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INTELLIGENT DECISION SUPPORT SYSTEMS IN THE DEVELOPMENT OF MEGALOPOLIS INFRASTRUCTURE

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Abstract. From the point of view of the management theory, a megapolis is a complex non-stationary spatial system. The problem of making innovative decisions on the development of their infrastructure is caused by the presence of a large amount of information, its uncertainty and inconsistency. This article discusses the principles of building intelligent decision support systems of a situational type for the innovative development of the infrastructure of megacities. Solutions are formed by logico-analytical processing of data on the situation in general and special cases of situations for the considered subject of the megalopolis infrastructure. For the practical implementation of the decision-making mechanism, the article proposes a linguistic-numerical method for determining the potentially best alternative and a fuzzy situational algorithm for managing the subjects of the megalopolis infrastructure, based on the structural generality of the situations of a fuzzy situational network. The obtained results were tested on two real infrastructure subjects of Kyiv.

Keywords: megapolis, infrastructure entities, intelligent decision support system, linguo-numerical evaluation of alternatives, fuzzy situational algorithm.

INTRODUCTION

From the point of view of the management theory, any megalopolis is a complex non-stationary spatial system. For objects of this kind, two main features are characteristic: the dependence of the parameters of the component parts of the object on their spatial location and the variability of these parameters over time. The study of such objects with sufficient versatility to obtain practically significant results, taking into account the fact that experimental effects on them for various reasons (limited time frames, the risk of irreversible changes, the high cost of experiments, etc.) are usually impossible or undesirable. It is possible to perform almost only by modeling possible situations [1–3]. Especially difficult is the problem of making effective decisions on the development of the megalopolis infrastructure, which is associated with large amounts of information, its uncertainty and inconsistency. This problem can solved by using intelligent decision support systems (IDSS). IDSS is a decision support system with embedded artificial intelligence techniques exhibiting some or all of the abilities indicative of intelligent behavior. At the same time, one of the main properties of the intelligence of this system is the ability to generate, analyze, display, search and design a solution that is not explicit and ready in the system [4–6, 18].

A review of publications on the problems of information IDSS in the field of infrastructure development of megacities shows that at present the use of intelligent information technologies in this area is mainly limited to the creation of reference and search engines. Hence, the task of creating fully functional systems that support all the main stages of decision-making — from the collection and storage of initial information to the presentation of a reasonable version of the optimal solution-remains relevant.

STATEMENT OF RESEARCH PROBLEMS

Let be $A_1, A_2, ... A_n$ — a set of alternatives. Alternatives may or may not specified at the time of the decision. Let's also define criteria for evaluating alternatives $K_1, K_2, ... K_n$, which are verbal gradations of quality $X_q = x_q^1, ..., x_q^m$, where is the gradation number ($q = \overline{1, N}$) , m — a set of values of estimates, or otherwise the scale of the criterion. For discrete scales, the number of gradations is usually small $m = 2, \ldots, 5$. Discrete scales are ordered in descending order (x_q^1 — best, x_q^m — worst). Utility of the *i*-th alternative A_i to the multi-criteria problem denote by. Sometimes it is allowed that, although in the general case. In addition, introduce solution classes, defined and ordered by quality (from best to worst). Then, if $U(A_i) \in C_u$, but $U(A_j) \in C_v$ and $u < v$, then $U(A_i) > U(A_j)$, i.e., the utility of the *i*-th alternative is higher, since it corresponds to a better class of solutions. This problem refers to the static problem of determining the optimal solution by determining the potentially best alternative. In addition to this task, the article deals with the dynamic problem of determining the potentially best alternative associated with the operational management of a dynamic object in uncertain conditions of its operation. The solution of these problems in this article carried out within the framework of the IDSS of the situational type based on the method of linguo-numerical estimates and a fuzzy situational control algorithm.

Literature review

When determining the rational solution to a particular problem that arises in the urban economy, as a rule, it is necessary to take into account a large number of uncertain and contradictory factors. Uncertainty is an integral part of decision-making processes for most infrastructure subjects of megapolis [7]. The uncertainty is primarily due to the incompleteness of knowledge about the problem solved and the inability fully take into account the reaction of the environment, i.e. the current situation. Inconsistency arises due to ambiguity in the assessment of situations, errors in the choice of priorities, which, in the end, greatly complicates decision-making. Research shows that decision-makers without additional analytical support tend to use simplified and sometimes contradictory decision-making rules. In this case, the most effective tool for making a potentially better decision is intelligent Decision Support Systems (IDSS). It should note that modern IDSS is based on the use of specialized information storage (Data Warehouse) and OLAP (On-Line Analytical Processing) technologies — operational data analysis. The main purpose of OLAP technologies is dynamic multidimensional data analysis using an effective Data mining tool, modeling and forecasting [8–10].

