Rubric 4. ECONOMIC TRANSPORT

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INSTITUTIONAL FORMS OF PROMOTION OF MAGNETIC LEVITATION TECHNOLOGIES AND THEIR IMPLEMENTATION IN THE ECONOMY OF THE RUSSIAN FEDERATION

Background: Industry 4.0 involves transition from industrial organization of production to the dominance of post-industrial technological paradigms. Magnetic levitation is one of the promising technologies of transport.

Aim: to justify the choice of institutional forms, which encourage promotion of innovative technologies (including magnetic levitation technologies) in the real economy of Russia.

Methods: to achieve the goal, such general research methods as analogy, comparative analysis, generalization, hypothetical method, historical method, and system's theory have been used.

Results: the relevance of carrying out fundamental foresight to determine perspectives of using maglev systems in the national economy has been substantiated. It has also been suggested that, in order to intensively *promote* maglev systems innovative projects, a special fund for their introduction into the real sectors of the national economy through civil institutions should be established. Finally, options, and developments in certain cases, of elaboration of target programmes initiated by the authorities are considered.

Conclusion: the realisation of the proposed measures through civil institutions and the authorities will result in determining the longer-term prospects for maglev technologies market development. The foresight project will provide opportunity to actuate the society on the issue of maglev systems development, considering differences between own interests of the groups involved, and to outline pixelated scenarios of the forthcoming future in terms of maglev transport as the product of the Industry 4.0 and transition to post-industrial technological paradigm predominance.

Keywords: Industry 4.0, technological paradigms, foresight, maglev technologies, innovative development fund, target programmes.

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ИНСТИТУАЛЬНЫЕ ФОРМЫ ПРОДВИЖЕНИЯ МАГНИТОЛЕВИТАЦИОННЫХ ТЕХНОЛОГИЙ И ИХ ИСПОЛЬЗОВАНИЕ В РОССИЙСКОЙ ЭКОНОМИКЕ

Революция 4.0 предполагает переход от индустриальной организации производства к господству постиндустриальных технологических укладов. Магнитная левитация относится к перспективным транспортным технологиям.

Цель: обосновать выбор институциональных форм, стимулирующих продвижение инновационных технологий и техники (к которым относятся магнитолевитационные технологии), в реальном секторе экономики России.

Методы: для достижения поставленной цели были использованы такие общенаучные методы исследования, как аналогия, сравнительный анализ, обобщение, гипотетический метод, исторический метод, системный подход.

Результаты: обоснована целесообразность проведения фундаментального *Форсайта* по определению перспектив использования магнитолевитационных систем в отечественной экономике. Предложено для интенсивного *продвижения* инновационных образцов магнитолевитационных систем создание специального фонда по их внедрению в реальные сектора отечественной экономики по линии гражданских институтов, рассматриваются варианты в отдельных случаях разработки целевых программ со стороны властных структур.

Заключение: в результате реализации предложенных мер по линии гражданских институтов и властных структур будут определены долгосрочные перспективы развития рынка магнитолевитационных технологий. Форсайт-проект позволит активизировать общество по вопросу развития магнитолевитационных систем с учетом различия партикулярных интересов заинтересованных групп и сформировать пиксельные сценарии приближения будущего в части применения магнитолевитационных технологий как продукта Революции 4.0 и перехода к господству постиндустриальных технологических укладов.

Ключевые слова: Индустрия 4.0, технологические уклады, Форсайт, магнитолевитационные технологии, фонд инновационного развития, целевые программы.

INTRODUCTION

Magnetic levitaiton has a relatively short history. A significant amount of researches and developments was carried out in XX century. Large contribution to design of levitation system, namely levitation in vacuum medium, was made

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by Russian scientists. In 1960s, the USSR was one of the world leaders in maglev systems development.

It is known that the first magnetically suspended train, i.e. "the novelty" turned into commercial offer, or "innovation", carried a group of passengers within Germany hosted International Symposium on Traffic and Transportation Technologies (IVA) in 1979. But there are few who know that in that very 1979, the Soviet maglev TP-01 ran its first metres at a test facility. The Soviet maglev vehicles have been preserved up to present days [1]. Notwithstanding, the level of application of these technologies in the national economy is fairly low both in the real economy and in the applied developments sphere. In other countries apart from continuing researches in this field, there is also commercial application of these technologies. For instance, China operates Shanghai maglev, built on the basis of the German Transrapid; Japan operates urban Linimo system; South Korea built ECOBEE line [2].

Further prospects of application of maglev are attractive with its rapid transport opportunities, application of magnetic bearings in key joints of mechanisms [3].

