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Research paper



The Interdependent Development Concept of Technological, Economic and Management Cycles

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Abstract

The article discusses the relationship between technological and economic cycles and management ones as a specific form of social control, it's peculiarities in the transition to a neo-industrial economic model.

Keywords: *Social management; socio-economic system; the organization; the law of ontogeny; industrial management; industrial cycles; management cycles; neoindustrial management; industrial management; industrial policy; strategic management.*

1. Introduction

Structural technological reconstruction of modern industrial economy in the transition to a neoindustrial economic model and the knowledge economy demands a respective reconstruction of social-economic structures management. A special emphasis should be made on a qualitative reconstruction of industrial management as a specific form of social control.

In the middle of the XXth century there appeared the idea about management as a specific form of social control based on theoretical views on management as a process in general and on this in industrial and economic spheres in particular.

Firstly, in this period a general theory of systems appears, which views systems as an organized whole of interconnected and purposefully interacting components. Secondly, cybernetics forms and starts to develop intensively based on the theory of systems. This is a science about management in physical, biological and social systems as they regulate respective informational processes. Thirdly, the theory of organization develops completely as a science about laws and rules of system interactions between individuals and groups of people during their regulated and purposeful social functioning and development.

These theories give a development impulse for system analysis, operation management, economic-mathematical modeling and working out of managerial decisions.

They start to look at management as a function of physical-technical, biological and social systems, providing their dynamic preservation of their structures and maintaining a certain mode of their functioning and development.

This means that there are three managerial classes – in inorganic nature (physical-technical systems), in organisms (biological systems), and in society (social systems).

Management in technical systems is managing production and technical processes, mechanisms, and machine systems. Management of processes in organic nature, which are connected with organisms' life activity correspond to managing biological systems. They are studied mostly by natural sciences.

Management in social systems is managing interactions (organizations) of people and their collaborative production and labour activity. It covers the impact on the activity of people, united in groups and teams with their different interests. This is the most complicated managerial sphere. It is the study object in social sciences. People unite in various organizational forms, i.e. social-economic systems in the process of producing, distributing and using material benefits.

Social management is a process specific to human society. It is implemented with the purpose to regulate, perfect and develop a society, preserve its qualitative features, and depends on the social nature of labour, as well as on the necessity to communicate in both work and life. Management emerges as a specific social activity mostly due to the emergence and development of labour division and cooperation.

So, a conclusion can be made, that a modern industrial management represents the next stage in historical development of the social management being its specific kind. Therefore, studying the laws of this development can help to forecast specific features and evolutional perspectives of the industrial management in the process of neoindustialization in the modern economy [1]. This receives a special meaning because an efficient scientific management turned into a strategic key factor for companies in particular, as well as national and regional economies in general in the XXth century.

2. Methodology

Historically the social management development consists of two main stages.

First one is the era of the primitive social management, linked to an appropriated economy.

This period includes historical times of savagery (primitive herds) and barbarism (primitive races). In the savagery period (primitive herds) only rudiments of social management appear based on the manifestation of the speech elements, consciousness and primitive social relations.

Using sticks, bones and stones as labour tools, developments of hunting and gathering demanded new forms to organize and manage a collaborative labour activity in tribes. Primitive tribes finally formed as social institutions of people's interactions and

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tribal chiefs and elders singled out as the first representatives of the managerial labour approximately 9 – 10 thousand years ago.

The second stage is the era of a civilized social management, linked to a reproducing economy. This era distinguishes historical periods of pre-industrial, industrial and post-industrial economies.

The transition to metal tools resulting in an increase in the labour productivity led to the appearance of new social institutions (way of people's interactions) about 5 thousand years ago. And this in turn required new forms of social management, such as the family, state, property, and church.

As a result, different economies appear, including natural economies with the systems of traditional and family management, state economies with the systems of governmental management, temple economies with the religious – cooperative management systems, and commodity economies with the systems of market – entrepreneurial management. Thus, the practices of reproductive economy form and develop, such as family-natural, temple, state, and market-commodity ones.

