

# The Information System as a Tool to Manage R&D at the National Academy of Pedagogical Sciences of Ukraine

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**Abstract.** This paper is devoted to the results of R&D entitled "Scientific and methodical support for an information system based on the Internet to manage R&D at the National Academy of Pedagogical Sciences of Ukraine," 0109U002139. The objective is development of technique and technology to build an information system to manage R&D. An information system towards this end was created and was launched in 2011. It is the first stage of deployment of electronic document management at the academy. This system provides documentary support to manage R&D at research institutions. It is designed as a corporate Internet portal (<http://planning.edu-ua.net>) on Microsoft Office SharePoint Server 2007 platform with added applications and document templates developed specifically to support R&D workflows in this system.

**Keywords:** information system, R&D Management, conceptual model, portal, MS SharePoint, electronic document management

**Key Terms:** Academia, Development, Management, Process, Research

## 1 Introduction

Implementation of information systems designed to management science and education is well timed because this contributes to the modernization of science and education in Ukraine. It corresponds to the actual for Ukraine the problem of forming a modern information society that legally defined in the Law of Ukraine "On main principles of information society development in Ukraine for 2007-2015" dated January 9, 2007 № 537. The main problem arising from this Law is to build national information systems, including information systems of management in education area.

Create an corporate information system of National Pedagogical Sciences of Ukraine (hereinafter referred to as "NAPSU") is a practical step to build similar systems.

This paper describes methodology and tools to create information system to manage R&D at the National Academy of Pedagogical Sciences of Ukraine (hereinafter referred to as "R&D Management").

## **2 Overall System Characteristic**

The goals of this information system are to manage R&D at the National Academy of Pedagogical Sciences of Ukraine (hereinafter referred to as “R&D Management”) and the automation of documentary support for “R&D Management” in research institutions in accordance with the state regulations for research. It should provide the data and documents uploaded by "R&D Management" to officers and researchers in the Presidium and Research Institutions at the National Academy of Pedagogical Sciences of Ukraine (hereinafter referred to as “NAPSU”) based on a permissions policy with varying powers.

### **2.1 Goals and Objectives**

The objectives of "R&D Management" are to design a system as a corporate Internet portal (<http://planning.edu-ua.net>) on the Microsoft Office SharePoint Server 2007 platform. The front-end portal is designed as a SharePoint site. The back-end portal includes the SharePoint basic tools for documents and workflows with added applications and document templates developed specifically for the "R&D Management."

"R&D Management" is the first step to create a corporate portal for electronic document management in the NAPSU. Such a system will provide conditions to migrate from a paper-based document management system to electronic document management system. This migration to an electronic document management system is well timed because the legislative and normative base is already in existence at the state level in Ukraine. Thus, "R&D Management" is a practical step to implement the state ICT policy to manage scientific and educational areas. The "R&D Management" essentially will promote the everyday use of ICT, reduce the time taken to process R&D documents, enhance the productivity of the researchers and thus be more balanced in the use of labor resources in the organization and implementation of the researches.

### **2.2 Subject Domain of the “R&D Management”**

The main activity of the institutions of NAPSU is scientific research. Currently, research management is going through the paper documents that are sent in duplicate from research institutions to the Presidium of NAPSU. Research management at the research institutions of NAPSU is regulated by the "Statute regarding implementation of research in the National Academy of Pedagogical Sciences of Ukraine" document (released 2011). This Statute is developed under the laws of Ukraine "On scientific and scientific and technical activity," "Regarding scientific and technical examination," "On innovative activity," the state standard of Ukraine SSTU, a 3973-2000 "System of development and imputing of products in production, rules of implementation of research works," General Charter of the National Academy of Pedagogical Sciences of Ukraine and other normatively legal acts that regulate relations in a scientific field. The Statute defines the basic principles to manage

research in institutions of NAPSU and sets general requirements for R&D: applications, approval, budget, monitoring, accounting, reporting, results assessment and acceptance criteria. The action of the Statute spreads to all fundamental and applied researches that are planned and performed in institutions of NAPSU by state budget funds and other sources.

