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Information Technologies for Supporting Administrative Activities of Large Organisations

Jamil Al-Azzeh

Department of Computer Engineering, Al Balqa Applied University, Amman, Jordan
E-mail: azzehjamil18@gmail.com

ABSTRACT

Study describes a specified analytical method and model for the organisational management of a company. The proposed solutions allow for revealing information resources, which can be used to support management decisions adoption and control of plans. Information obtained from programs and information systems of the electronic document flow of organisations were used as data sources. The result of configuration investigation and characteristics of information exchange in information systems can be used as administrative decisions support in the organisation. The conducted research allows for improved approaches to the creation and modernisation of effective information systems of universities. The offered software of administrative activity support allows us to increase the flexibility and adaptability of existing information systems and electronic document flow (program complexes) to increase the efficiency of their operations.

Keywords: Decision support systems; Administrative activity; Information exchange; Document flow; System of mass service

1. INTRODUCTION

At the present stage of the development of post-industrial society, organisational management differs in the universal introduction of information systems (IS) and information systems technologies (IST), as well as the organisation of electronic interactions, including interdepartmental electronic document flow among various governments and private institutions. The large-scale processes of the informatisation of organisational structures, which began in the 20th century, demanded the evolution of the usual IS in support systems for administrative activities[1,2]. In the last few years, the implementation of the intellectual components in IST have been considerably extended.

Traditional methods of using knowledge bases (KBs) in the decision-making support (DMS) for the management of organisations do not always guarantee the relevance of the data. As was shown by Demirkan & Delen[3], DMS connected with the resource intensity of problems of KB creation and support, the necessity for continuous updating of knowledge, adaptation of algorithms, etc.

Despite undoubted success in this area of research, the problem of the synthesis of methods, models, and algorithms of information support directed toward the improvement of administrative processes and an increase in the overall performance of large administrative organisations as the objects of informatisation is still urgent.

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2. LITERATURE REVIEW

The results of the research devoted to the management of IT infrastructure of organisations are rather discussed[4,5]. Research in approaches to management cover the systematisation of the purposes and tasks of the rational organisation of administrative processes in relation to IT infrastructure[6,7]. However, the offered methods and models have not yet developed into a formal format to make a complete hardware and software (SW) decisions.

The studies investigated the efficiency of organisational systems while carried out the strategic assessment of IT infrastructure development[8-11]. Parameters for the estimation of optimal management were reviewed with criteria for the evaluation of the management of behavioural systems[12,13]. However, today, there is still no completed research that can provide the joint analysis of these applied program systems to the problems of management DMS in large organisations. This situation is caused by the separation in the approaches to solving the problems of information-processing automation in applied IS and the orientation toward local functions in support of business processes.

The reviews concerned the potential of using data sources for the DMS of information resources of applied systems and using data for the expeditious management of organisations[14,15]. The research analysed the potential of using models of systems of mass service (SMS) as the unit for modeling information flows in organisations[16-18]. Research in this direction has not yet yielded a finished product for the implementation of the algorithms of SW products for electronic document

management systems.

Currently, there is a lack of investigation into methodologies for examining information resources, particularly SW systems to support the management decisions of large organisations[14,16,18]. The implementation of methods in IS functions to support management activities and the methodology for the development and modernisation of IS to support the management activities of large organisational structures (ISMAS) remains to be studied. Continued research to address the problems of ISMAS is important to the further development of methods and algorithms of informational support of managerial processes to improve the efficiency of organisations.

The purpose of this study is the development of methods and models allowing the creation of ISMAS in large organisations. To achieve the purpose, it is necessary to solve the following problems:

- To develop a method and model of administrative activity support that is based on information resources and allows for the creation and modernisation of the ISMAS of large organisations while taking into account the uniqueness and complexity of these organisations.
- To investigate the structure and characteristics of information exchange in ISMAS for the improvement of approaches to creating effective IS for large organisations.

3. MATERIALS AND METHODS

The analysis of the information resources of large organisations is reviewed at: operating systems, provision of life cycle software (LCSW), systems for decision-making support (SDMS), and applied functional tasks of organisation management. We assume that each information level (layer)[5,19–21] implements its functional orientation. For example, the levels of applied functional tasks and the corresponding SW enable the accumulation of the data on: information about the processes, the fulfillment of instructions, data on the participants and their experiences, and data on the tasks.

The level of SDMS contains a variety of KBs and data, as well as repositories of methods and algorithms for data processing that take into account the specifics of organisational work. The level of provision of LCSW allows us to accumulate data about the functioning and the complexity of an organisation as a whole and of individual subsystems within the organisation. During the implementation of methods and models, the analysis of the relationship of managerial functions and applications of IS, SDMS, and automated systems of the organisation aimed to find data sources for the support of managerial activities.