It is extremely difficult and almost impossible to reduce tasks with the above uncertainties by precisely set goals. To do this, you need to “remove” the uncertainty. One of the most common methods of withdrawal is the subjective assessment of a specialist (expert, manager), which determines his preferences. At present, the subjective assessment has proved to be the only possible basis for combining the heterogeneous physical parameters of the problem solved into a single model that allows evaluating possible solutions. Taking into account the factor of subjectivity of the decision-maker (LPR) in decision-making violates the fundamental principle of the methodology of operations research: the search for an objectively optimal solution. The recognition of the right of the decision-maker to the subjectivity of the decision is a sign of the emergence of a new paradigm, characteristic of another scientific direction — decision-making under many criteria. On the other hand, when making decisions on many criteria, there is also an objective component. Usually, this component includes restrictions imposed by the external environment on possible solutions (availability of resources, time constraints, environmental requirements, social situation, etc.) [11, 12].

Decision-making problems usually divided into well structured, weakly structured and unstructured. The first problem of a substantial relationship between the main characteristics can expressed quantitatively. Unstructured problems characterized by the fact that their description dominated by qualitative factors that are difficult to formalize, and the quantitative relationships between these factors usually not defined. The intermediate position occupied by weakly structured problems that combine quantitative and qualitative dependencies, and uncertainty has a dominant component. Unstructured decision-making problems are the most complex and characteristic of the infrastructure subjects of megalopolis. These problems are problems of unique choice in the sense that each time the problem either new to the decision-maker, or has new features compared to a previously encountered similar problem [13].

IDSS of situational type

To solve the above problems, the most effective is the situational IDSS, the structure of which shown in Fig. 1.

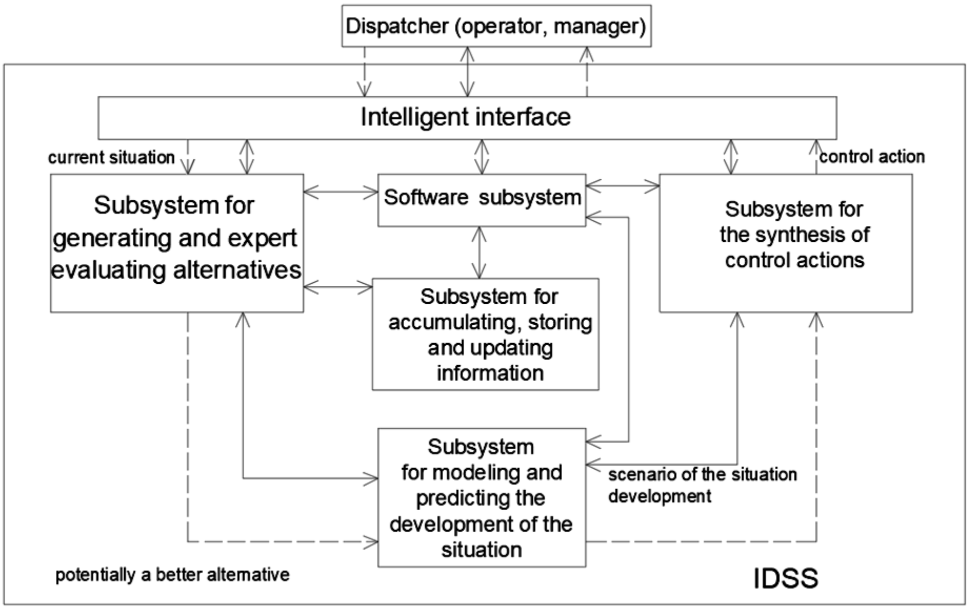

Fig. 1. Situational type IDSS structure

In the dialogue with the expert, the situational IDSS provides automated configuration of the parameters of the subject of the studied megalopolis infrastructure by entering the basic system of concepts, attributes, values, relations between them, as well as the types of situations that are typical processes and interactive user interface in the process of its functioning. The model of the process of functioning of the subject of the megalopolis infrastructure defined as a set of "regular" situations that represent a fuzzy situational network (FSN) (Fig. 2).

