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ANALYSIS OF THE APPLICABILITY OF EXISTING METHODS AND TECHNOLOGIES OF PROJECT-ORIENTED MANAGEMENT FOR GOVERNMENT AGENCIES IN THE REPUBLIC OF KAZAKHSTAN

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Abstract. *This article considers the main models of the architecture of agency systems of project-oriented management as stages of their development. The agent technology allows us to decentralize problem solving and create complex systems of project-oriented management, combining various processing methods such as modeling, reasoning, and machine learning, and also allows us to distribute knowledge. One of these models is an aggregated architecture for systems of project-oriented management, based on agents of a marked deductive system. This approach allows us to divide algorithms into separate modules and distribute the knowledge base into parts. The focus is on existing multi-agent data mining architectures and the roles of agents in them. An architecture is described* *to support the decision-making process in conjunction with the use of event-driven and task-driven data mining agents, as well as helpers and knowledge management agents. The article then considers a mathematical model of the proposed decision-making system, identifies key parameters, and suggests improvements to the model based on the proposed integrated software solution. The practical significance of this study is determined by the fact that not only was the software architecture developed and presented for the first time, but also a fully extended mathematical model of a project-oriented management system.*

Keywords: *agent data developer, decision support, expert system based on agents, logic of reasonable reasoning.*

Raktiniai žodžiai: *agento duomenų kūrėjas, sprendimų palaikymas, agentais grįsta ekspertų sistema, pagrįstų argumentų logika.*

Introduction

Recently, public interest in professional project management as an instrument of innovative transformation of the economy and society as a whole has been growing rapidly. Project management has become a recognized methodology for introducing changes to systems at any level. A significant number of publications on the use of project management in public administration have appeared (Fariz 2015; Kazík 2013; Sauter 1997; Wilk-Kolodziejczyk 2017). However, the public administration methodology still does not pay enough attention to current trends in project management, which increasingly concern socially-oriented project results, the formation of socially recognized values, and the social responsibility of project activities – "soft components" associated with the increasing role of the human factor in the knowledge-based economy which the advanced world is heading towards. Accordingly, the number of decisions made in the case of a project is growing.

The ever-increasing amount of data received by the solution maker (SM) requires effective processing in order to extract useful information from it. Since the data comes from a variety of sources – including automatic control systems of industrial enterprises and organizations of various profiles, social networking sites, supply chains, and government databases – these datasets are usually not structured and do not have a specific format or pattern. Data mining (DM) is a process that uses intelligent methods to extract interesting patterns of data and knowledge from large amounts of data (Marken 2016). To ensure the higher performance of computational processes, the concept of agents was adopted and, later, agents supporting the DM process were introduced in a system known as agent mining (AM). The distributed nature of AM provides several advantages for DM, such as autonomy, scalability, reliability, security, interactivity, and high speed (Han, Kamber, and Pei 2012; Borodin et al. 2019; Guschina et al. 2019). The ability of agents to learn from their experience complements the data mining process. Providing an agent helps to overcome the challenges DM faces in a distributed, heterogeneous environment.

The purpose of this article is to consider the main models of the architecture of agency systems of project-oriented management as stages of their development. The problem with the research is that the mathematical model of the project-oriented management system has not yet been fully extended. The primary research question of the article is as follows: "Are existing methods and technologies of project-oriented management acceptable for government bodies?". The objectives of the study are: to consider the main models of the architecture of agency systems; to divide the algorithm into separate modules and distribute the knowledge base into parts; to consider a mathematical model of the decision-making system; to identify key parameters; and to improve the model based on the proposed integrated software solution.

Literature Review

Today in Kazakhstan, almost all local executive authorities and local governments participate in the development and implementation of targeted programs of social and economic development. The existing system of developing and implementing targeted programs, which governed by Decree of the President of the Republic of Kazakhstan No. 636, dated February 15, 2018, "On Approval of the Strategic Development Plan of the Republic of Kazakhstan until 2025 and Recognizing Certain Decrees of the President of the Republic of Kazakhstan," does not comply with the requirements of the time, as evidenced by the findings of international scientists (Foster et al. 2005; Marken 2016; Tweedale et al. 2016). A. Fariz (2015) considers that the success of targeted socio-economic development programs should be measured not only by the economic component, which is of course important for achieving the objectives of the program, but also by contributing to the strengthening of territorial sustainable development. M. Sokolova and A. Fernandez-Caballero (2009) believe that now in Kazakhstan there is a need to establish a uniform procedure for the development and implementation of targeted programs implemented for public funds by standardizing their methodology based on a project-oriented approach. According to G. Legien et al. (2017), the main idea of project and program management is the creation of a new value, and this should be reflected in a new standard of public administration which currently does not exist in Kazakhstan.