This paper uses the following designations.

A: a set of tasks (instructions) that correspond to the tasks of the functional divisions of an organisation. Therefore, $A=\{A_1, A_2, ..., A_n\}$, where A_1, A_2, A_n are the data arrays of the applied subsystems of IS, automated systems, and SDMS.

$A_n = \{x_{n1}, x_{n2}, ..., x_{np}\}$, where $x_{n1}, x_{n2}, ..., x_{np}$ help the blocks of subsystems tasks. These blocks can be used as data sources when developing services for decision-making support of organisational management.

The following set of $D = \{D_1, D_2, ..., D_m\}$ describes business processes (operations). Their support demands data acquisition from applied subsystems of an object of informatisation. Coefficients $c_1, c_2, ..., c_m$ characterise the existence or lack of information for the corresponding operation. Coefficients can accept a value of 0 or 1.

The example of the interrelation of the sets *of A* and *D* for an option of business management by processes at large universities in Jordan is shown in Table 1. The cells filled with the sign "*" contain coefficients with a value of 1. Other cells cost 0.

The formal statement of the problem can be represented as follows.

All divisions of large organisations, such as universities, are defined as objects with many characteristics (OMC), i.e., $O = \{O_1..., On\}$. The activity of the divisions (objects (O)) can be estimated by following the results of the performance of tasks, which are recorded in a database and estimated by a set of criteria, $Q = \{Q_1..., Q_m\}$. Examples of criteria are shown in Table 2. Each criterion has a scale of assessment[17,18,20,21], which

Table 1. Interrelation of the Sets of A and D

Tasks \ Operations		Planning of activities	Adoption of operational decisions	Development of recommendations	Control of implementation of decisions	Assessment of processes of implementation of decisions	Assessment of workmanship of instructions	Control of plans
		D_1	D_2	D_3	D_4	D_5	D_6	D_7
		c_1	c_2	c_3	c_4	c_5	c_6	c_7
A_1	Documentation provided by university management	*	*	*	*	*	*	*
A_2	Personnel resources of university	*			*			
A_3	Material technical supplies of university	*			*			
A_4	Financial resources of university	*			*			
A_5	Scientific research by a university	*	*					
A_6	Other business processes	*	*	*	*	*	*	*

can be both quantitative and qualitative.

The assessment scale is designated by $Q_s = \{q_s^{es}\}, e_s = 1,...,h_s, s = 1,...m$ The estimates are sorted from the best to the worst $q_s^1 \succ q_s^2 \succ ...q_s^{hs}$

Within the offered method, each OMC can be described by a multiset:

$$O_i = \begin{Bmatrix} k_{O_i}(q_1^1) \circ q_1^1,...,k_{O_i}(q_1^{h1}) \circ q_1^{h1};...; \\ k_{O_i}(q_m^1) \circ q_m^1,...,k_{O_i}(q_m^{hm}) \circ q_m^{hm} \end{Bmatrix}, i = 1,...,n, \quad (1)$$

where k_Q is the function of the frequency rate of a multiset for OMC, which generates the domain $X = Q_1 \cup ... \cup Q_m$, for m scales of criteria; $k_{O_i}(q_s^{es})$ is the number of documents in IS, which allows the drawing of a conclusion on criteria assessment Q; and ° is the designation of the circumstance that is in the description of OMC, copies of a sign were used earlier q_s^{es}.

A problem of the OMC regulation is a matter of the streamlining of the corresponding multisets:

$$O_i^+ = \{k \circ q_1^1, 0,...,0; k \circ q_2^1, 0,...,0;...; k \circ q_m^1, 0,...,0\}, \quad (2)$$

$$O_i^- = \{0,...,k \circ q_1^{h1}; 0,...,0, k \circ q_2^{h2}; 0,...,0, k \circ q_m^{hm}\} \quad (3)$$

It seems obvious that the subtask choice of the unit with the best and worst objects, which are in turn characterised by Q_i^+ & Q_i^-.