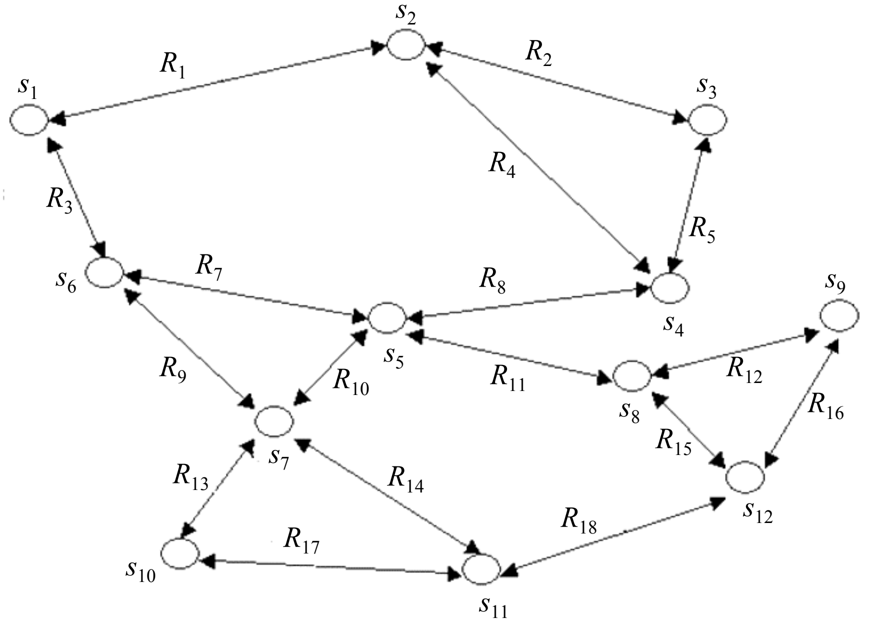

Fig. 2. FSN IDSS of situational type

Decisions about the situation formed by logical and analytical processing of data about the situation in general and special cases of situations for the considered subject of the megalopolis infrastructure. It assumed that the functioning of the studied subject of urban infrastructure described on the 'regular' situations, previously synthesized in the subsystem of generation and expert evaluation of alternatives. Subsystem also identifies for them the potentially best alternatives (PBA) of rational solutions and control actions.

A ready-made FSN used to determine the sequence of actions or transition paths between any source and target situation, and this process can fully automated. An example of a fragment of such a network is shown in Fig. 2, where S_i is the i-th regular situation, R_i is the functions that characterize the cost degree normalized in the range [0,1] during the mutual transition from S_i to S_j and vice versa.

To analyze the consequences of the use of certain management alternatives for current situations, the appropriate scenarios implemented in the subsystem of modeling and forecasting the development of the situation.

For the selected situation, depending on the goals and conditions of its implementation, the rational control formed in the subsystem for the synthesis of control actions.

Taking into account the specifics of the infrastructure of megacities in the ISPR of the situational type in the subsystem of accumulation, storage and updating of information, the corresponding requirements for the main structural unit of this subsystem — the knowledge representation model (KRM) should formulated. This concerns the system of concepts, the adequacy of the content and correspondence of the formulated knowledge to the studied processes, and the suitability for performing the required actions. A complete description of the situation does by the expert, if there is a complete set of indicators that characterize this situation. To take into account many factors, the original set of indicators can divided into fragments that combine indicators that form a relatively independent semantic group. Thus, the task of assessing the situation in the functioning of a megalopolis subject can divided into a number of specific tasks. The solutions generated by the particular problems are indicators of a higher degree of generalization, which serve as the initial data for the particular problems of the next level of the hierarchy, etc. This process of decomposition of the overall assessment task leads to the formation of a multi-level hierarchy of related input-output private tasks. They solution allows to form a system of solutions for individual aspects and a general decision on the degree of compliance of the current situation with the goals of the management in the subject of the megalopolis infrastructure.

Each task (subtask) in the accepted interpretation is a set of functional dependencies that describe the initial situation and the solution to the situation. Using the subsystem of logical inference of the generalized assessment of the situation and the formation of explanations, the rules built and the KRM updated. The solution of the applied problem carried out by applying the rules from the KRM database to the data about the current situation.

In other words, when creating an KRM, it is necessary to actually describe the semantic content of the functioning of the subject of the megalopolis infrastructure, which guarantees their processing by formal methods. Currently, many KRM have developed. Having a generic name, they differ in the ideas underlying them, in terms of mathematical validity.

Obviously, for the above-mentioned situational IDSs, the closest CRM is the frame model based on the concept of Marvin Minsky. His concept is that the frame model is a systematized psychological model of a person's memory and consciousness. In this sense, it is as close as possible to the creative activity of a person, including the development of the infrastructure of a megalopolis [14, 15].

