industrialists from strategically important regions and enterprises, outstanding public figures. (Fig. 14).

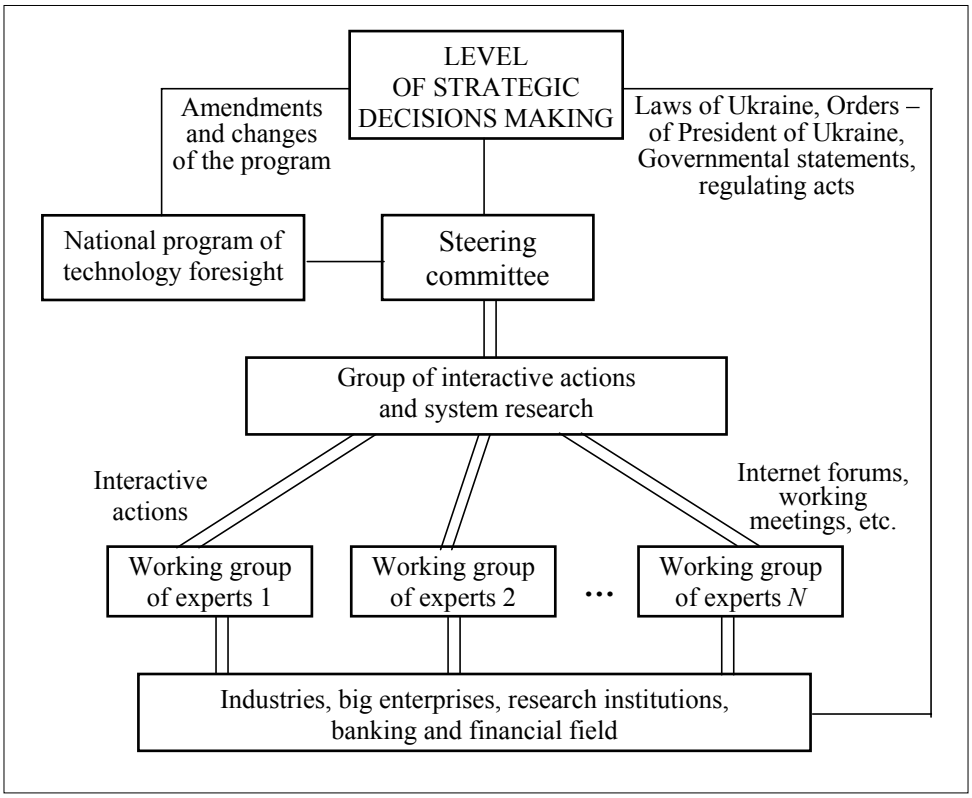

Fig. 14. Scheme of interactions of technology foresight works participants

- Setting up working groups of experts in the most important fields of industrial and scientific development of the country, these groups should consist of the experts of the highest qualification in the corresponding fields.

- Creation of the so-called group of interactive interaction and system studies which should consist of system analysts who will be able, on one hand, to work in the interactive mode with the working groups in each of the fields and, on the other hand, to carry out the necessary research, analyze, systematize and submit the obtained results to the committee. The latter will prepare its proposals in the form of draft of Laws of Ukraine, drafts of Orders of President of Ukraine, drafts of the governmental orders and regulatory statements, amendments and changes to the state program on technology foresight for the country leaders with the purpose of the final adoption of these proposals as strategic decisions.
- Selection of critical technologies and construction of optimal scenarios of development of the priority industries and the state industrial sector based on conduction of a complex of works on technology foresight.

In general these activities are divided into two qualitatively different parts – short-term and long-term foresight. The short-term foresight activities consist of identifying and referring to the group of critical technologies those important technologies which are already well developed in Ukraine and for which there is (or shortly there will be) demand in the world market. For example, for our coun-

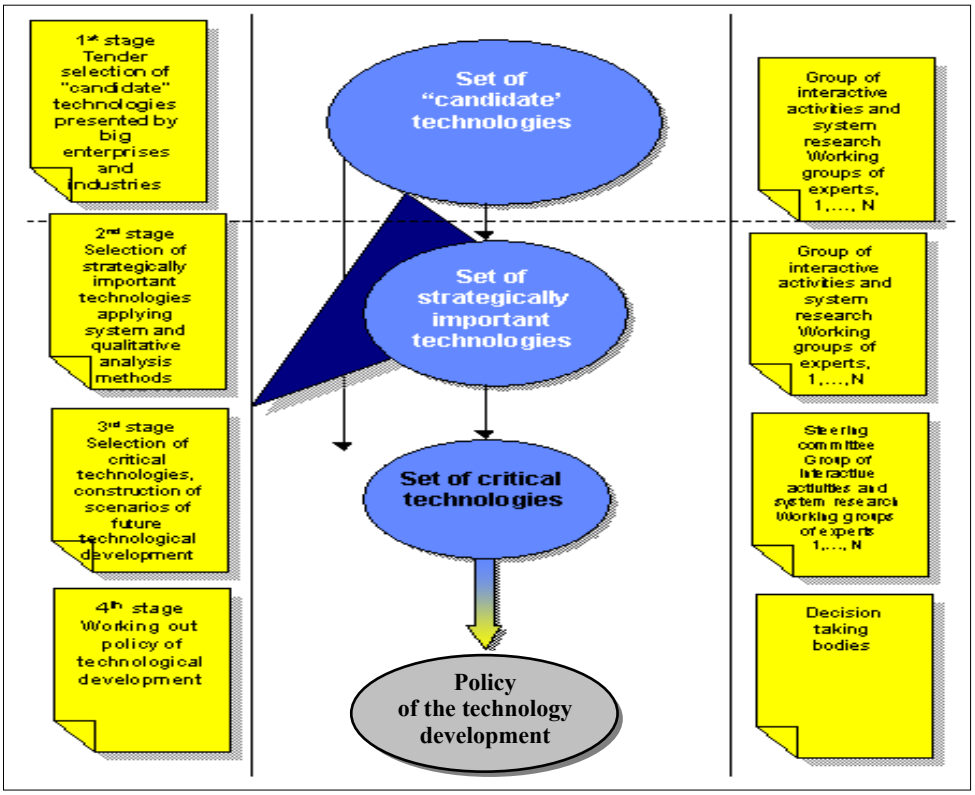

Fig. 16. Process of critical technologies selection (P. Bourgeois)

