The Development of the School of Spatial Analysis of W.Isard on the Basis of Economic and Supply Chain Management Models of the Petrochemical and Chemical Production Cluster

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***Abstract*- In the first post-war decade, studies of the problems of the regional economy were developed in many countries based on the supply chain management. Prerequisites were created for the unification of regional scientists and a new attempt to synthesize theories of spatial and regional economics. At this stage, the avant-garde role was played by an American scientist, W. Isard.Hi is first major monograph, "The Placement and Economics of Space," was published in which he posed the problem of eliminating the deep discrepancies that exist for more than 100 years between classical theories; accommodation and leading schools of general economic theory.W. Isard rightly criticizes all classical and neoclassical economic theories for the fact that they limited themselves to studying "a country of miracles devoid of any spatial characteristics." This was partly due to the classical placement theories, which were expounded in outdated language and with excessive simplifications of "partial equilibrium", constant coefficients, cost minimization, constant demand curves, etc. Overcoming the stereotypes of these theories, W. Isard will clothe the theory of locating production in a more general economic form. He deduced the following law: profit maximizing firms will be located; so that the marginal rates of replacement of transportation costs of goods from two different points (regions) are equal to the reciprocal of their transportation tariffs. From this condition of the first order of maximizing profit, one can derive all particular allocation theories (Tyunen, Launhardt, Weber, etc.). Further, W. Aizard links, where it is possible, the theory of location with the known theories of production, pricing, trade, etc.**

***Key words*-** *supply chain strategy, econometrics, economic and mathematical modeling, economic theory, regional economy, innovation management.*

1. Introduction

The practice of using the mathematical apparatus in economic research contributes to the intensive study of the problems of the regional economy, the interaction of regional economies within individual countries, as well as states in the world economic space. The appearance in the middle of the 20th century of high-speed computing allowed to process vast amounts of information. Strong schools of economists engaged in the study of regional economics using mathematical methods arose not only in the west (V. Leontyev, U. Ayzard and others), but also in the USSR (A.G. Aganbegyan, M. M. Albegov, A.G. Granberg, M. G. Zawelsky, V. I. Suslov, P. V. Shemetov, etc.). In his subsequent numerous writings, W. Isard adapts macroeconomic methods for regional studies and interregional relations, develops models of spatial equilibrium, game theory, the formation of an industrial complex, explores conflicts in regional systems, and seeks scientific advances in many other areas. The Association has united major scientific forces and has been carrying out regular activities for more than half a century, holding continental and world congresses, publishing journals and series of problem monographs, and organizing educational programs[1-4]. However, they all emphasize the interdisciplinary nature of a new science, which unites economists, geographers, planners, architects, engineers, ecologists, sociologists, political scientists, psychologists, lawyers and representatives of other specialties all those who find it expedient to study and solve their professional problems in a complex regional environment. When the process of formation of regional science was basically completed, W. Aizard and his student T. Rainer (T. Reiner) gave her the following detailed description: Regional science is a new field of social sciences that uses theories and discoveries other social disciplines. It emphasizes the study of the spatial aspect of human activity and its importance for understanding social behavior and social forms [5-9]. The purpose of this study is to identify spatial

relationships not only between people and their activities, but also between people and the natural or transformed geographic environment. Regional science makes extensive use of mathematical models in its theoretical structures. The use of the word "regional" implies a systematic approach to the space considered as the human dwelling, and the word "science" expresses an intention to apply to the analysis the criteria of exact research methods and to develop theoretical schemes and ideas of a general nature. Further, the name “regional science” should show that this discipline does not fit into the framework of any other social science, each of which has its own characteristic approach to the phenomena studied: it is associated with the regional economy, ecology, theoretical geography, regionalism (as understood experts in political sciences) and a number of other social sciences, and at the same time markedly different from them. Each of these sciences has its own useful characteristics, but they all very incompletely take into account the spatial aspects of social phenomena.

