

## МАКРОЕКОНОМІЧНІ ТА РЕГІОНАЛЬНІ ПРОБЛЕМИ РОЗВИТКУ ПРОМИСЛОВОСТІ

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### ATTAINING SUSTAINABILITY OF INDUSTRIAL PRODUCTION BASED ON ENVIRONMENT FOCUSED INNOVATIONS

Today mankind faces many problems that can not be resolved with in individual states. The signs of civilization crisis caused by environmental, socio-demographic, and economic factors appear more clearly. Continued economic development has created a series of environmental problems - loss of biodiversity and ecosystem services; contamination of soil, atmosphere, and ground and underground water with chemicals; production of large amounts of hazardous industrial and domestic waste; exhaustion and loss of fertile land.

Ukraine is not an exception; despite the positive economic and social impact of industrial production, its recovery and growth have increased the pressure on the environment. Moreover, the main contribution to economic growth was made by metallurgy, chemical industry, fuel, energy and agriculture sectors which exerted excessive pressure on the environment in large scale and caused deterioration of the ecological situation in Ukraine resulting in the deterioration of human health and opportunities for further development. Today Ukraine is among the top ten countries by the extinction rate of people; Ukraine ranked 124th out of 194 countries in life expectancy (the average life expectancy is 69 years). In 2011 Ukraine ranked 102 among 132 countries in the annual ranking of countries by the index of environmental sustainability taking into account the country's success in reducing the impact of environmental pollution as a result of economic activity on human health and natural ecosystems. Current ecological and economic problems become global. Due to the large scale of the world econ-

omy ecological system became ecological and economical and has been holding hostage by human activity. Therefore, identifying the characteristics and factors of development, managing the balance of environmental and economic goals becomes more important.

Economic growth and development are among the key issues addressed in the macroeconomic studies of foreign and domestic researchers. Numerous researchers have studied the nature and causes of economic development, wealth growth and accumulation. R. Nelson and S. Winter [1] must be the first authors to mention among the contemporary foreign researchers of macroeconomic development. Constituents and prerequisites of economic growth of the countries leading in the global economic development were examined by M. Yershov [2]. Understanding of a strong destructive relationship between the growth of global population, increased scale of material production, coupled with irrational consumption patterns and progressive depletion of the life-supporting potential of the planet, contributed to a range of studies addressing socio-economic and ecological trends of global development. The following works are among the trendiest: R. Carson's treatise "Silent Spring" [3]; marginal global development models formulated within the Club of Rome [4-7] kept on the traditions of T. Malthus's theory [8]; E. Schumacher's treatise "The small is fine: economics for man" [9]; technologic optimism models [10].

A positive relationship of technical progress and economic development is examined in the endogenous economic growth models.

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R. Solow [11] indicates in his works that the governing factor of economic development is technical progress rather than capital. B. Twiss emphasizes the need for efficient, profit-oriented, management of scientific and technical innovations [12]. Therefore, it is important to investigate the nature and specificity of an impact that the innovation constituent has on sustainable economic development.

Economic growth is related to a growing impact on the environment. With this in view, it is significant to identify key factors of economic growth and the harmony which exists between the economic and ecological systems [13]. The ecological situation in numerous emerging countries is complex: the high pollution level of all natural resources and deteriorating quality of ecological services reflect the exacerbation of a crisis in the interaction of society and environment; subordination of environmental interests is allowed in order to gain economic benefits. Excessive consumption of natural resources keeps growing, gradually resulting in destruction of ecosystems, waste accumulation, contamination of all nature components, and climatic changes (UNEP Report) [14]. Existent negative processes threaten the health and life of population.

So, at this stage the considerable range of theoretical and methodological guidelines and practical recommendations for the improvement of management and quality of economic development taking into account the environmental aspects of management is accumulated in the

scientific literature. This paper looks into the need for ensuring effective environmentally oriented investment and innovation activities as a tool of anti-crisis policy, which is very important in consideration of economic and ecological situation in Ukraine.

Therefore, the *aim of the article* is to develop effective tools for managing the development of industrial production at the level of state social and economic institutions and at the micro level of individual enterprises, thus achieving the tasks of high-tech and environmental development of the industry in the long run.