For the frame KRM, the data structure is a connected tree structure of nodes and rules of formalized data accumulated by experts for the subjects of the megalopolis infrastructure. In this case, the linguistic variable $\omega_п$ of the frame KRM can described by the following expression:

$$\omega_n = (n, T(n), U, G, M),$$

where $T(n)$ is a term — set of n values that represent the names of fuzzy variables; U is the domain of definition of each fuzzy variable; G is a syntactic procedure that serves to expand the set $T(n)$ to generate new elements; M is a special semantic procedure for forming a fuzzy set.

Knowledge Z is defined as a tuple of a set of objects Q with a set of implementations of relations F between them and a set of actions N that are performed on elements of Q, i.e.

$$Z = \langle Q, F, N \rangle, \tag{1}$$

Production rules can written as sets of fuzzy utterances $\widetilde{L}$:

$$\widetilde{L} = (\text{IF } (a_1 \text{ THEN } \beta_1) \text{ AND...AND } (\beta_l)\ \alpha_k \text{ THEN}),$$

where α is a generalized linguistic variable defined on the set of input parameters; β is a generalized linguistic variable defined on the set of output variables; k , l is the order of these variables.

For the frame KRM IDSS, the data structure of which is a coherent structure of formalized data on the subjects of the megalopolis infrastructure, the formation and selection of a potentially better alternative (rational solution) implemented on the linguistic-numerical method proposed below.

A linguo-numerical method for determining a potentially better alternative

The main task of the situational type IDSS is to determine the potentially best solution for the current situation, which can be static (for example, choosing the rational location for the construction of a supermarket) and dynamic (for example, passenger traffic management). Since alternatives to solutions in this IDSS can formed both quantitatively and verbally, a linguistic-numerical method for determining the potentially best alternative (PBA) proposed. The following is an example of a linguistic rating scale:

very low → 2, low → 3, average → 4, high → 5, very high.

To date, there is a large selection of methods for evaluating the generated set of alternatives and selecting the best alternatives [11, 13]. These decision-making methods for evaluating and selecting potentially better alternatives are effective with a small power of the set of evaluated alternatives (no more than 5–10). To evaluate the set of high-power alternatives, which corresponds to the above-mentioned tasks of managing the subjects of the megalopolis infrastructure, it proposed to use intelligent methods, in particular, fuzzy logic methods, which allow for automatic ranking of alternatives based on decision rules.

To enable the evaluation of alternatives based on linguistic variables, the scheme of the fuzzy inference procedure is used (Fig. 3) [16].

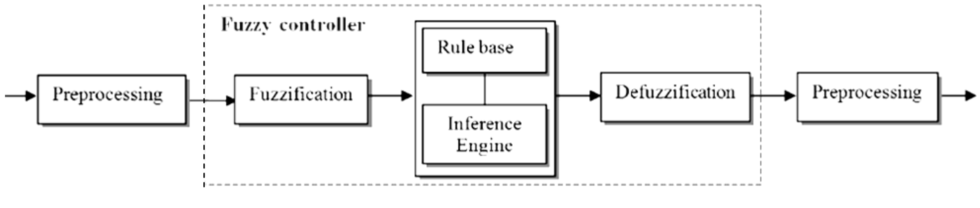

Fig. 3. The scheme of the fuzzy inference procedure

Since in the KRM, the reason corresponds to the KRM frame, which contains a ready-made mechanism for implementing this reason (sub-goal), the procedure for general fuzzy inference is greatly simplified. In addition, since the parameters that can qualitatively evaluated by the studied subject of the city infrastructure have a different physical nature, the natural requirement for its objective assessment is the introduction of a single normalized rating scale in a certain range at the fuzzification stage.

Let the attributes that form the alternatives A_i contain both numerical (quantitative) and linguistic variables (qualitative). In this case, each variable is assigned a belonging function. In this case, we will use the universal scale [0,1] to evaluate preferences. In other words, for the set $x \in [0,1]$ and the membership function $\mu :\ x \to [0,1]$, the fuzzy set is defined as

$$\widetilde{A} = \{(x, \mu_A(x)) \,|\, x \in X\}\,. \tag{2}$$

The belonging function (1) quantifies the membership of the elements of the set of alternatives A, defined by $x \in A$ to the fuzzy set $\widetilde{A}$, with normalized variables $\widetilde{x}$ A value of 0 means that the element does not include a fuzzy set, and 1 means that the element is completely described by this set. Among the most well-known and used belonging functions, the most convenient and universal for the variables under consideration are linear and trapezoidal functions of the form [6, 7, 18]:

The graphs of the belonging functions correspond to the ascending (Fig. 4, *a*) and descending (Fig. 4, *b*) preference scales, respectively. Thus, for all quantitative evaluations of max and min values of the variable a_{ij} and b_{ij} are known, and for all linguistic (verbal) ratings, they are determined by the maximum and minimum number of linguistic scale (see example linguistic scale).

