



Industrial architecture as a system

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Abstract

It is known that industrial architecture is the important part of modern world. It brings profits and goods to our globalized society. But industrial facilities is the most susceptible to obsolescence because of dynamics of technical progress development and different economic changes in societies.

Industrial architecture, as an independent type of an artificial anthropogenic environment, is about 300 years old. Over the entire period of its existence, it has changed many times, depending on the development of technological progress. The evolution of the ideology of industrial buildings on the territory of Ukraine was uneven with certain jerks. This was facilitated by certain socio-political and military historical events, so Ukraine achieved active industrial development in the -1950-70s. During this period appeared the scientific specialization 18.00.03 "Architecture of Buildings and Structures" which was combined with the specialty 18.00.02 "Architecture of buildings and structures" at the end of this period. From 1961 to 1991 the leading research and design center for industrial buildings was the Scientific Research Institute "TsNIIPromzdaniy", which is located in Moscow. This organization set the direction of development of enterprises to the whole Union (and for Ukraine, which was part of the Union). In the late 1980s, this organization carried out the development of new concepts of industrial enterprises under the state order. During this period a number of concepts of mobile and adaptive industrial enterprises were developed. Adaptive enterprises were introduced in the 90s of the 20th century. But this evolutionary change in the policy of development of industrial enterprises was outstripped by the collapse of the territorial organization of the Union.

Keywords: industrial architecture; system; labor; needs, consumption, functional connections, system components

1. Introduction

The development of industrial construction in Ukraine is currently experiencing a severe crisis. More precisely, the development of this construction and architecture field today is almost stopped since there are directly opposite trends associated with the general crisis of the Ukrainian economy. The construction of new industrial facilities and the reconstruction of existing enterprises have almost ceased.

At first glance, it seems that the number of existing industrial buildings that are not used now does not give grounds for talking about the construction of new objects. However, this impression does not correspond to the real situation because in the transition from one socio-political system to another there is a change in the principles of planning industrial production. This suggests that existing enterprises are not optimal in modern conditions. They were designed and built on the basis of exploitation socialist economy system. That system envisaged the planning of production in the context of the concept of the formation of large industrial associations and the concentration of production in certain areas.

In today's Ukraine, there is an urgent need to create a methodology for designing and constructing industrial enterprises that meet modern requirements. Such a methodology should "work" in the conditions of new construction and reconstruction of industrial enterprises.

1.1. Review of Research and Publications

The main features of industrial architecture ideology were presented by the scientific works of Dr.Sc. Y. Matveev, Ph.D. O. Metlyayev, Ph.D. D. Leikina, D.Sc. Y. Khromets, Dr.arch. M. Kim, Ph.D. L. Scrob, Ph.D. V. Bikov, Dr.Sc. B. Istomin, Ph.D. I. Cherepov and others. In each of these research areas, there were significant achievements. But in general, they are not united by a single system methodology. That fact is evidenced by the current practice of designing, building and operating industrial objects. Today, research results in the above-mentioned areas have not been published, which indicates that such research is not conducted or became a commercial secret of private industries.

1.2. The Purpose of the Work

The purpose of the work is to define the industrial architecture as

2. Statement of the Main Material

The problem of modern industrial building is the period of their construction. The term of construction of individual objects was 10-15 years at a rate of 1.5 -2 years. For example, the Zaturinsky industrial hub in Poltava and the central concentrating coal plant "Raspadskaya" (Russia) have been under construction for 19 years.

According to the current regulations, this construction period should be 2 years.

Spatially functional solutions of existing enterprises buildings have a rigid structure. Such a structure was formed with traditional spatially planning solutions of buildings based on traditional technological arrangements designed for maximum production capacity.

As a rule, in such a buildings threr are no phased development of the spatial and functional structures. The low aesthetic quality of industrial enterprises built in the second half of the twentieth century is confirmed by the decision of the Government of the USSR of 19.09.1987, No. 1058, where it is indicated: "The level of architecture of most industrial buildings and structures is not acceptable, which does not contribute to an increase in the culture of labor and negatively affects the results of production."

