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**THE PRINCIPAL ASPECTS OF MANAGEMENT PROCESS
OF THE GEOGRAPHIC SYSTEMS**

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The authors present their approach to the management of the geographic systems based on the following principles: (1) the principle of spatial differentiation, (2) the principle of attaining effective structures for geographic creations, (3) the principle of search for local non-uniformities, (4) the principle of spatial balance, (5) the principle of self-regulation and organization effects.

One of the most significant theoretic results of modern geographic science is the conception that territory is a complex and very peculiar natural-human integrity, which cannot be managed solely by mechanistic summation of impacts, affecting its sectoral and territorial components. The idea of emergent features of the territory (or the geosystem as a formalized model of it) and the related problems of management in geography both originate from the above concept. The problems that seem most important to us are discussed below.

On the one hand, it is the target-setting problem for the territory viewed as an integral object of management. On the other, it is lack of an effective mechanism able to coordinate in the interests of the society the external impacts on the managed territory with the immanent interests of the latter, determined by internal causes.

With regard to the problem of target-setting we consider it essential to acknowledge that not all socio-economic and natural phenomena and processes can be described in a strictly formal way, since they are inherently diffuse. It means that many concepts in geography can be expressed only in semiformal or non-formal terms and therefore such targets as

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functioning and development of territorial systems cannot be set fully unambiguously in principle. Only broad outlines of targets have certain meaning, since their details are blurred in a generally diffuse environment. Therefore models of geographic systems management cannot and should not be completely formally-qualitative, as well as methods of management - unconditionally directional. All that determines the necessity to employ logico-semantic methods and approaches and techniques of analysis, based on peculiarities and regularities of the geographic thought (Goodchild, 1985).

Such an approach demonstrates a geographic interpretation of the external supplement principle, borrowed from the general systems theory, which holds that if the object under management is very complex, then both content-control of the formally acquired results and the informal decisions to correct such results are required.

To solve the problem of target-setting in geography (along with other such tasks), a reasonable combination of formal and non-formal approaches can be set up. This process is alleviated by the currently available effective apparatus, which helps to describe quite correctly both non-formal and semi-formal situations which are typical for geography, and to use such descriptions in the decision-making processes. Here we mean the methods of diffuse (illegible) numbers theory, which represents a fundamentally new direction in mathematics (Zadech, 1965 and others).

A number of approaches to the problem of management in geography are discussed in several papers (Trofimov, Huzeev, 1985; Trofimov, Huzeev, Panasyuk, 1986; Huzeev, 1987 etc.). The authors draw the conclusion that there exists a very efficient approach in the research study of this problem, which embraces the following elements: building models of interactions within the geosystem, analysis of the geographic system structure and transformation possibilities, development of the means for purposeful influence on the object of management to regulate its functional and development processes. This approach is based on the number of geographic management principles, and the most important ones are discussed below.

THE PRINCIPLE OF SPATIAL DIFFERENTIATION

The problem of interaction is a major issue in geography. In the broad sense it substantiates and supports the formation of geographic structures in the geographic space, their spatial concentration and emergence of influence zones, formation of complexes etc. The more distinct is the structural organization of geosystems, the more sharp they stand out in the space, the more legible their outlines, boundaries. The general structure (viewed as overlapped and interlaced individual ones, with different organization and distinction degrees) gives us a formalized measure of differentiation of the geographic space, depicting the intersections and overlaps of geographic creations, that really exist in the environment. It is manifested by intersections and overlapping of boundaries with different nature and different degrees of diffusion and legibility.

Taking into account the principle of integration integrity, we can often assume the diffuse character of the situation within the geographic space as an axiom, so the diffuse character of boundaries is quite natural there. Consequently the problem of distinguishing the

boundaries (classes, types, regions, qualitative differences in the intensity of processes etc.) is the problem of function and contents, and detection of differentiation within the geographic space (including the attributive one), i.e. modelling of the realistic spatial situation represents a major aspect of environmental management.

To differentiate the geospace, several methods of automatic regionalisation and classification were developed and tied up to certain types of geographic tasks, then their effectiveness evaluated, an integrated system of quantitative regionalization methods elaborated and its major principles automated, and last of all, the techniques for both formal and non-formal estimates of territory classification quality perfected (the search for an optimal variant of regionalization) (Tikunov, 1985; Trofimov, Zabotin, Panasyuk, Rubtsov, 1985), along with some techniques based on the diffuse analysis concepts (Huzeev, 1987; Rolland, May 1987; Tikunov, 1989 et al).