The ecological situation in Ukraine is the most critical in Europe. In spite of the significant decrease in the production in the industry and agriculture the general ecological situation in the country remains at the unsatisfactory level. Such indices as resource expenditures per unit of gross national product and pollution per unit of output are several times higher in Ukraine than in the industrially developed countries.

The main ecological problem of Ukraine is its huge out-of-date industrial complex, which was got as the inheritance from USSR. The depreciation in industry is 65%. The greatest degree of depreciation of machinery and equipment is in non-ferrous metallurgy (76,7%), machine building and metalworking (71,4%), chemical and petrochemical industry (about 71%). For comparison, the degree of depreciation of fixed assets in the developed countries of the European Union does not exceed 25%.

Table 1

*The degree of depreciation of fixed assets in Ukraine, % [14]*

	2000	2005	2006	2007	2008	2009	2010	2011	2012
Total	43,7	49,0	51,5	52,6	61,2	60,0	74,9	75,9	76,7
Agriculture, hunting and forestry	47,3	52,2	48,2	46,2	45,7	39,6	40,8	32,6	34,6
Industry	48,8	57,9	58,6	59,0	58,0	61,8	63,0	56,8	57,3
mining industry	41,8	49,6	49,9	49,8	52,9	46,1	47,8	56,3	54,1
processing industry	52,0	59,2	60,0	59,7	57,3	64,9	66,8	56,8	57,2
energy, gas and water production and distribution	46,6	60,6	60,9	62,2	62,0	62,2	60,7	57,0	58,4
Education	40,5	59,7	61,6	57,4	57,8	62,4	62,5	43,7	43,6
Transport and communications	50,5	48,5	60,4	66,9	82,4	83,9	94,4	95,6	96,0
Health care and social assistance	37,8	47,4	45,7	44,0	43,3	46,7	50,8	42,4	42,2
Communal and individual service, activities in culture and sport	45,5	46,6	45,8	45,5	44,2	48,5	47,4	47,1	46,7

Industrial complex, which is placed mainly in the east of Ukraine, annually makes millions tons of industrial gases, millions cubic meters of the polluted water, poisoned with chemicals, and billions tons of industrial wastes.

Ukraine is suffering a lot of environmental problems. There are many consequences of damaging environment. One of them is the

water pollution. In total, in 2012 8,081 million m<sup>3</sup> of waste water was discharged into the surface water bodies, which is 37 million m<sup>3</sup> more than in the year 2011. The discharge of waste water according to its pollution category was as follows: polluted water – 1,521 million m<sup>3</sup> (91 million m<sup>3</sup> less than in 2011) including untreated polluted water – 292 million m<sup>3</sup>.

Table 2

*Dynamics of waste water discharge into surface water bodies in Ukraine, million m<sup>3</sup> [15]*

	2000	2006	2007	2008	2009	2010	2011	2012
Amount of waste water	10964	8824	8917	8655	7692	8141	8044	8081
polluted	3313	3891	3854	2728	1766	1744	1612	1521
without treatment	758	1427	1506	616	270	312	309	292

The biggest volume of polluted waste water was discharge by water users of Donetsk region – 554 million m<sup>3</sup> (36% of total amount of polluted waste water), Dnipropetrovsk region – 471 million m<sup>3</sup> and Odessa region – 117 million m<sup>3</sup>. Major water polluters are industrial enterprises – 910 million m<sup>3</sup> (mainly, by effluents discharged by electric power producers, steel metallurgy and coal industry in the cities such as Zaporizhzhia, Dnipropetrovsk and those of the Donetsk region) as well as by the housing sector and municipal utilities – 596 million m<sup>3</sup>. It should be noted that the quality of waste water largely does not meet established standards for MAD (maximum allowable discharges), and in a number of regions substandard operation of sewage treatment works is observed, and sometimes they do not function at all. The Dnipro and other rivers are in danger. They are filled with poison: industrial waste, all kinds of chemical elements and pesticides. Industrial enterprises of large cities discharge harmful substances into river and sea waters. Most of waste water treatment facilities in Ukraine are outdated and work with low efficiency of removing nitrogen and phosphorus. Ukraine releases polluted water, heavy metal, organic compounds, and oil-related pollutants into the Black Sea.