The main purposes of the decision support systems (DSS), which form the development of its architecture, are to provide the user with the opportunity to consult with an automated system when making decisions (Michalski and Collins 1989). D. Wilk-Kolodziejczyk (2017) suggests that the DSS includes a set of procedures, starting with the definition and processing of data and ending with the generation and evaluation of alternatives. Accordingly, a typical DSS can be logically divided between and represented by three main modules or levels: the first responsible for data fusion and preliminary processing; the second intended for necessary calculations (modeling, data mining, etc.); and the third performing modeling and driven by human–machine interaction.

According to D. Sharma and F. Shadabi (2014), the possible configuration of the DSS architecture, which represents the structure of a single decision-maker – i.e., several agents of data developers – has serious limitations when it comes to extensibility and the ability to integrate into the overall structure of support for organizational decisions. However, in many real-life situations, the system of sole decision-making still matters (UK Essays 2015; Konyavsky and Ross 2019b). In a modern organization, there can be many sources of organizational information, on the basis of which relationships and data patterns can be found to support the decision-making process of a single decision maker. As a result, the configuration of a DSS by a single decision maker with several data developers requires attention and analysis.

Materials and Methods

The methods used in projects and programs of a social orientation concern the ranking of objectives and the determination of priorities for activities that correspond to the interests and standards of society. In such cases, the "value" category becomes key in the overwhelming majority of development projects. Therefore, the most important success factors for projects and development programs are the "soft components" of project management: values, trust, social responsibility, interaction culture, etc. Creating and developing common values in projects that are shared by all participants and then transforming values into effective mechanisms of creative activity should ensure the integration of the efforts of all stakeholders, and optimize the use of human resources (Harnandez 2003). Therefore, the introduction of modern project management tools in public administration requires state managers to master new "soft competencies" – the ability to negotiate, to find creative solutions, to build trust, and to maintain common values.

The authors offer a method for assessing and improving the consistency of the DSS with elements defined by membership functions of an arbitrary type. This method is based on the entered definitions of a strongly consistent, poorly coordinated, and admittedly uncoordinated DSS, which uses the results of the defuzzification of DSS. The advantages of the proposed method are shown in comparison with the known methods for assessing the consistency of DM and DSS. Methods for analyzing hierarchies and networks are used to solve weakly structured and unstructured DM tasks that have their own characteristics. These features include, in particular, the uniqueness of the problem, the lack of optimality in the classical sense, the incompleteness of quantitative input information, and others (Turban and Aronson 2018; Sauter 1997; Marakas 1999; Tweedale et al. 2016; Konyavsky and Ross 2019a). The true solution to such problems at the moment of D cannot be known, measured by instruments, calculated, or evaluated by the methods of probability theory, statistics, econometrics, optimization, operations research, or other quantitative methods.

Under conditions where other methods cannot be applied, solutions of poorly structured and unstructured DM tasks are performed using the methods of analyzing hierarchies and networks, using expert estimates and the principle of decomposition of the task into subtasks, solving each of the subtasks, and aggregating local results (Parsons 1999; Harnandez 2003; Marken 2016). Also, in this work, the multi-criteria optimization method is used, and the system is distributed with respect to the integral formation of the DSS. For problems that are solved by quantitative methods, reliability is understood as the degree of approximation, i.e., the correspondence between the actual quantitative relations and their reflection in the indicators. This approach cannot be used to assess the reliability of decisions obtained by methods of qualitative analysis of hierarchies and networks for a specific, practical, weakly structured DM problem, since the true junctions for this task are unknown.