THE PRINCIPLE OF ATTAINING EFFECTIVE STRUCTURES FOR GEOGRAPHIC CREATIONS

The multitude of combinational conditions in the geographic space leads to appearance of the parts with favourable possibilities for emergence and functioning of special geographic situations, where most different geographic creations interact. The natural laws of concentration stipulate formation of specific local reproductive elements and specific kinds of objective and spatial connections. The latter give rise to the two-three types of territorial concentrations (partly according to Schmidt-Renner, 1984): a concentration of homogenous elements, and a complex (heterogenous) one. The complex type of concentration is the most natural process to balance out the geographic space, to link up its dissimilar, non-identical, multilevel by hierarchy components to a certain pre-determined target, the meaning of which is to attain most effective and rational functioning of the elements set up to achieve it.

The geographic complex represents the highest level in the balance of diffuse, dissimilar multilevel, components of geographic creations (geosystems). Here the components are tied up so that the integration effect of their interaction stipulates the most rational functioning of the system. The latter circumstance suggests that there exists some external function of the complex, since only in this case the notion of the harmonized (balanced) functioning acquires certain meaning. In this case a special structure of geographic complex appears, which facilitates the most rational and effective functioning to attain the pre-determined target (Trofimov, 1986).

The notion of structure is the most important one in the evaluation of the system's integrity, since it reflects the inner arrangement of the system and acts as a function bearer. Here is the most productive interpretation of the structure. Here, the structure can be most productively interpreted as a manner of coexistence for nonconformal interests of the elements, by which we achieve and sustain a compromise, that ensures integrity and stability of the system. Assuming as the natural premise that the higher the degree of interests conformity within the system is, the more coordinated is the functioning of its elements, therefore the measure for harmony of interests (or compromise quality measure) may serve

as a most general measure of the system's integrity. Thus we can get an evaluation parameter - an effective structure of geographic creations, which is understood as the inner arrangement of a geographic complex, under which the immanent and emergent interests become correlated (i.e. the capabilities of the elements and the functions, set up for them, coincide).

The concept of expediency and effectiveness of the structure is understood as a way of system organisation, which facilitates successful achievement of the targets set for its development (Trofimov, Huzeev, 1985). Since the degree of interests and functions compatibility can be different, there exists objectively the measure of effectiveness for the structure of geographic creation. This suggests that the management function includes such purposeful influence on the structure under which the degree of harmonization of interests in the system increases and consequently the degree of structure effectiveness too. The process of convergence between functions and interests can be considered as that of perfecting the structure. It is essential that under equal external conditions the more effective structure will be the more stable one.

If formation of an effective structure is implemented through purposeful influences, then we refer to the realization of the management aspect of environment development. Here, the process of management includes a combination of measures focused on the regulation of the functioning processes, with those of strategic character, aimed at facilitating changes in the required direction for the organization functioning techniques in geosystems.

THE PRINCIPLE OF SEARCH FOR LOCAL NON-UNIFORMITIES

Management of geographic creations development is based on two major points: detection of the functional essence of the process, followed by assessment of its evolution which gives rise to certain spatial forms; and, when the above essence is not detected the search for statistic approaches for interpretation of the development tendencies (trends). Still in both cases one should first find either the stable state of the dynamic equilibrium or the stable state of the spatial form of the process in the environment (i.e. invariants of the processes or the forms of distribution) and from that position current state, perspectives and future changes are assessed.

Such a stable state for geographic creations is provided by an effective structure, while assessment of spatial changes of the system's structure is achieved by searching and finding for the parts where „local non-uniformities“ are generated and then by purposeful work aimed to reduce or even eliminate „the environmental resistance“, which inhibits development of these non-uniformities (slope development, gully development).

From the viewpoint of spatial-temporal interpretation of the development trends, the seat of local non-uniformity embraces those spatial points and nodes, where new structures of the geographic space are nascent. It is important to detect the local non-uniformities and then to assess adequately the potential trends, to give the necessary impulse for development in the direction, which is beneficial for mankind, to determine their scale etc. The latter point gives us the concept of the major principle for geographic creation management, achieved by the studies of the state of and perspectives for the local non-uniformities in the geographic space and followed by the search for methods that facilitate their development

in the necessary direction by means of a system of measures that help to remove the „resistance“ of the environment.

THE PRINCIPLE OF SPATIAL BALANCE

All the components of a geographic system are linked up by fluxes of substances and/or energy into an integral unit. But any geosystem has different grouping and correlation of interactions between its components. Under these conditions any of such components can work as a stimulus, as a neutral or negative factor in the process of functioning and development. So a major task for the geographic creation management is the analysis of formal systems features, occurring in the space, and detection of the adequate types of processes. The point is that while these relationships develop, additional effects appear in the geographic space, that link up closely the processes and the forms of their manifestation according to certain laws (Claval, 1970).