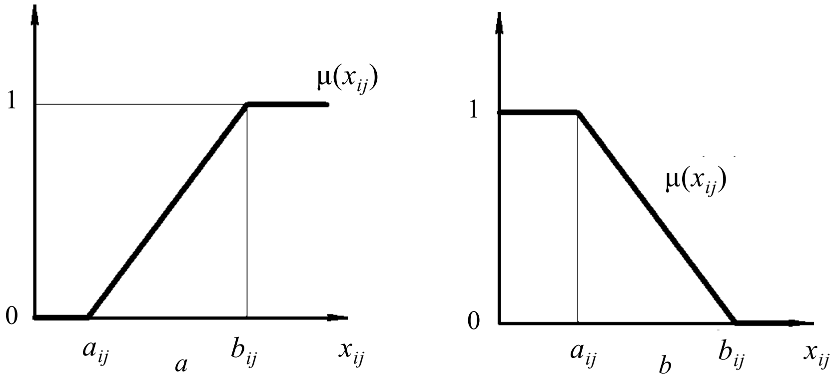

Fig. 4. Graphs of belonging functions

The potentially best alternative determined by the formula

$$\widetilde{A}_{iopt} = \max J_i = \sum_{i=1}^{n} x_{ij} \quad (j = 1,2,...,m)\,, \tag{3}$$

where $\widetilde{x}_{ij}$ — I variable of the j alternative.

The practical use of this method has shown the identity of its results to the well-known methods PARK, ORKLASS, QUERY, CORD, etc. [13], but the complexity of the decision-making process of the proposed method is significantly lower. This is due to the lack of a procedure for pairwise comparison of the selected parameters of the studied subject of the megalopolis infrastructure. The most effective application of this approach to the assessment and selection of the PBA of the studied subject of the megalopolis infrastructure is expedient with a large number of characteristic parameters of this subject.

Fuzzy situational control subjects of infrastructure of the megapolis

Let the current situation of a megalopolis infrastructure subject described as a fuzzy situation of the following type:

$$S_{TEK} = \{M_{s_i}(x_i)/x_i\}, \ x_i \in X \, , \qquad (4)$$

where the function of belonging to a linguistic variable x_i, describing the current situation.

Since each linguistic variable corresponds to the *j*-th term from the set of terms of KRM, the formula (4) can written as:

$$S_i = \{M_{M_{s_i(x_i)}}(T_j^i)/T_j^i\}, \ j = \overline{1, M}; \ i = \overline{1, N}; \ x_i \in X,$$

where *j*-th term *i*-th linguistic variable.

To determine the control action for the current state you want to compare this situation fuzzy fuzzy with each situation from a set of existing KRM in the test subject of city's infrastructure "regular" situations, which on the basis of expert methods elaborated by standard control actions.

From the point of view, the most convenient measure of proximity can considered the degree of fuzzy inclusion of the situation, which characterized by a certain inclusion threshold determined by the developer, based on the conditions in which the subject of the megalopolis infrastructure operates. The inclusion threshold defined, as well as the belonging functions, in the normalized range [0, 1] as follows:

$$t_{incl} \in [\alpha_{\min}, 1],$$

where the lower limit of the range of the degree of inclusion, usually. In this case, we can talk about how fuzzy the signs of the current STEK situation are indistinctly included in the fuzzy values of the corresponding signs of the situation [2, 6].

If a "regular" situation found that is sufficiently close to this current one, then from the set of alternatives for this "regular" situation, the PBA for which the control action implemented selected. If such proximity not found, then the current situation processed in the subsystem for generating and expert evaluation of alternatives, after which its dynamic assessment is carried out for the found PBA in the subsystem for modeling and predicting the development of the situation. Further, in the subsystem of synthesis of control actions, the corresponding control formed. This situation then transferred to the category of "regular". The algorithm for implementing fuzzy situational control based on IDSS shown by the dotted arrows in Fig. 1.

In addition, if the external working conditions of the studied subject of the megalopolis infrastructure change, it becomes necessary to move from one "regular" situation to another. The possible transition from one "regular" situation to another carried out with the help of some strategy.

