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SELECTION OF FUTURE TRANSPORT TECHNOLOGIES IN SILESIA WITH FORESIGHT METHOD

Summary. The article presents results of foresight project research over transportation and transport infrastructure for the Silesian Province until 2025. Technological development scenarios creation procedures were taken under special consideration.

WYZNACZANIE PRZYSZŁOŚCIOWYCH TECHNOLOGII TRANSPORTOWYCH DLA ŚLĄSKA METODĄ FORESIGHT

Streszczenie. Artykuł przedstawia wyniki badań analitycznych typu foresight z zakresu rozwoju transportu i infrastruktury transportowej dla województwa śląskiego do 2025. Szczególną uwagę zwrócono na procedurę budowy scenariuszy rozwoju technologicznego transportu.

1. INTRODUCTION

Cognition or forecasting future, and in peculiarity settlement how the most important economic tendencies will shape in future assumes to be a principle issue for economy of territorial councils as well as strategy management of enterprises.

With this reason many transactors often undertake the tests of analysis of future trends. Their attempts however are mostly short-term because of the large uncertainty of innovation development. The temporary horizon of accepted decisions about material and financial investments it usually carried out for 3 till 5 years. In the case of large investments, which return time is many times longer (e. g. the transport infrastructure financing) or such ones, which realization requires commitment of many sides, considerably longer time horizon should be taken under attention.

In the face of above mentioned many fields of science dealing with future visions investigations came into being (so-called: future studies). Among them there's a useful in many countries method, which gains more and more larger popularity "the active building of future vision" method - foresight.

The foresight research is the process involved in systematically attempting to look into the longer-term future of science, technology, the economy, the environment and society with the aim of identifying the emerging generic technologies and the underpinning areas of strategic research likely to yield the greatest economic and social benefits [3].

Systematic building of middle- and long-term developmental visions, their directions and priorities requires commitment of many sides: businessmen, scientists, representatives of public administration, non - governmental and social organizations as well as politicians. So as to the dialogue among above mentioned participants, representing their varied opinions in their known fields, was possible, the whole scale of methods for creating, sorting and assessment of such wide expert knowledge is indispensable.

Theses palette of methods consist, among other things, of:

- methods supported by expert knowledge – e. g. the Delphic method, discussion panel, brainstorming, STEEP and SWOT methods of analysis, social consultations, building scenarios of development;
- quantitative methods, supported by analysis of statistical data - e. g. the extrapolation of trends method, modeling, the cross-impact analysis of influences;
- methods useful in identification of key activities – e. g. key (critical) technologies, tree of references [1].

On every stage of foresight project depending on its character and range different investigative methods are being applied.

2. SCENARIOS CREATION ALGORYTHM

Transport technologies development scenarios for the Silesian Province were created while realizing the frames of works of Panel No. 6 "Transport and transport infrastructure", distinguished as one of seven working groups in foresight type project, entitled: *"Priority technologies for sustainable development of Silesian Province",* co financed by European Union funds.

Silesian University of Technology in Gliwice was the co-ordinator of this project, and besides it, a second higher university participated in scientific consortium (Academy of Economics in Katowice), research and development organization (Central Mining Institute in Katowice) and representatives of territorial council (Silesian Marshal Office in Katowice) [2].

Work over the project begun with division into individual thematic groups, and putting organizational frames for each panel by appointing experts for every thematical group.

Scenarios creating in every expert panel, as well as for the sixth was being proceeded according to equal algorithm, shown on fig. 1, hereinafter the comparison of individual thematic groups work was able.

