Chapter 21
Information Tool for Multifarious Scientific and Practical Research

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Abstract This article is devoted to overview of Belarusian software eLab meant for a wide variety of applications in science and practice. eLab was initially a laboratory information system with elements of electronic document management for laboratory testing of fuels and lubricants quality. Now it is used as an information tool for different purposes, including development of content management system of an educational and scientific Internet portal and information system in the field of nuclear and radiation safety. eLab principles of functioning and main features are described as well as possible applications.

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21.1 Introduction

At first sight it was very amazing to propose as a base of a content management system (CMS) of educational and scientific Internet portal the system of electronic document management of fuels and lubricants. Is it really possible? Yes! It was very original and effective solution realized in 2014. Why it was possible? Because of principles lying in the system. What are these principles? There are principles of free software and process system approach.

Currently, free software (libre software) occupies a large niche on the world information technology market, providing the user, in contrast to proprietary (licensed, commercial) software, four basic freedoms and rights: the right to unlimited installation, free use, modification and transmission of software [1]. Free software has a number of advantages, facilitating its certification, since source codes and full technical documentation are freely available. The use of free software is one of the real ways to increase the protection of information. This is the reason for the recent trend of the IT market towards free software in the West, in the East, in the post-Soviet space. In the Republic of Belarus, for the purpose of ensuring the security of information systems, a series of governmental decrees was adopted. For example, in

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accordance with the Order of the Minister of Defense of the Republic of Belarus No. 112 dated February 18, 2011 "On approving the list of presentation formats and data transfer protocols used in the information systems of the Armed Forces and Transport Troops", software supporting the Linux operating system and free software is a priority when used in the Armed Forces of the Republic of Belarus.

It is obvious, that in sensitive areas such as army or nuclear industry, consumers should be confident in the quality and security of used software. It must be configured in accordance with the national legislation. E.g. at the IAEA site it is available for free download and install software of Regulatory Authority Information System (RAIS 3.4 Web). It is stated that this software operates in over 80 countries. But it should be mentioned that this software does not comply with national legislation in some points and can be adapted to country specifics with some efforts.

So, below it is given an overview of Belarusian software eLab (that means "**e**lectronic **Lab**oratory") that is based on free software and is used now and can be used in the future for a variety of applications in science and practice.

Thus, the total purpose of the project considered is to create an information tool for different purposes, including development of content management system of an educational and scientific Internet portal, intellectual information system in the field of nuclear and radiation safety as well as implementation of clouds of electronic scientific resources etc. So, such software is designed to solve diverse problems. Diversity means that these problems belong to different areas of activity and various branches of knowledge.

21.2 History of eLab Development

System or framework eLab is intended for the implementation and harmonization of the electronic document management of accredited testing laboratories in accordance with international ISO/IEC 17025, ISO 9001 and ISO 9004.

Since 2012, the "Electronic system for quality control and inventory management of combustible and lubricating materials eLab-Fuel" stands on alert at 202 Chemotology Center for fuel for quality control and accounting of fuel and lubricants of the Armed Forces of the Republic of Belarus [2, 3]. This center is an accredited testing laboratory. It is estimated that over the past time, more than 50,000 custom tests have been conducted and logged using the system eLab-Fuel. In 2013, eLab-Fuel became a basis of management of fuels of Belarusian branch of Russian company GazPromNeft.

At that time the system eLab was adapted for accredited testing laboratories of the meat and dairy industry.