The strategy is described by the optimal FSN route between the current fuzzy situation $s_i \in S$ and the target situation $s_c \in S$. Transitions are determined by R_i solutions, which correspond to a certain degree of cost. The total number of situations and transitions between them in the FSN describing the real subjects of the megalopolis infrastructure can be very large. To simplify the search task, management strategies use various optimization methods (for example, the dynamic programming method).

Given that the subjects of the megalopolis infrastructure in most cases have mutual independence of the values of the features, it proposed to use the FSN compression method based on the definition of “community structures”. Community structures Oi that have non-empty intersections with each other called neighbors, and the set of vertices of the intersection area of two neighboring structures called the transition area of community structures. For the fragment of the FSN (Fig. 2), the structures of generality of situations with the costs of mutual transitions have the form shown in Fig. 5.

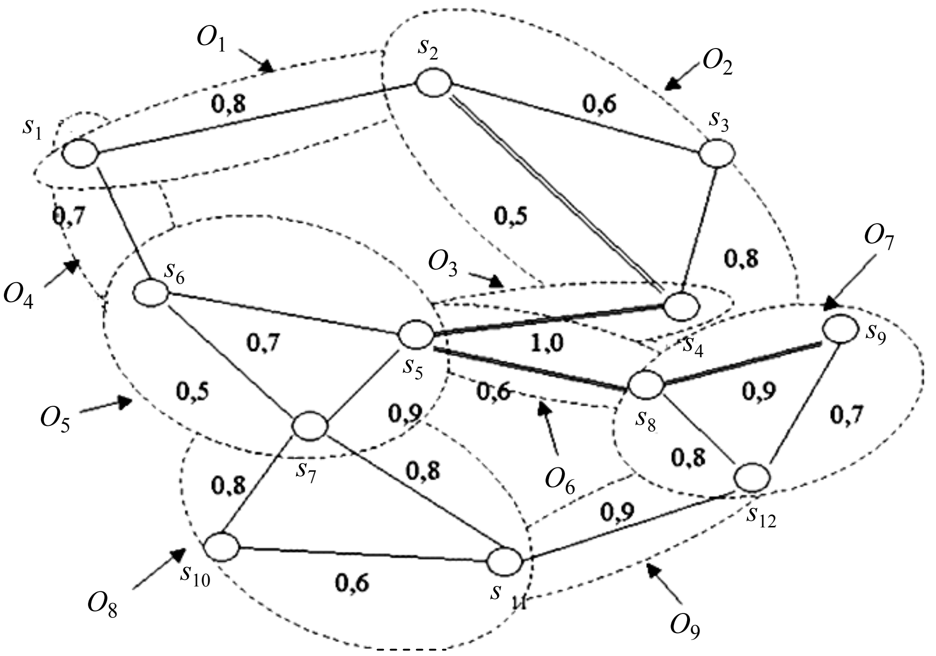

Fig. 5. Community structures of FSN IDSS

The essence of the proposed approach based on the NSS compression method for the given NSS fragment is as follows. As an optimality criterion in the conditional example, we use use the minimum of total costs. The path that has the minimum cost considered optimal. Let’s determine the optimal transition from s_2 to s_9. Given that $O_2 \bigcap O_9 = \varnothing$ (empty set), it is not possible to go from s_2 to s_9 using a single local control solution. Since there are no pairs of vertices adjacent to each other from the number belonging to O_2 and O_9, we proceed to find the shortest possible path between all pairs of vertices of the sets O_2 and O_9. The shortest path $L = (O_2, O_3, O_6, O_7)$. Moving to the transition points of neighboring structures of the common path *L*, we get the control strategy: $C(s_2, s_9) = (s_2, s_4, s_5, s_8, s_9)$. The desired path in Fig. 2 highlighted with a dotted line.

Practical implementation of the results obtained

The researches in the article was carried out within the framework of research work "Research of methods and tools for creating a hybrid computing technology for constructing a quasi-formalized forecasting model in conditions of data heterogeneity and non-normative deviations in organizational management systems" (S/R 0117U002448). The obtained results tested on two real subjects of the infrastructure of Kiev.

Construction of social objects. Assessed the appropriateness of the choice of the construction site of a supermarket. The expert group suggested the following criteria: price, population density within a radius of 1 km, the presence of competitors, infrastructure connections, the number of places for car Parking, access places through public transport and the visibility of the supermarket from the nearby major streets, as well as data on these criteria. Four possible supermarket construction sites were evaluated (alternatives var. 1 — var. 4). In one of them, a supermarket built in Kiev. Expert assessments listed in Table 1.

