THE FUNCTIONAL INFORMATION PARADIGM FOR EMERGENCY MANAGEMENT[1]

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Abstract

In this report, the application of a system approach to the support of decision making in emergency situations is considered by usage of intelligence methods, semantic and computer modeling. The principles of simulation of data processing for creation of a full work cycle of support decision making for some class of data domains described by large volumes of parsed information and a restricted span for development of the solutions are described. Usage of a system approach for mining the interdisciplinary integrated methods, algorithms and information technologies allows for effective use of large amounts of information and knowledge bases with allowance for the latest achievements in computer science, modern computing systems, vehicle of databases and knowledge, computer networks both in computer modeling and decision making.

Keywords: decision support systems, emergency situations, functional information

1. Introduction

Decision-making in emergency situations requires an operating system and an effective data processing system. In this report, the application of a system approach to the problems of support of decision making in emergency situations is considered by usage of intelligent methods, semantic and computer simulation. The principles of simulation of data processing for creation of a full work cycle of support of decision making for some class of data domains described by large volumes of parsed information and a restricted span for development of the solutions are described. Usage of a system approach for mining the interdisciplinary integrated methods, algorithms and information technologies allows for effective use of large amounts of information and knowledge bases with allowance for the latest achievements in computer science, modern computing systems, vehicle of databases and knowledge, computer networks both in computer simulation and decision making.

The developed technologies are grounded on usage of some class of base means:

- Base means (workstations, servers, local area networks, terminal means of telecommunication etc.);
- Base software (operating systems, programming languages, DBMS, intelligence systems, archive systems, systems of electronic document circulation, systems of multimedia, tools of mining of the functional programs etc.);
- Basic processes of creation program - technological of platforms for maintenance of distributed mining of theme systems and distributed processing (access) to the data.

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The primary goal of creation of modern intelligent systems is the mining of methods of integration of technologies of data acquisition and its analysis and methods of usage of these outcomes for decision-making.

2. Problem of support and actualization of the data in intelligence systems

It is extremely difficult to convince the developers and users of intelligence decision making systems in emergency management, that the common fallacy is that there is "too much" information to process. The practical activity with large amounts of information suggests that one of main problems of interaction with information resources is the inconsistency between quantity and quality (urgency, reliability, consistency, integrity) of the information.

It is the opinion of experts, that the 21st Century will be the information century. In a number of developed countries around the world, the information century has already arrived as the volume of gathered and parsed information is huge. One of the prejudices common amongst the majority is "the more information the better." Abstractly speaking, it can be so, but decision making in emergency situations this thesis presents many problems to the creators and users of emergency management systems (EMS). In other areas however, experts have already concluded that greater not always it is better (e.g. automobile manufacturing, apartment construction industry, city planning, and computer design.

3. Problem of mining of intelligence systems

The majority of failures of intelligence systems are created at the initial phase of their creation. A main reason of these failures is the misunderstanding that this phase is the most complex, poorly formalized and accountable. One of the main reasons behind the development of unsuccessful systems is the availability of the poorly formulated requirements. Why are we frequently not capable of formulating the requirements of a system? Because it is not simple and the system developers have weak understanding of the users needs. Further, the requirements of the system developers, at this phase of the work design are much different than the users requirements.

The solution to a complex problem requires definable requirements. In reality, problems and their solutions should be definable. Also, there is no guarantee that the total desired outcome would be attained. This process is almost always complex and the formulation of legible and clear requirements, is not as simple as describing all functions and processes.

The requirements of a system can vary and that is why it is necessary to have a capability to introduce and suggest change. The development of a problem solution, as a rule, requires conciliatory proposals. Unfortunately, we do not judge the success of a system unless it meets its stated goal, so that at the specification stage of development, it is difficult to judge a system's quality. To eliminate these difficulties as practically as possible, it is necessary to minimize their effect. The designers and users must have faith in each other and the reasons of such a relationship are obvious. In case of a failure of a system, there comes disappointment for the users from errors of the developers of a system and for the developers because, that they appear to be responsible.