Currently, after development of the prototype of software for accounting and control of sources of ionizing radiation eLab-Atom in 2014, the Intellectual Information System to ensure control (supervision) in the field of nuclear and radiation safety eLab-Control was created [2, 4] (see Fig. 21.1) and is ready to commissioning in the Department of Nuclear and Radiation Safety of the Ministry for Emergency Situa-
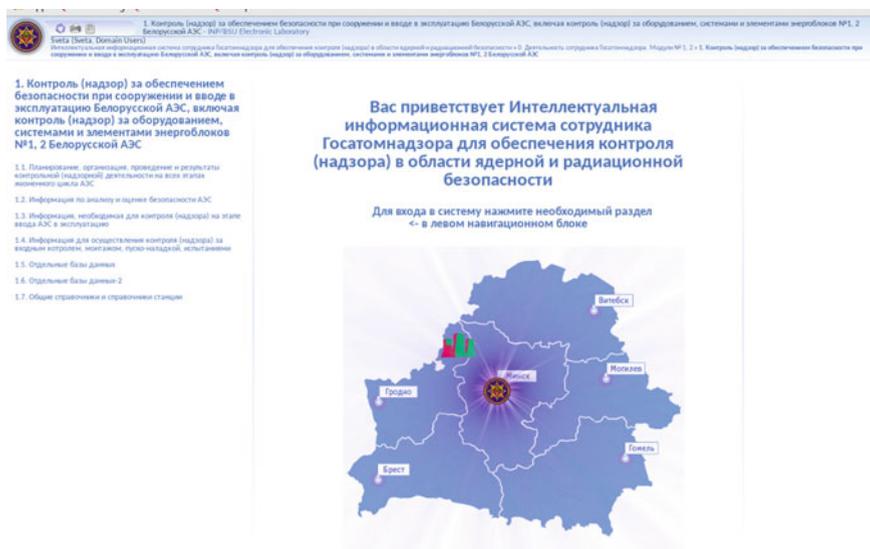
Fig. 21.1 Start page of the Intellectual information system of the Gosatomnadzor employee to ensure control (supervision) in the field of nuclear and radiation safety eLab-Control

tions of the Republic of Belarus (Gosatomnadzor). Gosatomnadzor is the Belarusian regulatory body in the field of nuclear and radiation safety. This system contains the following three modules:

(1) Module for safety control (supervision) during the construction and commissioning of the Belarusian Nuclear Power Plant;
(2) Module for monitoring (supervising) the radiation safety of ionizing radiation sources;
(3) Module for accounting and control of nuclear materials, radioactive waste and spent nuclear material.

The whole, the purpose of eLab-Control is to provide the registration of nuclear material, radioactive sources in the Republic of Belarus; control of radiation safety, monitoring and providing information on the status of nuclear material and radioactive sources, including repositories for storage and disposal, assistance to law enforcement authorities in the inquest of illicit trafficking of radioactive material and radiological emergencies; analyzing the state of radiation safety and ensuring awareness of the relevant bodies of the Republic of Belarus, as well as authorized international organizations in accordance with national commitment.

The start page of the system eLab-Control is depicted in Fig. 21.1.

Also, on the basis of framework eLab, an original content management system eLab-Science was developed to build educational and scientific portals of various profiles. The electronic portal of nuclear knowledge of educational institutions of the Republic of Belarus BelNET (***Bel**arusian **N**uclear **E**ducation and **T**raining) at

89 the address https://belnet.bsu.by/ was developed [5, 6] (see Figs. 21.2 and 21.3).
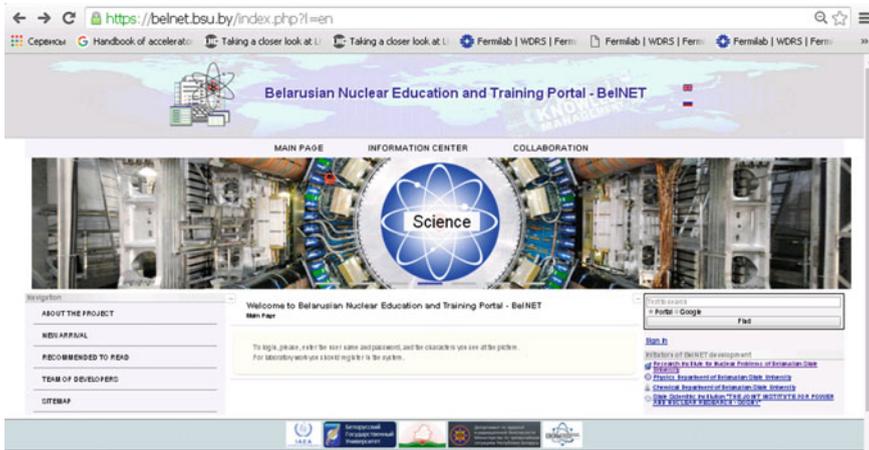90 The BelNET main purpose is popularization of nuclear knowledge in order to attract

