

DEVELOPMENT OF THE COMBINED METHOD FOR DESIGNING DATAFLOW SYSTEMS

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Abstract: *The methods of designing of information systems for large organizations are considered in the paper. The structural and object-oriented approaches are compared. For the practical realization of the automated dataflow systems the combined method for the system development and analysis is proposed.*

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ACM Classification Keywords: *D.2.2 Design Tools and Techniques: Computer-aided software engineering (CASE); H.4 Information Systems Applications: Workflow management*

Introduction

The informatization of the administrative activities in large organizations is inseparably linked with the use of the automated systems for ensuring of document circulation. Frame functions of dataflow systems are defined by the norms for management of documentary maintenance (MDM), as automation of technological processes for passing, processing and control of execution of documents. At that in each concrete organization these systems accompany the main primary activity and, apart from the listed functions, include functions connected with the specificity of branch of management [Brooks, 2000].

Thus, designers of information systems are compelled to investigate the specificity of the document circulation in the given organization, the characteristics of procedures for acceptance of administrative decisions and many other factors that influence on the functional features of the information system.

The development of the projects for large-scale information systems (IS) with complex architecture is impossible without the use of special methodologies and the automated instrument tools providing support for the processes of designing, realization and functioning of the IS.

Such tools are the program complexes for automated design or CASE-tools (Computer Aided Software Engineering). They are intended to reduce laboriousness and durability of the information system design owing to realization of special languages for designing and creation of collective means of system engineering.

Problem formulation

The development of the project for dataflow information system in a large organization requires choosing appropriate methodology for system designing that can provide the most effective work on revealing functional tasks and structure of the system. During the selection of this methodology it is required to take into consideration, that the work will be carried out both by experts-analysts and by specialists in the applied area which are not familiar with the methodology and methods of the IS designing.

According to the systematic approach (*Structured Analysis and Design Technique SADT*) the automated information system represents a set of interconnected objects (elements) that are functioning together for a shared purpose [Mapka, 1997].

The existing design methodologies realize the representation of the interconnected objects by using various graphical notations for the creation of visual models. At sufficient depth of the development work the visual model allows to present clearly not only the internal structure of the system, but also to reflect the basic features of its functioning.

Two basic approaches are the best known in the methodology of the system designing, as the fundamental distinction between them comes from the various ways of providing for system decomposition [Maklakov, 2003, Vendrov, 2003].

The Functional-modular or the structural approach is based on the principle of functional decomposition at which the model of the system is described in terms of hierarchy of functions and information transfers between separate functional elements.