It is necessary to have keep in perspective, that:

- The user has much more knowledge and experience in a specific area, than in general-system problems, so it is necessary that allowance be made for the knowledge of the existing system and defining the specifications of a new system (at this stage it appears that the user can better design the system than the developer);

- A priority of the user is the protection of his own concerns, therefore it is necessary to grant him such capability;
- The users require periodic, if not constant attention; it is necessary to interact with them personally and as much as possible.
- All should agree that an ultimate goal of the specification stage of development should be to determine what exactly is needed to develop a system.

Now we shall consider this problem from the point of view of the user. Apparently, the users accept the specification stage of system development as more of a whole rather than as components. To achieve the level of detail required by the developers, the users should consider deeply the course of a solution to a problem. The qualitative character of the specifications of the user implies that they will be updated later. The users think that by answering all questions posed by the developers, they guarantee fulfillment of all requirements in a new system. Regarding what is necessary for achievement of object in views unconditional fulfillment of all requirements without exception, users are often surprised, that some requirements are technically impracticable.

Users require flexibility of a system. The specification of a system should vary, as well as the system, pursuant to their needs, and the users should consider, that the process of the specification could be pulled in all directions. Finally, the users are interested in the specification of a system, which one worked, designing definite functions without failing, and which one will be effective and served the intended purpose.

If the users, determining a system, attempt to take into account concerns of the designers, they appear in an inconvenient situation. Specially it appears in situations, when:

- The discussed system is not specified by yet not conventional ways;
- The system can be determined, but the user does not knows exactly what he wants;
- The user knows what he wants and what is necessary, but cannot it formulate.

As a means of self-defense at creation of the specification of a system in satisfying the developers, the users have worked out a line of conduct that has already become classic. The users place into the specifications of a system absolutely everything, including exaggeration of necessities and assurances. Also symptomatic is a congestion of reports and characteristics stipulated for psychological reasons. This policy is most desirable to those users who do not know exactly what they want.

The definability of a system depends on its characteristics. Among the characteristics it is possible to select following:

- The type of a system (static, dynamic).
- Size of a system (quantity of designed operations; quantity of organizations; quantity of the people participating in the specification of a system; quantity of subsystems; quantity of interfaces).
- Complexity of a system (quantity of variables; a degree of independence of variables; quantity of databases and capability of their updating; logical complexity). The definability of a system is worsened proportionally to growth of complexity. It is very important to check, whether all scheduled characteristics of a system are truly indispensable.

For creation of an effective intelligence system it is necessary to try at an initial phase to execute the following requirements:

1. To the beginning of the specification of a system the document with stringent frameworks of the project should be developed.

2. The system should be divided into separate parts. It will call attention to problems of the coordination, but will help to better understand each part of a system separately.
3. It is necessary to differentiate subsystems oriented on fulfillment of different operations: transactions, processing, interface etc.
4. It is necessary to ask the users to arrange all requirements in terms of priority.
5. Limit quantity of variables and databases in a system.
6. Eliminate flexibility of a system, which cannot be controlled by the user. To establish, whether it is necessary for maintenance of often-recurring operations or infrequent exceptions.
7. Reject the inquiries for those characteristics of a system, which cannot be realized because of unwillingness of engineering or staff (technical veto).
8. Reject the characteristics, the implementation will cause large costs associated with machining time, disk space, and other resources of a computer (operational veto).
9. Reject the characteristic (or combination of the characteristics of a system), if one cannot be realized without disturbance of temporary limitations (resource veto). In other words, it is impossible to be silent, if one sees, that the system becomes supercharged. It is necessary to quickly state the guidelines on reduction to amend to the formal documents of the project with the substantiation of feasibility and cost, and also to require, that the users should have approved these changes.

4. Too much information

Why it is necessary to be focused on having the maximum amount of information? In some cases, large data volumes reduce the common value of intelligence systems. Now more than ever, solutions are derived as a result of computer analysis of volumes of information stored in computer intelligence systems. And though it is foundation of the most progressive technology of decision support systems (Decision Support Systems-DSS) [1] the solution is received by the person, he is compelled to trust in the computer system. In this situation large value is gained in reliability, urgency, consistency, integrity and accuracy of the information [2-4].