### 2.3 Types of Document in the “R&D management”

An R&D document is prepared in the institutes of NAPSU by R&D top managers, officials of the Academic Department and accountants:

1. R&D top managers prepare the following documents:

- R&D applications;
- Requirement Specifications for R&D;
- Description of R&D for NANU;
- Agreements of Vendors in R&D;
- Research Programs of R&D;
- Registration Cards of R&D; and
- Plan and Terms of R&D.

2. Officials of the Academic Council prepare the following documents:

- Perspective Thematic Plan of R&D;
- Annual Plan of R&D;
- Extracts from the minutes of the Academic Council Meeting:
  - to approve R&D;
  - to approve the Perspective Thematic Plan of R&D; and
  - to approve Research Programs of R&D.

3. Accountants prepare the following documents:

- Planned calculation of the estimated cost of work for each topic of R&D (includes cost estimates for all items);
- Protocol Agreement, the cost of work for each topic of R&D;
- Actual costs of the institution on a monthly and quarterly basis;
- Summary Cost estimates in all subjects of R&D.

The following supporting papers are used to complete documents that R&D top managers prepare:

- An overall picture of NAPSU;
- Resolutions of the Presidium of NAPSU;
- General description of the Departments of NAPSU;
- Protocols of the Bureau of the Departments of NAPSU;
- Log of R&D;

- Overall about Research Institutions of NAPSU;
- Staff list of the Research Institution of NAPSU.

#### **2.4 “R&D Management” Requirements**

"R&D Management" should support the comfortable environment of collective activity to manage R&D and effective automated procedures of management documents (forming, access and synchronization of changes). Thus "R&D Management" belongs to a class of systems of electronic document management (EDM) [1-2].

The defined feature of this class is to provide the document management and group work with documents. A management document requires the specific processing procedures corresponding to the specific document types and the tools to support the depository documents. Group work with documents should be determined by politics of permission and roles of users.

These fundamental requirements for electronic document management define the main design decisions of "R&D Management" [2].

### **3 Design Decisions “R&D Management”**

The data structure of "R&D Management" is specified as the set of fields of all types of R&D documents. To automatically fill out those documents, it is necessary to specify a set of the same fields (hereinafter named common fields), rules and sequences to process every common field in every document. The field in the document is filled by users manually, its value should be chosen from a set list, or the system should calculate values using fields, specified in supporting papers (financial performance, staff list, etc.). Supporting synchronic changes in common fields in all the documents is very important for "R&D Management".

#### **3.1 A Conceptual Data Model**

A list of common fields for all groups of documents was systematized and formalized as the conceptual data model of "R&D Management," which is described in the terms of subject domain [2].

The conceptual data model "R&D Management" being built is as follows:

1. To analyze R&D Management in NAPSU;
2. To compose lists of common fields in the documents, i.e., the same fields that are used in more than one document;
3. To identify fields;
4. To determine the source document for each common field;
5. To define documents that use each common field;
6. To determine and describe a procedure to fill each common field; and
7. To define fields whose values are selected from the appropriate set list.

The conceptual data model "R&D Management" is formally described as a table with the following column: Document Name, ID (Document Identifier), Owner (Department name where the document is prepared), Common Fields (consisting of two columns: Field Name and Field ID).

A unique identifier is appropriated for every document. A field identifier consists of a document identifier and a sequence number of the field in the source document. An identifier color is selected depending on the group. The following field groups are found in the conceptual data model:

- a field-source (it is filled out in this document, and its value is used in all other documents, so it is required unconditionally to synchronize a common value field through all documents);
- a field-source (it is filled out in this document, and this value is used in some documents, and thus required to synchronize a common value field in some documents);
- a copy of the field-source;
- the field is calculated automatically; the field is used to calculate other fields; and
- a check box.

Table of conceptual model "R&D Management" describes a total 147 documents and 253 common fields.

### 3.2 MS SharePoint – Software Platform "R&D Management"

As noted above, "R&D Management" belongs to a class of systems of EDM.

