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## INTEGRAL SYSTEM CHARACTERISTICS OF FRACTAL STRUCTURES IN THE STUDY ACTIVATION OF CLUSTER DEVELOPMENT UNITS ON VEHICLES

Volynets L.M., PhD, National Transport University, Kyiv, Ukraine  
Khomenko I. O., Ph.D., Chernihiv National University of Technology, Chernihiv, Ukraine

## ІНТЕГРАЛЬНІ СИСТЕМНІ ХАРАКТЕРИСТИКИ ФРАКТАЛЬНИХ СТРУКТУР ПРИ ДОСЛІДЖЕННІ АКТИВІЗАЦІЇ ПРОЦЕСУ РОЗВИТКУ КЛАСТЕРНИХ ФОРМУВАНЬ НА АВТОТРАНСПОРТІ

Волинець Л.М., кандидат економічних наук, Національний транспортний університет,  
Київ, Україна

Хоменко І.О., кандидат економічних наук, Чернігівський національний технологічний  
університет, Чернігів, Україна

## ИНТЕГРАЛЬНЫЕ СИСТЕМНЫЕ ХАРАКТЕРИСТИКИ ФРАКТАЛЬНЫХ СТРУКТУР ПРИ ИССЛЕДОВАНИИ АКТИВИЗАЦИИ ПРОЦЕССА РАЗВИТИЯ КЛАСТЕРНЫХ ФОРМИРОВАНИЙ НА АВТОТРАНСПОРТЕ

Волынец Л.Н., кандидат экономических наук, Национальный транспортный университет,  
Киев, Украина

Хоменко И.А., кандидат экономических наук, Черниговский национальный  
технологический университет, Чернигов, Украина

### **Problem.**

For the modern transport market, characterized by complexity and closeness of relationships between entities need to develop generalizing theory, able to provide the scientific basis for effective interaction, one form of which may make transport clusters. In carrying out socio-economic studies to analyze economic objects impossible experiments, both in the natural sciences. Sometimes all the components of the economic system separately with certain characteristics, but forming a coherent system of their properties vary depending on the structure, which complicates the analysis of such systems. And because transport research clusters, their individual components and integrated isolation system characteristics of fractal structures is of particular relevance.

### **Analysis of key studies and publications.**

A significant contribution to the modern understanding and development of the organization and management of transport activity belongs to scientists: V. P. Alfer'yev, I. D. Afanasenko, N. In. Afanasjeva, G. L. Bayevo, A. M. Gaginskaya, M. P. Gordon, V. A. Gudkov, N. E. Salmanova, K. V. Nutini, E. A. Kravchenko, A. A. Kroll, L. Would, Mirotin E. E., T. D. Novikov, A. A. Novikov, A. D. Protsenko, A. M. Spring, V. G. Sankova, A. I. Semenenko, A. A. Smekhova, D. V. Sokolov, G. G., Sokolov, I. V. Moot, M. M. Tretyakov, S. A. Uvarov, N. I. Chernyshev, V. V. Shcherbakov and others.

The article is disclosure of integrated system characteristics of fractal structures enhance the study of the development of cluster formations that will ensure the improvement of service quality and safety of passengers, rapid response to changes in passenger traffic, and significantly increase the efficiency of the transport system.

### **The main material.**

In the transportation market invariance is expressed through the self-similarity of some basic characteristics of the economic system at all structural levels: macro - system as a whole, the meso level - sectors and regions, micro - firms and companies. For economic systems, including the transport cluster characteristic property of self-similarity. Traffic self-similarity clusters manifested through their equal goal - profit maximization, repetition at certain stages of the life cycle of basic behaviors, germination strategies and tactics of subordination. Enterprises Cluster vehicle dynamics retain their key performance indicators, working with the same contractors, without changing the basic directions of its work, despite changes in the external and internal environment. Thus every company similar in structure to the cluster as a whole [1,2].

Often to the economic principle of similarity satisfied only approximately. And therefore advisable to assume that transport clusters - a quasifiscals. Quasifiscals main features are:

- Level transport clusters vary in size;
- Heterogeneity of the structure of each of the levels and under different composition elements
- Identity different levels of the structure;
- At the separation of any component of the cluster, there is a possibility of transformation by joining or creating the rest of the cluster.

After analyzing various types of fractals, in our view, appropriate to use fractals "Koch snowflake" [4], the extent of which are derived from the curve, compiled their three identical fractals.