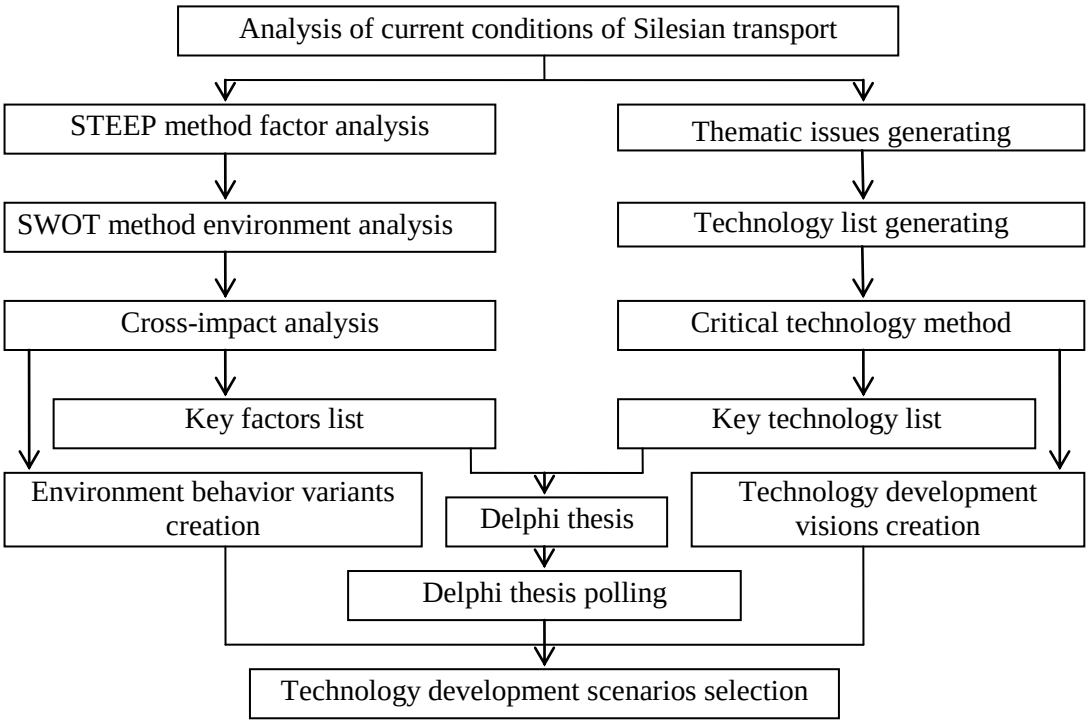

Fig. 1. The technology development scenarios creation algorithm with foresight method
Rys. 1. Algorytm budowy scenariuszy rozwoju technologicznego metodą foresight

Realization of panel's tasks begun from accurate analysis of present state of transportation in Silesian Province as well as the character, range and subject matter of already carried out world projects of foresight type with worldwide or nationwide reach.

The works of a panel were based on the SWOT analysis, which indicated out the biggest strengths and weaknesses as well as opportunities and threats having biggest influence on transport technologies functioning and development in Silesia. These groups of external factors in the method were considered, which was received as the result of the previous STEEP analysis realization (the factors: Social, Technological, Economic, Ecological the and politically - legal).

Thanks to structural analysis of influences, the list of key (critical) factors was selected (the matrix of factors was created), which have the largest influence on development of key technologies, and basing on them, four variants of their behavior were worked out: optimistic, realistic, stagnating and pessimistic.

Then, the experts' panel task was to assessment of growth, decrease or lack of external influence on every earlier chosen factor with regard to foundations of individual variants of environmental behavior.

At the same time, experts' panel with creative method of brainstorming prepared the areas of interests, and then specified the list of technology related to transportation and infrastructure transport. With the method of key technologies the ones from the list were assessed according to two criterions: importance (attractiveness), and also feasibility. The following list of key technologies for development of Silesian Province was received:

1) Technology of charge collection in public transportation and transport infrastructure utilization
2) Monitoring systems for traffic and information management for users and for traffic streams and transport demand identification
3) Tram-railway and light city railway technologies in the service for metropolitan areas
4) Technology of fast railway connections in regional traffic
5) New solutions of means of transport drives (also: alternative fuels)
6) Intermodal technologies and new generation of container terminal equipment

Those key (critical) transport technologies for Silesian Province may be divided into three groups according to these categories:

- technologies that allows to cope with the transport demand (technologies 1 - 2),
- system technologies in passenger transport (technologies 3 - 4),
- technologies of new technological and informatics solutions (technologies 5 - 6).

Basing on the key technologies and key factors lists together 32 delphi theses were then worked out on the basis of the experts' discussion. Every delphi thesis has been estimated by 90 consulting expert taking part in the research according to: the realization time, work that should be undertaken to realize each thesis as well as the influence that a given thesis will be put on improvement of transport situation in Silesia.

On the basis on the list of key technologies the visions of technological development has been worked out. Every vision characterized with different collection of technologies, according to the matrix, where technologies were placed in the lines and four visions in columns (tab. 1).

First vision entitled **"The vision of development of intelligent transport systems"** foresees the wide use of ITS technologies in transport in the area of Silesia, both in steering of the traffic flows and vehicles, as well as in charging fees in public transport and obtaining information for rational and effective transport system management purpose.