Fig. 21.2 Start page of the Internet portal BelNET. https://belnet.bsu.by/
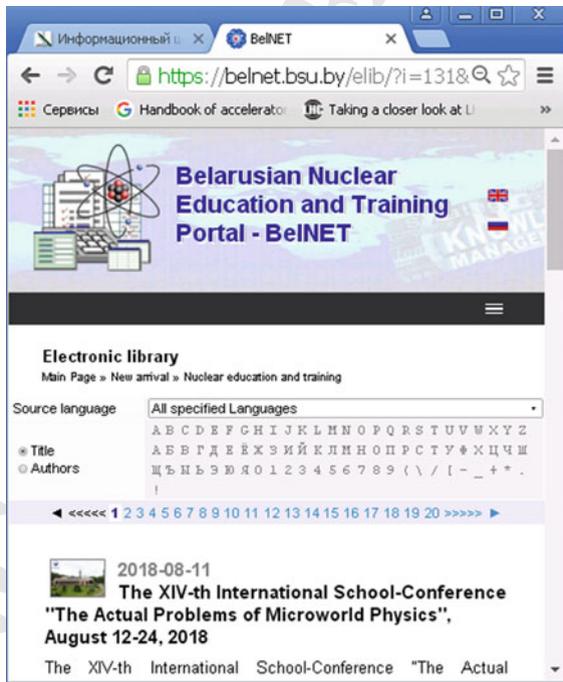

Fig. 21.3 Mobile version of BelNET

the most capable young people in this field and create a positive image of nuclear science and industry. At the moment, the content of BelNET contains over 800 original entries. In Fig. 21.3 a special mobile version of BelNET is proposed.

Also on the basis of eLab-Science the scientific portal of the project of the Program Horizon 2020 "Collective Excitations in Advanced Nanostructures" CoExAN was created at address https://coexan.bsu.by (see Figs. 21.4 and 21.5).

Editors providing formation and access to resources within CMS eLab-Science are the next: portal sections editor, resource type editor, editor of resource (see Fig. 21.5), systematization of resources, editor of access to files, portal structure editor, resource content editor, editor of test control questions, editor of the answers to the test ques-
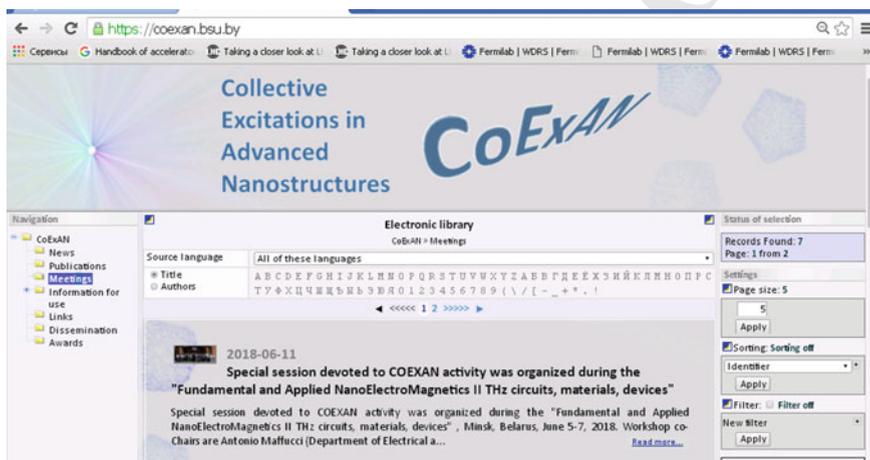