Thus, the forging of a technology and its commercial application differ just in the same way, as "novelty" differs from "innovation". By "innovation" the innovations introduction activities' *final result* is implied, which is embodied in the form of a new or a modified product *introduced on the market*, a new or a modifed process used in organisational activity, or a new approach to solution of social problems [4].

In the present article, the authors undertake to suggest certain institutional forms, that incentivise promotion of maglev technologies and their application in the national economy.

MATERIALS OF RESEARCH

There are no significant discrepancies in the literature, whether or not maglev technologies are worth studying. The point that more often sparks disputes is whether to use opportunities of those right now, as was done in the USSR in 1979, or the right time has not come yet. To avoid exhausting the readers of the article with a review of advocates and adversaries of maglev technology application in the national economy, let us focus our attention on the very circumstance that industrial development has its own logic. We assume that innovative development of the national economy is on the point of transition to post-industrial technological paradigm predominance [5].

The evolutionary nature of technological paradigms change, from our point of view, has the following tendency: from home-made production, in which almost all products were unique and were built according to client's individual demands; through machine production, providing mass supply of single-type

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products; to individualised mass production, able to mass-make products and serve individual demands of customers. Simple cooperation and labour distribution, which are characteristic of pre-industrial or home-made technological paradigms, lose their dominance in the industrial economy. The industrial technological paradigms, resting on factory organisation and further on − conveyor manufacturing, correspond to the third and the fourth technological paradigms. The latter ones prepare the ground for emergence of post-industrial technological paradigms, using hard (automated factories) and soft automated modules, which rest on application of standardised spare components and expensive creative labour of small number of workers.

In any economy one can trace this or that combination of technological paradigms. Innovative process manifests itself in a gradual replacement of the previous technological paradigms with the new ones, whose roles are not similar. Among the technological paradigms, there is always a leading, *dominant* one, or the major paradigm. Therefore, modernisation of the economy is viewed as the process of displacement of the previous dominant technological paradigms with others, which to a greater extent meet the demands of today. To assess the extent of the technological paradigms is possible by determining volumes of products manufactured, made with the help of technologies of various paradigms [6].

This means that just like the Industrial Revolution outpaced pre-industrial and home-made paradigms, Industry 4.0 will lead to end of the industrial stage dominance in the national economy development, and give start to dominance of post-industrial technological paradigms [7].

Change from steam power to diesel one, followed by electric one, corresponds to the first three industrial revolutions within the industrial technological paradigm. Other technologies, which do not base on wheel-rail concept, are the technological of post-industrial paradigms. Promotion of such technologies fosters abandoning industrial technologies for post-industrial way of national production organisation.

Generally, Industry 4.0 will influence consumers' expectations, improvement of products and goods, innovative development pace, and organisational forms. Authorities will acquire new means to enhance control over population, owing to powerful tracking systems and possibility to control digital infrastructure. Industry 4.0 will change not only what humans do, but humans themselves as well. It will influence humans' identity and everything that is connected with it. Professor Schwab sees three reasons why today's changes should be considered not merely a prolongation of the Third Industrial Revolution, but the arrival of Industry 4.0. These are the speed of changes, their scope, and systems impact [8]. Considering this tendency, efforts should be concentrated on development of engineering relating to post-industrial

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technological paradigms. It is this type of engineering that maglev systems are part of.

RESULTS

Promotion is a marketing tool. Within the whole complex of marketing activities, in promotion there is formidable role of such constituents as *advertisement, direct marketing, personal selling*, as well as tools, such as exhibitions and fairs, but most important − *public relations*. The first classic book on Public Relations, PR, by Edward Bernays published in USA in 1928, was titled "Propaganda". The author views propaganda and PR as equipollent tools for manipulation of public opinion, and considers it possible to use in political PR competitive fighting methods, accepted in business. The term "PR" means usage of certain technologies to effectively incorporate any theses into mass conscience of citizens and into activities of business institutions, society and authorities. According to Edward Bernays, PR is efforts aimed at *convincing the public* to change their approach or activities, as well as at harmonising activity of organisation with interests of the public and vice versa [9].

Promotion of post-industrial transport technologies, maglev systems in this case, means striving to convince the public in relevance of their application in national production. In order to systemise this work, it is relevant to use capabilities of either civil institutions or power of authorities. As a *civil institution*, a special *investment fund* is required to be established to support economy applicable maglev systems, and the purpose of the fund would be not support of researches or design of test samples, that is maglev novelties, but technical samples to be incorporated into industrial exploitation. The fund is to partially compensate for company's expenditures, which operates machinery employing post-industrial technology. This is the first that may be offered as institutional form that incentivises promotion of maglev systems.