The levels of social management appear simultaneously. They are macro level – state management, meso-level – regional and local management, micro level – managing individual households. Models of state and local management emerge, such as ancient Asian (oriental), ancient European (classical) and ancient American. Special organizational forms of social-economic management appear as well; these include slave-owning villas latifundias, feudal estates, temples and monasteries, peasants' households and communes, trade shops and merchants' houses (shops), manufactures.

Factory system of socio-economic management appears and starts to develop after the industrial revolution of the turn of the XVIIIth and XIXth centuries; in the XIXth and XXth centuries it is purposefully transformed through the corporate forms evolution, which arise in the industry in the second half of the XIXth century.

The evolution of social management forms is caused by the historical development of these social management practices and forms and their interactions. The system of entrepreneurial and market control, which was named management in the XXth century in the USA, develops in this process. Therefore, three main periods can be singled out in the historical development of management.

Firstly, the pre-industrial management stage is the period between 3 thousand B.C. and the industrial revolution of the second half of the XVIIIth and the beginning of the XIXth centuries. This is the era of slave-owning and feudal economies, when the production of goods played a secondary, additional role compared to natural and state economies. Entrepreneurial and market management was developing slowly, primarily in trade and craft structures.

Secondly, the industrial management stage is the period of the XIXth and XXth centuries, when the marketable value of all economies increases, and the commodity production starts to play the most important role in national economies. Entrepreneurial and market management develops intensively in the industrial production structures. As a result, the industrial management appears. This is the system of social management in organizations, engaged in mechanical labour and industrial production (with the help of machines).

Historically, there are two main stages in industrial management formation and development: the first is the pre-scientific period (the XIXth century); the second is the scientific one (the XXth century).

The pre-scientific management mainly aimed at organizing control in a partly-mechanical production and companies' working capital. The rational placement of machinery lines becomes the center of managerial activity in industrial enterprises in this period [2].

Scientific industrial management had to provide efficient control of a complex mechanical production, and the main material as well as industrial corporations' financial assets. In this period the managerial activity in industrial enterprises concentrates on organizing power-driven human labour and increasing its productivity as the basis of industrial competitiveness.

Thirdly, the modern era is the transition to scientific post-industrial management (the XXIst century). The neo-industrial management, forming now, represents a special stage in this transition, according to our point of view. It has to provide the development of systems managing automated knowledge-based production, human resources and non-material assets of innovative industrial and financial groups and transnational corporations, including the ones with state participation. The key factor is the development of strategic innovative management [3].

The theoretical basis of modern management as a science about governing organizations (socio-economic systems) in competitive environment of market economy is formed in the works of F. Taylor ("The principles of scientific management"), H. Fayol ("General and industrial management"), G.Mayo (the results of Hawthorne effect) and their successors.

These scientists formulate a principally new approach to the organization of industrial management: from understanding industrial management as managing machines (constructing industrial assembly lines) with people being their additional parts to seeing this as managing the production and labour activity of people, using machines to produce material goods and services (construction of productive and social organizations).

The change in forms of industrial management was objectively stimulated by the change in development stages of material and technical base of industrial production (fragmented mechanization, complex one, and the transition to complex mechanization with a wide use of automated means) between the XIXth and XXIst centuries. First the pre-scientific empiric management of the XIXth century appeared, then it was replaced by the scientific one of the XXth century, which was later changed by the scientific neo-industrial management of the XXIst century.

In the market economy the process of production and labour activity is reflected in entrepreneurial one and acts as an enterprise, i.e. its aim is to gain profit, which means that an income should exceed costs (investments) based on a private economic activity (their own market risk of the correct calculations of demand and supply), in the form of economic turn over, i.e. capital turnover. The latter includes the turnover of finance, personnel, goods, organizational and information resources alongside with the one of material and production resources (machinery, raw materials, infrastructure).

A theoretical and methodological basis appear in the sphere of state regulation in the economy in the first half of the XXth century, which was influenced by world wars and economic crises. The turning points in forming the macroeconomic regulating system are represented by the works of the German general staff about developing military mobilization system of controlling the economy before the World War I, and the study of J. Keynes "The General Theory of Employment, Interest and Money" (1936), that laid a theoretical foundation of anti-crisis and anticyclical regulation of national economies.