2. Methods

Regional science is also closely connected with some applied disciplines dealing with the problems of taking into account the spatial aspects of phenomena and the effects of a person on them. These areas include urban and regional planning and planning (transport, public administration) "Did the studies of W. Aizard, his associates and students, and the activities of the International Association of Regional Science lead to the creation of a unified synthetic science? Definitely an affirmative answer would hardly be legitimate. It is more reasonable to talk about the continuing development of the scientific direction, which has not yet solved many of the previously set tasks [10-14]. Of course, in this area there are many achievements that overlap the previous stages of the evolution of spatial and regional research, especially in the field of analytical tools. In this respect, the book by J. Paelinck and P. Nijkamp (J. Paelinck, P. Nijkamp) "Operational theory and method in the regional economy" and the already mentioned two-volume handbook "Regional and Urban Economics" are especially characteristic. However, it is because of this strong instrumental bias that regional science is most often criticized for replacing understandable theories with the construction of a “tool box”. To be fair, it should be noted that the leaders of regional science are always quite self-critical, but they believe that their science is far from exhausted its integration potential. Modern areas of regional research are largely covered by the scientific organizational framework of regional science. The regional economy, including the regional economic policy, as an independent branch of knowledge, has entered a stage of active formation relatively recently. In 1956, the first book of the American scientist W. Isard was published, in which he set the task of eliminating the discrepancies between the classical theories of production location and the leading schools of general economic theory [15-18]. The main object of regional science is the area, or territory, characterized, on the one hand, by special ties with the rest of the territory (specialization) and, on the other hand, having commonality, unity of the elements that make it up. The word "regional", as understood by W. Isard and other American scientists who collaborate with him, is synonymous with the concept of "territorial". Isard himself defines regional science as "a new interdisciplinary field within the social sciences system, which relies on the theory and achievements of other social sciences [19-22]. Its focus is on the spatial dimensions of human activity within the various types of its structures and functions and on the significance of these dimensions for understanding social behavior and its forms.

3. Results and Discussion

Spatial measurements relate not only to the territorial relations between people and their areas of activity, but also to relations with the natural and human-transformed environment on the earth's surface. Regional science makes extensive use of mathematical models that make it possible to determine its theoretical framework. The use of the word "regional" means a systematic approach to space in terms of human habitat. The word "science" expresses an intention to apply the provisions of exact technology to research in order to analyze and develop theoretical structures and concepts of general significance [23-26]. Further, regional science is structured in such a way that its field does not coincide with any of the social disciplines, each of which has its own approaches. But it is interconnected and mutually intertwined with regional economics, ecology, regionalism in the understanding of political science and other

social sciences, each of which has its own characteristic features except for relations to space and partially to social processes. Regional science is also very close to some applied sciences ... "Thus, "regional science" is a combination of data and methods taken from different social sciences and united by the fact that "regional science" considers them spatially and using mathematical models. It studies specific territorial combinations, systems of cities and cities as complex systems, etc. But at the same time, “regional science” does not consider the process of economic regional education as a result of the development of the territorial social division of labor, which in turn is determined by the entire course of the history of social production. The main work of W. Aizard "Methods of regional analysis" ("Introduction to the science of the regions") is devoted to a comprehensive review of industrial production. One of the chapters "Methods of regional analysis" is called "Analysis of the industrial complex". Under the industrial complex, he understands the totality of activities carried out in a particular place and united in a certain group (subsystem) by close industrial, commercial or other ties. According to W. Aizard, the study of the industrial complex is of a cognitive nature its analysis is aimed at studying the regional characteristics of the structure and development of groups that combine different activities based on the availability of technological (production), trade and other interactions [27-30]. Thus, “industrial complex” is a territorial group (agglomeration) of industrial enterprises with different types of interactions, which has a certain structure and development features. The main factor in the development of industry in Aizard is not production, but population size, its movement (migration), its consumption and maintenance, its income and expenses. W. Aizard in "Methods of regional analysis" developed new technical methods for the study of balance schemes, matrix constructions, various models and other mathematical and statistical methods for processing empirical data. However, all these methods basically represent only technical methods of processing of actual data and allow only some statistical trends and patterns (Fig. 1)[31,32].