Another problem is air pollution. An industrial and intensively farmed country, Ukraine contains some of the most polluted landscapes in Eastern Europe. Coal-using industries, such as metallurgical coke-chemical plants, steel mills, and thermal power plants are major sources of

high levels of uncontrolled emissions of sulphur dioxide, dust, unburned hydrocarbons, and other harmful substances. In 2012 the total emissions of pollutants and toxic substances into the atmosphere were 6821,1 thousand tons including 4335,3 thousand tons from stationary sources (various businesses), and 2485,8 thousand tons from mobile sources (vehicles) (figure 1).

Mining industry and energy production are the main pollutants of the atmosphere. Metallurgical enterprises are accounting for 35% of the total emissions (figure 2).

Presented information proves that the environmental situation in Ukraine is complicated: high pollution of all natural resources and reduction of quality environmental services reflect the deepening crisis in the interaction between the society and environment, the subordination of the environmental interests to economic benefits. Excessive exploitation of natural resources continues to increase gradually leading to the destruction of ecosystems, the accumulation of waste, pollution of all components of nature and climate change. Negative processes in the environment threaten the health and life. That's why current system of resource use management, protection and reproduction of resources, the efficient of functioning of which is a necessary prerequisite for ensuring environmental security, sustainable economic and social sectors development, needs to be reformed in Ukraine. The reforms are needed due to the fact that in the past large-scale transformation of natural resources systems, use of significant volumes

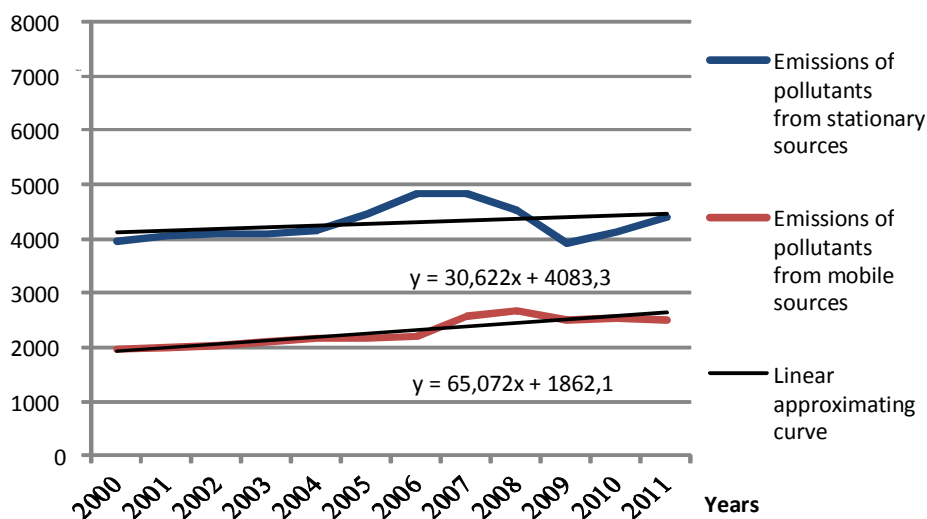


Figure 1. Trends in emission of harmful air pollutants in Ukraine (calculated by the authors based on [14])

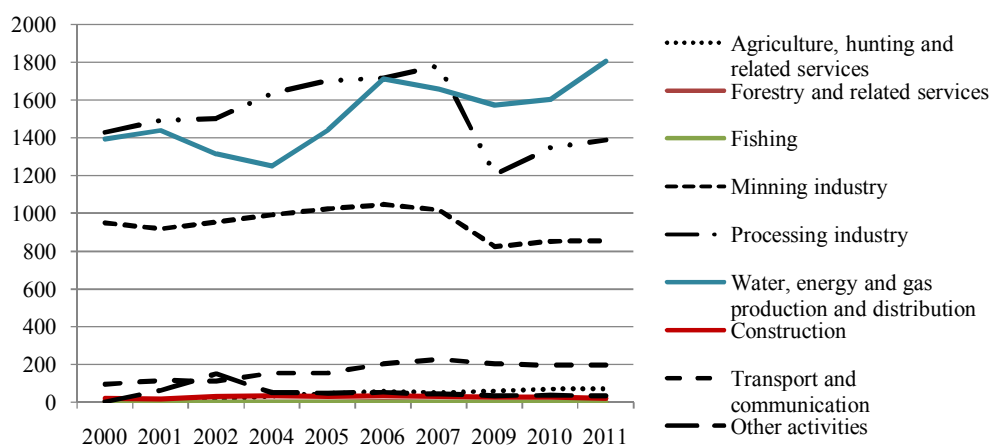


Figure 2. Dynamics of air pollution in Ukraine, thousand ton [14]

