SIXTH TECHNOLOGICAL MODE AND GREEN ECONOMY AS THE BASIS OF STRATEGIC RECLAMATION OF ARCTIC TERRITORIES

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ABSTRACT

This article systemizes and generalizes regularities of forming the global experience and tendencies of reclaiming Arctic territories within changes in the scientific and economic paradigm and transfer to the new (sixth) technological mode. The main goal of this article is to state important moments that predetermine the focus and specificity of the emergence of technologies of the sixth technological mode during industrial and research reclamation of Arctic territories. The scientific novelty of this research is related to the fact that based on the advanced global experience and tendencies in the area of reclaiming and developing Arctic territories, in order to minimize potential power, ecological and economic threats that may cause catastrophic consequences to the whole modern civilization, measures are recommended in relation to developing and pursuing the innovational economic policy for Arctic near shore and other states, namely

1. *Improving the level of the technological infrastructure and efficiency of reclaiming the natural and resource, and industrial and production potential of Arctic on the basis of the advanced technologies of the sixth technological mode,*
2. *Forming a reliable logistic, engineering, civil and industrial infrastructure required to provide stable and ecologically safe development of Arctic and subarctic territories in the current, medium-, and long-term period.*

Key words: Arctic territories, Arctic shelf, subarctic countries, technologies of the sixth mode, stable use of resources, Arctic strategy, institutionalization, "green economy".

INTRODUCTION

It is unmistakable that the modern situation in the Arctic Region attracts attention of many researchers. Arctic in the XX-XXI centuries became much "closer" and more understandable for people. Over the recent decades reserves of the hydrocarbon raw materials have been explored and rationalized. They are globally important for the whole human society. Arctic trans-continental sea and air routes have been explored long ago, and surfaces of the North Pole and underworld of the Arctic Ocean have been researched [1, 2]. Nevertheless, today's researchers

from all over the world go on analyzing and studying in details the issues related to the geographical position and climate of the Arctic Ocean, history of reclaiming cold ice spaces of Arctic, and the need to transfer the reclamation of the Arctic space to the technologies of the sixth mode.

Heterogeneity of interests and levels of development of the Arctic countries, and the fact that the region is one of the richest in natural resources can boost the intensity in the North. The economic component is an important factor in the struggle for Arctic possessions. In 2008 the US Geological Survey published its own conclusions that theoretically Arctic could contain up to 25% of the global oil and gas reserves [3, 4]. Such data was confirmed by the Wood Mackenzie consulting company. It estimates the reserves of oil in Arctic in the amount of 166 bln. Barrels, while the total reserves of oil on the US territory do not exceed 15 bln. barrels [5]. In their turn, European, American and Canadian researchers say about the global warming. According to their data, during the period of 1969-2004, the volume of ice in the east of the Canadian Arctic archipelagos has decreased by 15% [6, 7, 8].

At the modern stage of reclaiming Arctic territories it is possible to observe the tendency to intensifying practical resources use of Arctic not only in the interests that are common for the planet and the humankind, but also in the interests of separate states, as well as commercial national and trans-national corporations [9]. Not only states that are directly located in the sub-polar zone but also such countries as China, Australia, South Korea, Singapore, and India, which are rather remote geographically, display a specific interest in researching and producing natural resources of the Arctic and subarctic territories.

METHODOLOGY

Methods of comparative content-analysis (theoretic analysis), as well as comparative analysis of methodic and empiric publications were used to write this article. The publications are devoted to studying such extremely important aspects as technologies of the sixth technological mode and green economy in reclaiming Arctic, its geo-political position and importance, and a role of reserves of the Arctic hydrocarbon raw materials in providing the global energy safety. Thus, for example, the problems related to reclaiming the natural resources in the Arctic Region are considered by many researchers. However, it is necessary to acknowledge that this theme has not been sufficiently researched in the context of changing technological modes and using technologies of the sixth mode. In particular, the leading Russian researchers offer a new view on this process and implementing global projects by the leading states of the world in the region [10, 11, 12, 13].

REFERENCES REVIEW

In our earlier works [11, 12] we have already specified that the industrial and research reclamation of Arctic is related to both undisputable benefits (that are stipulated by a considerable volume of hydrocarbons reserves and exclusive climatic conditions; it allows to research regularities of global geo-physical processes) and threats that can become a reason of emergence of various undesirable events. Due to it, now it is necessary to intensively develop and implement technologies of the sixth technological mode in the process of reclaiming Arctic territories. In the general scientific context technological mode must be considered as

an aggregate of additive, informational and communicational technologies, robotics and automation of basic processes of the creative human activity.