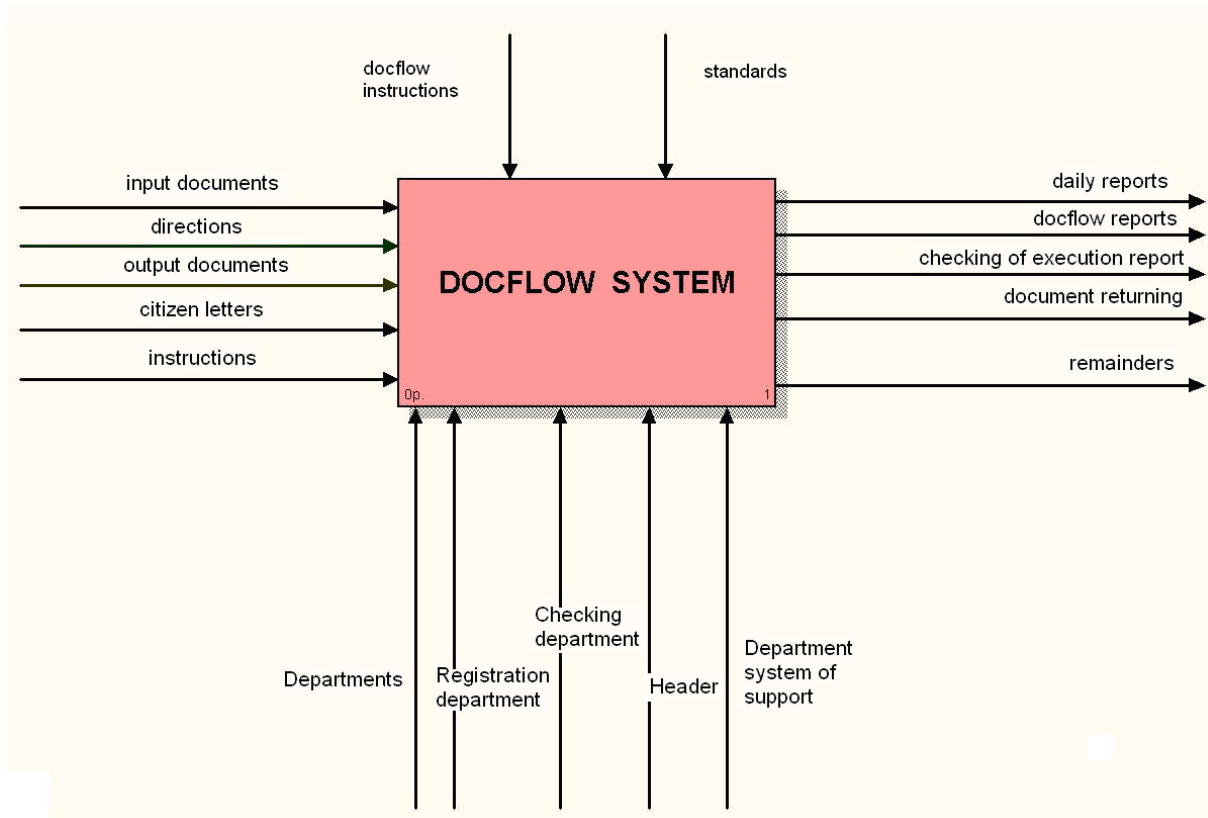


Fig. 1. The dataflow system with external world relations

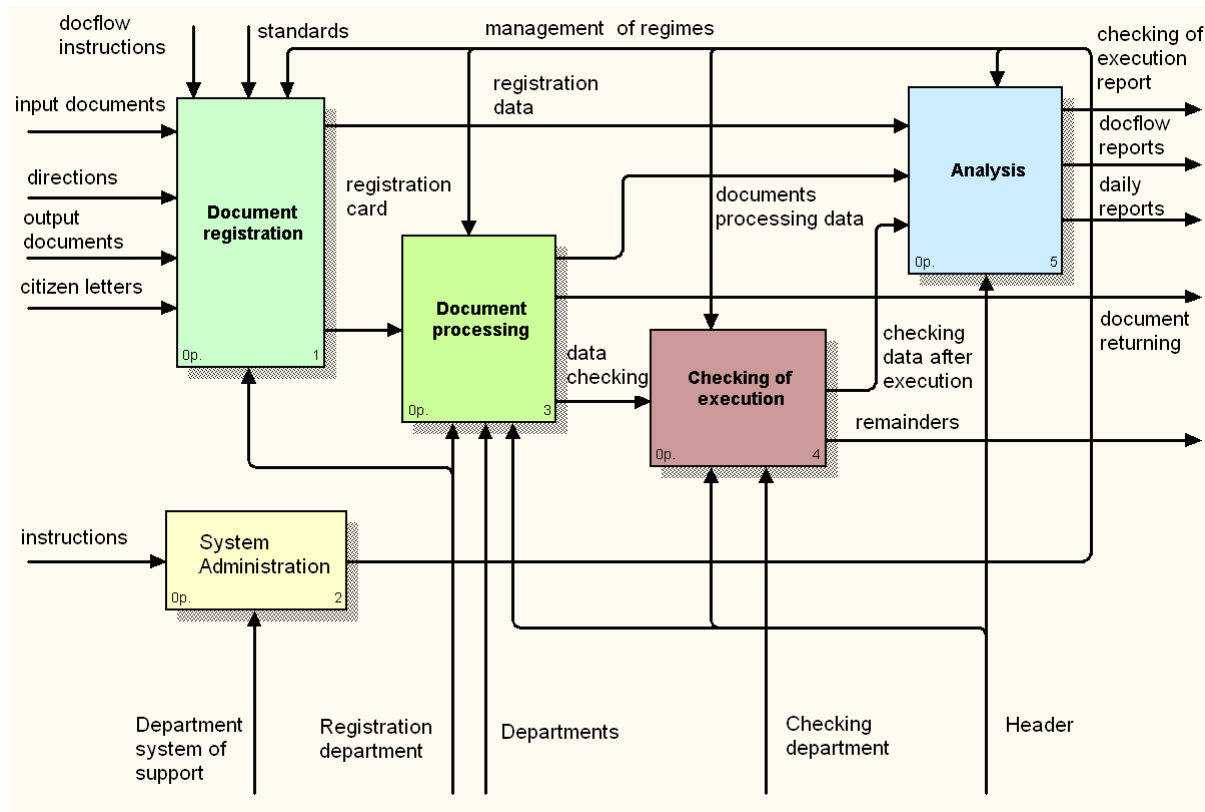


Fig. 2. The first level of dataflow system diagram decomposition

In figures 1 - 2 the fragment of representation of dataflow system in the form of its functional-modular diagrams is presented. In figure 1 the system as a whole and its relation to the external world is shown. Figure 2 describes the first level of system decomposition.

At the object-oriented approach the object decomposition is used. In this case, the structure of the system is described in terms of objects and relations between them. The behaviour of the system is described in terms of messages exchange between the objects [Vendrov, 2003, Booch, 2000].

The advantage of the functional models is the realization of the principle of "top-down design" that corresponds to the traditional representations of hierarchical functions in the organizational control systems [Belyev, 2000].

The disadvantages of the structural approach are complex conversion to the design of data structure and software; the necessity to use other methods and, accordingly, packages of automation.

For example, for the representation of models of the data, the developed program system requires the use of diagrams "essence – communication" (*Entity-Relationship Diagram – ERD*), but for the definition of external references and data storage other diagrams of dataflows (*Data Flow Diagram – DFD*) have to be used. The use of various kinds of diagrams complicates the work of the designers and accordingly increases the time for the project development.