Results and Discussion

As the specifics of modern projects require that the key tasks in them are performed for potential stakeholders, it is the value systems of these stakeholders that influence the processes of project formation. The specific mission of a program or project can be defined as providing value to all interested parties. Successful completion of projects/ programs aimed at achieving this goal means that the parties concerned are satisfied with the value received. The main means of managing projects and value-based development programs that can be effectively used in public administration are:

- the definition of the mission, designed to increase the potential value of the program. The value arises from the formulation of the general goal of the activity, which is adequate to the realities and expectations of the stakeholders, which is a difficult task;
- developing a program architecture in which a group of projects that form a program can work autonomously, being partially integrated to maximize the added value of the program;
- the formation of the program, taking into account the vertical and horizontal chains of value formation;
- principles of forming criteria for assessing the added value obtained from the implementation of the program;
- management of communities of stakeholders, which forms the intellectual space of value creation in the environment (Turban and Aronson 2008).

In September 2012, the international project management standard ISO 21500 (Guidance on project management 2012) was published. This is the first standard in the ISO family of standards which covers not only the management of individual projects, but also the management of programs and portfolios. Therefore, the ISO 21500 standard can be the basis for a national standard in the development of targeted development programs. The ISO 21500 standard pays a lot of attention to the interaction between the processes of projects, programs, and portfolios, and the system they serve given the scale of management and communication with the management structure. The close affinity of the ISO 21500 standard to the setups of the Project Management Body of Knowledge (Project Smart 2013), i.e, the basic project management standard, is immediately apparent.

The new standard quite clearly confirms that professional project management is moving away from “hard” planning tools and a predominant focus on optimizing financial profits, and increasingly focuses on creating new knowledge (ISO 21500 adds the process of “saving lessons learned”) and responding quickly to environmental change ("resource management" and "communication management" processes). It should be noted that there are disadvantages in the ISO 21500 standard (Guidance on project management 2012). We would like to reflect not only the previous stages of the development of the methodology, but also the promising proactive means of developing project management. The standard still lacks systems-based project-oriented development tools and tools that integrate development strategy with project management.

To implement the approach in the framework of the ISO 21500 standard, let us consider a model based on the improvement of the decision support system. The configuration of a single decision-maker can be easily extended to the group decision support system architecture (GDSSA). It is important to note that with the introduction of each additional SM agent, only an additional knowledge communication channel between the new SM agent and the knowledge manager is needed. In addition, the DSS in question represents an open architecture capable of integrating future technologies by including additional classes of intelligent agents. The method of assessing and improving the consistency of DSS is based on the proposed definitions, which determine the strong and weak consistency of DSS through the consistency of well-defined methods of pairwise comparisons (MPC), built on the basis of given DSS. Consider the MPC D, whose elements are positive, real numbers and are the result of the dephasing of the corresponding fuzzy sets – DSS elements:

$$D = \{(d_{ij})\} \in R^{+}_{nxn} \tag{1}$$

$d_{ij} = Defuz(\tilde{d}_{ij})$ if $\tilde{d}_{ij} \geq 1$; $d_{ij} = 1/d_{ji}$ will be different. Note that the second condition provides the necessary property of inverse symmetry of the MPC D.

Definition 1. DSS D is strongly coordinated, in the future – coordinated, if the agreed corresponding phasing of the MPC D (1), namely $d_{ij} = d_{ik}d_{kj}$ for $\forall i, j, k = 1, \ldots, n$.

Definition 2. DSS D is admittedly uncoordinated, if admitted the uncoordinated corresponding defasciated MPC D (1), namely $CR(D_{n\times n}) \leq CR^{porog}$, or $GCI(D_{n\times n}) \leq GCI^{porog}$, or $HCR(D_{n\times n}) \leq HCR^{porog}$, or $CI^{tr}(D_{n\times n}) \leq CI^{tr\ porog}$ (depending on the consistency measure that is used), where $CR^{porog}, GCI^{porog}, HCR^{porog}, CI^{tr\ porog}$ threshold values of the relevant indicators.

Definition 3. DSS D is poorly coordinated, if the corresponding defasified MPC D (2) corresponding to it is poorly coordinated, namely, ordinal transitivity is performed:

$$(d_{ij} > 1) \wedge (d_{jk} > 1) \Rightarrow (d_{ik} > 1), (d_{ij} = 1) \wedge (d_{jk} > 1) \Rightarrow (d_{ik} > 1), \tag{2}$$

$$(d_{ki} > 1) \wedge (d_{ij} = 1) \Rightarrow (d_{kj} > 1), (d_{ij} = 1) \wedge (d_{jk} = 1) \Rightarrow (d_{ik} = 1). \tag{3}$$

Definition 4. A fuzzy positive antisymmetric matrix A is consistent if $a_{ij}a_{jk} = a_{ik}$ performed for all $i, j, = 1,\ldots,n$ where n – extended binary multiplication operation.