of natural resources for the economy, water and air pollution caused deterioration of the natural resources availability potential of Ukraine. Significant anthropogenic pressure led to further deterioration of the conditions of ecosystems and decrease of living quality.

An increased number of strategic studies aim to overcome aggravating problems associated with the ecological confines of economic growth and promote a sustainable development

concept to increase production efficiency, change the consumption pattern towards optimized use of resources, and depart from material-intensive economic growth and maximal reduction of waste accumulation [16]. In other words, the basis of sustainable development is the 'greening' of economy, creation and development of the so-called 'green' markets. The following priority directions of the sustainable

economic growth concept that need concerted actions at the international level are identified:

1) promotion of more rational (thrifty) use of energy and natural resources, which will equally reduce the imprint and improve the competitiveness of the industrial sector of economy;

2) maximum possible reduction of waste generation at the all stages of the product life cycle. First, it can be achieved by decreased production waste 'at source' by developing and implementing more advanced technologies with lesser yield of by-products, and applying more efficient, state-of-the-art approaches to utilizing 'end-of-pipe' waste; second, at the expense of utilizing consumption waste – waste products, equipment and materials when service life is expired;

3) development of rational consumption patterns and improvement of ecological standards of management through target public contracts and procurement, which is especially topical for countries with dominating command and administration leverage of environmental management;

4) development of economic instruments to motivate behavioural responses of economic entities (both producers and consumers) by implementing the policy of environment focused on pricing, taxation, lending and deposit refund system as additional incentives;

5) implementation of environment legal norms in the system of social values, which will focus people on efficient consumption priorities with the help of educational, information and awareness raising programs, as well as marketing campaigns promoting an ecological lifestyle.

The main prerequisites to sustainable development are resource-saving and environment clean technological innovations, as well as environment institutional rules of business [17]. Sustainable development is defined as continuous long-term crisis-free development, and timely introduction of innovations with an allowance for the environment focused management vector. Environment focused innovativeness, initiative and loyalty of entrepreneurship are a decisive force in the formation of a socio-economic structure that meets dominating ideas of sustainability to optimize balance of economy and nature. This conclusion brings us back to the con-

cept of an initiative innovative entrepreneur, developed by J. Schumpeter [18], and the investment theory of economic cyclicity originated by P. Samuelson [19] and J. Hicks [20], i.e., to the issue of inevitable exhaustion of loan capital stock in accordance with cyclical development.

The works of numerous researchers who examined the aspects of economic development address cyclical issues. It stems from the cyclic nature of the development process which is accompanied with constant crisis phenomena and processes. Cyclic trends of global economic development necessitate the diagnostics of market fluctuations and the timely response by governments to potential threats of macroeconomic balance disturbance. The adoption of the concept of an endogenous and cyclic nature of crises in the economic theory promoted the emergence and development of a specialized direction of research, namely design of an anti-recessionary policy. Developments in this field primarily aim at preventing (where it is possible) or mitigating such destructive consequences of crises as inflation, unemployment and bankruptcy of companies [21]. The variety of available anti-recessionary programs and actions aimed at smoothing economic system departures from equilibrium can be combined within two main approaches – Keynesian and neoliberal, which are opposed by the free competition mechanism for balancing the economic system, and expedite state regulation of economy through fiscal policy.

As the experience of many developed countries (Japan, South Korea and France) suggests, state regulation is the most effective method. The majority of studies have been focused on the object of the regulation process (i.e., labour and capital). The regulation process has been reduced to selection of scopes and directions of investment. Empiric studies, however, have indicated that it is the ecological factor that has become a considerable constraint for efficient growth since the middle of the 20<sup>th</sup> century. The factor manifests itself in reduced natural resources and deteriorated quality of conventional factors (specifically labour).