Microsoft SharePoint Products and Technologies (hereinafter referred to as SharePoint), namely Microsoft Office SharePoint Server 2007, is adopted as the "R&D Management" platform due to the above EDM requirements.

The main factor for adopting SharePoint as a software platform for "R&D Management" is a familiar working environment (as a rule it is MS Office package and program browser), to which the user is accustomed in his/her daily activities. SharePoint integrates with Microsoft Office, which allows a largely familiar environment to be saved for the user. Moreover, the system developed on SharePoint platform does not require installing any additional client software or special user knowledge in information technology. To use this system, the user needs to have operating systems such as Windows (Microsoft Windows 98, Windows Millennium Edition, Windows XP and above), and a package of office applications (Microsoft Office 97 and above).

SharePoint also supports centralized repository of documents (SharePoint library), a mandatory component of any EDM.

In addition, SharePoint provides a lot of features to process documents. SharePoint has a Ukrainian localization. Sites based on SharePoint allow users to share their activity. They facilitate the interaction of web applications like Wikis and blogs and create a safe environment interaction. Their content management system is effective and usable. A Web Part, also called a Web Widget, is an ASP.NET server control which is added to a Web Part Zone on Web Part Pages by users at run time. The

controls enable end-users to modify the content, appearance, and behavior of web pages directly from a browser. It can be put into certain places in a web page by end-users, after development by the programmer. Therefore, one of the most widespread and everyday tasks of a developer on the SharePoint platform is the development of Web Parts. It is a flexible and accessible method to expand the functionality of the platform (regardless of whether it will be service of site news or difficult systems of accounting and document workflow, they can be easily and flexibly customized).

A Web Part can be easily encapsulated and removed. Nowadays, the trend of development for SharePoint is to create Web Parts, using custom controls and other similar tools. Those Web Parts can be added to any page in any combination, and the administrator has tools to customize the page if it is needed. Users have tools to operate with data in Lists and Document Libraries, using Controls and Web Parts.

Thus, SharePoint as software platform "R&D Management" provides a comfortable procedure for creation of a portal, use of built-in instruments for the base functions of document flow, and also tools to develop and integrate applications for R&D Management [3].

On the one hand, "R&D Management" has been developed by using standard SharePoint Services tools to create the Web Application. They are Web Parts, Lists, Document Library, Workflow and Website Template.

But on the other hand, there is an unusual implementation of SharePoint in "R&D Management"; which is a novel approach to processing documents. SharePoint is a web application platform. It supports work of its own web application ("R&D Management" is a SharePoint web application) through web server MS IIS. MS IIS gives access to data and content, stored in SQL database. In this way "R&D Management" is able to process data-only SharePoint objects at web level. Because SharePoint considers a document as an independent single object with inside data, it has no tools to control the data integrity of different documents with one and the same data in the SharePoint library. Support of data integrity, however, is an essential condition for business processes in "R&D Management." To solve this problem, special tools were developed; namely, features to synchronize data of documents in the "R&D Management" library.

Documents in "R&D Management" contain various shared tables. To process table data as express fields in terms of MS Office, special additional tools were developed in "R&D Management" because they were absent in SharePoint.

### **3.3 Basic Principles of the "R&D Management"**

"R&D management" supports operating R&D document flow in NAPSU through the Internet portal with an access authorized user. Access to menus and services in the portal is only for registered users with permissions, which are defined by their official powers in NAPSU and administrative subordination in the NAPSU (Leadership, Respective Departments and Research Institutions).

Documents are created and stored in the "R&D management" Library. Each type of document is described as a specific Content Type Template. The specific document is created according its Content Type Template and stored in the appropriate folder of the hierarchical tree structure, which reflects administrative subordination in NAPSU.