The sixth technological mode will define the areas and regularities of the modern civilization development since this (2016) year. It will enter the maturity phase in the 2040s. To a definite degree the contours of the sixth technological mode are manifested in the economy of the most developed countries, as well as countries that actively use science-driven solutions to provide the national economic growth (for example, countries of the South-Eastern Asia, China, etc.). This is the nearest future (in the period from 2020 to 2025) that is expected to observe a new qualitative leap in the scientific and technical progress. It will be based on developments, and synthesizing achievements in highly technological areas. There are grounds for such forecasts. For example, in Japan and the USA technologies of the sixth mode are involved in the socio-economic turnover and state management by more than 30-40%. Japan and the USA are going to entirely move to the new mode technology not later than in the third decade of the XIX century. However, Russia, some countries of the Southern America and almost all CIS countries rather considerably lag behind in terms of their indicators on acquiring technologies of the fifth and sixth technological mode. In particular, these regions have acquired technologies of the third and fourth technological modes by 50%, the fifth mode - by not more than 35%, and the sixth mode - by not more than 15% [1, 6].

We have already emphasized that the research and engineering thought, it's becoming and development go collaterally with the social and economic evolving of the modern civilization by forming new reserves and points of growth in the future. If we consider the periodization of technological modes as well as big economic cycles (that were discovered by a Russian economist N.I. Kondratiev), it is possible to see definite regular coincidences. Table 1 shows the periodization of the change of technological modes and changes of long economic waves.

Practical areas of implementing technologies of the sixth mode within the production and industrial, and research reclamation of Arctic can become research and industrial, and research and production clusters, distribution and renewable energy industry, new ecologically safe types of transport, full informational and communicational cover of the whole Extreme North and Arctic Circle by modern means of communication.

As a whole such technological approach to reclaiming the potential of Arctic complies with a new research and practical economic paradigm that defines the modern stage of developing national and global economic relations as cognitive economy (synonyms: digital economy, new industrialization, network economy, techno-economy, etc.). The technological sense of a new research and practical paradigm comes down to the fact that in order to carry out the economic exchange (both in the consuming and entrepreneurial/corporate segment), additive robotics and automation are actively used on the basis of forming a global computer system that provides the integration of geographically connected informational and computing resources.

Table 1
COMPARISON OF PERIODIZATION OF ECONOMIC MODES AND LONG ECONOMIC WAVES (GLAZIEV, 2011)

Period	Long economic wave	Technological mode
Industrial revolution		
From 1770 to 1840	The first economic cycle. Beginning of the increasing phase since 1770 to 1790, the peak of the cycle – approximately in 1820, the end of the cycle – approximately in 1840	The first technological mode. The driver is steam engines, the technology started being widely used approximately in 1790, the phase of quick growth ended approximately in 1830
From 1845 to 1896	The second economic cycle. Beginning of the increasing phase in 1847, the peak of the cycle – approximately in 1880, the end of the cycle – approximately in 1895	The second technological mode. The driver is a steamer, the technology started being widely used approximately in 1850, the phase of quick growth ended approximately in 1880
From 1900 to 1940	The third economic cycle. Beginning of the increasing phase from 1880 to 1900, the peak of the cycle – approximately in 1930, the end of the cycle – approximately in 1945-1950	The third technological mode. The driver is an electric motor, the technology started being widely used approximately in 1900, the phase of quick growth ended approximately in 1930
From 1950 to 1985	The fourth economic cycle. Beginning of the increasing phase since 1940, the peak of the cycle – approximately in 1970, the end of the cycle – approximately in 1985	The fourth technological mode. The driver is a combustion engine, the technology started being widely used approximately in 1950, the phase of quick growth ended approximately in 1970
Informational revolution		
From 1990 to 2018	The fifth economic cycle. Beginning of the increasing phase approximately in 1983-1989, the peak of the cycle – approximately in 2005-2010, the end of the cycle – approximately in 2018	The fifth technological mode. The driver is microelectronic components, the technology started being widely used approximately in 1980-1990, the phase of quick growth ended approximately in 2010
From 2020 to 2060	The sixth economic cycle. Beginning of the increasing phase approximately in 2020-2025, the peak of the cycle – approximately in 2040, the end of the cycle – approximately in 2050	The sixth technological mode. The driver is nano technologies, alternative energy industry. The technology starts being widely used approximately in 2015-2020, the phase of quick growth will end approximately in 2040

The system and structure of new economic relations go far beyond informational and communicational technologies and bear new methods of interrelation of developers, producers, entrepreneurs and markets. It will have a considerable impact on all areas of economy and social activity from retailing, transport, financial services to production, education, health care, mass media, etc.