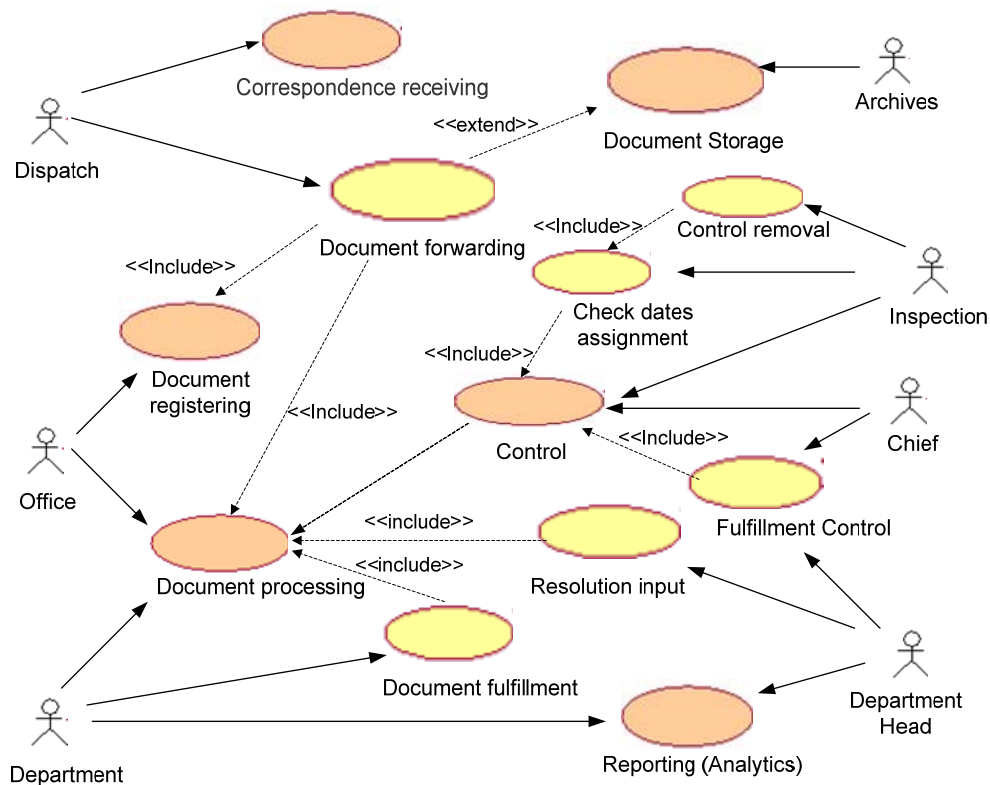


Fig. 3. USE-CASE diagram

The object-oriented approach (OOA) is a more progressive methodology. It is based on the object model representing the real world in the form of a set of cooperating objects. The methodology of the OOA is grounded on the principles of abstraction, modularity and polymorphism. The coordination of models of the projected system at all stages of its development is a requirement of the object-oriented approach [Booch, 2000].

For the realization of the object approach in the form of CASE-means, a special language for designing - UML (Unified Modelling Language) is developed. The UML language is a powerful instrument of designing and it is intended for use by highly skilled experts - designers of information systems [Ларман, 2001], but it is difficult enough to find common language with experts from the applied area.

On figures 3 - 4 examples of OOA diagrams are presented. In figure 3 the diagram of variants of use for dataflow system (USE-CASE) is shown. This diagram illustrates well requirements to the system, but does not show functional relations. In figure 4 the classes diagram is shown which reflects functional relations, but it is too complex for people not familiar with the UML language.