Table 2. An Example of Criteria for the Estimation of an Object

№	Criteria accepted in the ISMAS model	Estimates (Accepted by[17,18,20,21])	
		Tasks performed	Outstanding tasks
	Example: an indicator—"processing of the document"		
1.	Condition of execution	Ahead of schedule; in time; violation of term; other.	Term was not established; term did not expire; term expired; other.
2.	Efficiency of document acceptance accompanying a task	Accepted on day of mailing; accepted the next working day; accepted in 2–3 days;	The same
n	…	…	…
	Example: an indicator—"control of decision execution"		
1.	Performance of control terms	Removed from control ahead of schedule; removed in time; removed with violation of the term.	Term was not established; term did not expire; term expired.
2.	Adjustment of control terms	Not executed; executed once; executed repeatedly.	The same
n	…	…	…

The condition of ordering an object is its proximity to the conditionally best object in the analysed multisets:

$$\delta(Q_i) = l^+(Q_i) / \left[l^+(Q_i) + l^-(Q_i) \right], \quad (4)$$

where $l^+(Q_i) = l(Q^+, Q^-) \& l^-(Q_i) = l(Q^-, Q^+)$

The best option for the analysed object Q^* causes $\min \delta(Q_i)$. The ranging of the objects is the result of ordering, which is the ranking of the objects. The ranking can be made equal or unequal to the importance of the assessment criteria.

In the working model, a document was considered as a set of information processes in an organisation. In turn, especially in large organisations, information flow in terms of quantity is characterised by tens to hundreds of thousands of documents per year.

A schematic of a model of the movements of documents in an organisation is shown in Fig. 1. This model can be used to calculate a document management system as a kind of SMS.

The model of the movement of documents in an electronic document management system of an organisation (EDMSO) is considered as an open stochastic network serving the automated jobs of employees.

The average response time for an application is described by the expression:

$$U = \sum_{i=1}^{n} f_i \cdot t_i^{g} + \sum_{i=1}^{n} f_i \cdot t_i^{g} = \sum_{i=1}^{n} f_i (t_i^{g} + t_i^{g}) = \sum_{i=1}^{n} f_i \left(t_i^{g} + \frac{1}{\mu_i} \right), \quad (5)$$

where f_i is the frequency of receiving an *i*- application knot; t_i^{ex}, t_i^{se} – are the average time of expectation and servicing for an *i*- knot, respectively; $\mu_i = 1/t_i^{se}$ – is the intensity of service, where $i = \overline{1,n}.$.

The average time to pass a document through an EDMSO is calculated by the following formula:

$$U = \sum_{i=1}^{n} f_i \cdot \left(\frac{\varphi_i^2}{\lambda \cdot (1 - \varphi_i)} + \frac{1}{\mu_i} \right), \quad (6)$$

where $\varphi_i = \lambda_i / t_i^{se}$; $\lambda_i = \rho \cdot f_i$; ρ is the average intensity of document flow arriving at an *i*- knot.

The stay time for an *i*- knot can be defined by:

$$T_i = \varphi_i \Big/ \left(\lambda_i \cdot (1 - \varphi_i) \right) \quad (7)$$

The received Eqns. (6) and (7) were implemented in the module of an administrative activity support system of a university. These expressions can be also used in the ISMAS of other big organisational structures to define problem knots in their EDMSO networks.

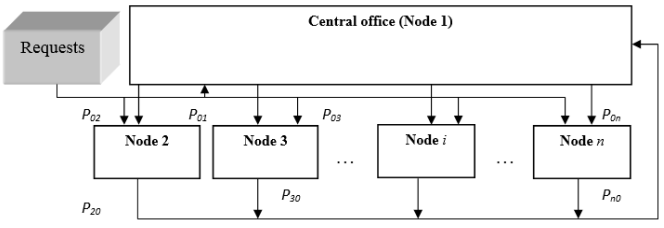

Figure 1. SMS scheme for modeling of movement of documents in an organisation.

4. EXPERIMENT

In the study of a university, an ISMAS module was developed, based on the proposed method and model. The SW prototype for the ISMAS module was implemented in the Rad Studio programming environment. The main interface of the module for simulating the time for performing tasks by units is shown in Fig. 2. The busiest terminals involved in the system of data exchange between the structural units of the university are highlighted in colour from blue (least loaded units) to green (the most loaded units).

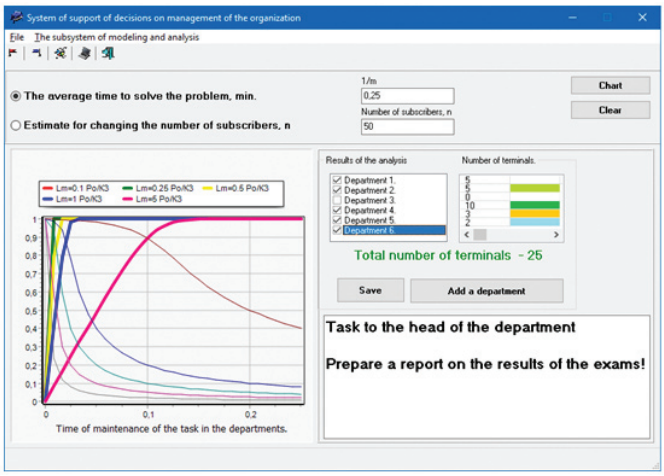

Figure 2. Module of decision-making support in an organisation to model the time taken to complete tasks in the organisation's departments.