At the present time projects on creating corporate structures of a new type on the basis of active use of modern informational and computer technologies (industrial Internet consortiums - IIC) have already been implemented. Leading IT companies participated in developing and implementing these projects (General Electric, IBM, Intel, AT&T, and Cisco). 192 members

from 26 countries have already integrated into the "Industry 4.0" industrial Internet consortium [13, 14]. The basic target benchmark of "Industry 4.0" is the creation of a new type of industry that is formed during the current (sixth) technological mode. Herewith, it is assumed to create a system of "smart" plants that will be united into a single chain for quick transformation of operational processes taking into account changes of the cost, as well as the availability of the resourceful provision, current and future market demand for goods, works, and services.

It is planned that the contribution of "Industry 4.0" into the global gross product will have increased up to USD 15tln by 2030. It will provide the growth of the global GDP by 11%. The "Industry 4.0" Internet consortium will integrate about 50bln machines and network devices used in various sectors of industry in construction and transportation. Defining common platforms and languages that the machines of various corporations will use for communication is one of the basic tasks in distributing cyber-physical systems of the Industrial Internet [13, 14].

Along with the informational and communicational technologies that can be used within the production and industrial, and research reclamation of Arctic, educational technologies of a new quality are actively developing. In particular, in the USA with the assistance of such companies as Google and such structures and NASA and DAPRA, a new educational structure Singularity Institute (educational courses on nano-biotechnologies, robotics, mechatronics, foresight design, entrepreneurship in cognitive economy) has been established [13, 14].

At the same time it is necessary to note that over the recent years both Arctic countries and the countries that are geographically remote from Arctic regions have increased their interest in more intensive reclamation of the natural and resourceful base of Arctic. However, they do not pay enough attention to ecological problems and rational use of resources. On the contrary, in Russia these issues are in the focus of attention. In particular, as it is noted in the resolution according to the results of the meeting of the Arctic Expert Club (in October 2015) "Green economy: ecological imperatives of providing economic development of the Russian Arctic", "… today Russia is actively returning to Arctic, renewing the Northern Sea Route, creating the most modern double-purpose infrastructure, and comprehensively solving other urgent tasks…, … the implementation of such large-scale target investment state programs especially on the regional level more likely becomes the business of future" [15]. However, technologies of the sixth mode in Arctic have not been enough distributed. That is why it is necessary to carry out a practical transfer to ecologically safe technologies of acquiring the research, nature and resourceful, and production and industrial potential of Arctic. It will serve the interests of all population because territories of the Arctic Region are characterized by an extremely high ecological sensibility and a long period of renewing the nature and resourceful potential.

It is necessary to understand "green economy" (according to the definition given by the UNO) as the performance of such useful economic activity that would aim at improving the national and global welfare, providing social equality and justness under simultaneous decrease in risks of the environment and nature impoverishment [16]. We also agree that it is necessary to refer "… types and results of the activity that along with the modernization and improvement of the production efficiency contribute to the improvement of the life quality and habitat" to "green economy" [16].

Promising areas of providing stable ecological and economic development of territories of the Arctic Region in the context of forming a new social and economic formation include the following basic tasks [15]:

1. Tasks on providing efficient and rational use of nature by applying ecologically safe and high technologies that form a "green economy" platform,
2. Tasks on implementing and applying modern technologies of energy generation (small generation, distributed generation, and renewable generation),
3. Tasks aiming at optimizing, revealing, and developing useful economic activity that also assumes the planned liquidation of loss-making contaminative productions and neutralizing (full elimination) of the earlier accumulated ecological damage,
4. Tasks on diversifying the economic activity in Arctic and subarctic regions taking into account rationalization and intensification of using the biological diversity of water areas and coastal territories, and
5. Tasks aiming at searching for resources of financing, using of private and state partnership and other tools for active promotion of investment projects of green economy.

It is impossible to solve the above tasks without deep innovational transformation, economic, financial, social and residential sector because this is now when it is necessary to overcome crisis phenomena for the faster transfer from the industrial scheme of reclaiming the North to the model of stable and ecologically responsible development. A number of projects must become a principle basis of transformations. These projects would accelerate solving a set of problems related to reclaiming the coastal territories under active mobilization of the research and technical potential. Along with this, there is an objective need to implement the projects that would aim at

1. Forming research and methodic and practical basics of calculating the admissible anthropogenic and techno genic loadings within the research and production and industrial reclamation of the Arctic potential (regularities and nature use standards),
2. Developing solutions that cover infrastructural aspects (energy conservation, efficient use of resources, and construction of buildings, facilities, important social and engineering facilities).