There is no absolutely reliable way to control input information. The probability of an error increases proportionally to information quantity (can be even proportionally to square or cube). As we become more dependent on information, it is ever more a requirement to establish reliability and accuracy of the data.

Other relevant factors include the technological capabilities of a data processing. These limitations are connected to size the different resources, capability of accommodation on disk or RAM, necessity of copying, backup etc.

It is necessary to determine if information is authentic it is therefore necessary it to check up, and to supplement with plenty of other data. In some cases, the necessity of data padding is not apparent. In summary, the volume of information can increase much more than expected

5. Actualization of the information

The very relevant problem is the capability of maintenance of an information base under actual conditions [5]. Many developers designing intelligence systems do not consider whether they, in time, can renovate the information. In some cases it is only a technical problem. A secondary problem is the reliability of information. A colleague of mine said that

the information is either valid or official. Unfortunately, there is a large degree of truth in this statement. Often we know, that official information is incorrect also we know the valid information, but we cannot always represent it as official. In the end, it is often necessary to create a database that is twice the size it was supposed to be at inception.

6. Optimum volume of the statistical data for mathematical processing

Currently, the process used in mathematical statistics for processing of measurements is the so-called the least squares process (MHK). This method guesses, that all statistical data comprise errors; these errors are accidental and are both are independent from each other and the estimations of these errors are known. At fulfillment of these suppositions as a result of mathematical processing we can receive unknowns parameters with accuracy, generally speaking, proportional quantity of measurements.

In practice, as a rule, there are no independent measurements. The errors of measurements are correlated because of reasons. It is errors of the same device, same person collecting the information, of some suppositions, hypotheses, and scientific theories. As a result of processing of plenty of the information we receive a much too optimistic theoretical estimation of accuracy of evaluated parameters [3]. Moreover, if we process an increased amount of information, the actual accuracy can even be worsened [4].

The more precise outcomes can be attained through the use of methods which take into account a correlation (method of maximum likelihood), but the data retrieval about a correlation usually is extremely composite problem, and often and insoluble. In this situation, the optimum solution is not the increase of an information quantity, and maximization of its efficiency: selection of the optimum program of data acquisition on an instant, structure, methods of the collecting etc. For data acquisition on motion of space vehicles this problem was well studied [5]. These outcomes can be interpreted, that there are instants, when it is necessary to concentrate all efforts on realization of measurements.

7. Information for decision-making

Presently, when there is a deficit of material resources, we can afford to collect, to store and to process the information, what it is possible, even only in some problematic areas [5-9]. As in most cases, information should be purchased. In this situation we should apply a system approach, considering all operation cycles of the information: who, where, for what money will collect (or to receive) the information to check up, to enter into the computer, whether there are limitations of access, as the problems of information safety (safety of the information and safety from the incorrect information) will be decided, who and when will be a user) of intelligence systems, on what conditions, reference time frames of obtaining of the information alleged volumes.

8. Principles of mining Emergency Management Systems

As a model example of creation of a data reduction system refer to the project " Creation of a unified system of the information about conditions in World ocean (ESIMO) [10]. In developing an EMS, it is necessary to base on existing systems of the information and their available information resources. It should be by a platform above the existing systems, some kind of the information trunk (bus) to provide valuable and effective utilization, interaction and development of existing intelligence systems of branches, to bound with the problems of EM.

8.1. Software and Hardware systems

The intensive development of information technologies in a large degree has been boosted by the widespread occurrence of the Internet network. By selection of hardware and program platforms for ESIMO, it is necessary to take into account prospects for the development both these platforms, and system ESIMO, costs of mining and maintenance of a system ESIMO on these platforms, speed, reliability, relative simplicity.

Apparently, the system ESIMO as a whole should be based on the technology of the Internet. The most essential minus however is protection of the information. In separate clusters ESIMO, on rallying points and the data processing can be established either separate computers, or it is necessary to recommend local peer-to-peer networks, or (that for rather large organizations) to an Intranet network. First, second and third levels with access to the Internet.

With client hardware platforms it is possible to use any reliable interaction from the Internet, thus at the first stage it is represented as follows: usage of available machines, but at new purchases nevertheless to be oriented on IBM-compatible platforms, as they are the most widespread and best in sense of both price and quality.