Definition 5. DM $\tilde{D} = \{\tilde{d}_{ij} = [l_{ij}, u_{ij}]\}$ is agreed if MPC D^L and D^U (4) are agreed (correlate):

$$D^L = \begin{pmatrix} 1 & l_{12} \ldots l_{1n} \\ u_{21} & 1 \ \ldots l_{2n} \\ \vdots & \vdots \ \vdots \ \vdots \\ u_{n1} & u_{n2} \ldots 1 \end{pmatrix}, D^U = \begin{pmatrix} 1 & u_{12} \ldots u_{1n} \\ l_{21} & 1 \ \ldots u_{2n} \\ \vdots & \vdots \ \vdots \ \vdots \\ l_{n1} & l_{n2} \ldots 1 \end{pmatrix}, D^M = \begin{pmatrix} 1 & m_{12} \ldots m_{1n} \\ m_{21} & 1 \ \ldots m_{2n} \\ \vdots & \vdots \ \vdots \ \vdots \\ m_{n1} & m_{n2} \ldots 1 \end{pmatrix}. \quad (4)$$

Definition 6. DSS with triangular numbers $\tilde{D} = \{\tilde{d}_{ij} = (l_{ij}, m_{ij}, u_{ij})\}$ is agreed if the MPC D^L, D^U and $D^M = \{(m_{ij})\}$ agreed:

We show that the use of definitions 4, 5, and 6 can lead to contradictory results. If the set of compared objects consists of only two elements then the result of a pair-wise comparison, as is well known, is always consistent, as inconsistency in its nature can occur only with the appearance of a third compared object. Therefore, a decision support (DS) of dimension 2x2 should be consistent, regardless of whether its elements are clear or fuzzy. Using Definition 4 for a 2x2 DSS, for example, with triangular elements:

$$\tilde{D}_{2x2} = \left(\tilde{d}_{ij}\right)_{2x2} = \begin{pmatrix} 1 & (l_{12}, m_{12}, u_{12}) \\ \left(\frac{1}{u_{12}}, \frac{1}{m_{12}}, \frac{1}{l_{12}}\right) & 1 \end{pmatrix}. \quad (5)$$

We obtain that this DSS is not generally agreed, since $\tilde{d}_{12}\tilde{d}_{21} \neq \tilde{d}_{11}$. Consider the DSS higher dimension, for example, with triangular elements:

$$\tilde{A} = \left(\tilde{a}_{ij}\right)_{n\times n} = \begin{pmatrix} 1 & (l_{12}, m_{12}, u_{12}) \ldots (l_{1n}, m_{1n}, u_{1n}) \\ (l_{21}, m_{21}, u_{21}) & 1 \quad \ldots (l_{2n}, m_{2n}, u_{2n}) \\ \vdots & \vdots \quad \vdots \quad \vdots \\ (l_{n1}, m_{n1}, u_{n1}) (l_{n2}, m_{n2}, u_{n2}) \ldots & 1 \end{pmatrix}. \quad (6)$$

For this DSS definition 4 and 6 require the following equalities:

$$\begin{aligned} l_{ij} * l_{jk} &= l_{ik}, \\ u_{ij} * u_{jk} &= u_{ik}, \\ m_{ij} * m_{jk} &= m_{ik} \end{aligned} \quad (7)$$

for $\forall i, j, k = 1,\ldots,n, i < j < k$.

Simultaneous fulfillment of conditions (7) is a rather strict requirement, and only individual DSS satisfy it in practice. For illustration, consider the following Example 2, in which for clarity, triangular fuzzy numbers are used. Example 2: Let the expert set multiplicative preference relations on the set A = {a1, a2, a3, a4} of the four alternative solutions, according to which the magnitude of the advantage of a1 over a2 and a4 is close to weak intensity, a2 is almost equivalent to a4 and so on. Suppose that the triangular fuzzy numbers $(l_{ij}, m_{ij}, u_{ij}), 0 < l_{ij} \le m_{ij} \le u_{ij}$, $l_{ij} = \frac{1}{u_{ji}}, m_{ij} = \frac{1}{m_{ji}}, u_{ij} = \frac{1}{l_{ji}}, i, j = 1, \ldots, n$ were used to formalize these expert estimates of pairwise comparisons, and as a result, the DSS is obtained:

$$\tilde{D} = \begin{pmatrix} 1 & (1,3,5) & (4,6,8) & (1,3,5) \\ (1,3,5)^{-1} & 1 & (1,2,4) & (1,1,3) \\ (4,6,8)^{-1} & (1,2,4)^{-1} & 1 & (1,2,4)^{-1} \\ (1,3,5)^{-1} & (1,1,3)^{-1} & (1,2,4) & 1 \end{pmatrix}. \tag{8}$$