It is necessary to note that the issues of reclaiming Arctic territories by using technologies of ecological construction are extremely important for further development of both the global and national economic of subarctic countries, as well as for ensuring ecological safety and stable development of the whole Extreme North and Arctic Circle. The implementation and use of eco-technologies in constructing civil and industrial facilities are an integral part of ecologically responsible socio-economic development that is characteristic of a new era of the modern civilization evolving.

At the present time the global energy industry is also characterized by structural changes in the power and energy balance. It also means the reconsideration of the role and importance of separate energy carriers. Herewith, the cost of goods and services production under conditions of high latitudes is considerably higher. It makes up definite difficulties for promoting results of useful economic activity performed in Arctic and subarctic regions [13, 17]. In this context the researches of I. Vozniuk and A. Barannik [18], L. Haines [19] and many other researches whose works have already been mentioned in this work are also urgent. In their joint article the researchers consider Arctic as an important geostrategic region where interests of the leading countries of the world clash. They come to the conclusion that today both the official external policy and unofficial actions of states in the Arctic Region are actively developing.

DISCUSSION AND RESULTS

Numerous researchers specify that one of the most promising areas of reclaiming territories of the Arctic Region in the context of forming "green economy" is the development of "green" energy industry. The territory of the Extreme North and Arctic Circle is characterized by inhomogeneity in providing power resources and developing the power sector infrastructure. Centralized power supply is developed on territories with the relatively high density of population where there are large industrial enterprises and large settlements. At the same time territories beyond zones of industrial reclamation are characterized by a number of small consumers. Power for their needs is produced in the decentralized manner at the facilities of small power.

A considerable part of power is produced on the basis of the fuel and power resources. It is necessary to bring fuel to some regions from far off, and create its considerable inter-seasonal reserves. It, as well as a long heating season stipulate high price of the produced power. The reclamation of local alternative sources of power is considered as a measure that contributes to decreasing the acuteness of these problems. Herewith, the most often non-traditional renewable sources of power (NTRSP) are meant. In many regions of the North the technical potential of NTRSP is considerable. However, in spite of it, plans related to constructing large power stations on their basis remain on paper. It is noticeable that projects in the area of NTRSP are implemented in Northern regions with the furthest territorial remoteness, with a considerable number of de-centralized consumers of power, with the lowest level of transmission networks availability, and under-developed transportation network.

In the Russian Arctic, as well as on other Arctic territories that belong to the countries that have a direct exit to Arctic, important experimental projects on creating tidal power plants, and using generating wind plants have been implemented. The Far-Eastern regions implement solutions on using geothermal plants [11]. The power potential of Northern rivers is rather high. That is why its use in Northern and subarctic regions can be considered as the most promising area of developing alternative and renewable energy industries as small hydro industry [16, 17, 18]. Here the main advantages of small hydro industries for Northern regions may include [17]:

1. Improvement of supplying power to the local population,
2. Decreasing threats for local eco-systems,
3. A lower level of investments for constructing mini-hydro-power stations as compared to large ones,
4. Short terms of construction,
5. Lack of need to construct high-voltage power transmission lines and power transformer plants,
6. High term of stations exploitation (above 4 years) under the inter-repair periods up to 5 years,
7. A low cost of power, and
8. Architectural and construction facilities of small hydro energy industry can become places of interest in organizing ecological tourism, etc.

The basic measures of stimulating the implementation of small hydro energy industry in Arctic and subarctic regions must include the following:

1. Development of internationally unified regulatory and legal acts aiming at stimulating the development of innovational technologies to increase the power efficiency of the economic and social and residential sector of Arctic,
2. Preparing engineering and technical and management personnel on the work with the renewable energy industry under conditions of the Extreme North and Arctic Circle,
3. Financing projects on small hydro energy industry by using many-sided forms of private and state partnership and attracting investments from large national and trans-national corporations, and
4. International implementation of a "green" tariff for alternative power to increase the pay back of projects related to small hydro energy industry in Arctic and subarctic regions where international projects are implemented.

Developing the "green" energy industry in regions of Arctic, it is necessary to take into account that along with the advantages, the alternative energy industry has serious disadvantages (disseminated nature of power of alternative resources, less attractive economic indicators, irregularity of power delivery, need to reserve powers of traditional energy industry, etc.). In the regions with a great number of de-centralized consumers who supply power from small energy industry facilities, advantages of alternative power plants are more vivid. However, on the industrially reclaimed territories with a relatively high density of population, where historically the creation of large power stations (mainly thermal and or hydro-power) is emphasized, disadvantages of alternative energy industry play a considerable role. And here the traditional power energy industry will prevail for long.