Simultaneously strategic and operational spheres start to separate, as well as formal and informal organizational mechanisms, permanent (continuous) and discrete (project) approaches to constructing social management systems.

As a result, three interconnected forms of the modern scientific industrial management emerge in the middle of the XXth century. The first one is the production and entrepreneurial management (the level of controlling the inner environment in companies' departments and small business structures). The second one is the corporate management (the strategic management of corporates' competitive adaptation to the outer environment). The third is the public (state and municipal) management, that is managing the organizations' outer environment dynamics through forming and implementing the respective competitive industrial policy.

Two main tendencies have become the characteristic development features in the modern industrial management.

The first trend is the increase in specifically national features, which results in emergence and development of different national models and modifications of the modern management. This

tendency is due to the influence of socio-cultural, political and legal, economic, historical and national, natural and climatic factors on management development in different countries.

As a result, different models and modifications are distinguished in the modern managerial science, such as the North American one (the USA, Canada), the Western European one (Great Britain, France, Germany, Sweden), the Eastern European one (Russia, Ukraine), and the Eastern Asian one (Japan, Korea, China).

One can also single out forming modifications of the modern industrial management, including the Latin American model (Brazil, Chile, Argentina, Venezuela, and Mexico), the South-Asian form (India, and Indo-China), and the Middle-Eastern one (influenced by Islam).

Each model possesses specific management styles, leadership character, the balance between formal and informal relations and communication mechanisms, centralization and decentralization of management. They also treat differently human, material, and technical production factors. Therefore, respective national models of the corporate management start to develop.

Secondly, the modern social management becomes increasingly global, that is reflected in the development of its theoretical and methodological foundations, as well as its functional and technical instruments.

The development of these foundations is the reason for the progress in the theory and methodology of management organization in socio-economic systems in the competitive market economy. This development helps to formulate and improve laws, regulations and principles, methodological approaches to organizing control, as well as fundamental notions and categories of managing social systems.

The development of functional and technical managerial instruments gives rise to the evolution of the instruments' methods, techniques, and mechanisms – managerial problems challenge, problem situations analysis and solutions development, forming of managerial organizational structures, management's functions implementations, such as planning, organization, motivation, control, coordination and regulation.

Technological evolution in production process is provided by scientific and technical progress, which results in developing economic processes in public reproduction. This, in turn, stimulates transformations in people's socio-economic relations in the economic process, resulting in improvements in organization of managing these interactions.

To improve the organization of management in socio-economic industrial systems, two successive key tasks should be solved in the modern social management development. First, the problems of public control that are challenged by the social and economic developments should be considered theoretically, as well as theoretical and methodological foundations to solve them. Secondly, new economic conditions demand working out new methods, technologies and instruments to implement the newly developed theoretical and methodological foundations of managing social systems.

Thus, the modern industrial management development includes the inner harmonization of its theoretical and methodological foundations, methods and instruments.

The key purpose of industrial management is to provide organizational and human development (purposeful alteration) in the managed structure and its human resources in the market environment. As a result, the organization receives a new competitive advantage, strengthens its position, implementing which allows the organization to reach its strategic functional goals and solve operational entrepreneurial tasks.

In essence, the labour productivity, production efficiency and business in general lay the foundation of social structures competitiveness. At the same time, the industrial management efficiency consists of financial and economic efficiency, and social and organizational one. This is due to the fact that an organization (socio-economic system) integrates human resources in their interaction with material and technical ones, because public labour (production) has two dialectically connected sides; the first includes technical and technological aspect (instruments impacting materials and supplies), while the second consists in socio-organizational one (people's interaction in the labour process).

The financial and economic efficiency of industrial management is the efficiency in functioning of the inner production system. It can be represented as a ration between the volume of goods (services) production in an organization and cost of resources to provide this production. This category pays attention to the indicators and characteristics of the inner environment in an organization between the results and material, technical and financial resources spent. The financial and economic efficiency indicators mean economizing resource expenditure per production unit. (It reflects so called "concept X" in the industrial management system).

Social and organizational efficiency of corporate management means the efficiency in structural functioning of the corporate production system. It must consider the interaction character between the organization and the environment alongside with the cost effectiveness; that is its resistibility and adaptability indicators towards the dynamic environment. Their basis involves an adaptation development in organizational structures and human resources. (It reflects so called "concept Y" in the industrial management system).