Table 1. Initial expert assessments

x_{ij}	**Variables**	**Alternatives**			
		var. 1	var. 2	var. 3	var. 4
x_{1j}	The number of places for car Parking, max	400	300	250	150
x_{2j}	Presence of the competitors, min	1 (few)	5 (many)	3 (average)	5 (many)
x_{3j}	Population density in 1 km radius, max	200	4500	6000	7000
x_{4j}	The cost of the placement, million UAH, min	6	16	12	20
x_{5j}	The flow of public transport, max	1 (low)	3 (average)	5 (high)	7 (very high)
x_{6j}	Main street visibility, max	5 (good)	5 (good)	3 (average)	1 (bad)
x_{7j}	Infrastructure, max	3 (average)	3 (average)	5 (good)	7 (very good)

After the procedure of fuzzification and normalization of linguistic variables according to the formula (2) and Fig. 4, *a*) and Fig. 4, *b*), we summarize their values in Table 2.

Table 2. Sum of data

Variables	**Alternatives**			
	var. 1	var. 2	var. 3	var. 4
$\tilde{x}_{1j}$	1	0,6	0,4	0,0
$\tilde{x}_{2j}$	1	0,33	0,66	0,33
$\tilde{x}_{3j}$	0	0,63	0,85	1
$\tilde{x}_{4j}$	1	0,285	0,57	0
$\tilde{x}_{5j}$	0	0,33	0,66	1
$\tilde{x}_{6j}$	0,66	0,66	0,33	0
$\tilde{x}_{7j}$	0,33	0,33	0,66	1
$\sum_{i=1}^{7} x_{ij}$	3,99	3,165	4,13	3,33

Then, using the formula (3), we obtain the following estimates of alternative options: 3,99; 3,165; 4,13; 3,33, from which it follows that the potentially best alternative (PBA) is the alternative var. 3, which confirmed the feasibility of this supermarket construction site. It should note that the alternative var.1 is also of interest to the decision-maker.

Public transport. Today, the development and effective management of transport is unthinkable without the development and application of intelligent control systems. The process of transportation of passengers by urban passenger transport based on the observance of the schedule of movement of vehicles along the route in accordance with the pre-established schedule of movement. In most motor transport companies of Ukraine, the management of the passenger transportation process controlled by the dispatcher for compliance with the traffic schedule.

Due to the transience of changing road situations, the lack of complete information about the situation on the route, the presence of many uncertainties when receiving it, it is impossible to build a reliable forecast of the development of the situation over a long time interval. Thus, the decision-making by the dispatcher takes place in a difficult situation and requires a lot of psycho-physiological stress from the dispatcher [17, 8].

To assess the effectiveness and sustainability of the decisions made by the dispatcher in the process of managing the movement of public transport, one of the bus routes in Kiev selected for the study. The scheme of implementation of control solutions for fuzzy situational management of public transport traffic shown in Fig. 6. The use of a fuzzy situational algorithm for controlling the movement of urban transport for 3 weeks made it possible to increase the efficiency of transport on this route (Fig. 7, red line). In addition, the dispatcher with the help of the ISPR could quickly make operational decisions on the “emergency” situations that arose, which reduced the economic losses of the transport company.