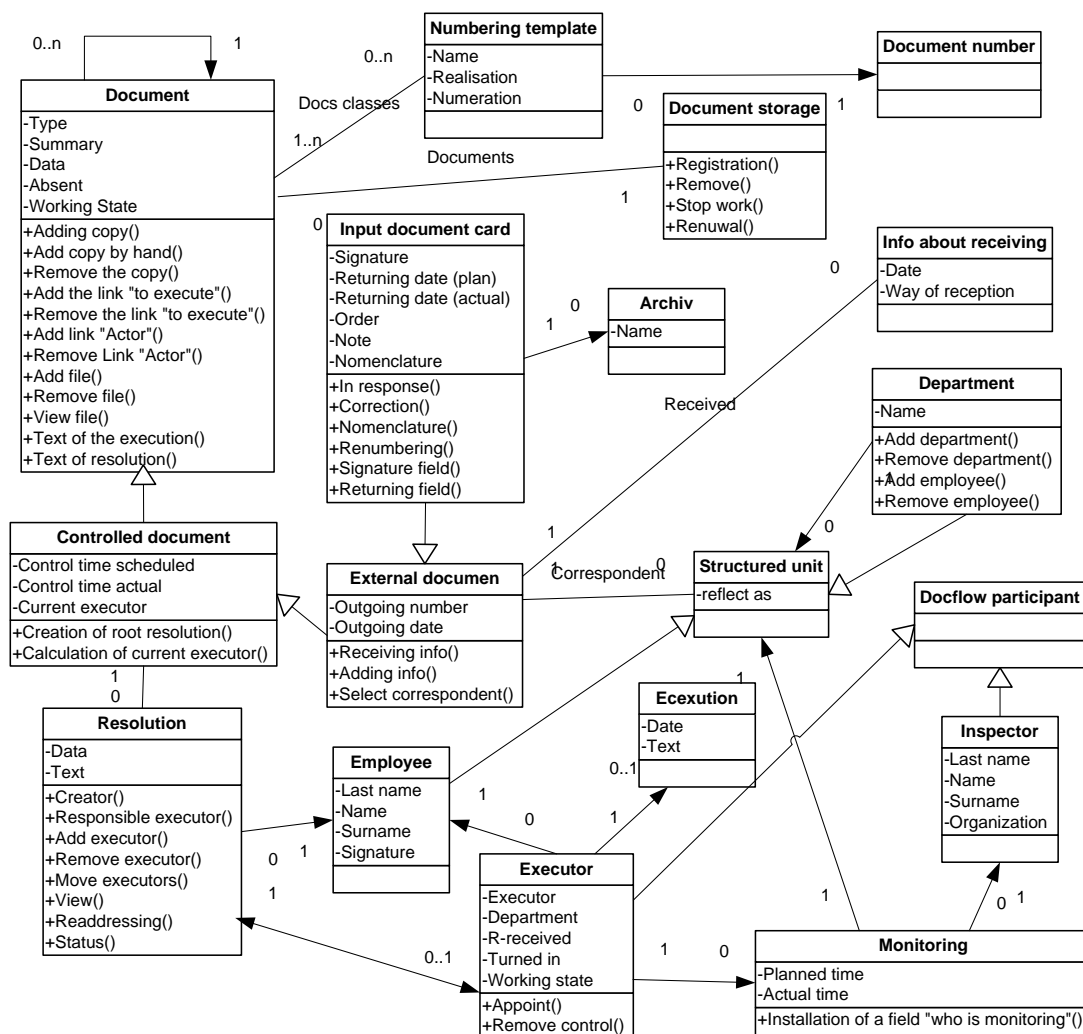


Fig.4 Classes Diagram

Variant of the solution

As the analysis of *hopeless projects* [Ларман, 2001] shows, the basic mistakes in the designing arise at the stages of the conceptual project, at the coordination of the functions of the system with the experts of applied area, at the determination of the limits of the system and the consideration of its development perspectives.

The main objective for the application of the CASE – technologies is to supply all of the participants in the project with common language of "understanding". A combination of both the structural and object-oriented methods appears to be the most effective way for achieving this objective.

At all advantages of OOA, the most critical and labour-consuming parts in the given approach remain making the correct choice of needed objects and their further development. The criteria for the choosing of appropriate objects are based first of all on the principles of reusing and optimization of construction of the system's software complex. These principles are far beneath to be obvious for the experts from a subject domain. On the other hand, certain difficulties can arise for experts - analysts from the applied area, which can have a lot of particularities that are not appreciable at first sight. The structural diagrams are simpler for understanding and allow performing the analysis of necessary functions of the system.

Having in mind these problems and standing on the basis of the available experience of the development of large systems [Баканова, 2003], it was proposed (in order to ensure a dialogue with experts of a subject domain and prompt studying of the features of the created system), at initial stages of designing to use the structural approach. This will provide:

- precise delimitation of the system;
- definition of input/output streams of information (contextual diagrams);
- process of designing of functions "from top to down", that corresponds to the traditional representations of the hierarchical organization of work;
- an opportunity for construction variants of logic schemes for documents processing ;
- functional detailed elaboration of procedures for documents processing which allows to reveal shortcomings of existing processes (useless, uncontrollable and duplicated works).

In the combined method it is offered to conduct the coordination of the two types of diagrams: functional diagrams and diagrams of logic level OOA after functional decomposition executed up to a level of logic operations. It allows using as much as possible knowledge of experts from the applied area for revealing all necessary functions and construction of the consistent project for the system.

The process of objects allocation for OOA is caring out on the basis of the already developed specifications after the work with functional diagrams is done. Such approach has shown good results at designing systems for automation of document circulation in large organizations in which subject domain experts were specialists on the office-work, not familiar with the existing designing technologies.

Conclusion

For achieving the most effective utilization of expertise from a subject domain at the construction of large information systems it is offered to use the combined method of designing in which at the initial stages it is recommended to apply the structural approach. The next step in the designing procedure should be the preparation of specifications on all stipulated works of the structural approach for revealing objects and transition to the OOA.

The specified combined method of designing has been used for creation projects of dataflow systems for a diversity of large organizations, including: Presidium of the Russian Academy of Science, the Ministry of transport of the Russian Federation and others.

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