The location of production facilities, for example, machine building for the coal industry, was carried out without taking into account the regional needs for their products. Therefore, in order to compose the technological line for coal enrichment, it was necessary to bring technological equipment from all the coal basins of the former Soviet Union. Construction of other enterprises was also carried out on the principle of "the whole union" despite its sizes.

Such complexities led to the need to create large enterprises and industrial centers on the basis of differentiation of production of industrial and agricultural. The class theory of socialist society in determining the location of industrial objects also played a role. For example, almost the entire processing industry was located in cities. That fact led to the artificial division of production workers into the working class and peasantry. Peasants were excluded from the processing of industrial products. In addition, in such way the growth of material well-being of the "most conservative class" was deterred, as determined by Volodymyr Lenin.

Global planning of industrial production based on an ideological and economic approach has created an economic system that is not sensitive to nuanced changes in the ratio of production and consumption.

The proof of this is the current situation of the Ukrainian economy (with all its giant enterprises), which is similar to the huge machine in which the engine works, but it does not move without obeying any objective or subjective levers of control.

An objective motive is the need of people in consumer goods that are produced in the process of human activity in the field of industrial production. The main obstacle to production in Ukraine is the discrepancy between the population material wealth and the high cost of industrial products. As a result, consumer goods does not have consumers. Therefore, human activity as a specific form of attitude to the surrounding world, the content of which makes it a feasible change and transformation does not reach its goal.

Subjective levers of influence on the industry are management decisions. They will be effective when such decisions are based on the principles, depending on which combination of heterogeneous, at first glance, elements acquires a completely new quality - integrity. (e.g. Henadii Lavryk). This is possible only with a systematic approach to industry in general and industrial architecture as part of such a system.

"For a long time, they (economists) have tried to solve the problem of optimal management of the economy, based only on economic processes. But it turned out that with this approach, the economic system must be perfect ... without people, because, above all, people, with the variability of their desires and interests, introduce arrhythmia into the planned flow of economic development." (e.g. I. Blauberg)

- to be designed and built at high tempo;
- to have a flexible spatial and functional structure;
- to create the appropriate parameters of the environment for effective work and recreation of people.

The environment parameters for performing industrial processes and workers recreation in the structure of production buildings often have not only low aesthetic qualities but also inappropriate geometric, physical and chemical parameters. The reason for this

is traditional design methods when functional and technological (layout) solutions are the main ones.

In order to overcome the listed shortcomings, many scientific works have been performed on several areas of industrial architecture:

- improvement of the functional-spatial organization of local industrial formations (industrial zones and industrial units);
- Improvement of spatial and structural solutions of industrial buildings;
- improvement of spatial-planning decisions of enterprises of various industries.

2.1. System Features in Industrial Architecture

Industrial architecture as a system can be defined only when certain criteria are defined. The criteria by which the system can be distinguished from the environment. The main criterion is the intended purpose of the system. It is important to highlight the system levels that underlie the functioning of the system.

One of the promising approaches to the definition of system levels is the consideration of an object from the standpoint of systems, which contain it and which have the same qualities as it. (e.g. I. Blauberg)

The problem of defining architecture as a system is devoted to a number of scientific works of the Dr.Sc. Henadii Lavryk. In his research, it he proved that architecture, in general, is a system and component of demoecosystem with its own hierarchical structure and a constant number of system-forming components. As for industrial architecture, only its place in the hierarchy "architecture" is defined. Defining the system levels of industrial architecture is the main task of research on industrial topics.

Consider the industrial architecture from the standpoint of the system "human - environment", while using the mathematical notion of "set".

For clarity, we accept the conditional image of the set, or system of sets is a circle. The system - the system of sets - the circle. Based on this in the study, the graphic representation of any set is a circle. (Figure 1) depicts the "human-environment" system. Two smaller circles A and B are large systems of sets "natural environment" - A, and the "population" - B. A and B circles overlap and form the intersection of two sets. In this case, each point of the intersection belongs to both the set A and sets B. On a functional-essential side, the intersection is a zone of "a specific human form of active attitude to the surrounding world, the content of which is appropriate for its change and transformation" . In other words, the activity of the population is an integral part (component) of the system "human-environment".