Graphs automatically reflect the time spent by the documents in the knot (department or terminal) from the intensity of document servicing.

As an example, we consider the result of a researched document flow of an organisation (faculty) for a variant of the network, including the central office (knot 1) and several (from 5 to 10) divisions (departments).

We assume that the entrance flow of documents arrives at knot 1 with the following probabilistic parameters: $P_{01}=1$, which is the probability of denying service to the document at knot 1; $P_{0i}=0$, which is the probability of denying service to the document on knots $i=\overline{2,10}$. The performed tasks (the processed documents) with probability "1" ($P_{i1}=1, i=\overline{2,10}$) come to knot 1 (the central office or dean's office). In the calculations, it is accepted that leaving the system happens to probability "0,1". Figure 3 shows the results of modeling and checking in practice of outcomes for the time when documents are staying in the knot: $\Lambda = \lambda_i / t_i^{ex} = 0-25$ document/h.

In an ideal (standard) case, we believe that the time to solve a task, i.e., processing of the document does not exceed 20–30 min. From the received schedules, it is possible to judge the rational value of the intensity of documents' being serviced by $\mu_i = 1/t_i^{se}$, which makes for the accepted initial values: $\mu_i = 100-150$ document/h. Thus, if the terminal productivity (the automated workplace) is about 8–10 documents/h, then the minimum quantity of such jobs can be determined. For the

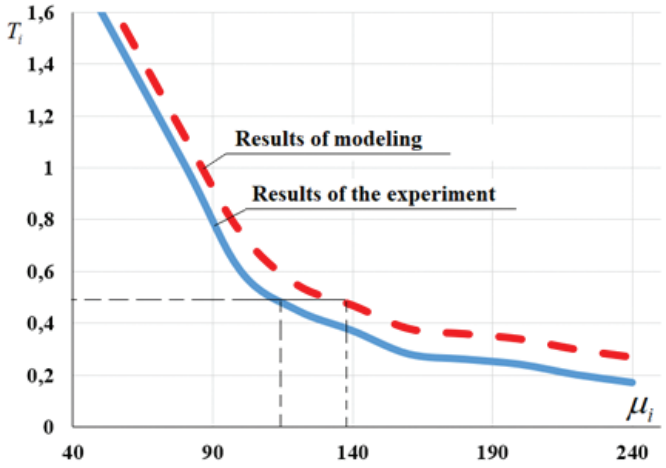

Figure 3. Results of modelling and checking in practice of outcomes for time when documents are staying in the knot.

initial data in the considered example, this size makes 20–23 per workplace.

Therefore, the operating influence in the organisation and its system of document flow must result in an increase in jobs, or as an alternative, the development of measures for the combination of the tasks solved by a department.

5. DISCUSSION OF SPPR TESTING RESULTS AND PROSPECT FOR FURTHER RESEARCH

The offered approach and the results received during the development of a method and model for supporting administrative activity, which are based on the information resources of large organisations and enterprises, increased the efficiency of supporting decision-making and estimations of management processes in comparison with alternative techniques by 9–12 per cent[5,16,20,21].

The advantage of the offered methods and model is the ability to integrate the developed SW into the existing IS. A certain lack of work is lack of approbation of the developed SW on many enterprises, since the study was conducted only in Jordan. Further research provides the possibility of approbation and expansion of using offered program complexes by large organisations in other countries of the Middle East.

In addition, the design of specialised interfaces for various modes of management support is envisaged. In the future, this will ensure that the preferences of employees are reflected in their interaction with the IS used by the enterprise in which they work.

In general, based on this research study, it is possible to state the efficiency of the offered method, models, and SW for SDMS to support managerial decisions and controlling (correcting) plans based on the data of the involved SW complexes.

6. CONCLUSIONS

A method and model of analysis of organisational management in a large organisation was developed. The proposed solution allows for the identifying of the information resources used in the process of supporting managerial

decisions, as well as controlling, correcting, and coordinating plans. The information received from the IS and electronic document management systems of organisations were used as the source of data.

The configuration and characteristics of the information exchange in ISMAS in large Jordanian organisations were investigated to improve approaches to the creation and upgrading of effective IS. This study determined that the proposed SW for management support enhances the flexibility and adaptability of the existing IS of the reviewed organisations, as well as increases the efficiency of their operations.