The research object of industrial management as a science includes socio-economic systems of industrial units. The organization is considered as complex of assets and social unity (collective), which provides the people's interaction in operating assets of socio-economic system and their relations.

The research subject involves organizational relations (organizational mechanisms), regulating processes in socio-economic systems, which control the human resources activity in an organization and provide the goal achievement. Structurally organizational mechanisms consist of management subjects, management objects, direct and reverse links between them.

Certain laws, regulations and scientific principles determine the functioning and development of organizational relations (organizational mechanisms), regulating processes in socio-economic systems and as a result, social and production interaction of people. First, they include laws and scientific principles of managing social and economic systems (organizations), organizational laws of synergy, awareness and order, self-preservation, the unity of analysis and synthesis, composition and proportionality, system development, the law of the least, as well as the laws and rules of social unities functioning, individual and group behavior in the units in the process of joint production and labour activity.

Secondly, they are the laws and rules of economic activity, functioning of socio-economic structures in the market economy; economic laws, such as the laws of raising needs, scariness of resources, demand and supply, money circulation, private consumption dependence on income, diminishing marginal utility, diminishing marginal productivity, diminishing return, increasing implicit costs.

Thus, each industrial structure includes two interconnected systems: the first is the system of economic complex (material and technical resources, such as production, financial and commodity-based ones); the second system includes interaction of people, exploiting this complex. The industrial management system appears and starts to develop based on these interconnected systems, that is the one, forming organizational resources of the corresponding industrial unity.

The assets' functioning and development possesses a cyclical character, i.e. it is implemented in lifecycles connected to industrial economic cycles. Organizations (corporations) lifecycles are dialectically linked to capital turnover cycles, but at the same time, each of them has its own features, that determine principal differences in strategic and operational management.

In addition, there is a cyclical character in the functioning and development of human and organizational resources in socio-

economic structure, that means it has lifecycles, connected to industrial economic cycles, and the ones of social systems' material and technical resources development.
With that said the organization system of managing human resources acquires a specific strategically active role. This is the industrial management system as a specific from of social management. Thus, we separate the operation system and development cycles of material and technical complex, as well as the system and development cycles of organizing human resources management in a social structure.
In turn, these independent and interconnected systems are caused by the technological progress, resulting in changing technological modes of industrial production, and economic industrial cycles, which provide the form for economic progress in industrial system.