As is shown earlier, due to these processes the structure of geographic time-space domain is getting more regular and more refined. Geographic complexes manifest themselves as the form of balance. Note that the process of balancing is seen as the unified one in all the attributes of the geographic time-space. As is shown by D.K. Galeeva (1987), the process of formation and development of an integrated national economy complex leads to the balancing of economy, and to creation of such organizations as territorial-industrial or agricultural-industrial complexes etc.

It is a complex approach that is able to realize most effectively the concept of spatial balance (Benneth, 1984; Freeman, 1986).

The idea of spatial balance can be easily described by the example of another new notion - „the harmonized development of a socio-economic region“ (Sus, 1984). Harmonization of the development process includes attainment of such response level for the economy, when the social costs for retaining the state of equilibrium are optimal or nearly optimal. Several authors define the harmonic development as a cyclic process of self-occurring, organized deviations from the equilibrium within the range permissible from the social politics viewpoint. Therefore, harmonization of development is closely connected with the mechanism of self-regulation. Harmonization of the national economy embraces economic subjects, i.e. the workforce, the production sphere, resources and social environment, economic and social infrastructure, geographic position, natural background.

The principle of spatial balance presupposes the analysis of contents in the geosystems processes, which would explain to us the most important properties of the geographic space. The balance processes are closely tied with the mechanism of self-regulation within the geographic creation, and lack of knowledge here would make it impossible to apply effective purposeful influences into the object under management.

THE PRINCIPLE OF SELF-REGULATION AND ORGANIZATION EFFECTS

The principle of self-regulation and organization influence is a major one in the management of geographic space development. It assumes a thought out and well-founded

dosing of the influence ratio between the self-regulation processes and external purposeful inputs on the total process of functioning and development of geographic creations. Since the processes of self-regulation are determined by the inner driving forces of the development while the external inputs reflect the policy of higher levels in the hierarchy of geosystems we believe that the principle discussed is in fact the basic principle in the management of geographic creations.

In other words, this principle shows the necessity to create a mechanism of management which gives the controlled object the degree of freedom required for territorial adaptation of the external control inputs, to the mutual benefit of both sides concerned, i.e. in the interests of the society as a whole.

Geographic space is formed by the complex interaction of its components: the nature, the population, the industry and the infrastructure. In the process of interaction each component forms a special zone of influence, which determines a generally complex nature of coordination, conflict and balance in every point of the interaction space. All these factors determine the anisotropic character of the geospace. As we see, it is connected with the complex character of interactions and conflicts. Very often these interactions are heterodynamic.

For example, industrial impacts on the nature include pollution along with removal of certain natural resources, as well as the disturbance of environmental equilibrium, and so on.

Still, not only this is important. The nature represents the environment for economic activities: though it is much less active, it serves as the basis for making assessments of the results obtained by interactions with the other spheres. It is precisely the factor that predetermines the initial anisotropy. Original peculiarities of interactions between components also stem from here, and in the course of time they show more and more evident influence upon other components of the geographic space. Being ambiguous and asymmetric this influence does not always manifest directly. The effect of complementarity, acceleration and retardation of processes is seen here most clearly. It is determined by the adaptation peculiarities of basic components within the geographic space of interactions. Particularly, the natural environment has the highest adaptation ability and the longest pitch of impact perceptibility, but at the same time its burden-absorbing capacity is limited and irreversible changes occur when it is surpassed. It should be noted, that these spheres evolve in most cases through self-organization and self-development (Armand, 1986).

So, specific geosituations develop in every point of the geographic space, and the multitude of their interactions governs perspective development of the environment. As is shown earlier, it is precisely the environment that forms the character of the geographic creations development. The principle of environment. or conditions is a major one among the factors, governing the development of geographic space. The researcher should take into account that the existing character of geosystems development is „permitted“ by the outer situation, circumstances, conditons. The character of geographic creations development is determined by a special type (type, feature) of environment, that dominates in every single historic period of its evolution. Such creations exist and develop in the pre-set direction and mode as long as the conditons, or circumstances of the outer environment would „permit“ them. The conditons or circumstances mentioned earlier, can be identified

as stable geosituations. To study them is to pave the direct way to the study of the management mechanisms.