According to the theory of basic dual organization and management of socio-economic systems, complex structure and management entities, in this case, clusters have two areas: governance functioning and development management. With this organization of transport clusters become adaptive properties and the corresponding level of organization and self-development that meets the objectives and the state of their internal and external environment. Thus, based on the main provisions of the theory of dual organization and management of socio-economic systems purpose vehicle cluster can be represented as a dialectical unity of functioning and development necessary to ensure the sorted stable state and integrity of (self), which essentially determines the competitiveness cluster on market.

The development of transport cluster is the result of their interaction with business entities, government and others. At the same time the key components of development are influenced by the environment. For the sustainable development of transport clusters, they must have the ability to form important elements of the structure, using the environment as a raw material base. Ensuring the purposes and efficiency system requires unity of purpose and structure and structural and functional subsystems activity.

After determining the target and functional relationships needed to transport the existence of clusters should characterize their structure, ie identify motor company serving a route. It uses functional and structural analysis that allows to determine the territorial boundaries and optimal number of companies included in the transport clusters needed to service routes and specific goals. Reproduced approach enables the most efficient allocate functions and define management component at each level, and identify the relationship between enterprises of one branch.

The name "fractal" comes from the English «fractal» - an incomplete, partial. Fractal - is infinite, which has roughly the same forms and structures (morphology) by changing the magnitude of their consideration. The key features of fractal structures clustered units on a vehicle are: similarity, self-organization, optimization, target orientation dynamics.

1. The similarity. Transportation clusters similar to each other, but each has its task (maintenance of a transport network), and thus various automobile companies that are to it, the structure, the total cost of running parameters, etc

2. Self. Transportation Cluster - is self-organized structural units, as part of a current through the mechanisms of self-organization based on an integrated set of regional trucking companies, representatives, other transportation companies, local authorities and research institutions.

3. Optimization. Transportation clusters are created for specific, clearly defined functions to achieve the optimal equilibrium of the entire system (sorted steady-state) and ensuring integrity.

3. Target orientation. ATP combined in a cluster transport by using highly intelligent information and communication system that achieves the goals of the system through logistics co-ordination center. The results of transport clusters continuously analyzed, evaluated and adjusted.

4. Dynamics. Transportation clusters depending on the specifics perceived impact of the environment (receptor function), transmit them to the information and communication system (control function) and transformed (effector function), striving for equilibrium.

The advantage of using fractal approach for studying transport clusters is that regardless of the size of the system and hierarchical levels, the deviation of the individual fractal element serves as an indicator of the feasibility of the cluster strategy as a whole, since the optimal flow of processes should not have any contradictions between fractals and their value has to approach to the ideal.

Transport cluster - a certain set of trucking companies that implements a particular function of the cluster and is aimed at the socio-economic efficiency of its operations by achieving an orderly, steady state. Transportation clusters function as fractals and developing countries on the verge of chaos and the results of their activity are deterministic chaos. In completely chaotic forecasting systems possible in the time interval, depending on the K-entropy Kholmogorov.

The study of the transport clusters by studying the fractal dimensions based on the definition of system settings characterized by chaotic and random natural behavior. Operation of transport clusters as dynamic systems by studying the fractal dimension (the dimension of the attractor smaller dimension of the phase space) in time is divided into two main classes: 1) movement to an attractor; 2) motion on the attractor (is a finite space in the phase space of the system).

An integrated approach to the analysis of transport clusters showed that they will not be in equilibrium, and will always move from one state to another, even when exposed to minor factors. Full description of system dynamics on attractors possible only when the number of variables is equal to the dimension of attractor in this case is characteristic transformability state attractor fractal dimension [3].

Structural harmonization complex structure of transport clusters, implemented through a mechanism of self-organization directly related to its restructuring - the redistribution of the weight of structural elements, ATP, departments, functions and so on. Mr. Facilities such changes and save the new status, namely Support mode continuous reproduction performance of the integrated transport clusters need additional resources inflows, assets or sources of inputs. Accordingly, the structural transformation of transport clusters associated with systemic signs of internal growth, accumulation interconnection differences closely associated with the process of functional changes - activation of individual ATP, accelerating their development life cycles seal, dialectical relationship of outcomes operation and key financial indicators. Given that relations order (priority) for members of the cluster are impossible, intensification of resource flows in transport clusters can also be the cause of structural change in the absence of clear regulation is subject to the availability of a sufficient number of degrees of freedom owned automobile enterprises and their structural units.

Setting transport clusters constant certain level of quality of transportation that guarantees the preservation of their integrity, adequate level of certain organizations is tantamount to achieving structural and functional level according fractal organization.