In the real economy, there are many techniques for promotion of maglev systems application ideas, and one of them is one of the most up-to-date, that is the foresight technology.

Today's foresight is used as system's tool for influence on shaping of the future and its approach, considering potential changes in all spheres of public activity: science, technologies, economy, social relationships, and culture. Foresight is viewed as the newest technology, which allows participating actively in shaping of the future, most successfully coordinate own interests of the participants of the changes, and looking into the future. In other words, on the basis of received collective experts' assessments, a proactive representation of the forthcoming changes in the reality is shaped in the longer-term perspective. The foresight [10] is different from almost all known scientific forecasting tools in a way, that it not only provides for participation of many

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interested layers of the civil society in the shaping of the forecasting image, but calls participants for active actions to realise the changes suggested by them themselves. And it is desirable that emerging civil initiatives should be coordinated to some extent. And although the foresight fosters aspiration to develop consensus among active representatives of the interested layers of the society, it does not persuade anyone to damage their own private interests. The foresight is a new forecasting technology, by virtue of which discussion of potential changes takes place. In other words, it is forecasting of new phenomena and processes, maturing in today's reality.

This tool started spreading especially intensely in the European Union from 2000 when the Lisbon Strategy was adopted [11], which benevolently suggests that all EU states use the innovative tool, that is the foresight technology [12–15].

France's experience in employing the foresight (Greater Lyon, Grand Lyon in French). In December 1997, the mayor of Lyon Raymond Barre (French Prime Minister in 1995–2001) launched a project (the first foresight project in France) focusing on sustainable development of the city. Now Lyon is a smart city, where the biggest innovative centres of the country are concentrated, and broad-scale construction using innovative technologies is underway. It is a platform for inventive minds, sustainable growth and harmonious life.

Experience in application of the municipal foresight in Great Britain. Manchester is a city and municipal district in Northwest England. In 2003 on the initiative of the University of Manchester, it was proposed to conduct the foresight study to carry out strategic review of Manchester Science Park (joint vision of universities' future development, roadmapping). Now the University of Manchester ranks among the world-class universities, and attracts foreign investments of transnational corporations and entrepreneurs. It is characterised by well-developed intellectual network – companies of various sizes and ages are in constant search for knowledge and people.

Similar results are ensured by the foresight in the field of technologies as well. The foresight itself is a relatively new technology, by virtue of which the discussion of potential changes in the future is held. This is done through consolidation of efforts of active participants of changes forecasting process in the chosen segment by highlighting effects and processes, which are deemed to become *dominant* in the future. The foresight is essentially a periodically renewable process of coordinating efforts of interested participants in terms of future shaping. Just like under influence of magnetic field metal chips arrange into a certain pattern, the foresight fosters coordination of multidirectional initiatives of various groups of active participants.

In 1972 in USSR, under the aegis of the Gosplan (the State Plan), Gosstroi (State Committee for Construction in the Soviet Union) and the USSR

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Academy of Sciences, the draft Integrated Programme of Scientific and Technical Progress and its Social and Economic Outcome (hereinafter – the Programme) was developed. On July 12, 1979, the Central Committee of the Communist Party of the Soviet Union and the Council of Ministers of the USSR adopted Resolution "On Improvement of Planning and Strengthening of Influence of Economy Mechanism on Increase of Production Efficiency and Labour Quality", which included elaboration of the Programme for a period of 20 years. It was planned that every five years the Programme should be prolonged for another five year period and supplemented with modifications. The Programme was developed for 1981–2000, 1986–2005, and 1991–2010 [16].

The foresight projects are unique events. As to the foresight project relating to maglev technologies development prospects for the national economy, it can be noted that to realise those, the *thematic*, to be more precise, the *fundamental* technology-directed foresight should be used, and apparently this should be top-down.

The first criterion by which the foresights differ, is consideration of anticipated changes in technologies. If forecasting is built involving new technologies, patents, new technical solutions, then this foresight is a *technological* one. This is inherent to earlier stages of the foresight technology evolution. If in the process of forecasting no focus is made on dominant technical solutions, but transformation of social relationships is the subject of consideration, then we deal with a *social* foresight. Accordingly, the foresights are divided into technological and social by their focuses.

In certain projects the initiative is top-down and interrelation is given little significance. To have these projects as the foresights, it is necessary that they engage a wide range of source data, which are processed by a small pundits group. The group should be composed of representatives of various interests, that is they should not be various fields forecasting experts only, but practitioners as well (i.e. businessmen or politicians).