REFERENCES

1. Bonczek, R.H.; Holsapple, C.W. & Whinston, A.B. Foundations of decision support systems. Academic Press Academic Press, Inc., 2014
2. Galliers, R.D. Leidner DE. (Eds.). Strategic information management: Challenges and strategies in managing information systems. Routledge, 2014
3. Demirkan, H. & Delen, D. Leveraging the capabilities of service-oriented decision support systems: Putting analytics and big data in cloud. *Decis. Support Syst.,* 2013, 55, 412-421. doi: 10.1016/j.dss.2012.05.048
4. Kerzner, H. Project management: A systems approach to planning, scheduling, and controlling. John Wiley & Sons, 2013
5. Peppard, J. & Ward, J. The strategic management of information systems: Building a digital strategy. John Wiley & Sons, 2016.
6. Seuring S. A review of modeling approaches for sustainable supply chain management. *Decis. Support Syst.,*2013; 54: 1513-1520. doi: 10.1016/j.dss.2012.05.053
7. Crone, D.A.; Hawken, L.S. & Horner, R.H. Building positive behavior support systems in schools: Functional behavioral assessment. Guilford Publications, 2015.
8. McKelvey, B.; Tanriverdi, H. & Yoo, Y. Complexity and information systems research in the emerging digital world. MIS Quarterly, 2016.
9. Bakanova, N. & Atanasova, T. Development of the combined method for dataflow system. *Int. J. Inf. Technol. Knowl.,* 2008, 2, 262-266.
10. Winch, G. & Leiringer, R. Owner project capabilities for infrastructure development: A review and development of the "strong owner" concept. *Int. J. Proj. Manage.*, 2016, 34, 271-281. doi: 10.1016/j.ijproman.2015.02.002
11. Kelly, Rainer R.; Brad, Prince &Casey, G. Cegielski. Introduction to information systems: Supporting and Transforming Business 5th Edition. Abridged, 2014.
12. Wang, S.; Noe, R.A. & Wang, Z.M. Motivating knowledge sharing in knowledge management systems: A quasi–field experiment. *J. Manag.*, 2014, 40, 978-1009. doi: 10.1177/0149206311412192
13. Urbach, N. & Ahlemann, F. Structural equation modeling in information systems research using partial least squares. *JITTA*, 2010, 11, 5.
14. Bardhan, I.R.; Demirkan, H.; Kannan, P.K.; Kauffman, R.J. Sougstad, R. An interdisciplinary perspective on IT services management and service science. *J. Manag. Inf. Syst.*, 2010, 26, 13-64. doi: 10.2753/MIS0742-1222260402
15. Kwon, O.; Lee, N. & Shin, B. Data quality management, data usage experience and acquisition intention of big data analytics. *Int. J. Inf. Manage.*, 2014, 34, 387-394. doi: 10.1016/j.ijinfomgt.2014.02.002
16. Giachetti, R.E. Design of enterprise systems: Theory, architecture, and methods. CRC Press, 2016.
17. Dudin, A.; Gortsev, A.; Nazarov, A. & Yakupov, R. (Eds.). Information technologies and mathematical modelling-queueing theory and applications. *In* 15th International Scientific Conference, ITMM 2016; 12–16 September 2016; Katun, Russia. Springer. vol. 638 doi: 10.1007/978-3-319-44615-8
18. Luo, A.; Fu, J. & Liu, J. An impact analysis method of business processes evolution in enterprise architecture. *In* Progress in Informatics and Computing (PIC), 2016 International Conference IEEE. pp. 733-737. doi: 10.1109/PIC.2016.7949595
19. Lahno, V. Ensuring of information processes' reliability and security in critical application data processing systems. *MEST Journal,* 2014, 2, 71-79. doi: 10.12709/mest.02.02.01.07
20. Pearlson, K,E.; Saunders, C.S. & Galletta, D.F. Managing and using information systems, binder ready version: A strategic approach. John Wiley & Sons, 2016.
21. Wager, K.A.; Lee, F.W. & Glaser, J.P. Health care information systems: A practical approach for health care management. John Wiley & Sons, 2017.

CONTRIBUTOR

Dr Jamil S. Al-Azzeh received his PhD (Computer Engineering) from Saint Petersburg State University, Russia, in 2008. Currently working as an Associate Professor in the Computer Engineering Department. Faculty of Engineering Technology, at Al-Balqa' Applied University, Jordan. His research interests include : Image processing, computer system architecture, parallel processing FPGA. digital systems design, network operating system, and microprocessors.