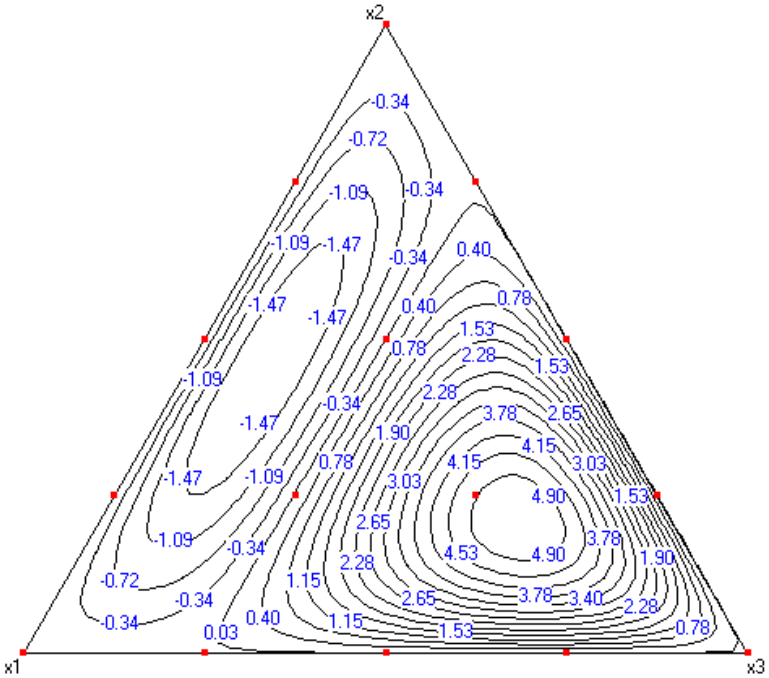

Figure1. An example of a digital optimization model of the total export of the Republic of Tatarstan of plastics and their products (x1): synthetic rubber (x2): tires (x3)

Another important work of W. Isard is the book "General Social Regional Theory", in which he and his co-authors made a step towards sociology, analysis of a multi-district social system.Shortly after the release of this book, he turned to the study of "humanized" environment (nature). Initially, W. Izard and the Association of Regional Science created by him were very wary of geography, considering it a descriptive science, far from the use of mathematical and statistical computation techniques. Then, with the advent of theoretical geography, William Aizard began to change his attitude towards geography as a

whole. He decided to combine economic regional analysis with environmental. In the last two books - "Communion in Art, Science and Religion: Perspectives of Evolution" and "Methods of Interregional and Regional Analysis" W. Aizard proposes a new logic of systematization of methods and theories of regional science, notes the productivity of physical and chemical models and analogies, considering that there are many similarities between physics and chemistry, on the one hand, and regional science, on the other. So, he emphasizes that today the gravitational model and the model of gravitational type are widely used in economics, geography, urban and regional planning, and, of course, in regional science(Fig. 2).