The effect of economic depression is now accompanied with the longer and acuter ecological crisis. The drop in financial reserves of

companies due to economic stagnation results in the cost reduction of both current financing of environmental activities and investment in development and introduction of ecological innovations. Social problems (unemployment) and maintenance of competitiveness of domestic producers are the priorities. Environmental actions and environment focused developments are generally financed on the residual principle (especially in developing countries). This leads to conservation of obsolete technologies (resource-intensive and faulty) and total wear of fixed assets, including those that are environmentally targeted, and to the degradation of the technological base. As a result, in spite of the reduced rate of environmental pollutant emissions in physical terms directly during the economic crisis, the yield of emissions per unit in specific terms is growing. Due to the lack of financial and technological capabilities, an increase in production capacities in the future will aggravate the environmental pollution situation. Thus, to secure sustainable (continuous, crisis-free) economic development the following tasks have to be addressed:

reduction or elimination, if possible, of the economic slack: time compression, contraction of peak-to-peak fluctuations;

focus on the process of innovative changes in technological patterns according to the development of ecological (green) economy.

Both tasks require a highly professional coordination of actions, concentration and effective management of investment and intellectual resources at the macro level of the national industrial complex and at the micro level of individual companies. Introduction of innovations at the growing phase of the economic cycle increases its duration and reduces the recession (or crisis) period. The waves of similar frequency (length) and coinciding phases create a resultant wave with the same frequency but multiplied amplitude [22]. The result of superposed waves with different frequencies depends on the degree of discordance between the cycle phases. The greater the phase difference the smaller the resultant shift, and the closer the phases the larger the shift. Consistent and timely introduction of innovations secures continuous sustainable development of the economic system in the longer term [23]. Optimal management of available

production, human, financial and intellectual resources must support high rates of sustainable economic development in order to maximize the efficiency of their application in time. Reducing the risks of uncertainty and fallaciousness of managerial decisions, as well as avoiding unnecessary costs related to misallocation of the production potential, determine theoretical and methodological provisions and practical recommendations for improvement of mechanisms and instruments of crisis management for industrial production development.

Environment focused crisis management of industrial production development is the transition of a national economy to a sustainable development model that can be achieved through the design of an effective anti-recessionary state policy that secures operational stability of industrial production from a continuous environment focused technological progress or green innovations. The main managerial tasks at the macro level have to be as follows:

creation of a favourable institutional environment for ecologically focused investment and innovation activities in the industrial sector of economy and development of green market of commodities and services;

control over observance of 'ecological norms of special nature management' (i.e. in commercial quantity) as a compulsory minimum established at a legislative level by all actors of the commodity-money relations as well as over adequate operation of relevant economic and social institutes in the field of environmental management;

regulation of the economic and ecological system with the help of 'built-in stabilizers', 'fine tuning', and 'indicative planning' during recession phenomena in order to mitigate their negative impacts.

The aim reflects a general idea of results at which the formation and application of a mechanism of environment focused anti-recessionary management of industrial production development is a target for effective management of industrial production development securing its continuity, sustainability, and environmental friendliness. The mechanism of environment focused anti-recessionary management of industrial production development is shown

in Figure 3. The overall structure of the mechanism includes:

social and economic institutes which provide for its organizational form and are management subjects that operate the mechanism of environment focused anti-recessionary management of industrial production development;

management instruments – evolutionary methodology, economic and mathematical

methods, indicative planning and market management instruments which secure the achievement of the goal of sustainability and environmental friendliness of industrial development;

management objects – intellectual capital, financial capital, time – resource support to the eco-innovative type of industrial production development. The given mechanism is created and employed to exert a targeted influence on these objects.