Integral characteristics of fractal structures are divided into two groups: general and specific. Specific features include characterizing functional features clusters of transport, namely transport productivity, quality of transport services, reliability, economy, environmental friendliness, ergonomics, knowledge-based, and others.

Modeling causal relationships within the fractal structures and the formalization of relations is trivial in nature and in most cases either impossible or possible part. Thus to solve the problem of modeling of fractal structures existing mathematical apparatus can not be used in pure form. Thus, formalization of fractal structures in the study of activation of the development of cluster formations on a vehicle can be achieved through systematic analysis that uses mathematical tools listed together on the basis of solving these research objectives: 1) building a fractal structure of clusters of ATP vehicles consisting of a unit management (subject), forecasting, planning, unit operation (facility), information control actions, decision support unit; 2) a hierarchical structure of indicators of the work and development of transport clusters; 3) the unity of the structure of the transport cluster; 4) minimizing the impact of external factors.

An important role in the management of transport clusters belongs automated information system that the presence of these subsystems decision support modeling significantly improve the efficiency and management. With better self-regulation in the market structure is complicated clusters. Another feature of self-transport clusters is their ability to ensure the sustainability of development [5-8].

In general, the development of transport clusters defining characteristics such as self-organization, self-regulation and self-development. Self fractal structures is the ability to transform their own structure while maintaining its basic quality characteristics. Self-organization allows you to adjust some settings through targeted streamlining its structure and functional relationships to counterbalance the impact factors of the environment. Changing the fractal structure of clusters accompanied ordering transport links in the system, the accumulation of information, the formation of new and existing structures complication, reformat management mechanism.

Self-regulation reflects the relationship between vehicle subsystems cluster in which the performance of the deviations from normative values that determine the rational parameters of the operation and Development, is the reason for their adjustment to the desired level. It provides integrated system availability characteristics of fractal structure elements, characteristics, establish and maintain financial condition parameters required to achieve high performance.

Self-development clusters allows the vehicle to determine the goals and criteria for their achievement, determines parameters fractal structure and other characteristics of the operation. In

addition, the function is the ability to self cluster in environmental conditions to ensure expanded reproduction.

### Conclusions.

Summarizing the results of studies should be noted that the operation and development of transport cluster is a continuous transformation of its system fractal characteristics that determine the level of socio-economic effectiveness. Mechanisms interconnection system processes and structural changes to the efficiency of managing a fairly complex and multifaceted, which complicates their analysis and impact on system performance.

### REFERENCES

1. H. Jurgens, Kh.O. Paytgen, D. Saupe language fractals. In the world of science. 1990. № 10. P. 36-44. (Rus)
2. Sumin VI, Smolentceva TE Using the fractal dimension in predicting the behavior of complex nonlinear systems. Socio-economic phenomena and processes. Tambov, 2010. № 6. P. 166-169. (Rus)
3. Belyakov S.S., Ovcharenko N.F., Tebueva F.B. Identification of fractal characteristics for the process time series forecasting tax revenues. Successes contemporary science. - 2005. - № 2 - P. 54-55(Rus)
4. M. Schroeder, Fractals, chaos, power laws. Thumbnails of the infinite paradise.- Izhevsk: SIC "Regular and chaotic dynamics", 2001. - 528 p. (Rus)
5. Gvishiani D.M. dialectical materialist foundation for System Studies. D.M. Gvishiani // Dialectics and systems analysis. - Moscow: Nauka. 1986. - P. 5 - 18. (Rus)
6. V.V. Chernyshev Classification and properties of the economy. V.V. Chernyshev // Innovative Economy: Ukrainian scientific-production journal. - 2012. - No 12. - S. 296 - 297. (Ukr)
7. Kustovska A.V. system approach and methodology of research. A.V. Kustovska. - Stockholm: Economic thought, 2005. - 124 p. (Ukr)
8. A.N. Gorban Basic theory of Systems. A.N. Gorban, V.E. Bakhrushins. - Brussels: Directorate "Humanities", 2004. - 204 p. (Ukr)