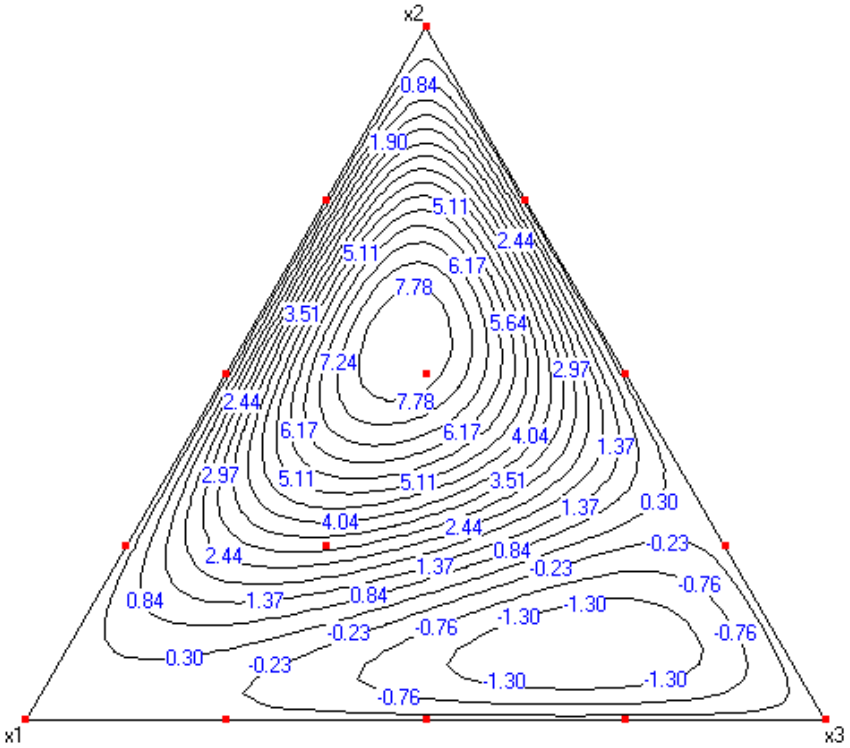

Figure2. An example of a digital simplex model of total imports of the Republic of Tatarstan of plastics and products from them (x1): organic chemical compounds (x2): essential oils, perfume-dimensional, cosmetics (x3)

4. Summary

The presented models are used to understand the understanding of trade between regions and states, migrations, labor trips, medical trips, shopping trips, leisure trips and other types of flows within urbanized territories and regional systems. Chemical processes, including polymerization, they also give rise to a fruitful search for parallels with them in regional science. Such views of an outstanding regionalist scholar may raise doubts and disputes, but they seem to be of undoubted interest as the search for new methods of geographical research.The regional economy studies the problems and patterns of the functioning and development of the country's economy, which is considered as a system of interacting regions, free economic zones, large economic regions, separate territorial-industrial complexes, as well as large industrial and urban agglomerations.

5. Conclusion

The regional economy studies the totality of economic and social factors and phenomena that determine the planned formation and development of productive forces and social processes in the regional system of the country and in a particular region in particular. As the main component of the regional economy, the scientist considered the location of the productive forces, the main factors of production in the country in order to reduce production costs as much as possible in order to increase the competitiveness of regional production.The course of the regional economy is closely linked with other economic and social sciences. Its subject matter includes questions from economic theory, sociology, demography, political science, management and other sciences. The subject of the regional economy in a broad sense is complex and multilateral. Its main components are: the economy of individual regions;economic ties between regions; regional

systems.They include not only various aspects of economic life, but also the system of state administration and regulation in the region, the system of regional budgets relations, regional and municipal levels

Acknowledgements

The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.

References

[1] Yazenin I. A. *Minimal risk and efficiency portfolios for fuzzy random data, XXI Seminar on stability problems of stochastic models*. Abstracts, Eger, Hungary, P. 182, 2001.

[2] Crowther K.G., Haimes Y.Y. *Development of the Multiregional Inoperability Input-Output Model (MRIIM) for Spatial Explicitness in Preparedness of Interdependent Regions*, Systems Engineering Vol. 13, No. 1, 2010.

[3] Dimitras A.I., Slowinski R., Susmaga R., Zopounidis C. *Business Failure Prediction Using Rough Sets* , European Journal of Operational Research 114, 1999.

[4] Juan R. Castro, Oscar Castillo, Luis G. Martínez. *Interval Type-2 Fuzzy Logic Toolbox*. № 8, 2007.

[5] Nilesh N. Karnik, Jerry M. *Mendel. Operations on type-2 fuzzy sets*.№ 4, 2000.

[6] Zadeh L. *Toward a perception-based theory of probabilistic reasoning with imprecise probabilities*, Journal of Statistical Planning and Inference 105 ,p. 233-264, 2002.

[7] Inuiguchi M., Tanino T. *Portfolio selection under independent possibilistic information*, Fuzzy sets and systems. V. 115. P. 83-92, 2001.

[8] ErdalKayacan, Ph.D. *Candidate. Contributions to Type-2 Fuzzy Sets.* Theory and Applications in Control Engineering and Robotics. № 10, 2009.

[9] Beilin I.L. *Economic-mathematical modeling of the total costs of innovative chemical enterprise methods of fuzzy set theory* , Journal of Engineering and Applied Sciences, Volume 12, Issue 19, 4865-4869, 2017.

[10] Beilin I.L., Khomenko V.V. *Theoretical bases of project management in conditions of innovative economy based on fuzzy modeling* , Journal of Physics: Conference Series 1015 (2018) 032013 doi :10.1088/1742-6596/1015/3/032013.