Demoecosystem

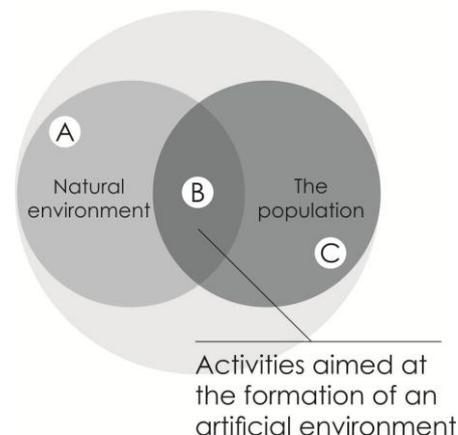


Fig. 1: Scheme-model of "human-environment" system. A -natural environment, B - activities aimed at the formation of an artificial environment, C - natural environment.

It is commonly known that the components of any activity (Figure 2) are the purpose, means, result and the process of activity itself. The central concept of the psychological theory of activity

is the vector "motive - purpose". The motive of activity in the research will be treated as the needs of the individual (population). Confirmation of expediency of such an identity "motive - need" is the statement of D.Keknadze. (e.g. D.Keknadze)

Activities

Persuasive → Means → Process → Result
 Persuasive → Goal

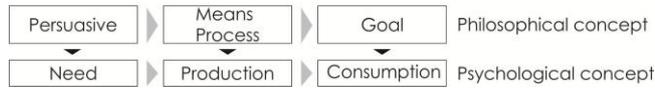


Fig. 2: Scheme of functional model of activities system.

The purpose of the activity is **what must be acquired** by the human through its activities. Here it is necessary to distinguish between the purpose and the result of the activity. The result is **what the human in the process of the activity gains**.

The purpose always serves as a criterion for activity result. When the result and the purpose of the activity coincide, the purpose becomes the manifestation of the perfect result of the activity.

The essence of the philosophical generalization approach to the definition of "activity" is the motive, means, process, result. The essence of the psychological approach, taking into account the above, is the need (motive), the process of activity (using certain means), or purpose. A comparison of the determinants of activity on the basis of both approaches makes it possible to talk about the need for their association due to the functional identity of their structural elements for further functional analysis.

The first component is a motive or need. Let's define the "need" as a functionally more specific one. The second component is a means, process or process of the activity. Both definitions of these components are functionally not specific, and therefore do not meet the objectives of defining industrial architecture as a system.

It is correct to define the process of activity as a production since this terminological replacement does not violate its functional-essential significance. This is confirmed by the expression "Production ... is the process of active nature transformation by the human in order to create the necessary material conditions for its existence." (e.g. I. Frolov). "Activity is a specific form of human relation to the surrounding world, the content of which makes it a worthwhile change." (CEE t.7). Whereas the first quotation of the definition of production as a process of creating only material goods is quite controversial.

The third component of the "activity" system structure is the result or purpose. As in the previous case, these definitions are not functionally specific to this study and need to be replaced. In the philosophical dictionary (Moscow, 1980, p. 289) needs are defined as the need for the subject of consumption «The need imply the request for the consumption object." (e.g. Philosophical Dictionary)

Therefore, the logical substitute is **"consumption"**. The structure-logical scheme of the functional system "activity" is depicted in Figure 2 The arrows depict the directions of information transfer (factor influence) in the internal and external functioning of the system. As can be seen from the figure, the system "activity" has a cyclic scheme of functioning and consists of four components. The two components are material and the two are intangible. Material components include production and consumption. The intangible components can include the need and information. Such an approach is conditional, because it is determined by the criterion of the material state. So the need and the information may not have a specific material design, that is, they are not created from a specific substance. In Figure 2, "information" does not look like a set of systems, because it "dissolved" (present) in all components of the system. The "registration" of information may be a communication component, but then the analysis of the system passes from the functional plane to the functional-spatial plane. However, this is still, prematurely, in defining the industrial architecture in the system of activities.

To check the functional integrity of the system "activity" under the above scheme, it is necessary to suspend any information communication, or exclude any functional component. For exam-

ple, under the influence of external and internal factors, a human (or society) needs a certain subject. As a consequence, production begins to work, correlating its function with the factor influence of demand and consumption. Then there is consumption under the factor influence of production and needs. The final cycle of activity at a certain level is the functional vector of consumption, namely the need. The essence of its content is the assessment of the subject of consumption according to the criterion of compliance with the need - the purpose of the activity. Thus, the internal factor influence on the system "need" appears. Obviously, the exclusion of any component violates the functional integrity of the system.