As a whole, it is necessary to note that a high level of uniqueness of projects and operations in the area of reclaiming territories of the Arctic Region in the context of forming "green" economy defines special requirements to the quality of such projects management. In order to implement "green" ecological and economic projects in Arctic, it is necessary to improve standards of project management, and to develop a concept of ecologically responsible management when managing projects that may have an effect on the Arctic eco- system. The ecologically responsible project management must be also standardized for the repeated use of resources and equipment that completed their technological cycle. It allows to modernize systems of wastes circuit in industry, agriculture and residential sector of Arctic and subarctic territories.

The implementation of ecological procedures in standards of project management in various areas of the global "green" economy will allow to solve the problem related to managing expectations of the interested projects members, and to discover perspectives of optimizing stability, reliability, safety, economic efficiency, and innovative nature of projects [15]. Consequently, ecologically safe projects on reclaiming territories of the Arctic Region must be provided by modern informational technologies that do not hedge anthropogenic and techno genic loading on the eco-system of Arctic.

Thus, the reclamation of territories of the Arctic Region must unconditionally be based on technologies of the sixth technological mode and achievements of the "green" economy. Promising areas of the "green" economy of the Arctic Region include comprehensive use of nature, highly ecological technologies of wastes utilization, as well as development of the "green" energy industry. A high level of unique nature of projects in the area of reclaiming territories of the Arctic Region under conditions of forming the "green" economy defines special requirements to the quality of management.

They must be provided by the development and use of national standards of "green" project management as well as implementation of informational systems of managing power and resource-saving "green" economy.

CONCLUSIONS

As a whole, today the increase in the interest of a number of countries in Northern territories activates an important task on ensuring the national safety of Arctic countries – to solve the Arctic issue as a component of creating safety surrounding. The most serious claimers to reclaim the resourceful and industrial potential of Arctic remain five states of the "Arctic club" the USA, Canada, Denmark, Norway, and Russia. They actively develop projects on extending economic zones in the region for strategic purposes.

However, not only the above countries that have their territories there display serious interest in the Arctic Region. Subpolar states (Island, Sweden, and Finland) have developed their own Arctic strategies. The European Union pursues its own aims. Asian countries: China, Japan, India, the South Korea, and Singapore show certain economic, technological, military and strategic, and other interests. Thus it is possible to forecast with certainty that in the XXI century Arctic will be in the focus of close attention of not only official subarctic states, but also a number of states whose territories are rather remote from it. Herewith, it is necessary to note that, according to experts, under the modern difficult geo-political conditions, the reclamation of Arctic territories without the active use of technologies of the sixth mode looks difficult and irrational.

Summarizing this article, it is necessary to note that the becoming and development of the engineering thought (both the global and the Russian ones) actively stimulated evolving of the special and economic relations. Engineering played and goes on playing a leading role not only in forming the innovational potential, transforming the development of separate national socio-economic systems and regions (for example, the Arctic Region), but also the whole modern civilization, in general:

1. In the historical context this is the engineering thought that created and formed stimuli for intensive development of socio-economic relations. Due to accumulating the cognitive factor, as a whole global social and economic relations gradually moved to a new stage of development by maintaining and increasing the characteristics and features accumulated before and considered as the potential of evolving.
2. The change of phases of technological and economic development is conjugated. Every new economic cycle has a key technological driver that starts forming in the period between the decreasing and increasing phases of the economic cycle (long Kondratiev wave). Thus, producing, diffusion and successful acquisition of innovations become a basis of stable development that must be actively and intensively developed for the production and industrial and research reclamation of Arctic and subarctic territories, and Research and engineering thought is developed not only in the military but also in the civil area. The development of the military aspect of the research and engineering thought is not an aggression; it contributes to strengthening the defensive capacity of states. In the second case it allows to create the required science-driven products and technologies meant for social consumption. Taking into account that Arctic is not only a center of scientific and commercial interests but also a center of military and strategic interests, the creation of new highly technological double-purpose products (goods, works and services) is an absolutely reasonable solution. Within this article we have not considered such aspects.
3. Basic areas of harmonizing national legislations of subarctic states in compliance with the standards of

the international law,

4. Providing ecological safety within scientific researches and exploration of the resourceful base of Arctic, and
5. Key solutions on developing the infrastructure and civil society on subarctic territories.
6. The authors suppose that these and many other aspects related to the production and industrial, and research reclamation of Arctic will be considered in the next articles.

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