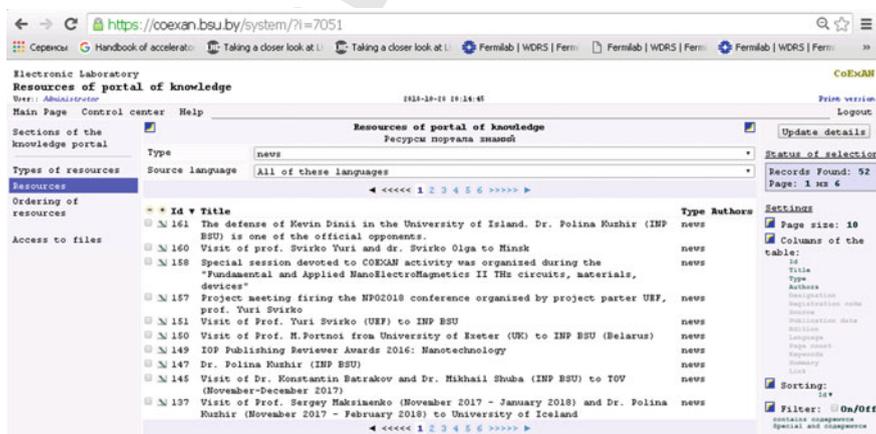Fig. 21.4 Start page of the Internet portal CoExAN. https://coexan.bsu.by

Fig. 21.5 Redactor of resources of CMS eLab-Science

101 tions, instrument of preview. They realize the possibility to input texts and formulae
102 in LaTeX-similar form, load different types of files, references, video, photos and
103 pictures as well as provide tests for students. So, editors allows to lay out in general
104 access any text as resources – not only laboratory works, but also various scientific
105 materials and articles containing complicated formulas and pictures.

21.3   eLab Features

107 Let us depict structure and features of framework eLab. It has a client-server archi-
108 tecture based on free software: Debian GNU/Linux, Web-server Apache, the Firebird
109 database server, PHP application server. The system runs under Windows and Linux
110 operating systems. The work is carried out through the Internet in multiplayer mode,
111 with the division of access rights by way of widespread browsers: Mozilla Firefox,
112 Google Chrome, Opera etc. The system is hosted on a virtual machine (VM) of the
113 VMWare ESX server. It can be hosted on a physical server or single computer.

114   The network structure of the system is shown in Fig. 21.6. Here users can work
115 both inside the corporate network, and from remote workstations through the Internet,
116 and if necessary - using VPN (virtual private network).

117   eLab specification is the next. Software system is open to modifications by users.
118 System includes a standard set of log forms of accredited laboratory and it is easily
119 adjusted to the specifics of each individual laboratory. It runs on a secure server. It is
120 not required to install some software on the client computer, it is sufficient availability
121 of a standard browser. Framework eLab can operate both on a local intranet, or the
122 global Internet network, as well as on a local computer. The structure of the system
123 allows in the frame of a single installed copy of the product at the same time maintain
124 the workflow of many laboratories and organizations, with different profiles.

125   System eLab, having a platform independence of server and client components,
126 allows to automate laboratory processes, significantly reduce the time to registra-
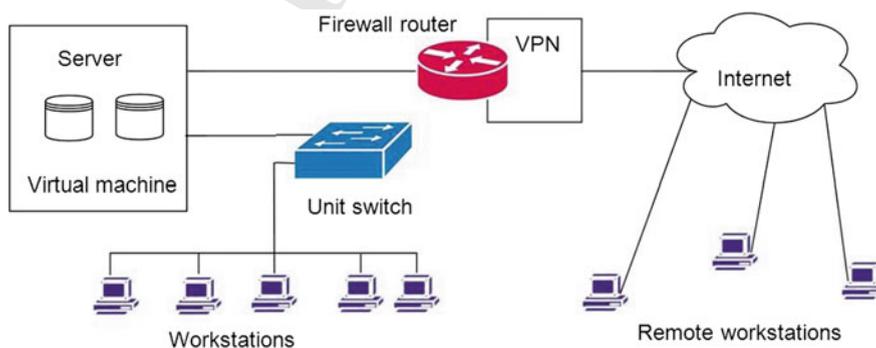

Fig. 21.6 Network structure of eLab

127 tion of samples and test results, extract certificates of product quality, search the
128 appropriate entries in the laboratory journal, eliminate operator errors when creating
129 documents, generate summary laboratory reports, increase lab productivity, quality
130 of work and quality of monitoring of the works.