The values of the common fields in various documents are changed synchronically with the change of the field source according to rules, which are defined by the field group. To work with documents (create, view, edit) the user opens the document in the portal using the appropriate application of the MS Office package (MS Word, MS Excel, etc.) and performs the necessary operations in documents in the usual manner. The only difference between the document opened in the portal and the document opened locally is that the documents in the portal already contain data in those common fields, which had been already filled out in the source documents. For example, the document "Application R&D" for specific R&D contains the value "Scientific and methodical support for an information system based on the Internet to manage R&D at the National Academy of Pedagogical Sciences of Ukraine" in the field "Title R&D." When each of more than 20 documents for this R&D will be open, the field "Title R&D" will contain the above value. Moreover, when it is necessary to change the value in this field (often by the advice of the Academic Council officials, expert conclusions, etc.), then change the field "Title R&D" only in the Document "Application R&D". Completing this feature is based on a function of express blocks in Word 2007 to define reusable fields within a document and add them to specially created template express blocks. Once the content is added as an express block, the user gets access to it for reuse in any Word 2007 document. Synchronization values in express fields (We named them "common fields") in various documents in "R&D Management" provides by special application developed in C#.

### 3.4 Sequence of Projecting

"R&D Management" consists of two parts: external, it is actually portal – front-end portal, and functional part – back-end portal.

Back-end portal. The sequence for projecting the back-end portal contains the following steps: analysis, requirement definition, design, and developing. The conceptual model is the result of analysis. The conceptual model is the base for requirement definition that determines templates and documents processing rules for data processing and workflows. Data processing is provided by using SharePoint features and additional applications to synchronize the alphanumeric fields, table synchronization, and data calculations. Additional applications implement synchronization handlers in C# and processors of the XML configuration file. A diagram of analysis and design of "R&D Management" is shown in Fig.1-4.

The main task for projecting the "R&D Management" back-end portal is the synchronization of documents; namely, synchronous modification of the common fields in all documents when the value in the field-source is changed. The UML-sequence diagram of "R&D Management" applications is shown in Fig.5.

Front-end portal. Sequence for projecting of «R&D Management» front-end portal is shown in Fig. 6.

### 3.5 Current Status and Prospects of “R&D Management”

R&D Management" version 1.0 was launched in 2011. The R&D documents for the 2012–2014 of Research Institutions of the Department of General Secondary Education NAPSU have been uploaded and processed in the system. The implementation received a positive evaluation. The entire "R&D Management" is to be implemented in 2012. Current version of this system is the first step to manage start to automation R&D in NAPSU. Further development of "R&D Management" consists of expansion of functionality for support of processes of R&D monitoring principles and integration with electronic library of NAPSU.

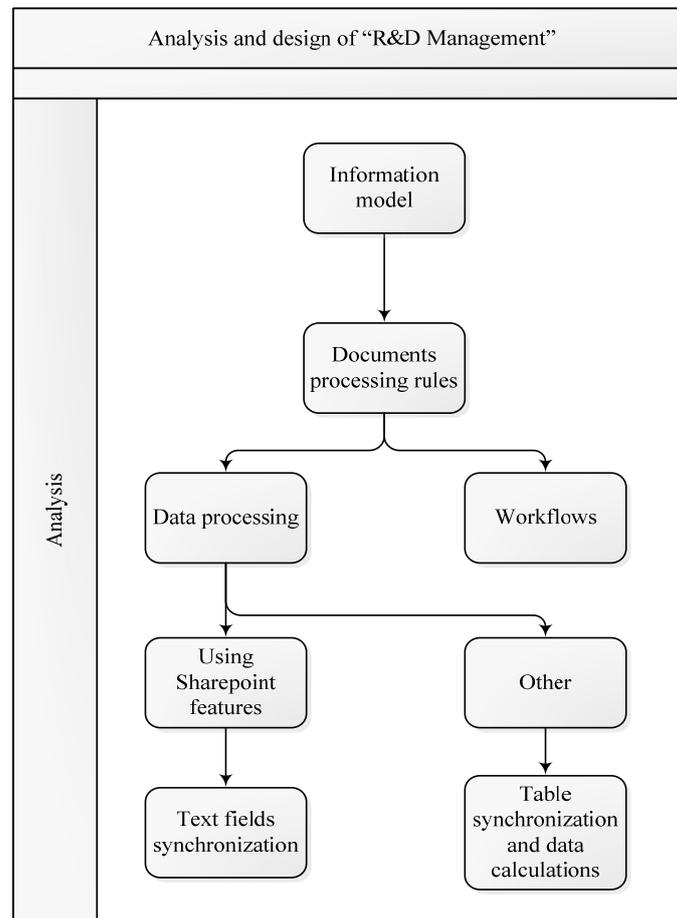


Fig. 1. Analysis and design of “R&D Management” (document processing).