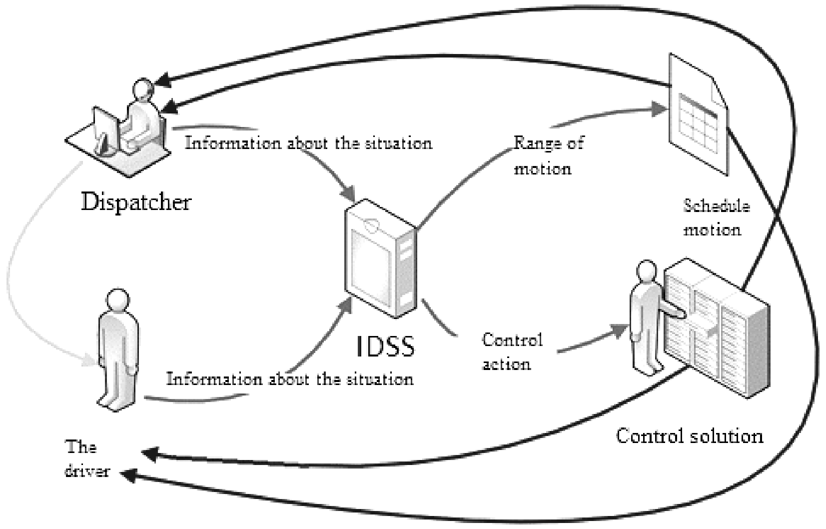

Fig. 6. Fuzzy situational control

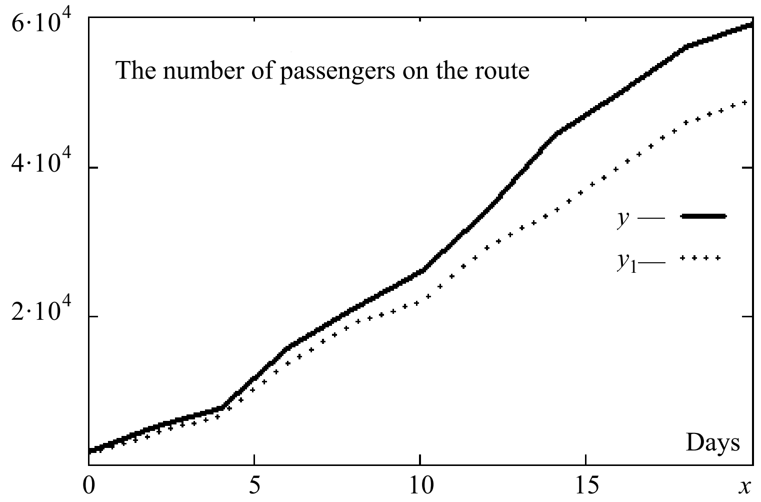

Fig. 7. Loading schedule

The article proposes an intelligent decision support system, the main elements of which are a fuzzy situational network and a frame model for representing the knowledge of the subjects of the megalopolis infrastructure. This allows us to formalize the "regular" situations that arise in the course of the activities of the subjects of the megalopolis infrastructure using the theory of fuzzy sets, and then determine the optimal control actions for them. If it is necessary to move from one "regular" situation to another with minimal costs, an algorithm based on the structural generality of situations is used. When an "unregular" current situation occurs, its maximum proximity to one of the "regular" situations determined and linguo-numerical alternatives to decision-making generated. The selection of the potentially best ones based on a logical inference scheme. After that, the optimal control action for this current situation synthesized and identified in the knowledge representation model as "regular".

CONCLUSION

The article proposes an intelligent decision support system, the main elements of which are a fuzzy situational network and a frame model for representing the knowledge of the subjects of the megalopolis infrastructure. This allows us to formalize the "regular" situations that arise in the course of the activities of the subjects of the megalopolis infrastructure using the theory of fuzzy sets, and then determine the optimal control actions for them. If it is necessary to move from one "regular" situation to another with minimal costs, an algorithm based on the structural generality of situations is used. When an "unregular" current situation occurs, its maximum proximity to one of the "regular" situations determined and linguo-numerical alternatives to decision-making generated. The selection of the potentially best ones based on a logical inference scheme. After that, the optimal control action for this current situation synthesized and identified in the knowledge representation model as "regular".

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ІНТЕЛЕКТУАЛЬНІ СИСТЕМИ ПІДТРИМАННЯ ПРИЙНЯТТЯ РІШЕНЬ У РОЗВИТКУ ІНФРАСТРУКТУРИ МЕГАПОЛІСУ / О.М. Трофимчук, О.А. Стенін, А.О. Солдатова, І.Г. Дроздович

Анотація. Мегаполіс з точки зору теорії управління являє собою складну нестаціонарну просторову систему. Проблему прийняття інноваційних рішень щодо розвитку їх інфраструктури зумовлено наявністю великого обсягу інформації, її невизначеністю і суперечливістю. У роботі розглянуто принципи побудови інтелектуальних систем підтримання прийняття рішень ситуаційного типу для інноваційного розвитку інфраструктури мегаполісів. Рішення формуються шляхом логіко-аналітичного оброблення даних про ситуацію в цілому і окремих випадках ситуацій для розглянутого суб’єкта інфраструктури мегаполісу. Для практичної реалізації механізму прийняття рішень запропоновано лінгвочисловий метод визначення потенційно кращої альтернативи та нечіткий ситуаційний алгоритм управління суб’єктами інфраструктури мегаполісу, заснований на структурній спільності ситуацій нечіткої ситуаційної мережі. Отримані результати протестовано на двох реальних об’єктах інфраструктури Києва.

Ключові слова: мегаполіс, інфраструктурні об’єкти, інтелектуальна система підтримання прийняття рішень, лінгво-числове оцінювання альтернатив, нечіткий ситуаційний алгоритм.