As with Intranet-servers for small organizations it is possible also to recommend IBM-compatible platforms, for large organizations - Sun, Silicon Grafics, Hewlett Packard or other. With the technology of Internet client platforms and servers it is not necessary, though in general it is preferred, to use unitized architecture. Precisely also, on different workstations diverse software can be used.

8.1.1. Operating systems

On workstations of a complex ESIMO depending on types and the powers of client platforms used, the capabilities, strategy and specificity should be determined by the organization. However, our guideline is to be oriented on IBM-compatible computers, it is therefore necessary to stay on a Microsoft Windows 95/98 for small computers systems and on a Microsoft Windows NT 4.0 - for more powerful, with the subsequent transition on a Microsoft Windows 2000.

The greatest popularity as an operating system for the server is a UNIX system and constructed on its base LINUX. Activity of these systems, which one can be established practically on all hardware platforms, justifies itself, however for set-up and maintenance of these systems and also for maintenance of protection of the information highly qualified experts are required.

At considerable expense, it is better to use Sun computers under "native" Sun Solaris, under UNIX or LINUX. The quality of Web-servers (programs maintaining the inquiries of clients and regulating information highways on the basis of general minutes HTTP /Hypertext Transfer Protocol) also can be selected differently. For servers on the basis NT, a reasonable solution - Windows NT Server, containing all indispensable means (system of organization and control of the Web-server, system of maintenance of fast information retrieval on Web-servers, toolkit for creation and organization of Web-pages, browser of Internet) can be used.

8.1.2.Languages and programming systems

As base software usage of the following programming systems is obviously important. The access to a DBMS is made through the special agents (PL/SQL Agent), to execute

indispensable procedures and transfer a conclusion to the client. The architecture of a system allows support of the most miscellaneous configurations in a network. It is possible to adjust the server to activity with the remote appendices and it is possible to collect on one computer the whole information complex on the basis of Oracle products.

General tool software of workstations ESIMO – a means is necessary to create Web-clusters and Web pages on the basis of language sectoring of hypertext HTML (Hypertext Markup Language). As in a system ESIMO it is necessary to supply interaction in both communication of the diversified appendices and databases working on computers of different types. With different software, it is necessary to use the General Inter-network Interface (CGI). As base software for mining the Internet of the appendices ESIMO is possible to recommend to use the new derivative language of sectoring of the documents XML (Extensible Markup Language), permitting to structure the information of a miscellaneous type, using for this purpose an arbitrary set of the instructions. XML has appeared rather recently and the separate components of this language are in stage of adaptation. On the basis XML there are modern languages that have been developed for the numerous Web-servers operating this technology for organization of the information, stored on them.

ESIMO guesses association of many information resources with independent interfaces. It is therefore imperative to use the language permitting to link these interfaces. Such language can be served with the language generated on the basis XML. This language describes the whole class of objects of the data called XML as the documents. This language is used means for the description of grammar of other languages and control for regularities of compilation of the documents.

One of apparent advantages XML is the possibility of using it as a universal query language to storehouses of the information. Besides the XML-documents it can represent itself as a unique way of data storage, which one includes simultaneously means for an analysis of the information and performance on the party of the client. In this area, one of perspective directions is the integration Java and XML technologies permitting the use of both technologies at construction of the machine-independent appendices, operating, besides a universal data format at exchange of the information.

XML also allows one to execute the control of the correctness of the data stored in a database to make checks of hierarchic ratio inside data arrays and to establish the unified standard on the frame of massifs by contents. It means, that it can effectively be used at construction of composite intelligence systems, a reference example is ESIMO, in which one problem of information exchange exists between the different appendices working in one system. Creating frame of the gear of exchange of information at the beginning of the project, the developer can save many problems, system incompatibilities used by different components of data formats.

8.1.3. DBMS

At the considered ESIMO development approach, different DBMS (unique requirement - interface with Web-technologies) can be used. In the inferior case, for obsolete DBMS, it is necessary to develop the interface for communication with Web-clusters that can appear much easier, than transition to a new DBMS. At the organization of new databases or at small costs of transition to other DBMS, it is necessary nevertheless to work in the same DBMS adopted in all system ESIMO in terms of quality standards. The availability of a "standard" DBMS considerably refines "mutual understanding" between different organizations ESIMO. That is most important, will simplify and will speed up process of information exchange in a

network. As such, "standard" DBMS, it is necessary to select most perspective and reliable, checked on practice and "entered" in the technology of Internet.