country to such technologies may belong space and aviation technologies. By applying the methods of system and scenario analysis along with the qualitative analysis methods for the group of critical technologies, the scenarios and policy of future technology development of the country for the period of 5 – 10 years are worked out. The process of selection of the critical technologies and formation of technology development policy is schematically shown in Fig. 16.

The long-term forecast activities are for the period of time up to 20 years and they are connected mostly with looking for new fields of activities in which Ukraine has good preconditions for entering the world market and construction of scenarios for conduction of the comprehensive complex of works aimed at creation of competitive critical technologies for these fields, provision of necessary organizational, scientific, financial and other support. For example, Ukraine has considerable unused resources in the field of production and highly technological processing of various agricultural products, in development of many types of high intellectual technologies with involvement of its own scientific potential (technologies of mathematical programming, biotechnologies, etc.)These programs should be strategic, long-term programs for the period of 20–30 years.

3. THE REGIONAL COLLABORATION ON TECHNOLOGY FORESIGHT

Today **the regional collaboration on technology foresight is very important for Ukraine, especially in terms of how UNIDO could promote this cooperation.** There are few important priorities for Ukraine.

- **First**, elimination of the consequences of the Chernobyl catastrophe, which require a complex of scientific and research measures to utilize the sarcophagus, ecological recovery of the vast territory of the Eastern European region (Ukraine, Belorus, Russia, Poland and other countries), putting the Chernobyl Power Plant out of operation and utilization of nuclear fuel. Solving this problem is of global importance and requires the efforts of the world community and involvement of advanced technologies from all over the world;
- **Second,** solving the problem of the Black Sea contamination and related problem of the Dnieper river basin. This problem causes concern not only of the countries of the Black Sea region, but also the countries of Europe and Asia, since solving these problems means reduction of contamination of such big rivers as Danube, Dnieper, Don, South Bug, Dniestr and others. Here one should take into consideration the extraction of oil and gas in the Black Sea shelf and other aspects that influence the Black Sea contamination. The cascade of hydroelectric plants on the Dnieper has already caused the climatic changes in Ukraine and a distortion of balance at least at one stage may result in regional catastrophe. This global problem is to be solved by the international community involving the most progressive technologies.
- **Third,** solving the problem of flooding and soil shifts in the Carpathean Ukraine, Slovakia, Hungary, Romania. The global warming up, unreasonable felling of the woods, deviation from the required technologies during dam construction result in tragic consequences in this region.

One country of this region alone cannot solve the above problem. It is by common efforts of many countries applying new progressive technologies and creating principally new technological solutions that the negative ecological consequences in these regions can be reduced.

In its turn, possessing considerable scientific and technological potential Ukraine can suggest to international community cooperation in the field of avia-

tion and space technologies (the "Sea Launch" project, joint manufacture of AN-140, AN-70 airplanes and others), resources and energy saving and management (economical heat power generating technologies), development of new substances and materials (materials with shape memory properties, bio-compatible materials, materials with controllable functional properties), protection of natural ecosystems and improvement of people's living conditions (technologies of drinking water purification, technologies of agricultural wastes processing) and others.

4. CONCLUSIONS

- Technology foresight is a very complicated process which is characterized by considerable scope of research of interdisciplinary nature, voluntary nature of criteria and objectives selection, presence of significant portion of so-called **empiricism** and indistinct foresight process, which causes certain risks of "not feeling" or "not seeing" some important (critical) technology of the future. However, as the experience of all developed countries of the world which are actively struggling for possessing natural resources and markets for selling products and technologies has shown, there is no alternative to this approach. It has becoming the necessary tool for governing institutions of all levels, from state and industrial which are responsible for economic and industrial development of the country to the management personnel of a separate enterprise, company or non-government organization in the course of taking strategic decisions.
- Irrespective of the fact that technology foresight is an attempt to look into the future, it should rely on realistic basis. Therefore, in the course of technology foresight one should observe the condition that any desirable object of material culture the creation of which is foreseen and expected by the society should be demanded at the given stage of its development, and the material culture itself must be able to create such a product.
- Methods of technology foresight and procedure of their application in this or that field of human activities vary considerably. The invariable is the system and scenario analysis methodology and the philosophy of innovation and renewal, which demands training a new generation of specialists capable of large scale, interdisciplinary, system thinking, able to effectively apply technology foresight with the purpose of innovation development of a country, region or enterprise.
- Some countries, Ukraine among them, may consider that due to methodological complexity and considerable expenses required for practical implementation of technology foresight, it would be much easier and cheaper to buy the results of its application for the similar branches in other countries and to use the results, however, it is impossible, since groups of participants of innovation development and connections between them in each country have their peculiarities. Therefore, it is practically impossible to find two identical systems in the world. As a result, the outputs of technology foresight and conclusions drawn for different systems would principally differ. Therefore, each country, and in the first turn Ukraine, should independently sort out the problem of innovation development.

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