[11] Beilin I.L. *Economic optimization in chemical enterprises* , International Journal of Economic Perspectives, Volume 11, Issue 4, 670-677, 2017.

[12] Tardy Yves, *Petrology of Laterites and Tropical Soils*. ISBN 90-5410-678-6, http://www.books.google.com/books. Retrieved April 17, 2010.

[13] Dimova L., Sevastjanov P., Sevastianov D. *Fuzzy Capital Budgeting: Investment Project Valuation and Optimization* , Chenstohova Tech. Univercity Proceedings, 2001.

[14] Shang-Ming Zhou, Robert John, Francisco Chiclana and Jonathan M. *Garibaldi. New Type-2 Rule Ranking Indices for Designing Parsimonious Interval Type-2 Fuzzy Logic Systems*, 2007.

[15] *Fuzzy Sets in Management, Economy and Marketing* /Ed. By Zopounidis C. and oth. – World Scientific Pub Co, 2002.

[16] *Hua Wang Fuzzy Control Systems Design and Analysis: A Linear Matrix Inequality Approach.*, 2011.

[17] Zimmerman H.-J. *Fuzzy Sets Theory -and Its Applications. -Kluwer Academic Publishers*, 2001.

[18] Zobel C.W., L. Khansa *Quantifying Cyberinfrastructure Resilience against Multi-Event Attacks*, Decision Sciences Vol. 43 No. 4, 2012.

[19] Rose P.R. *Risk Analysis and Management of Petroleum Exploration Ventures American Association of Petroleum Geologists*, Methods in Exploration Series, 2001. N12.

[20] Uziel Sandler, Lev Tsitolovsky Neural Cell *Behavior and Fuzzy Logic*. Springer, 478 с, 2008.

[21] Takafumi, N., Fminori, T., Kamran, M.N. Bernardino, M.C. and Alessandro P.F., *"Practical Equations for the Elatic Modulus of Concrete"*, ACI Structural Journal, September-October, Vol. 106, No. 5, 2009.

[22] *A Novel Algorithm for Tuning of the Type-2 Fuzzy System: Материалыконф* . / First Joint Congress on Fuzzy and Intelligent Systems Ferdowsi University of Mashhad, Iran, 29-31 августа 2007.

[23] LeSage J., Fischer M. *Spatial growth regressions: Model specification, estimation and interpretation.* Spatial Economic Analysis, 3, 275–304, 2008.

[24] LeSage J. Parent O. *Bayesian model averaging for spatial econometric models*. Geographical Analysis, 39 (3), 241–267, 2007.

[25] Kleibergen, Frank and Richard Paap , *Generalized reduced rank tests using the singular value decomposition*, Journal of Econometrics, 133, 97-126, 2006.

[26] Corrado L., Fingleton B. *Where is the economics in spatial econometrics?* Journal of Regional Science, 52 (2), 210–239, 2012.

[27] Chen, Xiaohong and DemianPouzo: *Sieve Wald and QLR inferences on semi*/nonparametric conditional moment models, Econometrica, 83, 1013-1079, 2015.

[28] Fisher M., LeSage J. *A Bayesian space–time approach to identifying and interpreting regional convergence clubs in Europe*. Paper

presented at 53rd ERSA conference, Palermo, August 27–31, 2013.

[29] Gibbons S., Overman H. G. *Mostly pointless spatial econometrics?* Journal of Regional Science, 52 (2), 172–191, 2012.

[30] Hansen, Bruce E. *The Integrated Mean Squared Error of Series Regression and a Rosenthal Hilbert-Space Inequality, Econometric Theory*, 31, 337-361, 2015.

[31] Zikai T. An *Overview of Economical Corruption in USA and Analysis of its Future*. Journal of Humanities Insights. 02(01):43-50, 2018.

[32] Hamed ,Mostafaei , Mojtaba ,Hosseini, Hossein ,Jenaabadi. *The Investigation of the Relationship between the Aggression and Addiction Potential High-school Male Students*, UCT Journal of Management and Accounting Studies, Issue1, pp. 01-04, 2014.