The obvious leader for years among DBMS is Oracle. A DBMS Oracle8i, which one, except for other, introduces many novelties to the Oracle server, transforms it into the database for information management in Web environments. The new version Oracle8i is a step forward on a direction from the technology the client-server to distributed Internet-calculations. Oracle8i Server grants tools for control of all data types used today on the Web clusters, provides productivity and the scalability indispensable for support of large clusters and other strategic relevant appendices. Oracle8i is a key component of Oracle Internet Platform, where one may also enter the Oracle Application Server and development tools Oracle.

9. Modern open intelligence systems and interaction of their units

9.1. Integrated information storehouses

There is a judgement, that standard transaction systems (management system of resources of firm, ERP-system) and the information storehouses in the new millennium will work jointly, deriving a unified frame — (Corporate Information Factory). The data, which are received in outcome transaction processing, will be integrated and to supply the information storehouse. Within the two last decades, to save competitive advantage, corporations all over the world inserted ERP-systems. In the beginning of the millennium, main information technologies that ensure strategic business advantage will become technologies of construction of information storehouses.

9.2. Information technologies and means of engineering and analysis of distributed intelligence systems

The intrusion of distributed intelligence systems as fundamentals for system information is directed on integral support of activity of all scientists and experts on all development phases of the information. Now in the software market we have large number of products for the solution of different applied problems. Thus in most cases for more or less complex problems any product that does not approach completely the solution we face by selection of one of the poor solutions: to attempt to create the program complex, in which one all requirements and specifications will be taken into account. This version requires large resources, temporary, financial etc. What to do with remaining problems it is not clear, as the program complexes are customarily closed for the users, and to hope, that the developers can in acceptable time address these problems, is very problematic. There is one more version - to attempt to integrate available software products to use all of the advantages (for the given problem) of each product [8]. This version lacks too: it is necessary to purchase (to obtain a license) some program systems; to conduct analytical research on advantages and disadvantages of each product and the most complex challenge to execute integration of products.

Now for the solution to problems of analysis of increasing amounts of information. Therefore, the requirements to quality of means of processing and analysis of the information and to appropriate tools increase. Thus it is necessary to attract the experts, that is, experts, advisers, and systems analysts. The software and hardware means should provide for their joint activity. This direction has received a title groupware (system formation activity).

In modern conditions volumes and heterogeneity of the data circumscribing different data domains considerably increases. Groupware can offer considerable help to the users in processing and data analysis, especially when taking into account processed and parsed information. The mining and implementation of similar systems at present has developed into

a large industry, and now an avalanche growth of concern to products of this class as stipulated by extremely practical reasons is anticipated. At implementation it is supposed, that the problems of creation of workstations, bound with fulfillment of current information functions and control of information highways of the information at all levels have been previously resolved.

Until recently, there were two approaches to the solution of a problem center of storage and processing of the information:

- In-house installment of a corporate system (including usage of off-the shelf or custom software products permitting one to automate separate workstations or productions).
- Intrusion of an off-the shelf intelligence system at the corporate level.

The advantage of the first approach was since the systems were created in-house it is possible to take into account requirements and specificity. It is known that the automation of poorly organized business processes will only to worsen a situation. Therefore, mining of an intelligence system should precede the analysis, and if it is necessary, a re-engineering of a production activity. Besides the "developmental" character of gradual improvements with a capability of installment financing in many cases looks more attractively as contrasted to risk of cardinal transformations and considerable costs, bound with an intrusion of off-the shelf systems.

Corporations with indispensable financial assets prefer off-the-shelf program systems. However, the success from an intrusion of such a system largely depends on readiness (and capability) of a corporation to work by "rules", with a gained intelligence system. The "off-the shelf" intelligence system has the modular architecture and the process of an intrusion of such system can be executed in stages-since modules automate the most critical active legs. Thus, this system allows one to take advantage on appropriate workstations by new functions of connected modules is provided.