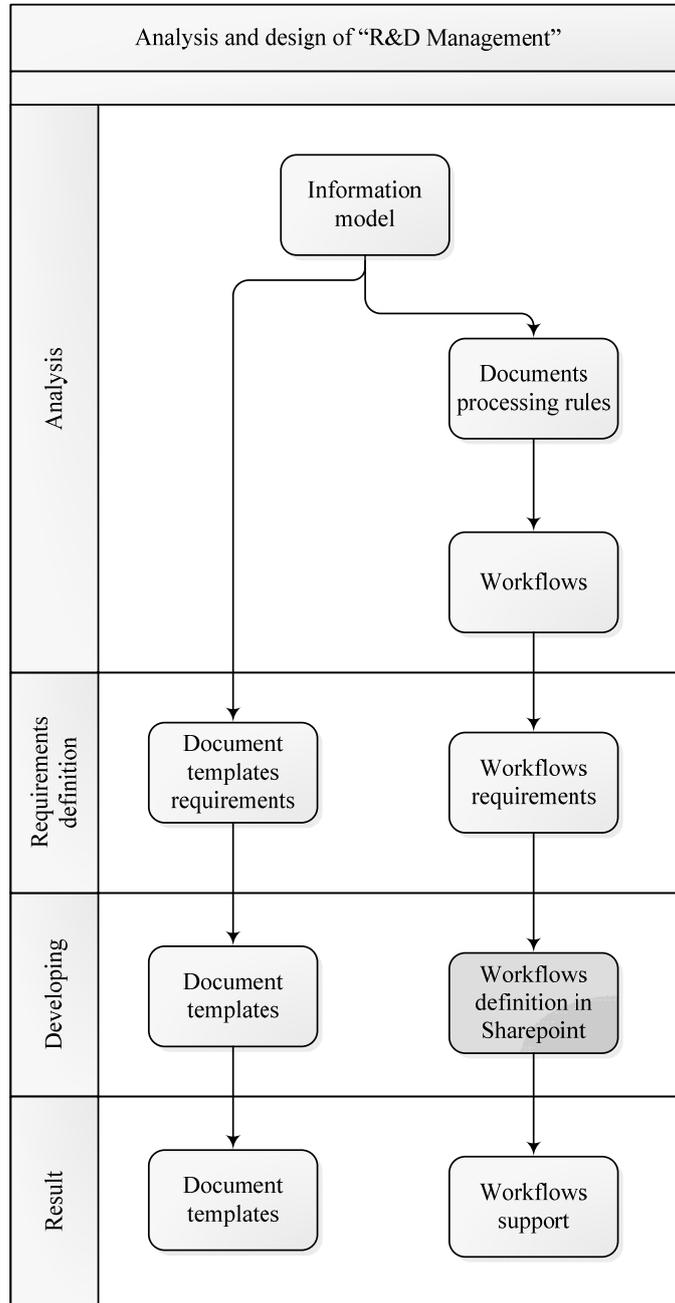
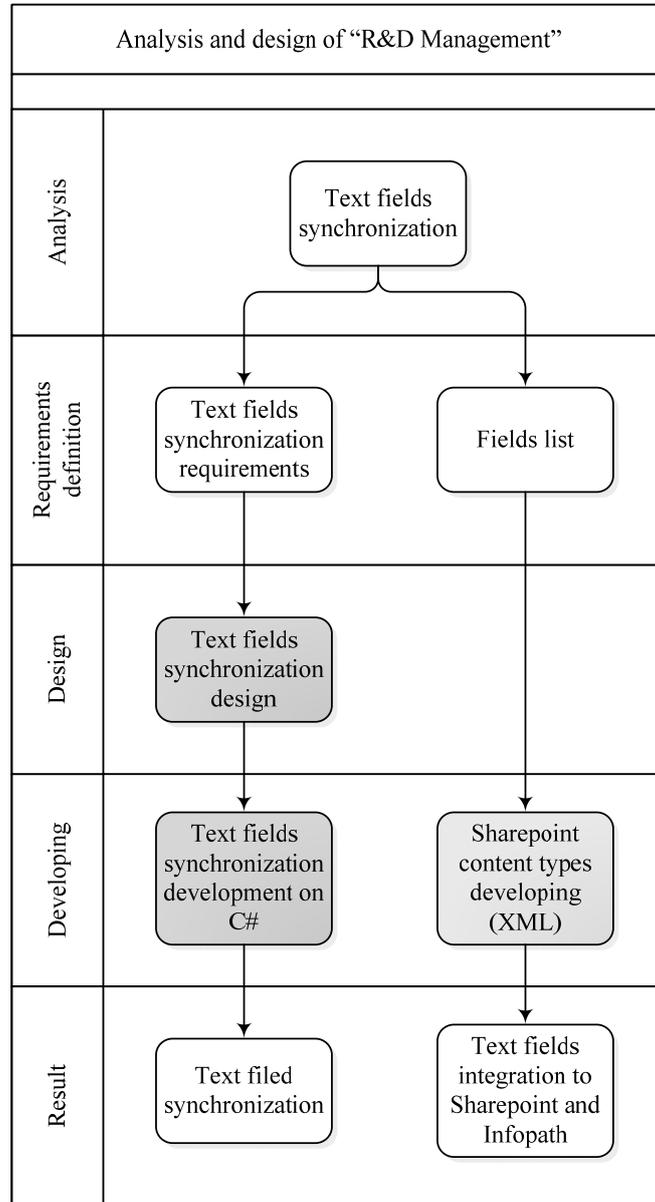
