Intellectualization of decision making in information systems lifecycle management in fintech

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Abstract. The organizational aspects and technologies for modeling the processes of information system life cycle management in fintech are considered. The current growth rates of the amount of information requiring processing in real time, as well as the trend towards the creation of an increasing number of remote jobs in various sectors of the economy, force us to reconsider the views on the organization of the information systems lifecycle management process.

Keywords: Intellectualization of decisions, Information systems, Technologies for modeling.

1 Introduction

The relevance of creating methods for describing and modeling information flows is caused by a high degree of intensification of information exchange and the prevalence of the use of new information technologies. The construction of models of life cycle (LC) management processes of information systems (IS) is designed to provide support to decision makers (DM) for timely intervention in the development of the information system of the company.

Timely identification of trends that can negatively affect the life cycle of a financial organization IS, their elimination through its revision and updating will not only adequately calculate the necessary resource costs for system support, but can also serve as a signal for the need to make changes in the established business processes of the organization [1].

Despite the fact that, in general, the IS includes almost all of the organization's resources that one way or another process information or participate in information flows, the most important is that part of the financial organization's IS that provides automation of the main functions of business units. It is usually called an automated banking system or corporate information system (CIS). It is the CIS that is considered by the authors as an object of research, the modeling of the life cycle of which can be extrapolated to the IS of fintech.

The life cycle model of the corporate information system of a financial organization is a combination of a sequence of life cycle stages and transitions between them, necessary to ensure the achievement of the goal set for the project. The specificity of the life cycle of fintech CIS is that the initial stages of the life cycle, such as the survey of the subject area, the statement of the problem, design and development, now no longer make sense, since very few new financial organizations are opening, but for them there are many ready-made automated systems on the market, the implementation of which significantly reduces the period for launching a CIS.

Deployment and implementation for fintech are very complex processes, since they take a significant amount of time, while the business must remain continuous. The likelihood of the need to dispose of the current corporate information system and the introduction of a new one is intended to minimize for fintech this study in an effort to preserve the current corporate information system. We will focus on the stages of Operation, support and modernization of the corporate information system. The decisions made on them should ensure maximum compliance of corporate information systems with business requirements at minimum costs.

The operation of the corporate information system, which is the main stage, the balance of which must be maintained, is ensured by the IT department of the organization through the stability of the operation of hardware, system software and end-user support. At this stage, the intellectualization of the decisions made in the management of the life cycle of the corporate information system is especially important, since it helps prevent serious consequences associated with a decrease in the qualitative and quantitative indicators of the corporate information system in comparison with the reference ones that correspond to the changing business requirements [8].

2 Statement of the corporate information system support and modernization

2.1 Criteria for assessing the compliance of a corporate information system with the requirements of a business customer

In their activities, employees of the organization are guided by certain regulations that describe business processes that can be assessed in terms of the time spent, and hence the level of automation [2]. Subsequent monitoring of the compliance of this assessment with the average or reference value can be an important indicator of the need to make changes both in the corporate information system and in the business process itself. Multi-criteria assessment and monitoring of the main business processes indicators will allow avoiding critical situations when the revision of the corporate information system may be either economically ineffective or ineffective in terms of meeting business requirements.

In addition to the time indicator, the degree of automation and formalization of tasks performed by employees is considered. A decrease in this indicator entails additional costs in time for manual processing of documents.

The convenience of the CIS interface, and, consequently, the laboriousness of employees performing their business functions is the most difficult to perceive factor, however, significantly affecting both the speed of information processing and the efficiency of the organization as a whole. Routine actions are no longer critically assessed by performers, but newly hired employees can draw attention to the low level of business processes automation. At the same time, the analysis and control of such situations can be automated.

The launch of the CIS revision and adaptation processes to the rapidly changing business requirements is possible only through constant monitoring of many factors and processes occurring in the corporate information system. However, for this it is necessary to formalize these factors and processes as much as possible.

2.2 Application of the apparatus of fuzzy logic in assessing the relevance of CIS

The use of fuzzy logic makes it possible to assess the relevance of the current CIS and to select an adequate organizational impact on its life cycle. If the corporate information system does not provide the required efficiency of the business process, its revision may be required (setting the configuration of the interconnected components that make up the corporate information system). In a critical case, the introduction of a new IS may be required [9].

It is necessary to choose such a conceptual solution (configuration) that, with maximum utility (or quality) of the IS, ensures the efficiency of the business process, while meeting the requirements is a necessary condition, but does not guarantee the achievement of maximum efficiency (the ratio of effectiveness and costs).

Usefulness - the degree of user satisfaction with a set of functions (modules) of the CIS. Since the revision of the CIS is characterized by a given labor intensity and risks (design or technical), the effectiveness can be assessed using a composite criterion that includes indicators such as Ui – the utility of the i-th component of the CIS (for example, a module that generally performs one function) , Ti is the complexity of the implementation of the CIS component (set during business planning) and Pi is the probability of the successful implementation of the CIS component (estimated by experts).