This DSS is obviously inconsistent according to definitions 4 and 6, since for it $l_{ij} * l_{jk} = l_{ik}$ and $u_{ij} * u_{jk} = u_{ik}$ the equalities in (7) are fulfilled. However, for $\forall i, j, k = 1, \ldots, n$ for $m_{ij} * m_{jk} = m_{ik}$ being satisfied. Consequently, there is a contradiction of the results on the basis of a clear and phase-defined MPC. Namely, in this example, when formalizing expert estimates using a clear MPC, we will get complete consistency (MPC is consistent $D^M = \{(m_{ij})\}$), and using fuzzy triangular numbers will not only not get complete consistency, but will not even get acceptable inconsistency.

Definition 7. MPC $\tilde{D} = \{\tilde{d}_{ij} = [l_{ij}, u_{ij}]\}$ is called consistent if $\exists w$ the weight vector, $w_i \in R, w_i > 0, \sum_{i=1}^{n} w_i = 1$, that $l_{ij} \le w_i / w_j \le u_{ij}, i = 1, 2, \ldots n-1, j = 2, 3, \ldots, n$.

It was obtained that the use of different types and parameters of the membership functions of the DSS elements leads to almost the same results of the consistency assessment. On the basis of the definitions introduced 1–3, a method for assessing and improving the consistency of DSS is proposed, which consists of two main stages: to build a defasified MPC $D = \{(d_{ij})\} \in R^{+}_{nxn}$; perform an assessment and increase the consistency of MPC. Features of the proposed method of assessment and improving the consistency of the DSS are as follows:

- allows us to establish weak consistency of DSS and evaluate the admissibility of inconsistency of DSS for calculating weights, in contrast to the known methods that use definition 4–7;
- makes it relatively easy to implement improved DSS consistency, in particular to find the most inconsistent elements and cycles in the DSS;
- is used to evaluate DSS with any types of elements: triangular, trapezoidal, Gaussian, etc., as well as discrete fuzzy sets;
- does not lead to a contradiction in a separate case of evaluating the consistency of the DSS for $n = 2$.

Table 1 shows the results of the calculation of weights by known methods based on the MPC D. In particular, in the two-stage Temporary Liquidity Guarantee Program

(TLGP) and System Liquidity Guarantee Program (2SLGP) methods, the first stage is devoted to assessing the consistency of the MPC. As the data in Table 1 (Guarantee program model, GPM; lower and upper approximations model, LUAM) demonstrates, different methods led to the same ranking of alternative solutions. This is a consequence of the weak coherence property of the MPC D. The nonzero value of the index J in the TLGP model indicates the inconsistency of this MPC D.

Table 1. *Weights of Alternatives by Various Methods Based on the MPC D*

Weights	TLGP	TLGP (rephrase.)	GPM	2SLGP	LUAM
***J* 1.610**					
w_1	[0.268; 0.749]	0.080	0.04	1	0.109
w_2	[1.958; 3.107]	0.396	0.424	5.576	0.273
w_3	[0.514; 0.720]	0.097	0.094	1.28	0.119
w_4	[0.621; 1.000]	0.127	0.148	2.021	0.125
w_5	[1.599; 2.245]	0.301	0.281	3.655	0.177

The increase in the reliability of input expert assessments in solving a practical problem of DS takes place through the use of a more effective evaluation method proposed in the work and by increasing the consistency of expert assessments represented by general comparison matrices. This method can be applied to all currently known partial types of matrices of even comparisons, in particular multiplicative, additive, and linguistic. The effectiveness of this method for evaluating and improving the consistency of expert assessments of paired comparisons of model elements is proposed to be measured by the indicator:

$$J = dist\ (w, w^*) \qquad (9)$$

where w^* is the known vector of real weights of the model elements, w is the weights vector, and dist (x, y) is the distance function, for example the angular distance function proposed in Parsons (1999).