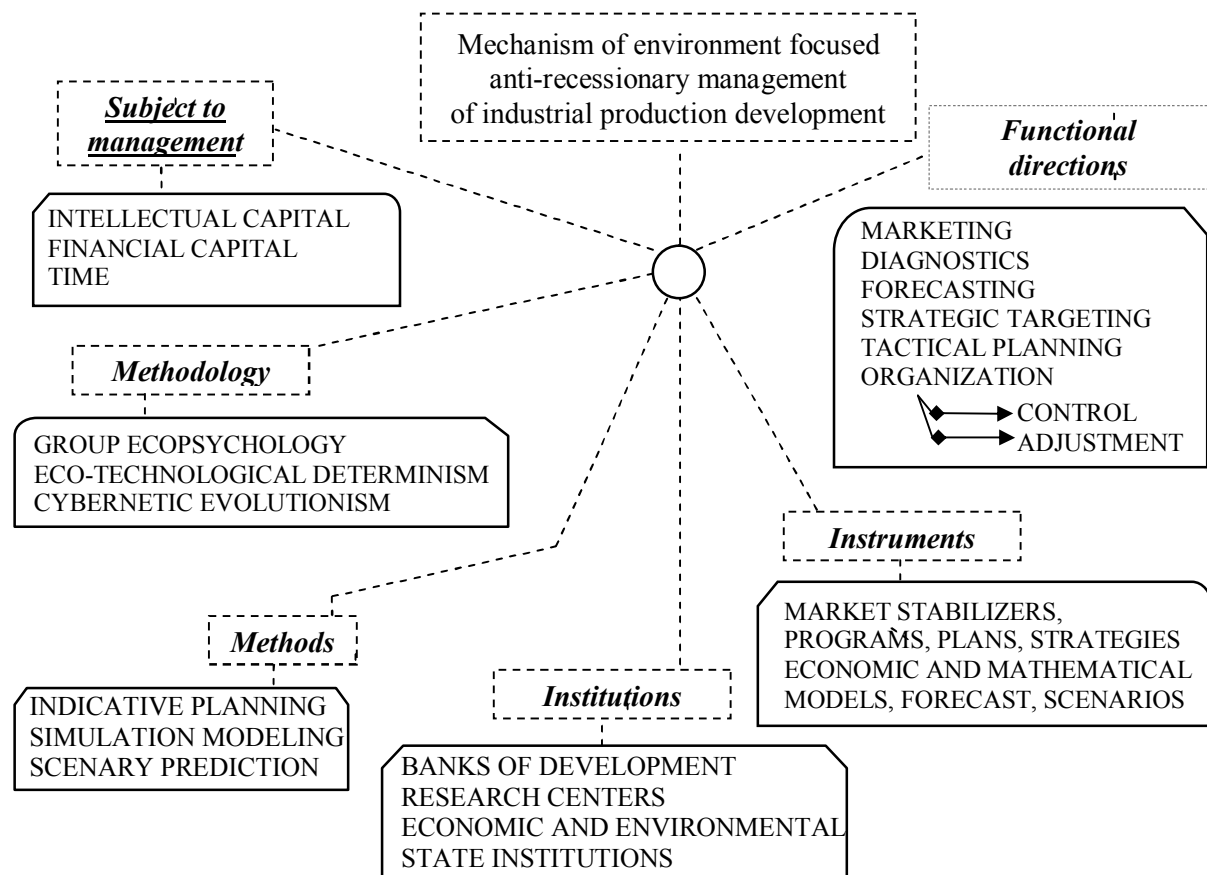


Figure 3. Mechanism of environment focused anti-recessionary management of industrial production development

Social and economic institutes of environment focused anti-recessionary management of industrial production development include:

specialized public institutions (ministries and departments) that shape and implement the national economic policy including the industrial, fiscal, and environmental policies. Such national institutions in Ukraine include the Ministry of Economic Development and Trade of Ukraine, the Ministry of Ecology and Natural Resources of Ukraine, the Ministry of Revenue

and Duties of Ukraine as well as their subordinate establishments and departments. The management subjects at the regional level are Oblast State Administrations, City Administrations and territorial subdivisions of specialized public institutions;

international, national and regional development banks – specialized public (and sometimes private) investment as well as financial and credit institutes engaged in long-term lending to industry;

research centers specialized in development and testing of environment friendly innovations.