The functional structure of the system "activity" has the ability to evolve and degrade because it is a living system. The basis of these processes is the level of influence on the system of "activity" of external factors that do not respond to the corresponding action of the system (subsystems). (e.g. H. Lavryk). The higher system hierarchical level of external influence initiates a certain interpretation of its components of the system between which there is a change in the hierarchical levels of factor influence with direct and reciprocal action. If the system at a higher level of external factors increases its own hierarchical level, it develops. If it does not react, it operates on the bases of reducing the level of factor influence - it degrades. Reducing the level of influence of external factors (reducing the level of requirements of the external world system) leads to degradation of the system "activity". This is another confirmation of the systematic concept of activity.

For the selection of industrial architecture from the system of "activity" further analysis of the internal world of this system in the functional plane (functional aspect of the system) is needed.

Consistently consider each subsystem of activity: need, production, consumption. (Figure 3).

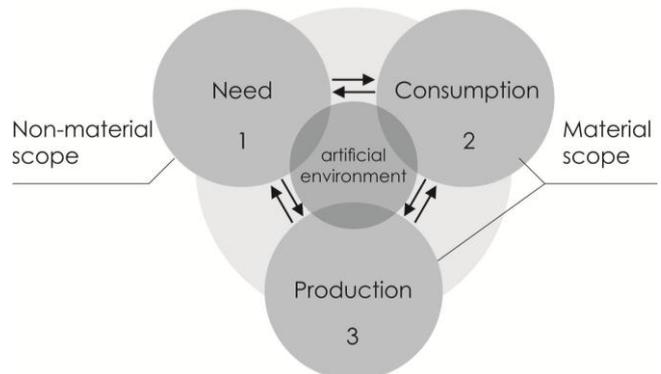


Fig. 3: Scheme of functional model of activities components.

Needs - are elements of the non-material world. They are the main motivator of human activities. It consist of some systemic functional components as: spiritual needs, material needs, social needs. They appears as the reflection of certain functional elements` presence in the system. All of them have a mutual influence, which can be attributed to the internal factor influence of the "need" system. Under the internal factors it is necessary to understand the direct opposite influence of components. External influence does not have reciprocal influence. (e.g. H. Lavrik).

Spiritual needs include the needs of human (the population) in non-material beginnings of consciousness - beliefs, ideals, world outlook. The level of spiritual needs and the level of their realization actually determine the effectiveness of such activities as art, science.

Material needs - the needs of man (the population) in certain things, and therefore is the main motivational component of the activity for the production of elements of the real world.

Social needs are the motivator of activity, which determines the priority of the real and non-material needs of the entire population. Activity based on social motivation involves a result that satisfies the society and its individual members. Examples of such activities are religion and lawmaking. Not the least role is played by social motivation in architecture when designing and building

large public buildings and territories of real formations - settlements.

The mutual influence of components of the system "Needs" can be proved by depicting components of the subsystem "need" in the form of mathematical sets - intersecting circles. (Figure 4). The integrity of the functioning of the system is formed in the zone of imposition of functional sets of its components, when each of the points of imposition belongs to each of the sets. The interconnected functioning of the components of the system involves in-system factor influence - direct and inverse.

Persuasive - Need

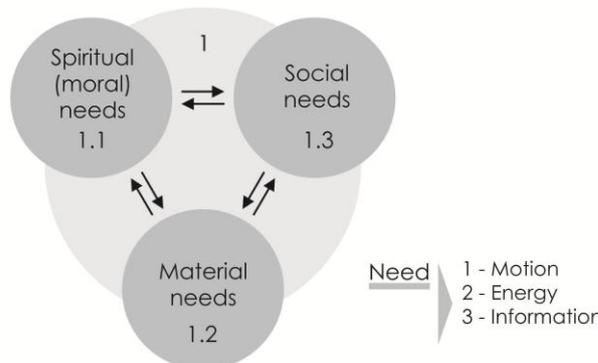


Fig. 4: Scheme of functional model main elements of activities system. Persuasive - Need.