The experience of mining of applied intelligence systems has allowed us to form a new approach to the creation of corporate intelligence systems, founded on the "assembly" of systems from program "components" of different corporations and manufacturers. The component architecture of corporate intelligence systems has become possible due to support by the manufacturers of the software using general standards on designing, mining and technology of component intelligence systems sold on different soft-hardware platforms.

At the present stage of development of information technologies the component technology of creation of corporate intelligence systems looks most attractive. Moreover, the component technology allows one to operatively make modifications to an existing intelligence system without upsetting its functionality. Thus, the new appendices can work with new modules, and aged - with former modules, which remain in a system. The problem of the "inherited" systems - is removed there is no necessity for their replacement for change or extension of functionality, so the costs of tracking and modernization of an intelligence system decrease.

The component architecture of intelligence systems has become a reality and are indispensable given these conditions:

- Availability of a methodology of engineering and analysis of intelligence systems ensuring component mining and "assembly" of systems,
- A market for an off-the-shelf program component maintaining general standards on the technology of mining and assembly and,
- Standard components of the software of "infrastructure" of intelligence systems, maintaining interaction between components of a system.

The precipitant increase in the number of accessible program components and their libraries has permanently extended the marketability of tool software. This software can be used for analysis, design and system development with component architecture and support of multi-component systems on different soft-hardware platforms is capable, and in the opinion of many experts in the field of information technologies, will change the appearance of corporate intelligence systems. The tendency to create multi-component systems is especially obvious in the Internet/Intranet technology, in which one the components ActiveX and Java Beans will be actively used.

A key factor is the success in implementation of the component technology to become a methodology and means of engineering and analysis of multi-component intelligence systems. The methodology of creation of intelligence systems with the component architecture has grown from an object-oriented methodology of designing of distributed systems. Thus, the component technology of designing and mining of intelligence systems for today disposes an indispensable arsenal of means - starting from tools of the visual analysis and simulation maintaining existing development tools, and finishing with a broad selection of libraries and off-the-shelf components, including components of "infrastructure" for different soft-hardware platforms.

The creation of heterogeneous distributed intelligence systems at different stages will permit developers to more and more actively apply object methodologies and technologies. Thus the increase in popularity of object methodologies and technologies is accompanied by both the appearance of object methodologies of engineering and analysis, which one in aggregate already now makes a powerful methodological basis, and the construction of heterogeneous distributed intelligence systems, what are CORBA, Java, and DCOM.

Today with confidence it is possible to say, that the distributed object technologies can become an effective construction tool of distributed intelligence systems. Their exact usage can essentially lower the risk of failure of projects with the creation of an IC, to simplify stages of an intrusion and tracking of systems. On the other hand, it is necessary to note, that there is a number of barriers hindering an effective utilization of the data of technologies at creation of an IC. In this regard, it is meaningful to pay attention to the technological solutions, approaches and principles, which were applied to the successfully finished projects that were used in distributed object technologies, namely the technologies CORBA and Java.

10. Conclusion

In this report, the problems arising at practical mining, tracking, actualization and usage of the information from computer intelligence systems is defined. Behind the framework of material there were a number of other problems, such as a filtration of input information, principles and methods of activity with the inexact information, interaction of the initial and aggregated information. The statement of these problems is connected to the practical activity with intelligence systems. Many of these problems arise from direct experience and cannot be defined beforehand. The solution of these problems is very important and allows one to advance to the successful usage of intelligence systems for decision-making in complex situations.

As an example, researches put within the framework of creation a universal EMS problem that does not have an off-the-shelf solution to the majority of the considered problems. The existing methodologies of designing and creation of the integrated intelligence systems are calculated on much more formalized objects, which one are not unique. Conclusion about the

necessity of constant methodological tracking of development of the project, acceptance of both implementation of the "soft" solutions and floppy approaches from here follows, which will allow one to accept new technological and system solutions that develop during the project.

Modern information technologies varying every 3 years, and pose problems for creation of multi-structure programs - technological environments integrating information subsystems, set up on miscellaneous technological levels. The authors do not know of off-the-shelf technological solutions realizing such approach. Padding research and mining of the original solutions are required.

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