### ПЕРЕЛІК ПОСИЛАНЬ

1. Юргенс Х., Пайтген Х.О., Заупе Д. Язык фракталов // В мире науки. 1990. № 10. С. 36-44.
2. Сумин В. И., Смоленцева Т. Е. Использование фрактальной размерности при прогнозировании поведения сложных нелинейных систем // Социально-экономические явления и процессы. Тамбов, 2010. № 6. С. 166-169.
3. Беляков С.С., Овчаренко Н.Ф., Тебуева Ф.Б. Выявление фрактальных характеристик для процесса прогнозирования временных рядов налоговых поступлений // Успехи современного естествознания. – 2005. – № 2 – С. 54-55
4. Шредер М. Фракталы, хаос, степенные законы. Миниатюры из бесконечного рая. - Изhevск: НИЦ «Регулярная и хаотическая динамика», 2001. - 528 с.
5. Гвишиани Д. М. Диалектико-материалистические основания системных исследований / Д. М. Гвишиани // Диалектика и системный анализ. – М.: Наука. 1986. – С. 5 – 18.
6. Чернишов В. В. Класифікації та властивості систем в економіці / В. В. Чернишов // Інноваційна економіка: Всеукраїнський науково-виробничий журнал. – 2012. – №. 12. – С. 296 – 297.
7. Кустовська О. В. Методологія системного підходу та наукових досліджень / О. В. Кустовська. – Тернопіль : Економічна думка, 2005. – 124 с.
8. Горбань О. М. Основи теорії систем і системного аналізу/ О. М. Горбань, В. Є. Бахрушин. – Запоріжжя : ГУ «ЗІДМУ», 2004. – 204 с.

### ABSTRACT

Volynets L.M., Khomenko I.O., Integrated system characteristics of fractal structures in the study enhance the process of cluster units on vehicles / Volynets L.M., Khomenko I.O.// Project management, systems analysis and logistics. Science journal: In Part 2. Part 2: Series: "Economic sciences " - Kyiv: NTU, 2014. - Vol. 14.

The article identifies defines and describes integrated system characteristics of fractal structures that will consolidate efforts and coordinate the actions of all stakeholders passenger traffic. According to

the results, it is shown that the operation and development of transport cluster is a continuous transformation of its system fractal characteristics that determine the level of socio-economic effectiveness.

The object of study - the organization and management of transport clusters.

Purpose of the study is disclosure of integrated system characteristics of fractal structures in the study enhance the process of cluster formations that will ensure service quality improvement and safety of passenger transportation, rapid response to changes in passenger traffic as well as significantly improve the functioning of the transport system.

Methods of research are theoretical and empirical methods of learning, analysis and synthesis.

The study of the transport of clusters based on the study of fractal dimension based on the definition of system settings characterized by chaotic and random natural behavior.

Privacy transport clusters as dynamic systems based on the study of fractal dimension (the dimension of the attractor dimension smaller phase space) in time is divided into two main classes: movement to al tractor and move on attractors (space is the final phase space of the system).

The results of the article can be used to extend the theoretical and methodological studies of the main provisions of the clusters.

Expected assumption about the object of the study is opening new options and features of the clusters.

**KEY WORDS: FRACTALS, SYSTEM, TRANSPORT CLUSTER.**

#### РЕФЕРАТ

Волинець Л.М., Хоменко І.О. Інтегральні системні характеристики фрактальних структур при дослідженні активізації процесу розвитку кластерних формувань на автотранспорті/ Волинець Л.М., І. О. Хоменко // Управління проектами, системний аналіз і логістика. Науковий журнал: в 2 ч. Ч. 2: Серія: „Економічні науки” – К. : НТУ, 2014. – Вип. 14.

В даній статті визначено та охарактеризовано інтегральні системні характеристики фрактальних структур, що дозволить консолідувати зусилля і координувати дії всіх учасників процесу пасажирських перевезень. По результатам дослідження встановлено, що при функціонуванні та розвитку транспортних кластерів відбувається безперервна трансформація його системних фрактальних характеристик, які визначають рівень соціально-економічної ефективності їх роботи.

Об'єкт дослідження – організація та управління транспортними кластерами.

Мета роботи – розкриття сутності інтегральних системних характеристик фрактальних структур при дослідженні активізації процесу розвитку кластерних формувань, що дозволить забезпечити підвищення якості обслуговування і безпеки перевезень пасажирів, оперативне реагування на зміни пасажиропотоків, а також значно підвищити ефективність функціонування транспортно–дорожнього комплексу.

Методи дослідження – теоретичні та емпіричні методи пізнання, аналіз і синтез.

Вивчення поведінки транспортних кластерів на основі вивчення фрактальних розмірностей ґрунтується на визначенні системних параметрів, що характеризується хаотичною і природно випадковою поведінкою.

Функціонування транспортних кластерів як динамічних систем на основі вивчення фрактальних розмірностей (розмірність аттрактора менше розмірності фазового простору) у часі розбивається на два основні стани: рух до аттрактору та рух на аттракторі (являє собою кінцевий простір у фазовому просторі системи).