According to the definition that was proposed in the philosophical dictionary, edited by I. Frolov (e.g. I. Frolov) Production - the process of work to achieve a certain goal - the components of production are the objects of labor, the means of labor and labor itself, by itself. There are three objects necessary for the production of any object: the object of nature from which it can be made, the means of labor through which this production is carried out and the purposeful activity of man - his work. Production is a functional component of the "Activity" system and is fundamental to creating an artificial real world. The motivator for the functioning of production as a system is the external factor influence of the system "Needs".

"Production" has a reverse effect on "Needs" directly and indirectly. Direct factor influence takes place in the highest in the hierarchy of the "Activity" system. At the lower level, when "Needs" and "Production" work as independent, functionally integrated systems. The reverse factor influence takes place through the system of "Consumption". This is because at this level of the hierarchy of the system (subsystems) with respect to one to one, there are "external worlds" that do not involve direct communication. (e.g. H. Lavryk).

Components of the "Production" system demonstrate an obvious transition from the sections of the functional-information system to the cut of functionally-objective (Figure 5). Of the three components: "the means of labor", "labor", "the subject of labor", only one - "labor" is not material, but energy. The other two are material.

Consumption - the component of the system "Consumption" is located in the functional-subject plane. (Note, therefore, in this study in the future, areas of consideration will be called only material and non-material). The result of the functioning of the "Consumption" system is the use of certain things in accordance with the needs. During consumption, an estimation of the production result according to the "purpose" criterion is carried out. That is, in the world of consumption there is a comparison of the result of production and its purpose, defined by the component of "needs". If the purpose of the activity is not achieved, the motive for the further functioning of the system becomes only external factor influence.

Means - Process - Production

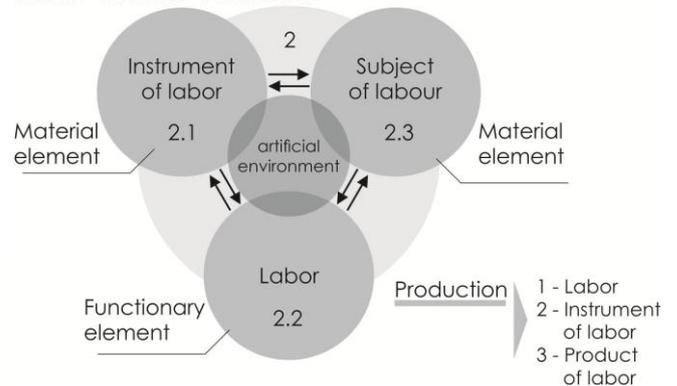


Fig. 5: Scheme of functional model main elements of activities system. Means - Process - Production.

The structural and logical scheme of the "Consumption" system is depicted in Figure 6. It is a material reflection of the system "Needs" - things of spiritual consumption (meaning a certain material design of information and energy subjects); things of material consumption; things of social consumption - things whose consumption is determined by the needs of the whole society, or its large groups, for example, laws that have certain things, social buildings, housing district formations.

Goal - Consumerism

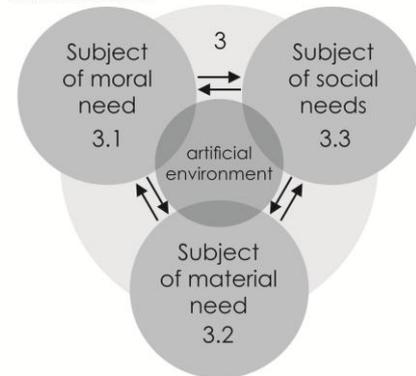


Fig. 6: Scheme of functional model main elements of activities system. Goal - Consumerism.

In the transition to the consideration of the system in the material plane, it becomes apparent that there is a certain real component on the resulting schemes, which provides the necessary things of the functional components of the "production" and "consumption" as well as the system "Activity" in general, while being their elements. This is an artificial real world - the result of the functioning of the "Activity" system.