The search for systemic and technical solutions, including the optimization of the U, T, P indicators of individual components, will maximize the usefulness of the corporate information system, which will help improve the efficiency of the business process.

However, the high rates of development of information technologies lead to the fact that CIS requires constant improvement. On the information technology market, there are many new practices aimed at active interaction of IT professionals, both developers and administrators, in order to increase the pace of their interaction and improve the efficiency of issuing updates to the CIS. For example, DevOps (development & operations), supplemented by a flexible approach to Agile development, focused on the use of iterative development, dynamic formation of requirements and

ensuring their implementation as a result of constant interaction within self-organizing working groups, consisting of specialists of various profiles.

The DevOps approach forms the continuous interaction of employees in the IT department, without which the benefits of life cycle modeling and the intellectualization of decisions made can be reduced to zero. If, for example, administrators do not have time to deploy the releases supplied by the developer into production, updates accumulate, and business customers do not receive the necessary functionality.

In addition, recently the so-called microservices (MS) have become popular, on the basis of which the CIS of a financial organization is built. MS are used as building blocks to automate various parts of business processes [3]. Microservices architecture has its advantages in upgrading and scalability of CIS, but it also contains disadvantages associated with managing the growing number of microservices.

Modern information technologies that make it possible to bring the process of updating and upgrading the corporate information system to a completely new quality level using adaptive algorithms and using knowledge bases significantly reduce the costs and terms of implementing improvements to the corporate information system and minimize the risks associated with personnel qualifications.

3 Methods of decision support using the apparatus of fuzzy logic

3.1 Basic tools for creating mathematical models of CIS

As a tool for creating mathematical models (MM), the method of group accounting of arguments [7] can be used as one of the most effective methods of structural and parametric identification of complex systems based on observational data under conditions of incomplete information. In order to increase the information content of the initial data and the accuracy of solving identification and optimization problems, it is necessary to classify objects. For classification, it is advisable to use clustering methods that allow the division of the studied set of systems into separate classes, within which the systems are considered to be of the same type. The k-means method or mutual absorption method is used as a clustering algorithm. Using this method of splitting into classes allows you to obtain subsets containing objects that are homogeneous in terms of the values of the properties that characterize them. The selected subsets have this property because the mutual distance (absorption radius) between any pair of objects in the subset is less than the distance between two objects in different subsets.

Then the search for optimal alternatives in its class is carried out using the Pareto method. The choice of the optimal from this set of alternative options is possible using an additional criterion. For this, a compositional method for choosing alternatives is being developed. It combines the solution of the problem of optimizing the objective function and the reduction of private preferences to general requirements, which makes the choice more objective and accelerates the calculation.

The objective function in the construction of a corporate information system is an efficiency criterion, which will be built using the developed method of forming an integral efficiency criterion using a set of models with signs of their significance, thus increasing the degree of certainty in decision-making.

The decision-maker, in the course of his activities, proceeds from experience, intuition and knowledge. However, these foundations are difficult to algorithmize, as a result of which active algorithmic support of choice is required when making decisions by building adaptive models.

Experts play an important role in decision-making processes. At the same time, the competence of experts is usually unknown, and expert assessments may be biased. Decision support technologies implemented with the use of classification technologies and optimization of variants, as well as with the use of fuzzy logic, are effective.

3.2 Application of fuzzy logic to support decision-making

Continuous improvement of business processes leads to an inevitable change in the conditions for the functioning of the information space of a financial organization, which predetermines the need to adapt the corporate information system to changing requirements, as well as to assess the effectiveness of the current CIS within its life cycle.

The restrictions imposed by the requirements act as a criterion for assessing the effectiveness of the corporate information system. Often, such an assessment is carried out formally, and the failure to comply with non-critical restrictions that do not reduce the value of the corporate information system may lead to the fact that the corporate information system will be rejected, although de facto it is still capable of performing the specified functions within its life cycle. Therefore, in order to minimize the number of such situations, an approach to formalizing requirements using the apparatus of fuzzy logic is proposed.

Let us denote the set of requirements for the characteristics of the n-th component of the CIS (for example, a module that generally performs one function) as $R_{nl},\ l=\overline{1,L_n}$. Usually, in practice, the requirements are formalized by specifying are as y_{nl} for the corresponding characteristics in the form of one-sided or two-sided inequalities, for example, $y_{nlL} \le y_{nl} \le y_{nlH}$. The predefined possible values can be presented in tabular form.

If we take for r a variable that shows whether the requirement R is fulfilled or not, for example, for r = 1, the requirement R is fulfilled, and for r = 0, it is not, then we get a full set of alternatives for which the requirements for the CIS are fulfilled. Given the rigidity of such a selection, we can with a high degree of probability get a situation when either there are no results at all, or they do not satisfy possible modifications or changes in the configuration of the CIS. In addition, this approach imposes rather strict restrictions when formulating the corresponding requirements.