This feature of the geographic creation development can be defined, according to the terms proposed by N.N. Moiseev (1987) as an adaptive type of the system development mechanism. It determines the compromise between the system development and the outer environment. The spatial-temporal structure of the system therefore is the consequence of this compromise. It can be characterized as the invariant of the system in the time domain, but it is not completely stable and there exists a certain threshold state for it. Beyond this state the perspective realization depends from casual influences, fluctuations, i.e. different emergent geosituations, and it is impossible to predict what kind of new form of equilibrium would be realized. It shows that self-development would give rise to the multitude of different emergent forms of the processes manifestations. Nevertheless, this is not so important for the management aspect. Under this „bifurcation“ - type in the development of a system, the latter does not „remember“ its past state¹ after it has passed the critical threshold value; the direction of development is cut off and gets a different character. The latter is determined by the development of the accidental geosituation, which facilitates (influences) the movement of the modified structure of the geosystem towards a new (and uncertain) state of equilibrium. It is evident that the study of geographic situations of interaction is very important for the perspective process of the geographic creations management.

The objective is to detect the necessary geosituations, to choose most promising among them and then, by means of balancing and coordination in the processes of self-development and organization, to bring them purposefully to the final stage of development. Here we see the major instrument for the management aspect of the rational time-space organization problem. While the balance is achieved „from within“, by the processes of build-up and spatial interaction development, there exists consequently an analogue of homeostatic equilibrium of this space (e.g. there is an analogue of the preferred state of systems in the nature, that is the dynamic equilibrium) and the formation of geographic creations has „elemental“ character, i.e. it is achieved by the forces of that space. Profound study of interaction processes occurring in the geographic space facilitates purposeful organization of the latter, and therefore to direct purposefully the process of formation and development of the desired geographic creations. And this represents the major process of management through the formation of a rational territorial organization.

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¹ Bifurcation development is defined as ramification of the evolution paths as soon as the organization threshold has been passed (Moiseev, 1987).

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PRINCIPIÁLNE ASPEKTY PROCESU RIADENIA GEOGRAFICKÝCH SYSTÉMOV

Problémy skúmania riadenia v geografii vyúsťujú do modelovania vzájomných vzťahov v geosystémoch, do analýz štruktúry geografického systému a možností jeho premeny, do vypracovania spôsobov cieľavedomého pôsobenia na štruktúru objektu riadenia za účelom regulácie procesov fungovania a rozvoja. Vychádza sa pritom z týchto základných princípov riadenia v geografii: z princípu priestorovej diferenciacie, princípu dosiahnutia efektívnych štruktúr geografických útvarov, princípu hľadania lokálnych nehomogenít, princípu priestorovej rovnováhy a princípu autoregulácie a organizačného efektu.

Jedným zo základných problémov v geografii je problém vzájomnej interakcie. Práve tento problém (v jeho najširšom chápaní) spôsobuje v priestore vznik geografických štruktúr, priestorovej koncentrácie a vznik sfér vplyvu, formovanie komplexov atď. Celková štruktúra určuje formalizovanú charakteristiku diferenciacie geografického priestoru, zobrazujúc pritom v životnom prostredí reálne existujúce prieniky geografických útvarov. Celková štruktúra sa vyjadruje prienikom a prekrytom hraníc rôzneho pôvodu a rôzneho stupňa presnosti a striktnosti.

Predstava o cieľuprimeranosti a efektívnosti štruktúry sa chápe ako taký spôsob organizácie systému, ktorý umožňuje úspešne dosiahnuť cieľ rozvoja tohto systému. Stabilný stav geografických útvarov je podmienený ich efektívnou štruktúrou. Na zhodnotenie priestorových zmien štruktúry systému je potrebné hľadanie a nachádzanie miest zrodu „lokálnych nehomogenít“, ako aj cieľavedomé znižovanie až odstraňovanie „odporu prostredia“ voči vývoju týchto nehomogenít.

Princíp priestorovej rovnováhy (vyváženosti) predpokladá takú obsahovú analýzu procesov v geosystémoch, ktorá by odhaľovala najpodstatnejšie stránky geografického priestoru. Procesy rovnováhy sú úzko späté s mechanizmom samoregulácie geografického javu, bez poznania ktorého nie sú možné efektívne a cieľavedomé vplyvy na objekt riadenia.

Princíp účinku autoregulácie a organizácie je základným princípom riadenia rozvoja geografického priestoru. Jeho uplatnenie predpokladá dobre premyslené a zdôvodnené dávkovanie pomeru vplyvu pôsobenia síl samoregulácie a vonkajších cieľavedomých účinkov na celkový proces fungovania a rozvoja geografických javov.

Preložil J. P r a v d a