The material component is present in any element of the "Activity" system and acts as a cause, as a consequence of activity. The motivation of activity is a manifestation of the functional activity of a particular real biological system - human. The primary problems of the biological system are the maintenance of one's own life. That is, the production and consumption of those things that restore the energy costs of a person, regulate its activity, and also perform protective functions from the negative environmental impact.

The energy base of human life is the things of internal systemic consumption - food (food production - food consumption). Protection from the negative impact of the natural environment is, as is known, through the creation of an artificial environment - the construction of buildings of different purposes, according to different types of human activities (Figure 7).

Figure 7 shows that "Production" and "Consumption" as elements of human activity have their own supply, which means the presence of an appropriate type of activity of the artificial environment - a spatially localized object, in which the processes of human life are taking place. In scientific works H. Lavryk (e.g. H. Lavryk) identified four types of activities:

- processes related to the production of artificial world (technosphere) of human society, as well as energy and science (production of energy and information), that is all that can be combined with the concept of "Production of the first type" (P1);
- processes of service of the population, education and formation of a fully developed person, that is, processes that are components of "Production of the second type" (P2);
- processes connected with human rest, restoration of their health and efficiency - processes of the recreation sphere (R);
- communication processes that provide a mutual connection, that is, the exchange of matter, energy and information between the groups of processes of human activity that are listed above (C).

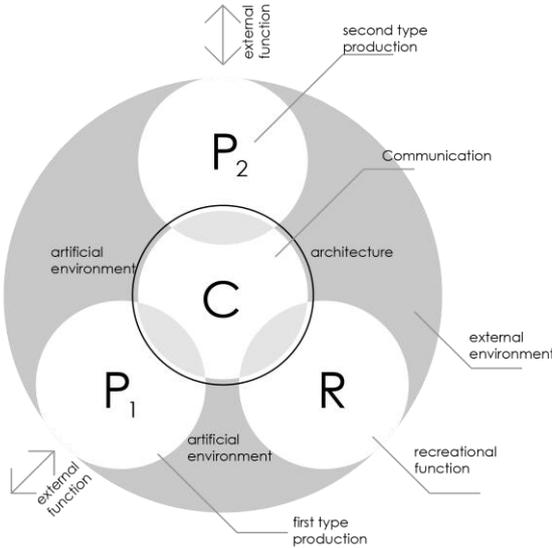


Fig. 7: Scheme of functional model of architectural system.

If we compare the component composition of the system "Activity" and "Life" of a person, it becomes apparent that in the system "Activity" a person acts as an element of the social aspect of the "Population" and therefore acts only by its external connections, which prevents the definition of industrial architecture as functionally integrated, spatially localized system. For these purposes the system (subsystem) "Life activity" of a person is more suitable. The structure and definition of functional components is given by H. Lavrik in his dissertation in defining architecture as a functionally integral system. "... the notion of a holistic architectural system must be understood as a spatially localized object (environment), in which, as a rule, all functions necessary for normal human life are realized".

Figure 8 shows a functional "cut" of the "Architecture" system. Again, the obvious place is the functional basis of industrial architecture - component detected to "labor" circle - the processes associated with the production of the real world (technosphere) - the main function of industrial architecture. Its systemic functional integrity lies in the joint operation of the main production and associated components Means of labor (processes of training and maintenance of production personnel), Labor - includes recreational processes in the field of production, and communication maintenance of production. The practice of designing, building and operating industrial enterprises confirms the authenticity and legitimacy of such a functional division. (Figure 8). That is, industrial architecture is a system of functionally integrated, spatially localized objects (environments), in which, along with the main function of industrial production, there are functions that ensure the normal livelihoods of production personnel. Its components are separate functionally integral, spatially localized production objects. They can be handmade and industrial. Handmade - home, manual, non-factory production. (e.g. S. Ozhegov). Therefore, further in the text under the industrial objects should be understood objects of industrial production. The operation of such objects involves the use of machines and mechanisms (technological

equipment) that can meet the needs of the majority of the population in certain things.

If you return to the "mechanism" of the functioning of the "Activity" system and consider it in a functional - time plane - opens the possibility of identifying one of the criteria for optimality of the system as a whole and its components.