3. Results

The technological progress also causes cyclical development of economic systems, whose transformation leads to corresponding development cycles in social industrial management systems. Every development cycle manifests itself in accordance to laws and rules of social management organization, among which a special place is occupied by the ontogeny law. The industrial management system cycle's analysis opens the perspective to rationally forecast the industrial management evolution as a crucial factor of a competitive success in the transition to neoindustrial economy.
The industrial cycles' material and technical basis is formed by periodical mass modernization of the main production capital, its dynamics and direction is influenced mainly by the scientific and technical progress. Thus, it becomes evident that in the XXIst century the economic development will be determined by the corresponding technological growth poles. Different productions become the technological focuses of these poles, for example the ones producing nano, bio, and information technologies. This is the concentration and the level of managerial efficiency in investments' processes regulation in respect to the technological growth poles, that will eventually determine the leaders and outsiders of neoindustrial competitive race between countries, regions, and corporations [4, p. 41].
Economic cycles stimulate not only production capital renewal, but also corresponding improvements in institutes and technologies of organizing and controlling production processes, i.e. their management. Therefore, they push corresponding managerial cycles, in industrial conditions this means industrial management development cycles. According to historical evidence, such countries, regions, corporations become the leaders of the competitive race on its certain stages, which could theoretically consider development problems in due time, then develop and implement corresponding management technologies and instruments, relevant to possibilities and challenges of a certain economic cycle. In modern conditions these are the problems and perspectives of the industrial management development.
In our opinion, such management cycles of the industrial management development system should be analyzed based on the ontogeny law, singling out the phases of origin, formation, maturity, stagnation, and crisis.
The transition to reproductive machine manufacturing was accompanied by the change of manual labour into mechanical one. The main position was occupied by the economic relations of appropriation and use of material, technical, and financial assets (capital). As a result, individual partner factories appear, then corporate and state-entrepreneurial ones.
The first economic crisis of the industrial era broke out in England in 1825, and in fact it marked the end of the first economic wave and the beginning of the second long cycle of the industrial economy's historical development, connected to building railroads and steamships, and the machine building became a leading independent industry [5, p. 28].
Simultaneously, pre-scientific industrial management was founded, and Manchester became its center, unification and standardization start to develop in industrial production. The British entrepreneurs' achievements in factory management provided their industrial leadership in the XIXth century.
Economic crises of 1873 and 1882 marked the end of the era of railroad construction boom and the second mode of industrial production, which started to approach the third industrial and technological mode at this time. The core of the third mode constituted electro-technical and heavy machine building, steel production, electrification, and inorganic chemistry. At the same time, the technological progress in production stimulates the industrial management development. Its scientific foundations started to be developed, that led to emergence of scientific industrial management in the USA and Western Europe.
The industrial management perfection gives an impetus to forming big corporations, broadening state regulation institutions of national economies, the concentration of financial capital in the banking system, the separation of management from property. In the innovation sphere in-house research and development department were created, scientists and engineers with university degrees started to be used in production, national institutes and laboratories appeared, universal primary education was introduced.
The economic crisis of 1929 – 1933 marked the end of the steel and electric engines era, and the beginning of the transition to the fourth technological production mode in industrial countries, which was characterized by the development of the precision and sophisticated engineering. That was the crisis, when the era of modern economic cycles started, where the periodical mass modernization of the assets was more and more linked to introducing automation to both production and management [5, p. 27]. The processes of the micro-level physical and chemical impact formed the basis of these production means' technological use [6].
In the management sphere the state regulation systems of national market economies were formed in the period of the fourth technological mode domination in industrially developed countries. The practical management in companies started to use line and divisional structures, and long-term planning. Military-industrial complexes appeared in these economies. At the same time different economic institutions began to develop, including transnational corporations, world oligopolies, vertical integration and production concentration. The state anti-cyclic system to regulate industrial economy was introduced in the USA during the crisis for the first time in the modern history.
The fifth technological mode, dominating in the modern world, started to form influenced by the newest scientific and industrial revolution achievements in the 1950s and 1960s. It turned into an integral reproductive system, which forms the basis for economic growth in industrially developed countries, after the structural crisis of the 1970 – the beginning of 1980s. It will act as the main mode in the production base of these countries until about 2030s – 2040s [7, p. 28].
The core of the fifth technological mode is formed by electronic industry, computing and fiber-optic engineering, programming, telecommunications, robotic industry, gas production and processing, information services. The key factors are computers, micro-electronic components, information technologies.
The current management phase involves the development of state regulation of strategic information and communication infrastructures, financial institutions and markets regulations, optimizing the state role in national economies. Strategic management appears in the corporate management sphere. The international integration systems of medium and small companies are formed in the management institutions development, as well as production and distribution integration; the institutions of global regulations in economic processes are being established.

Horizontal R&D integration, designing production and education are developing in the innovation activity management. Computing networks are formed, as well as governmental support systems for new technologies and cooperation between universities and industries, new modes for software and biotechnologies property are being formed.

The world economic crisis of 2008 – 2010 demonstrated, that the era of computers and micro-electronic components finished; industrial countries started to turn to a new technological mode of production. This turn is accompanied by an increase in the role of state industrial policy, strategic corporate management and the development of project approach to meet the challenges of increasing innovative competitiveness.

Modern crises in the Russian economy, the actuality of the import phase-out and national economic security problems show that the country is facing the next development cycle of industrial management. The development of innovative competitiveness in corporate unities and national economy depends on the success in forming new system of industrial management.

A characteristic feature of the transition to the neo-industrial economic development consists in qualitative shifts in the content of assets themselves, influenced by science and production integration. This is reflected mostly in increasing in the share and role of non-material assets, innovations, and human resources motivation. This inevitably must be demonstrated on the production capital reproduction's character and competition mechanisms for markets and economic resources.