Second vision, which is **"The vision of integrated public transport development"** is based on the assumption that strengths and means will be targeted on efficiency increase and public transport organizational improvement.

In third vision: **"The vision of sustainable development of regional transport system"** assumed that the financial means on the investigation and development of transportation will be sufficient to harmoniously improve new transport systems in regions, and so the innovation in transport infrastructure's development becomes one of the most important priorities Silesian development economic growth.

Table 1

Matrix of visions

Key technologies list	Vision 1	Vision 2	Vision 3	Vision 4
Technology of charge collection in public transportation and transport infrastructure utilization	×	×	×	
Monitoring systems for traffic and information management for users and for traffic streams and transport demand identification	×	×	×	
Tram-railway and light city railway technologies in the service for metropolitan areas		×	×	×
Technology of fast railway connection in regional traffic		×	×	×
New solves of means of transport drives (also: alternative fuels)			×	×
Intermodal technologies and new generation of container terminal equipment	×		×	×

Fourth vision: **"The vision of new transport technologies initiation"** is a result of conviction that the technical development of means of transport will be dominant for improvement of transport services will make possible to satisfy transport needs of Silesian society.

In multi-criteria scenarios of technological development creation, it is necessary for a panel of experts to establish the probability of appearance of each vision when given variant of environmental behavior would turn out. The influence of behavior variants on the key factors chance of realization was assessed with 1 to 5 scale, where 1 means low chance of appearance and 5-high. Tab. 2 presents the averages results of the experts' opinions.

Table 2

Matrix of visions and environmental behavior variants combination

Key factors behavior variant	**Vision 1**	**Vision 2**	**Vision 3**	**Vision 4**
	Development of intelligent transport systems	Integrated public transport development	Sustainable development of regional transport system	New transport technologies initiation
I. Optimistic	4,08	4,25	3,83	**4,33**
II. Realistic	3,50	**4,33**	3,58	4,17
III. Stagnating	2,50	3,25	2,67	**3,42**
IV. Pessimistic	2,00	1,83	1,75	**2,25**
TOTAL	**12,08**	**13,66**	**11,83**	**14,17**

As the tab. 2 presents, the biggest possibility of realization with optimistic variant established vision 4 has, for realistic variant - vision 2, for stagnating variant - vision 4 and for pessimistic one - vision 4. This also means that for all established variants of environmental behavior (the total) the largest chance of realization has the vision 2 and 4. Vision's 4 highest possibility of occurrence is for variant I of key factors behavior and that is why it may be named: **the optimistic scenario**. Biggest chance of realization for vision 2 is observed when variant II would occur - **the realistic scenario**.

3. SCENARIOS CHARACTERISTIC

The optimistic scenario implicates as a leading vision: new transport technologies initiation. Technologies 3-6 were numbered among them.

In case of tram-railway, light city railway technologies in the service for metropolitan areas as well as technology of rapid railway connection in regional traffic, they all present their research state as level of commercial initiating. Since, on the market, there are many technological licenses, as well as finished trains or transport management systems accessible.

Rapid regional railways should be used at those routes, where passengers' flow is comparatively large, which can contribute to continuous usage of rail transport by already existing customers.

The modern solutions of means of transport drives, which can be used in public transport vehicles and mechanical handling machines, have to be characterized with energy low consumption, it should not to call out the ecological threat as well as high exploitation of mechatronics. Some of the modern technologies which fulfill these conditions are: hybrid drives, plants origin fuel as well as engines with hydrogen drive.

In order ,decrease of emission of fumes as well as working expenses for Silesia, it seems very rational to the investigations over alternative fuels introduction and initiating to practice and launching production of hybrid drives in buses of Upper-Silesian Agglomeration.

The aim to growth of "integrated loads" goods transport both road as well as rail and water. Technology and organization of this type of transports here seems to be unusually essential. The smooth passage between rail on road transport (or inversely) if it would be possible was to realize a combined transport system which enlarges forwarding efficiency of this system, without need of excessive infrastructural investments.

Basing on the key technologies used in the scenarios and results of delphi method polling, technology roadmapping of each scenario was able. To create a road map it is needed to identify technology alternatives and their timelines. These steps create the actual roadmap. Fig 2. presents an example of road map for optimistic scenario. Similar one has been done for the other scenario.