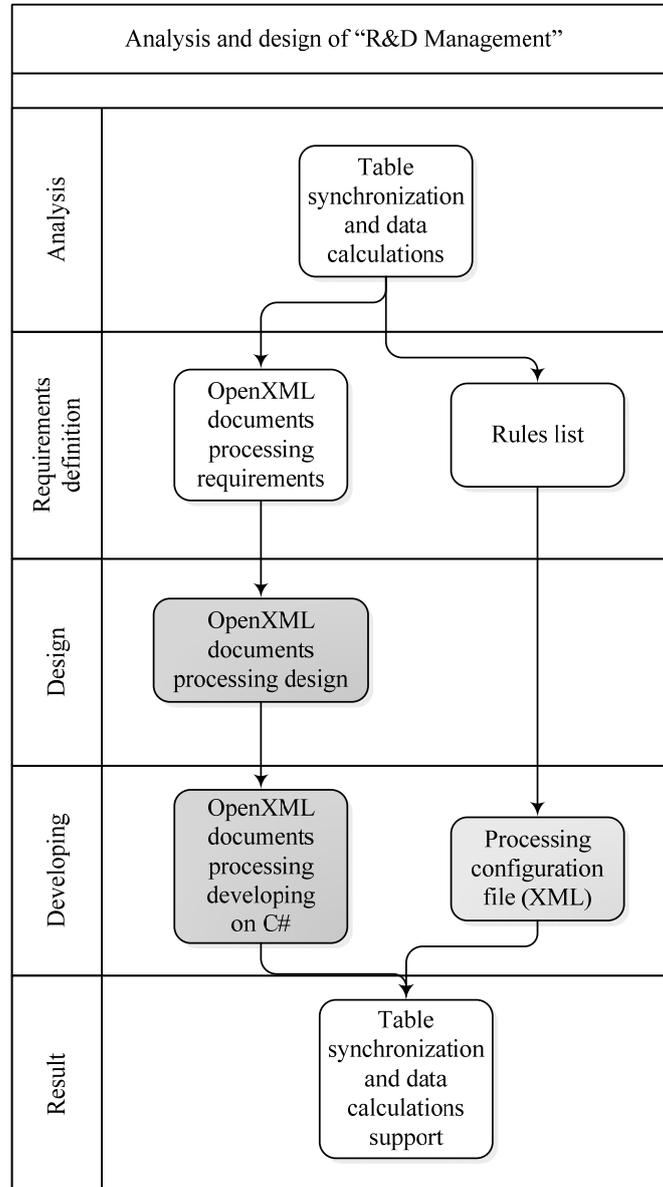