131 Let us indicate such distinctive characteristics of the system eLab as its ability
132 to extend the functionality, customizable user interface and the preservation of its
133 current state, fast convenient system of sorting, filtering and retrieval of data. Other
134 characteristics are the possibility of automatic update and display the current sta-
135 tus of the sampling, simple insertion mechanism, editing, deleting records, editing
136 multiple records simultaneously as well as validation of input data, the abolition
137 of common mistakes, exclusion of input data duplication, automatic generation of
138 output documents for reports in prescribed form. The possibility for user to make
139 changes to the templates of the final documents, exclusion of the human factor and
140 related errors in records and output documents are important too.

141 Thus, the eLab system has proved to be flexible and easily customizable for
142 the purpose and needs of the project. The system is in constant development and
143 improvement.

144 Requirements for security in framework eLab, taking into account its implemen-
145 tation in the Armed Forces and national regulator Gosatomnadzor are increased.
146 First, the eLab system provides access to the HTTPS protocol. Secondly, remote
147 access of employees to the workplace via VPN is organized. As a result, the speed
148 of access is significantly increased and access to a system with encryption support
149 is provided to improve security. Let's note that the use of VPN component of the
150 network infrastructure is not mandatory. The decision on its use should be made by
151 the organization who is the user of the system. It should be based on an analysis
152 of the risks of unauthorized access and operation of private key infrastructure for
153 remote users and branches. The third component of security in the system is the
154 implementation of the original algorithm for secure connection to databases.

155 Software eLab is protected by four Certificates of the National Intellectual Prop-
156 erty Center of the Republic of Belarus for registration computer program.

21.4 Process System Approach

158 Very often, the result of computer automation of different technological processes
159 is the identification of existing non-optimal steps of processes, in particular, the
160 duplication of certain actions on some subprocesses, the presence of non-optimal
161 sequences of steps, the identification of unnecessary actions. This entails a review
162 of existing processes and their subsequent optimization.

163 All over the world, for the effective operation of accredited testing laboratories
164 at various levels, based on the key provisions of ISO 9001 and ISO 17025, infor-
165 mation systems should support all stages of the life cycle of laboratory activities.
166 The development of such information systems should be conducted on the basis of
167 a process system approach [7–9], which involves understanding and management

168 of interrelated processes in the organization to achieve its effectiveness. It is neces-
169 sary to understand that in the management of business processes (a stable, repetitive
170 activity) there is a transformation of resources at the input to the results at the output.
171 Therefore, it is necessary to identify the business process, its detailing, the definition
172 of process participants, the appointment of the manager of the process and delegating
173 to him the authority and responsibility. The information system should ensure the
174 conduct of the business process from start to finish.

175 These principles underlie the creation of the system eLab since its very first
176 modification, eLab-Fuel.

177 In general, laboratory testing modifications of eLab solve the following tasks:

178 • management of samples entering the tests, recording test results, certification and
179   quality control of samples, maintaining laboratory logs in accordance with estab-
180   lished standards in the quality management system of the organization;
181 • determination of quality indicators in the framework of ongoing tests strictly reg-
182   ulated by list of test parameters, allowing to monitor performance, minimize costs
183   and ensure efficient use of equipment and consumables;
184 • warehouse management of consumables, including used chemical reagents,
185   accounting and control of measuring instruments and testing equipment;
186 • maintenance of document circulation between customers and laboratory, includ-
187   ing the contract management system, management of invoices and acts of work
188   performed according to established norms.