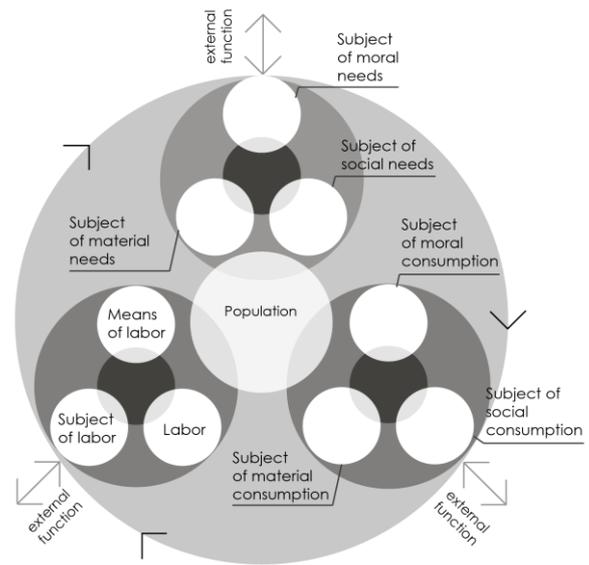


Fig. 8: Scheme-model of activities system.

As is known, the functioning of the "Activity" system occurs under the influence of external and internal factors. Conditional accept their action as simultaneous (their action takes place during the same time) The system interprets them for certain needs. But factor influence is variable in time. This means that the achievement of the objective of activity as a criterion for the conformity of the result of the activity needs is in the sphere of objective category - time. The faster the result is obtained, the greater the probability of achieving the goal, because when reducing the term of a certain action becomes less likely to change the need as a consequence of external and internal factor influence. Minimization of the term of achievement of activity result is possible at the reduction of the term for obtaining the result in each individual link of the functional chain of "activity" - the need - production - consumption. Obviously, in real activity of the population, the time distribution between them depends on the links is not uniform. (Figure 8) The realization of production takes much longer than the formation of the need, or a certain consumption of the produced thing. This means that at this stage of development of society, the optimality of the functioning of the "Activity" system depends on minimizing the term "Production". The optimal term is the minimum possible time required for production. The size of the minimum possible term depends on many objective and subjective factors - the development of science, technology, production culture of the population, consideration of which is not within the scope of this research.

Industrial architecture is both a component of the "Activity" system and the result of this system. Therefore, the criterion for the optimal functioning of this mega-system is minimizing the time of achieving the goal, and is relevant for its component - industrial architecture, both in its creation and in its functioning. In the functional and material plane, industrial architecture is one of the goals of functioning of the "Activity" system to meet the balance of needs (material, spiritual, social) in an artificial environment for the industrial production of certain things. That is, in the functional chain "demand - production - consumption" industrial objects are the actual components of "Production" and "Consumption", therefore, according to the above, the optimal functioning of their creation is activity with the minimum possible time achieving the goal. Taking into account the general functional structure of industrial architecture, the production function of the first type (produc-

tion of the real world) is dominant, so the functional and spatial structure of industrial objects should be formed taking into account the minimization of the time to create their construction and technological part, considering the technological part as an integral part of the artificial production environment.

The second important criterion for evaluating the quality of society and individuals is the total equivalent of money. "Money is an economic category, which means a specific product that performs the role of a generic equivalent in a society. Serving all spheres of economic relations in the process of social reproduction. ". (Banking Encyclopedia., Edited by Prof. A. Moroz) (e.g. A. Moroz)

3. Conclusions

In the conditions of a market-oriented economy, the functioning of the "Activity" system, which means that the production and consumption of the material world should be economically feasible, that is, the costs in the process of activity should be minimal to obtain the maximum profits generated as the difference between the value of goods in the field of "consumption" and in the sphere of "production". Lack of economic feasibility (lack of profit) is an indicator of not optimal functioning of the "Activity" system. As a consequence, the general economic direction that industrial architecture should reduce its value in the field of "Production" and "Consumption", that is, in the design, construction and operation of industrial facilities. Given that money is not an objective criterion for the optimality of "Activity", because it is a consequence of the development of commodity production and the constituent element of the commodity economy, that is, the consequence of human society, the objective criterion of minimum time remains to meet certain needs as the basis achievement of economic efficiency of Activity - subjective criterion of optimality of "Production" and "Consumption" of the material world.

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