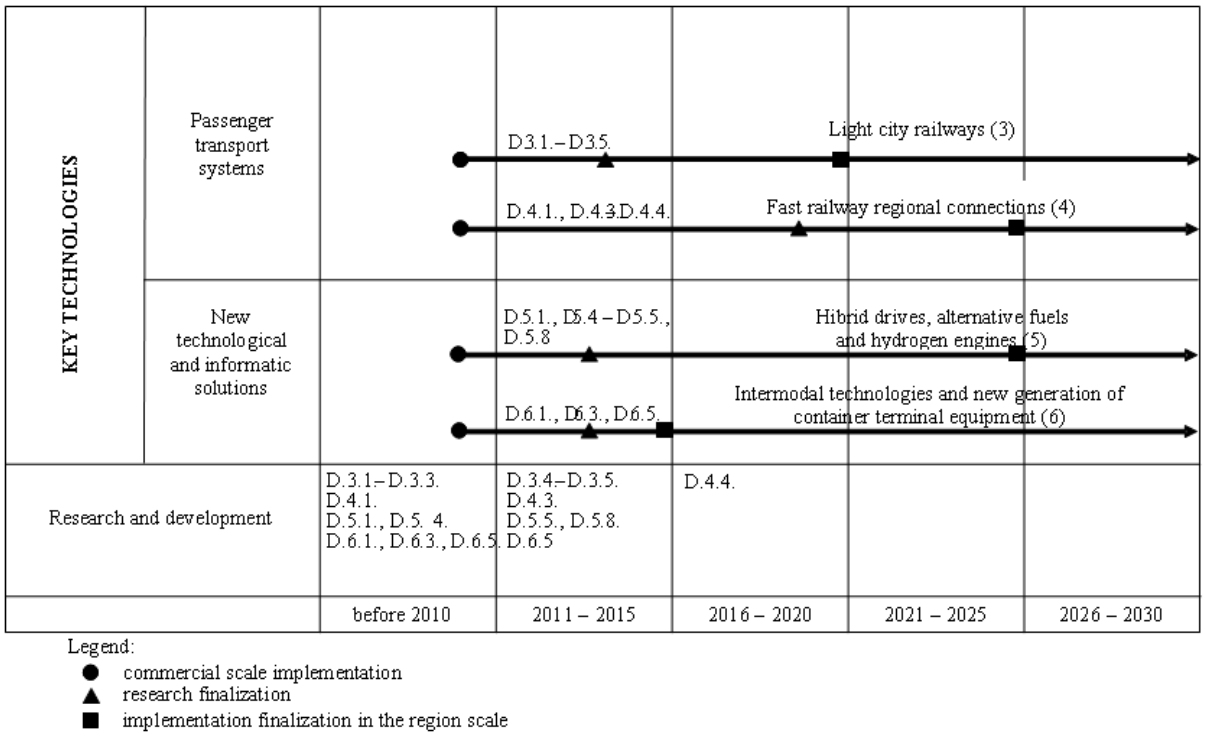

Fig. 2. Optimistic scenario of transport technology development road map
Rys. 2. Mapa drogowa dla scenariusza optymistycznego rozwoju technologii transportowych

Captured in the presented scenario the processes of transport development technologies should be realized while regional conditions generate surroundings for their realization extremely favorable. The processes of initiating the proposed scenario technologies in regional scale will end in years 2015-2025.

The realistic scenario brings into groups technologies that allow to cope with the transport demand and system technologies in passenger transport. It implicates the vision of integrated public transportation development, which contains the technologies 1 to 4.

At present in stage of development of transportation conceptions of solutions aiming to match growing economical and social demand on transport are most necessary. The technologies of intelligent transport systems (ITS) are one of them. Their main task is increasing the efficiency of existing infrastructure without the necessity of its extension. The technologies proposed in remaining realistic scenario concern people transport systems.

The transport development technologies discussed in the scenario should help to obtain by the region status of area with modern public passenger transportation in cities and in the whole province.

The process mentioned above will continue in reasonable conditions of simultaneously harmonious development of regional economy. Taking over the initiatives by regional council is the most important indispensable factor (among other things: by financial supports of regional initiatives with national and European funds) for success of realistic scenario.

4. CONCLUSIONS

Building the scenarios of transport development technologies, as one of the finishing method of foresight procedure is a long process which involves commitment of many persons (experts) as well as use of a dozen or so methods. The works of Panel No. 6 allowed to point out these technologies, which can contribute to largest economic development of Silesian Province in years 2008 - 2025 in the field of transportation and transport infrastructure.

Transport technologies specified in scripts will require the concentration on them, works connected with fundamental researches, possible to be realized on higher universities as well as individuals research and development enterprises located in Silesia.

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