Fig. 2. Analysis and design of "R&D Management" (template & workflow).



**Fig. 3.** Analysis and design of "R&D Management" (text field synchronization).



**Fig. 4.** Analysis and design of "R&D Management" (table and data calculation).

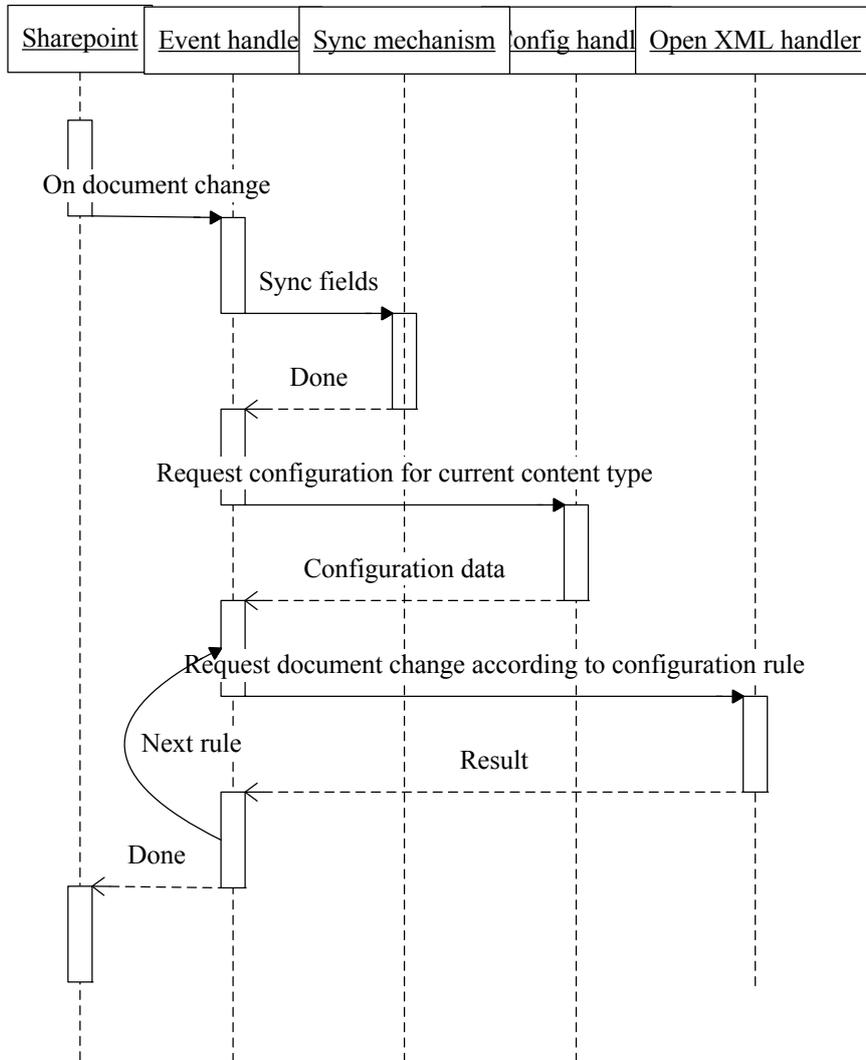


Fig. 5. UML-sequence diagram of “R&D Management” applications

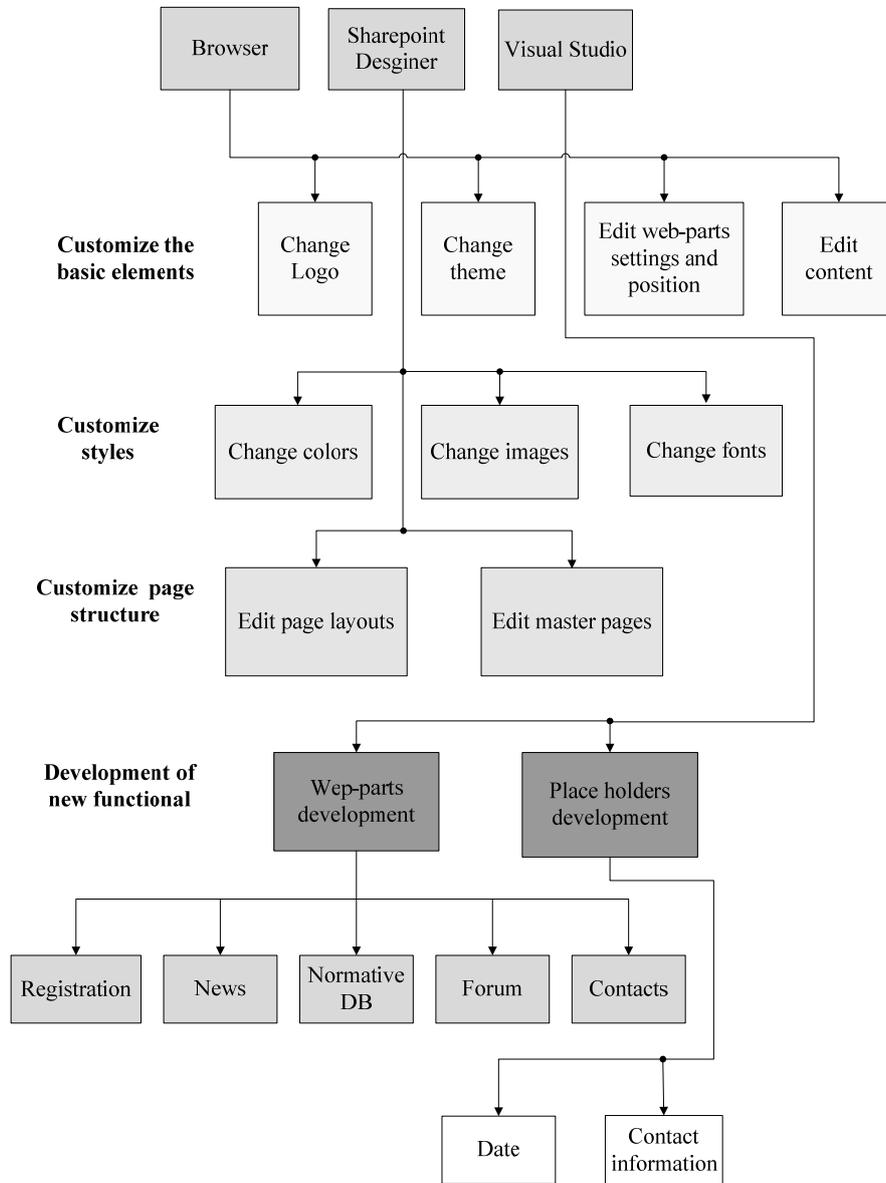


Fig 6. Sequence of projecting of “R&D Management” front-end potral

## 4 Conclusion

“R&D Management” is platform to deploy the electronic document management corporate portal of NAPSU for the whole spectrum of functions in document flow.

Further development of "R&D Management" consists of expansion of functionality of the corporate portal NAPS of Ukraine.

Design decisions of the “R&D Management” can be used for creation of similar systems in establishments which perform R&D with state budget funds and other sources.

Developed for “R&D Management” tools to synchronize data of documents in the SharePoint library as well as tools to process shared table data as express block (in terms of MS Office) can be used for development SharePoint web application to process shared documents.

Design decisions and actual “R&D Management” are useful as learning tool for special course “Electronic Document Management”.

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