The methodology of environment focused anti-recessionary management of industrial production development is underpinned by the following assumptions:

1) eco-technological determinism – absolute priority of environment clean equipment and technology as crucial determinants of transforming a technological pattern that is traditionally antagonistic to nature and securing sustainable (environmentally friendly) development of socio-economic structures in the long term;

2) group eco-psychology – creation of a pro-ecological active nucleus of socially responsible business, which represents the industrial sector of economy and acts in commodity-money relations as well as introduces and adopts environment based institutional rules of market management as generally accepted principles of business culture [24];

3) cybernetic evolutionism – manageability of a process of gradual (rather than spasmodic) qualitative transformation of cause and effect relations in industrial production, similar to closed cycles of substances and energy, and waste-free reproduction of wildlife based on ecologically clean symbiosis of biotic as well as electronic and mechanical systems.

Mechanism of environment-oriented anti-recessionary management of industrial production development includes seven complementary functional directions. Management process of modernization and greening of the industrial sector and effective positioning on investment, innovative and consumer markets is provided by conducting functional directions: marketing, diagnostics, forecasting, strategic goal-setting, tactical planning, organization and control.

Functional component ‘marketing’ formed the basis of information survey on the external object management and covered the following spheres [25]:

scientific and social programs and other initiatives on development ecology-oriented innovation and reducing anthropogenic influence on the environment;

environmentally-oriented investment projects at local, regional, national and international

levels are of high priority for sustainable industrial development;

market of environment focused innovation of all types (raw materials, technology, equipment, finished product);

market of natural resource, sources of clean energy, quotas for emissions of pollutants into the environment;

market and administrative incentives for ecological industrial modernization (preferential taxation, loans, mortgage-back system, limits, etc.).

Functional component ‘diagnostics’ is focused on collection and analysis of information on national industrial complex in general and its sectors with the aim to identify economic and environmental problems and to find the best ways to overcome them.

To insure the environment-oriented anti-recessionary management of industrial development it is recommended to use systematic, problem-based, normative and situational methodological approaches of diagnostics [26].

The system-based approach should be used at the initial stage of diagnostics (introduction). It will provide a comprehensive analysis of linkage between economic and environmental components of industrial relations and elements of industrial complex (branches and enterprises). After receiving general vision about industrial complex as a subject to management a problematic diagnostics needs to be done. At this stage the management situation is examined by modeling of different combinations of economic and environmental problems which can occur in the process of the industrial reproduction.

Establishing main interrelations, getting comprehensive insight into industrial production, and fixing a hierarchy of existing problems impede sustainable and ecologically safe development. The creation (or selection if available) of an economic and ecological production relations benchmark secures the optimal reproduction level by maximizing economic profits while minimizing ecological losses. Achievement of this benchmark will be a target of subsequent strategies and plans of environment focused anti-recessionary management. Thus, the next stage of diagnostics is identification of deviations of the object state from the standard de-



terminated by established quality indicators – a normative approach.

After selecting the optimal development strategy among the available alternatives its efficiency must be assessed by quality criteria at check points, which correspond to certain time periods allocated to implementation of individual programs and activities. It is topical to apply a contingency approach of diagnostics. The state of the controlled object is assessed for compliance with specificity of a particular situation, which is a unique link of a continuous chain of different management situations that form a process of environment focused anti-recessionary management of industrial production.

‘Forecasting’ is used for the pre-evaluation of anticipated development prospects and risks of industrial production, as well as market trends for the future, by two aspects:

search forecasting of the economic and ecological state of the management object if the trends observed in future persist, i.e. according to the so-called inertial development scenario which does not imply any outside interference in the processes;

normative forecasting specifies benefits, risks, their probability and methods for optimal achievement of the target economic and ecological state of the management object on the basis of predefined criteria [26].

‘Strategic goal-setting’ of environment focused anti-recessionary management of industrial production is a complex of economic, social, and ecological goals and principles, which meet strategic provisions and the nature of addressed tasks that reflect the main idea of a managerial impact. Monitoring of economic development stages is an important instrument that secures the achievement of the tasks set. It is assumed here that an active state policy is implemented at the downturn and recession stage, whereas substantial liberalization takes place during the prosperity and stabilization periods.