In this regard, it is proposed to apply fuzzy logic approaches to solving this problem, which provide a more flexible formalization of requirements. In this case, the logical values 1 or 0 are replaced by a wider range of options given by the member-

ship function (MF) to a fuzzy set $r = \mu_R(y)$. In this case, the degree of fulfillment of the requirement is determined as the value of the corresponding membership function $r \in [0;1]$.

The quantitative characteristics of the CIS can be formalized [5]: a linear s-shaped membership function for restrictions on the right, a linear z-shaped membership function for restrictions on the left, and a trapezoidal membership function for two-sided restrictions.

Thus, we move from rigid binary constraints to a more flexible formalization of requirements [4].

To take into account the peculiarities of meeting the requirements, membership functions (Figure 1) to a fuzzy set of a special type are proposed:

$$\mu_S(y) = \mu_S(y; y_B, y_T, c) = \begin{cases} 0 & ; y < y_B \\ c & ; y = y_B \\ \dfrac{(1-c)y + cy_T - y_B}{y_T - y_B} & ; y_B < y \le y_T \\ 1 & ; y > y_T \end{cases} \quad (1)$$

– Unilateral restrictions from below;

$$\mu_Z(y) = \mu_Z(y; y_B, y_T, c) = \begin{cases} 1 & ; y < y_B \\ \dfrac{(c-1)(y - y_B)}{y_T - y_B} & ; y_B < y \le y_T \\ 0 & ; y > y \\ c & ; y = y_T \end{cases} \quad (2)$$

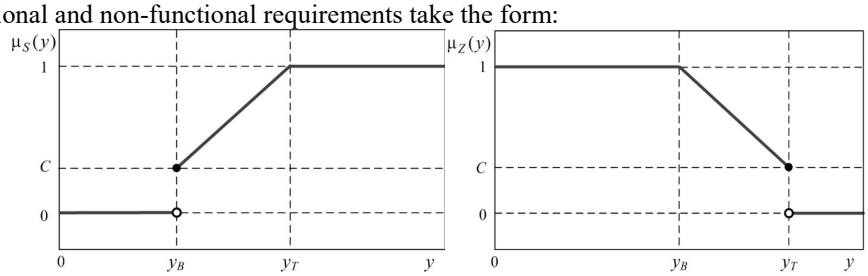
– Unilateral restrictions from above.

Parameters of MF (1) and (2) are the boundary required values determined by the initial inequality constraints, an additional value, starting from which the MF takes a unit value and an estimate of the degree of fulfillment of the requirement when the boundary required value is reached. The “step” in the MF (Figure 1) provides a transition through a point corresponding to the boundary required value [10].

MF serves as a transition from strict to softer restrictions, allowing the decision maker to expand the choice of alternatives within the framework of improving the CIS. It becomes possible to compare various characteristics and more flexible determination of their compliance with the established requirements [6].

Taking into account the need to fulfill all the requirements and the impossibility of compensating for non-fulfillment of some requirements by fulfilling others, let us determine the coefficients of compliance with the requirements using the t-norm of the "minimum" type. Let all the L requirements be ordered and the requirements

from the first to L_F are functional, and the subsequent requirements from L_F+1 to L are non-functional. Then expressions for the coefficients of compliance with functional and non-functional requirements take the form:



a) b)

Fig. 1. Graph of membership function: s-type (a) and z-type (b).

$$K_F = \min_{l=\overline{1,L_F}} r_l \quad K_{NF} = \min_{l=\overline{L_F+1,L}} r_l \quad , \tag{3}$$

Here $r_l = \mu_{R_l}(y_l)$ is the degree of fulfillment of the lth requirement. If it is necessary to take into account the significance of individual requirements to determine the coefficients of compliance of alternatives with the requirements, a weighted t-norm [7] of the "minimum" type can be used:

$$K_F = \min_{l=\overline{1,L_F}} \{1-w_l(1-r_l)\} \quad K_{NF} = \min_{l=\overline{L_F+1,L}} \{1-w_l(1-r_l)\} \quad , \tag{4}$$

Where w_l is the weight that determines the significance of the lth requirement.

4 Conclusion

Requirements for CIS, as well as for IS in general in a financial organization, are constantly changing, which imposes additional requirements for its flexibility, security and speed of adaptation. Constant changes in legislation introduced by the regulator are associated with a risk that must be taken into account in the activities of the organization. These changes can have a serious impact on business processes, and, therefore, on the company itself.

Thus, the conceptual model of managing the life cycle of the corporate information system, as the most subject to changes in the element of the financial organization's IS, is the basis for creating a universal technology for building the corporate information system. These mechanisms will make it possible to track seemingly invisible negative trends in the degradation of corporate information systems, including within the framework of its integration with other systems, both in monolithic and microser-

vice architectures. The ultimate goal of implementing these models is the ability to automate monitoring of the corporate information system compliance with changing needs, incl. in the future, and inform decision makers about the need to intervene in the life cycle of the IS. Continuous improvement of IS will ensure its harmonious evolutionary development within the framework of fintech business functions, and not in isolation from them.

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