The component of the developed method for assessing and improving the consistency of expert assessments of pairwise comparisons is the method of searching for the most uncoordinated element of the DS. It is proposed to measure the effectiveness of the latter method on the basis of the simulation results of test-and-control flow test problems, in which the most inconsistent element becomes known using the indicator:

$$\mu = p / N \qquad (10)$$

where p is the number of experiments in which the most inconsistent element was found correctly, and N is the total number of experiments.

The following indicators of sustainability are proposed. The index of the stability of local ranking to perturbations of the element d_{ij} MPC:

$$I_{ij} = min\left(\left(\underline{SInt_{ij}}\right)^{-1}, \overline{SInt_{ij}}\right) \tag{11}$$

where $\underline{SInt_{ij}}$ and $\overline{SInt_{ij}}$ and are the ends of the stability interval, $i, j, = 1, \ldots, n$. The sensitivity index of the *cl* criterion in the hierarchical model to the change in the global ranking of solution alternatives:

$$SensVal\left(c_l\right) = min_{i<j}\left(\left|\delta_{i,j,l}\right|\right) \tag{12}$$

where $\delta_{i,j,l}$ is the value of the relative change in the global weight of the element c_l, which leads to a change in the global ranking between alternatives a_i and a_j, i,j=1,...n, l=1,...,m.

Conclusions

This study does not exhaust the problems of scientific research, it remains limited. The conclusions reached by the authors may become the basis for further research related to the reproduction of human potential. Studies of the development of the architecture of the agency system of project-oriented management have led to the following conclusions.

1. The article identified various issues related to the architecture of the DSS, including decision making with the participation of the decision maker, the development of multiple data streams, knowledge sharing, and system coordination, which are central to this integration of two different technologies. In particular, the DSS architecture has new features.
2. In the framework of the DSS, three different types of project-oriented management agents were identified. Data agents extract samples and models from information sources. User assistant agents serve as factors that facilitate the interaction of knowledge between specific decision makers and the DSS system. The knowledge manager agent plays the role of an administrator, coordinator, and knowledge broker, who controls the flow of knowledge between various project-oriented management agents in the DSS. In the framework of the DSS, data developers can discover hidden relationships and dependencies in a huge mass of organizational data to support arguments in the decision-making process.
3. The repository in the DSS provides a centralized view, that is, a common dictionary, and also allows the exchange of knowledge and communication. The multilingual on-

tology of DSS provides an easy construction of DSS-type systems by incorporating not only domain models, but also knowledge of the system itself.

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Šiuolaikinių į projektą orientuotų valdymo metodų ir technologijų pritaikomumo Kazachstano Respublikos valdymo agentūroms analizė

Anotacija

Straipsnyje nagrinėjamas pagrindinių į projektą orientuotos agentūrų sistemos architektūros modelių valdymas per jų vystymosi etapus. Agentų technologija leidžia decentralizuoti problemų sprendimą ir sukurti kompleksines, į projektą orientuotas valdymo sistemas, derinant įvairius apdorojimo metodus, tokius kaip modeliavimas, samprotavimas ir mašininis mokymasis, taip pat įgalina paskirstyti žinias. Vienas iš modelių yra apibendrinta, į projektą orientuotų valdymo sistemų architektūra, pagrįsta dedukcinės sistemos agentais. Šis metodas leidžia algoritmą suskaidyti į atskirus modulius ir paskirstyti žinių bazę į tam tikras dalis. Didžiausias dėmesys skiriamas esamoms daugiaagentėms duomenų gavybos architektūroms ir agentų vaidmenims jose. Architektūra apibūdinama kaip skirta palaikyti sprendimų priėmimo procesą kartu su įvykių ir užduočių duomenų gavybos, pagalbiniais ir žinių valdymo agentais. Straipsnyje nagrinėjamas siūlomas sprendimų priėmimo sistemos matematinis modelis, nustatomi pagrindiniai parametrai ir siekiama patobulinti modelį remiantis siūlomu integruotu programiniu sprendimu. Praktinę tyrimo reikšmę lemia tai, jog buvo sukurta ir pristatyta ne tik programinės įrangos architektūra, bet ir išplėstas į projektą orientuotos valdymo sistemos matematinis modelis.

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