‘Tactical planning’ expresses a strategy which envisages its refinement: detailed elaboration, specification, adjustment, supplement of tasks, their execution periods, actual contractors, volumes of required resources and their allocation within the time period that is a planning horizon. This depends on the necessity to adapt

to the changing internal and external environment of the management object.

Such functional direction as ‘organization’ governs constant and temporary interactions between structural elements of the industrial complex and socio-economic institutes of the management superstructure and determines the procedure and conditions of:

organization of the infrastructure and operation of the market of environment focused innovations;

reorganization of the current technological platform of management and industrial use of natural resources on the basis of its upgrading and becoming green.

‘Regulation’ aims to prevent departures of industrial production from standard operational conditions, liquidate their adverse consequences and exert a corrective influence on the management object to bring it back to standard. Thus, regulation of the trajectory and targeting of industrial production development, with the help of the proposed mechanism of environment focused anti-recessionary management, implies alternation of two interrelated functional directions: control and adjustment. Both activities have to be carried out on the basis of transparent quality indicators to define the level and environmental friendliness of industrial development.

*Resume.* In the early 1960s mankind noticed an increased negative anthropogenic impact on the environment and began to actively discuss consequences of global ecological crises such as acid rain, smog, ozone holes, greenhouse effect, and meltdown of polar glaciers and loss of biodiversity. The optimal use of natural resources and mitigation of negative environmental impacts are important for survival of all people. Researchers then forecasted that wastes and emissions would have grown 2-3 times by the early 21<sup>st</sup> century.

The sustainable development concept for a well-balanced combination of economic, social and ecological development secures continuous economic growth and development. It is proposed to handle the issue of continuous economic growth and development within the framework of the given concept that implies effective state regulation of economic processes,

with account of social and ecological specificity of individual countries.

The growth continuity process is very complicated due to the market economy cyclicity. This property brings about deceleration and relapse of many economic processes. There are two extreme viewpoints regarding the potentiality of continuous growth: the concept of 'non-interference' in market processes as well as state regulation and support of economic growth. The majority of developed countries experienced that state regulation is the most effective method. Public policy must focus on the efficient use of innovation for economic development, support better financing of the research sector, and promote production and creation of cooperation centers to successfully overcome the financial crisis. Allowance for the ecological imperative in the management of the national economy has to be a distinctive feature of the process.

The process to secure sustainable (continuous, crisis-free) economic development is to reduce or eliminate economic slack and focus on innovative changes to technological patterns for development of an ecological (green) economy. A mechanism for environment focused anti-recessionary management of industrial production development was elaborated, underpinned by: the methodology of eco-technological determinism, formation of group eco-psychology, and cybernetic evolutionism.

Socio-economic institutes must build up their organizational forms, serve the management subject, and ensure high quality management by upgrading the processes of the industrial sector. They must introduce an effective orientation on the investment, innovation, and consumer markets. The following important functional directions are proposed as a part of the mechanism for environment focused anti-recessionary management of industrial production development:

environment focused marketing of the raw material, investment, innovation, and consumer markets;

range of diagnostic approaches: system, standard, contingency, and problem;

search forecast of the economic and ecological state of the management object, if the trends under the inertial development scenario

persist, and normative forecast of the target economic and ecological state of the management object based on pre-established criteria;

strategic target setting and tactic planning of environment focused anti-recessionary management of industrial production;

organization of constant and temporary interactions between structural elements of the industrial complex and socio-economic institutes of the management superstructure;

regulation of the trajectory and targeting of national economy industrial sector development.

Implementing the proposed state policy of encouraging environment focused investment in the long run (over 10 years) will offer an opportunity to initiate a multiplier effect of emerging and expanding green innovations among micro level economic agents. As a result of large-scale development of unique hi-tech products and their expansion on the market, coupled with greening of the life cycle, a conventional resource-intensive technological pattern will be transformed into 'environment clean'. This, in turn, will develop a green gross domestic product and secure high living standards for the population. In further studies the authors assessed the long-term trends of economic and environmental development of Ukraine based on the cognitive and system-dynamic models.

In the future we are going to develop the set of instruments of ecologically oriented management of industrial production in Ukraine including proposals for creation of a favourable institutional environment for ecologically focused investment and innovation activities in the industrial sector.

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