The groups should use data and findings obtained from most various participants. Frequently, in this process formal methods are used, such as the Delphi method. Open discussions are possible. Final materials are reflected in the findings, obtained by a group of pundits.

It is not a rare case that several expert groups work in parallel on different topics, and the responsibility for consolidation of the findings obtained is within one group's scope. The main difference in this kind of approach to the foresight from a more narrow forecasting initiative lies in its openness to many other individuals' data, as well as in the form of communication while making decisions.

In the projects where the initiative is bottom-up, much significance is given to interaction between the participants, in particular to consideration of

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opinions as to who should participate in the project delivery. There can be opinions on forming of the future, contents (i.e. scope of topics under study), how and whom to address the messages, etc.

One can use a wide range of methods to ensure expression of opinions: discussions on websites, live and special group meetings, presentations at forums. Certainly, the necessity in coordination of participants' interest is recognised, and some of the committees or teams are tasked with preparation of final declarations and plan of actions. However, even the outside-of-attention participants have an opportunity to come to their own conclusions, meeting their organisational requirements.

It is necessary to mention the foresight projects containing elements of the two approaches. The bottom-up approaches are in advantageous position, i.e. they allow assembling fairly extensive information out of a large number of sources, increase legitimacy of the activity, and can provide big profits. These projects require time, careful planning and organisation, i.e. they cannot be realised hastily or without substantial preparation. Moreover, they are hard to control, they pose risks of emergence of politically motivated views or ideas, that can rise as a result of the foresight project realisation, its shapes or actions of its participants, who are in decision-making process. Of course, this drawback is characteristic of democracy of any forms, and the foresight bottom-up projects can be viewed as an attempt to engage the largest possible number of people in the process of political decisions making.

Thus, the second criterion of the foresight typology is how exactly the project is delivered. By their formation type, all foresights are divided depending on which type of view on the development process is prevailing: top-down or bottom up.

Classic, or *fundamental* foresight projects are realised within a long timeframe (at least one year), build on multiple rows of surveying various groups of experts using ranges of methods, the Delphi method in particular, with broad mass media coverage, at final results workshops and conferences, and preparation of a pilot report.

Sometimes the rapid projects are completed, without using in-depth forecasting methods. The importance of such projects should not be underestimated, but they cannot be called fundamental as well. The rapid foresight is a foresight project with duration from three to six months, without using the Delphi method.

Besides, there are foresight sessions conducted for period of one or two days. Usually, during the foresight sessions simulation of the technology foresight takes place, which is brought down to conducting one (and incorrectly organised) brainstorm. Thus, the third criterion of the foresight is discrepancies in the depth: fundamental or rapid foresights.

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The foresight is widely employed in military, social and political spheres. For instance, such projects as national health foresight or education foresight are classified as thematic. This type of the foresight can include the Foresight for Transport [17] as well, which was supported by the European Commission under the "Competitive and Sustainable Growth" Programme (1998–2002).

There are also *corporate* foresights as well, which received less coverage in literature. This is not surprising, because in the documents covering these studies, there are strategic plans for development, which are expected to grow into competitive advantages of the companies. However, some distinctive features of such foresight studies can be highlighted. The features of the corporate foresight studies and their differences from the general technological foresight are presented in the work by P. Becker [18].

If the foresight initiators have become interested in their company's future state, then they ponder, what their company's competitive position is and what changes there will be in high quality production and services, which might decrease the company's competitiveness and sustainability. Consequently, the foresight initiators are eager to assess the competitiveness and sustainability of the company in the longer-term vision and outline departure points in the company's corporate strategy. The aim of the foresight project is to jointly find ways to enhance company's competitiveness and investment attractiveness in the long-term perspective for new products and services, new technologies application, and personnel training. This type of the foresight project targeting company's fate forecasting was named corporate foresight.

It needs pointing out that the foresight is conducted at the national, regional, and corporate levels. In Great Britain, for instance, small and medium sized foresights were conducted, as well as the youth foresight for attracting young people into scientific and technical activity. Western Europe uses the foresight more frequently at national and regional levels, whereas in USA the corporate level foresight became widespread [19].

The territorial foresights are quite widely-known and involve vision of development of a certain country's economy, or that of a region or several countries. The territorial foresights are classified (by their geographical scope) into interregional, national and regional). In the interregional foresights, as a rule, attempts are made to identify key economy development tendencies in several countries.

The fourth criterion of the foresight typology is the subject of consideration, in relation to which a decision has been made to set up the foresight studies: thematic, territorial, and corporate.