Результати статті можуть застосовуватись для продовження теоретико-методологічних досліджень основних положень розвитку кластерів.

Прогнозні припущення щодо розвитку об'єкта дослідження – розкриття нових параметрів та характеристик кластерів.

**КЛЮЧОВІ СЛОВА: ФРАКТАЛ, СИСТЕМА, ТРАНСПОРТНИЙ КЛАСТЕР.**

#### РЕФЕРАТ

Вольнец Л., Хоменко И.А. Интегральные системные характеристики фрактальных структур при исследовании активизации процесса развития кластерных формирований на автотранспорте / Вольнец Л., И. А. Хоменко // Управление проектами, системный анализ и логистика. Научный журнал: в 2 ч. Ч. 2: Серія: „Экономические науки” – К. : НТУ, 2014. – Вип. 14.

В данной статье определены и охарактеризованы интегральные системные характеристики фрактальных структур, позволит консолидировать усилия и координировать действия всех участников процесса пассажирских перевозок. По результатам исследования установлено, что при функционировании и развитии транспортных кластеров происходит непрерывная трансформация его системных фрактальных характеристик, которые определяют уровень социально-экономической эффективности их работы.

Объект исследования - организация и управление транспортными кластерами.

Цель работы - раскрытие сущности интегральных системных характеристик фрактальных структур при исследовании активизации процесса развития кластерных формирований, что позволит обеспечить повышение качества обслуживания и безопасности перевозок пассажиров, оперативное реагирование на изменения пассажиропотоков, а также значительно повысить эффективность функционирования транспортно-дорожного комплекса.

Методы исследования - теоретические и эмпирические методы познания, анализ и синтез.

Изучение особенностей транспортных кластеров на основе исследований фрактальных размерностей основывается на определении системных параметров, характеризующееся хаотическим и случайным поведением.

Функционирование транспортных кластеров как динамических систем на основе изучения фрактальных размерностей (размерность аттрактора меньше размерности фазового пространства) во времени разбивается на два основных состояния: движение к аттрактору и движение на аттрактор (представляет собой конечный пространство в фазовом пространстве системы).

Результаты статьи могут применяться для продолжения теоретико-методологических исследований основных положений развития кластеров.

Прогнозные предположения о развитии объекта исследования - раскрытие новых параметров и характеристик кластеров.

**КЛЮЧЕВЫЕ СЛОВА:** ФРАКТАЛ, СИСТЕМА, ТРАНСПОРТНЫЙ КЛАСТЕР.

**AUTHOR:**

Volynets Ludmila M., Ph.D., associate professor, Natinal Trasport University, Ukraine, 01010, Kyiv, Suvorova str. 1. n

Khomenko Inna O., Ph.D., associate professor, Chernihiv National University of Technology, e-mail: inna\_khomenko@mail.ru, тел.+380503703037, Ukraine, 14027, Chernigov, st. Shevchenko str. 95.

**АВТОРИ:**

Волинець Людмила Миколаївна, кандидат економічних наук, доцент, Національний транспортний університет, доцент кафедри транспортного права та логістики, 01010, м. Київ, вул. Суворова, 1.

Хоменко Інна Олександрівна, кандидат економічних наук, доцент, Чернігівський національний технологічний університет, доцент кафедри теоретичної та прикладної економіки, e-mail: inna\_khomenko@mail.ru, тел.+380503703037, Україна, 14027, м. Чернігів, вул. Шевченко, 95.

**АВТОРЫ:**

Волынец Людмила Николаевна, кандидат экономических наук, доцент, Национальный транспортный университет, доцент кафедры транспортного права и логистики, Украина, 01010, г. Киев, ул. Суворова, 1.

Хоменко Инна Александровна, кандидат экономических наук, доцент, Черниговский национальный технологический университет, доцент кафедры теоретической и прикладной экономики, e-mail: inna\_khomenko@mail.ru, тел.+380503703037, Украина, 14027, г. Чернигов, ул. Шевченко, 95.

**REVIEWER:**

Il'chuk V.P., Ph.D., Economics (Dr.), professor, National Technological University of Chernihiv, head of finance, Kyiv, Ukraine.

Baziluk A.V., Ph.D., Economics (Dr.), professor, National University, professor, head of finance, Kyiv, Ukraine.

**РЕЦЕНЗЕНТИ:**

Ільчук В.П., доктор економічних наук, професор, Чернігівський національний технологічний університет, професор кафедри фінансів, Київ, Україна.

Базелюк А.В., доктор економічних наук, професор, Національний транспортний

університет, професор кафедри фінансів, Київ, Україна.