First, this circumstance insistently demands to develop understanding of the technological advances' perspectives, where the modern industrial production, influenced by the scientific and technological progress, is moving. Secondly, it demands to work out and improve new mechanisms of the state macro-economic regulation on international, national and regional levels. Thirdly, it becomes extremely actual to reconsider the challenges and perspectives of the industrial management development, its transition to the neo-industrial stage [8, p. 113].

Cardinal basic interconnected changes in technology, economy, and then in management are gradually taking place in society in the modern change of technological and economic eras. New levels should increase in production. Gradually new sectors, technologies, approaches, and knowledge will become leaders and will start to remake partly the old modes of production principles. The welfare excess will increase significantly.

The transition to neo-industrial production will allow to feed much more people. So, we will see either an increase in their number, or an increase in the standards of living and life expectancy. The dependence of nature will significantly decrease, while the ability to influence it will grow. The borders, put by geography, will change principally. The density of production and economic contacts between societies will rocket, as well as the exchange of achievements, the volume of energy use and information [9].

At the same time, the historical evidence suggests that the transition to a new technological and economic development stage does not happen simultaneously and quickly, but represents a long process, which starts in some places and then spreads to more economies and territories. Moreover, each transition is the result of a long-term accumulation of quantitative and qualitative changes, a big break in continuity, leading to a growing complexity in the public labour division and production integration.

However, it must be noted that during the described stages the elements constantly move from technical to economic sphere. This process inevitably brings certain positive changes to the economy, provoking economic progress. But the economic progress results in increasing **entropy** in both economic and social spheres. The development of management becomes the solution to this increase and the instrument to decrease it.

4. Discussion

Thus, as the historical analysis shows, technological progress causes economic progress through moving innovations from the technological sphere to the economic one. These changes benefited the economy on the one hand, as they increased the labour productivity and the standards of living. On the other hand, they produced failures and crises, which cannot be solved based on old forms and principles of social management. This causes the origin of a special acceleration sphere in social and economic progress, namely, the social control and management as its specific kind. The development of this sphere is linked to both the crisis bailout, and a further development of the technological and economic progress.

The development of technological modes and as a result, the change of economic cycles have symmetrical and wave-like character.

During the upward phase there is an intensive growth in the technological and economic progresses. However, the entropy accumulates in the aggregate of these systems. The entropy level reaches its peak in the turning point, where a qualitative jump takes place, during which this aggregate of systems moves to an extensive development stage. This phase flows into a crisis.

However, a management system starts to develop intensively during the downward phase of a long economic wave. At this point principally new management approaches are created, they provide an effective transition to the upward phase of the next long economic cycle.

For example, the downward phase of the first long industrial cycle (1800–1825) was marked by separating the managerial and executive roles. During the downward phase of the second long industrial cycle (1847–1882) cooperative unities appear, management starts to be closely linked to economics. The downward phase of the third long industrial cycle (1904–1929) gave the origin to theoretical management as a science, its integration with sociology and psychology. The downward phase of the fourth long industrial cycle (1957–1980) stimulated the foundation of the system and project approaches to social control.

The downward phase of the fifth technological development cycle in the industrial economy, which started after the world economic crisis of 2008–2010, involves objective needs in absolutely new theoretical and practical solutions to managing socio-economic systems in modern conditions. Therefore, we should search for these problems and the possibilities to solve them in the view of development tendencies of the interaction between technological and economic progresses.

5. Conclusions

To conclude, the progress in management cannot be separated from technological and economic progresses, taking into account all mentioned above aspects of the modern management's ontogeny. Every long cycle causes not only the appearance of new technologies and a qualitative economic development, but also the appearance of new managerial systems. According to the ontogeny law, every new system of industrial management moves through the phases of origin, formation, maturity, stagnation, and crisis (liquidation).

The analysis of modern economic conditions and technological progress dynamics allows to conclude that the end of the first third of the XXIst century will be marked by the appearance of new systems and mechanisms of neo-industrial management. New strategic and project approaches to economize the time on the basis of innovations must become the key point in this system. This is due to the fact that the competition between economic agents will take place for intellectual resources as the innovation source and the speed of introducing new innovational products and services to the market, but not for land or capital.

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