189 In Fig. 21.7 one can see business process of testing laboratory realized in eLab-
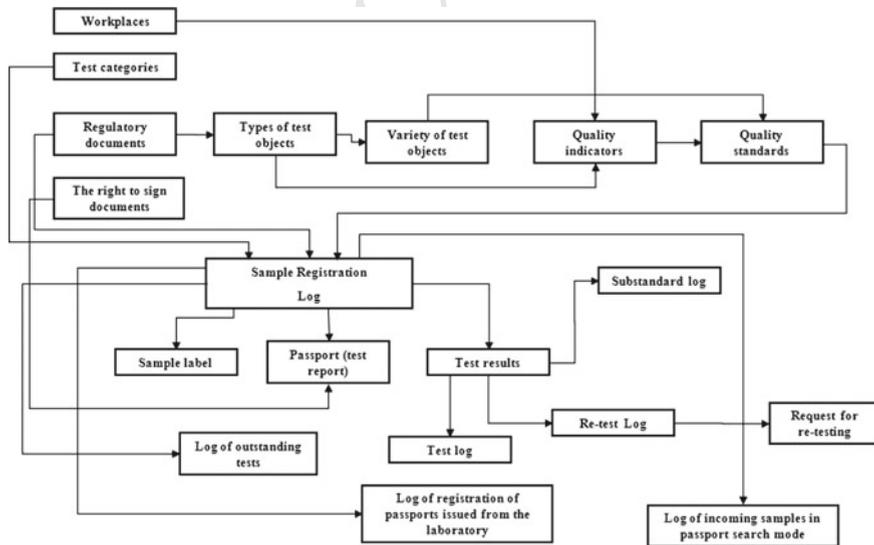190 Fuel and eLab-Meat. It begins from laboratory workplaces, then in strictly execution

Fig. 21.7 Business process of testing laboratory realized in eLab-Fuel and eLab-Meat

of regulations, norms and quality standards goes via sample registration to test results, stated in different types of logs.

IDEF, a methodology of the ICAM (Integrated Computer-Aided Manufacturing) family for solving the problems of modeling complex systems, allows displaying and analyzing activity models of a wide range of complex systems in various sections. At the same time, the latitude and depth of examination of processes in the system is determined by the developer himself, which allows not to overload the model being created with excessive data.

Let us consider the scheme of the functional structure of the Information System of the Gosatomnadzor employee to provide control (supervision) in the field of nuclear and radiation safety (Fig. 21.8) in the IDEF0 notation.

Information links between the system and the external environment are realized through documents coming in from outside or formed inside the Gosatomnadzor (in paper or electronic form) of various types: information, orders of higher state bodies of state administration; messages and appeals of international organizations; proposals of supervisory (supervisory) bodies, action plans, decisions of working groups; applications for the issuance (modification, termination) of permits (licenses), etc. All types of incoming documents are regulated by law.

The system at the output to the external environment gives out reports that are generated in electronic form with notifications of verification; letters on the results of consideration of reporting documents of audited organizations; acts (certificates) on the conduct of the audit; instructions for the elimination of violations; orders to suspend (prohibit) activities, etc.