So, there are four criteria of the foresight typology indicated, whereas there are few "pure" foresights. Most frequently, they are conducted as social and technological, regional and thematic, technological and countrywise. In each

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of them, certain fragments are represented as mixed techniques, characteristic of various types of the foresight.

The foresight project for maglev transport technologies development perspectives should be fundamental, conducted during a long-term period (at least one year), based on multiple tours of questionnaires of various groups of pundits, with the use of a range of methods, namely, the Delphi method, with a broad mass media coverage, at final results workshops and conferences, and with preparation of a pilot report. The foresight project for maglev technologies is a thematic foresight. It includes determination of long-term perspectives of market and economy development, in particular maglev technologies market. This will be a top-down project, because these technologies have not gained mass development, just like post-industrial technological paradigms on transport.

Thus, our suggestion in terms of development of institutional forms stimulating promotion of maglev systems, is brought down to conducting the foresight for determination of maglev technologies development in the national economy.

The foresight will be started by people or organisations, interested in it. From the moment when the task of conducting the foresight is approved by project team steering committee, the stage of the pre-foresight is finished, and this is where the foresight itself starts.

At the foresight stage, all its participants are engaged, with its pundits working, researches being conducted, and final documents being prepared. For each foresight there is a specific set of methods.

In the pilot reports which conclude the foresight project, possible solution scenarios and tendencies updates are considered, outlined in the forecast. The final pilot report is usually a closed confidential document. As a rule, for publication the extract of the final pilot report is prepared, complemented with a short presentation. In the final pilot report there are sections "Outputs[1] and Outcomes[2], where the results of future visioning in the foresight and expected shifts in the field in question are fixed. It is these results that are used to monitor forming of the future.

The post-foresight stage is a foresight results assessment. This is the most important and yet the most closed procedure. Outputs and outcomes fix the results of future visioning in the foresight project and expected shifts in the process, running in the field under study. It is these parameters of the foresight that are used to monitor the process of the forming of the future. Scanning spots the emerging changes in the foresight, expected events (transformations) are

[1] Outputs – in the foresight terminology, the existing norms, containing weak signals which in the future may dominate the traditional phenomena.

[2] Outcomes - in the foresight terminology, degree of distribution of forms, containing weak signals, and assessment of their development dynamics

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verified as the result of the laws adopted. The civil society foresight will serve as a guide for science, business, regional authorities, consumers' and civil institutions' behaviour. Alongside the law-obedience, the observance of civil communication norms, resting on moral principles developed in civil institutions, will become of no less worthy. Systematic work on conducting the foresight will become a crucial factor of post-industrial technological paradigms development, first of all, in terms of stimulating promotion of maglev systems in the national economy.

CONCLUSION

Considering the nature of Industry 4.0, efforts should be focused on technology of post-industrial technological paradigms. This is the technologies the maglev technologies relate to. Therefore, it is necessary to convince the society in relevance of their application in national industry. In order to systemise this work, it is relevant to establish a civil institution or an authority body. This is the first that may be suggested as an institutional form, that stimulates promotion of maglev technologies.

As a *civil* tool, a designated *investment fund* for support of maglev systems development should be established. In the beginning, the sources of financing of such a fund may be sponsor donations, insurance companies' and maglev systems manufacturers' contributions, as well as budget contributions under the state's innovative policy. Accumulated funds can be used to support the market participants, who seek to use maglev technologies. The authority bodies can use this tool as target programmes.

As the second institutional form, that stimulates promotion of maglev systems, the foresight for determination of maglev systems development in the national economy is suggested. The foresight is capable of drawing the future closer [20].

Financing of the foresight can be done by the state, it can be private and mixed in the form of financial projects. The financing of the foresight by the state is provided through national, regional, and municipal authorities (in practice allocating the largest volumes of financing) and some of the most interested municipal institutions engaged in the project, or universities, big research and innovation centres. Besides, the funds are often provided by organisations engaged in implementation of innovative technologies, and foundations for analysis and study of social and economic processes development. Private financing is possible as well.

As the available experience shows, in Great Britain, Germany, Hungary, France and Spain, the informational support is provided by the government, whereas in Sweden, Italy, and Portugal it is initiated by business society. In our

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case, it seems that preference should be given rather to an institution engaged in implementation of innovative technologies, e.g. the International Maglev Board.

The application of opportunities provided by the identified institutional forms above will enable intensifying application of maglev technologies and enhance transition of the national economy to post-industrial technological paradigms.

The Author (-s) hereby state that:

1. They have no conflict of interests;
2. The present article does not contain any researches involving humans as objects of research.

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