Figure 21.8 is a top-level scheme. Then it should be proposed the scheme of the functional structure of the system "To carry out activities to ensure control (supervision) in the field of nuclear and radiation safety". It is followed by the functional
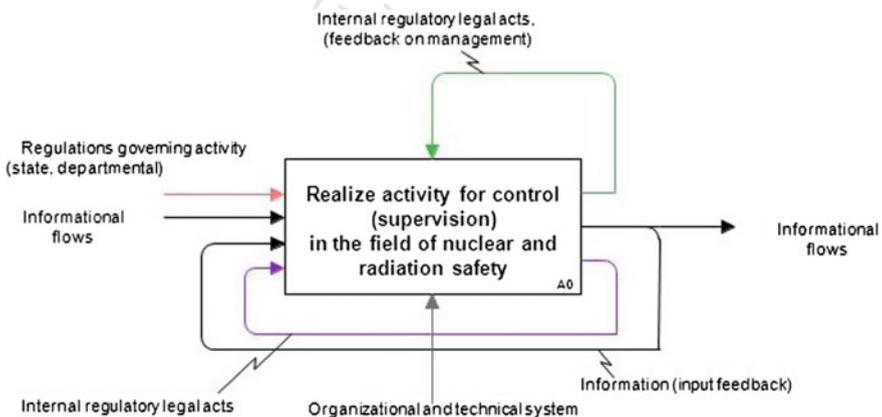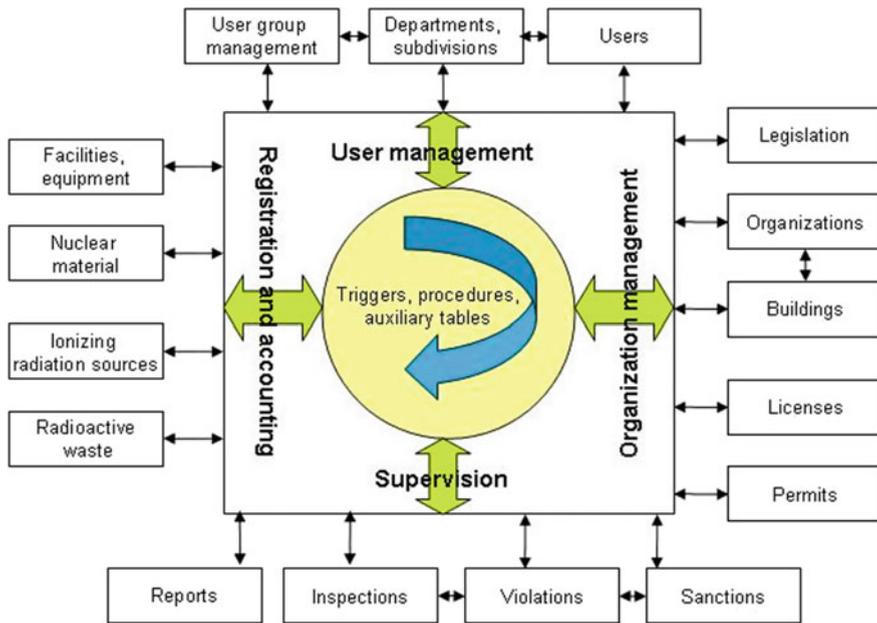

Fig. 21.8 Functional structure diagram of the Information System of the Gosatomnadzor employee in the IDEF0 notation

Fig. 21.9 Four main components of business process in the field of nuclear and radiation safety realized and connected in data base within eLab-Control

diagram of the process of the next level "To supervise (ensure) safety during the construction and commissioning of the Belarusian NPP".

Other side of process system approach can be presented at the level of data base as in Fig. 21.9. Here one can see four main components of business process in the field of nuclear and radiation safety: user management, organization management, registration and accounting of radioactive material and corresponding facilities, equipment as well as process of supervision. All they are realized within the system eLab-Control.

21.5 Propositions and Conclusions

The possible propositions for future development and applications of Framework eLab are the next (but they are not limited to the list given below).

The experience obtained during the work of portals BelNET and CoExAN indicates the possibility of using CMS eLab-Science for organizing cloud solutions in various fields of science and practice.

It should be noted beginning of development of Belarusian electronic scientific archive on the basis of eLab-Science. This is an archive of publications of natural and humanitarian profile that provides speedy operational placement of scientific

articles, including preprints, pre-publications etc. in English, Russian, Belarusian. The purpose of such archive is to promote the dissemination of scientific knowledge. In Russian-language countries there are not similar Internet resources.

In conclusion, we present some possible applications of software products developed on the basis of framework eLab:

(1) an electronic quality control and inventory management system for combustible and lubricating materials eLab-Fuel, ready for installation in appropriate organizations;
(2) accounting and control system of trafficking in explosives and other hazardous substances;
(3) electronic document management system in the nuclear industry;
(4) laboratory information system in the nuclear industry.

So, framework eLab with its safety and functionality as well as the long-term uninterrupted operation of the eLab-Fuel on duty shows that it is a well-developed software product easily modified and adapted to the project conditions. This system is a vivid example of enterprise applications and is developed in strict accordance with the basic principles and ideas for creating such applications.

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