Developing an Information System for Classified Electronic Documents

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Abstract – **The process of classifying information regarding the level of secrecy is performed in business organisations every day. As a result of that process, a number of classified information in electronic format is created. The information requires the fulfilment of strict security criteria with the aim of preserving its confidentiality, integrity and availability. We believe that the only safe and dependable manner of handling such classified electronic documents is through special information systems used exclusively for managing the above-mentioned type of sensitive data. Thus, this paper discusses developing an information system for managing classified electronic documents.**

I. INTRODUCTION

As a consequence of computerisation of everyday business operations, an enormous amount of electronic format data has appeared in business organisations. By creating their own information systems, business organisations have managed to process, unify and store this great number of electronic information, and make it available when the need arises.

Likewise, there is also data and information that is of special importance for successful business operation of an organisation at one point in time or during its entire life span in an information system. Thus, it is necessary to handle that information in a different manner. Usually such information requires a higher degree of protection and special security mechanisms and procedures that would guarantee exposure only to authorised persons. The procedure of determining the importance of a single piece of information and the classification procedure of information regarding the level of confidentiality and marking the specific information with the appropriate classification marking singles the said piece of information our from other, unclassified information [1].

When talking about managing classified information, there is a prominent lack of publicly available literature and high quality information solutions. Many information systems for exchange and storage of classified information used nowadays do not provide a sufficient level of security for information which then becomes susceptible to deliberate or accidental disclosure. On the other hand, commercial Document Management Systems like Microsoft Office SharePoint Server 2007 provide good basis for the creation, exchange and archiving of electronic documents, but they do not meet all the security requirements when dealing with classified information [2]. The aim of this paper, thus, is to show the development of a specialised information system used exclusively for managing classified information; a system that would in every moment be able to meet all security requirements and enable secure and reliable handling of classified electronic documents.

This paper is organised as follows. The operation model for managing classified electronic documents is presented in section two. The third section describes the development of individual components of an information system for classified electronic documents, and the technologies used. The conclusion is given in section four.

II. OPERATION MODEL FOR MANAGING CLASSIFIED ELECTRONIC DOCUMENTS

The purpose of an information system for classified electronic documents is a simple, efficient and secure creation of classified electronic documents, archiving of the said documents and quick access to documents depending on user rights. Such an information system, due to sensitive and specific content stored within it, must meet strict security measures; confidentiality and integrity of such a system must be maintained at all times [3].

Advantages of using such an information system are speeding up of the creation and distribution process of classified electronic information, uniformity of all documents within the system, consistency of document archiving and most importantly, availability of searching all documents within the information system, depending on the user's access rights. Of special importance is the fact that by using such an information system, security rules and procedures for managing classified documents are automated thus reducing the possibility of certain security oversights.

The first step in the development of an information system of stated characteristics is defining and presenting an operation model for managing classified electronic documents. Figure 1 shows an operation model for classified electronic documents and all the necessary elements for its correct and safe functioning. The elements entered below enable a secure and reliable communication between end users and the system itself, enabling the end user access to all necessary information resources.

The operation model for classified electronic documents consists of the following: the control system, database of classified documents, user database, reports database, users, entry and delivery. The figure shows interrelations and associations between individual elements. The circles represent processes, the rectangular shapes the storage of data, while arrows point to relationships between individual elements. The central part of the model represents a control system the purpose of which is management and control of other model elements.
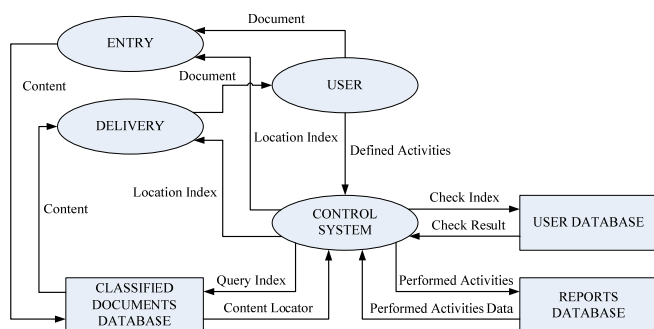
Figure 1 - Operation model for managing classified electronic documents

There are five basic types of defined user activities affecting the behaviour of the model itself. The first defined user activity represents the interaction with the system in which the user delivers a new classified document to the system. Delivery of a classified document means entering a new classified document into the system, while its recipient and classification mark are stated in its attributes.

The second defined user activity represents the interaction with the system wherein the user expects the delivery of a classified document from the system. The delivery of a classified document to the user here means the opportunity for the user to gain insight into the classified document whose attributes correspond to the rights of that user.

The third possible user activity presupposes the possibility of searching the classified documents database using the defined search conditions and user rights in the system. Searching the classified documents database means that the user defines the search conditions based on which, in combination with his predefined rights, the control system will search the classified documents database. The search is conducted under any defined attributes of the classified document, including the text body of the document itself.

The forth defined user activity is the forwarding of the classified document, which represents the most complex interaction with the system. This activity enables changes of certain attributes of the delivered classified document, however, only if the user has sufficient rights defined in the user database. The user has the right to forward the document to any other user within his subordinate user groups, irrelevant of the level of classification of the document in question. In addition, multiple forwarding of the document is also enabled, providing, of course, that the document is always forwarded to the subordinate user group.

The fifth defined user activity represents the possibility of approving classified documents by superior users, before the document becomes visible to addressed recipients. This activity, similar to forwarding, represents a complex interaction of users with the system during which it is possible to change certain attributes of the classified document, and re-enter such a changed document into the system. During this activity, the approval attributes of the classified document, which regulate whether the document can be delivered to addressed recipients or if it is necessary to go through an additional level of approval or correction, are changed. As with forwarding, the approval activity represents a combination of defined activities of entry and delivery of classified documents.

The above-mentioned operation model for managing classified documents provides for an increased level of access control for individual documents, as well as recording all the activities inside the system itself. All records of activities inside the system are stored in the records database which can provide the control system with all data on activities performed upon a defined query at any given moment. This possibility represents an additional security mechanism, seeing as it is possible to analyse all conducted activities at any given moment. Based on the analysis conducted, it is possible to react proactively and set additional security mechanisms on potentially sensitive locations inside the system.

The operation model described above represents the basis for development of an information system for classified electronic documents. Based on the above-mentioned operation model, a conceptual object model of an information system for classified electronic documents has been modelled [4]. By defining an operation model for classified electronic documents, basic functionalities, operation mode and processes taking place within the system itself have also been defined. Main roles in the system have been defined, as well as their interdependencies and the data used for interaction between them. Thus, all the requirements have been met for the implementation of an information system for classified electronic documents.

III. IMPLEMENTATION OF AN INFORMATION SYSTEM FOR CLASSIFIED ELECTRONIC DOCUMENTS

Implementation of the classified electronic documents information system is based on three-layer architecture of the system shown in Figure 2. The first layer of the information system represents a layer of the user interface; the second layer represents the layer of business logic, while the third layer represents the data layer. The data layer means the data stored in the database and it is achieved by a database server. The business logic layer implements business logic of the information system and acts as a link between the data layer and user interface layer. In the case observed, the business logic layer is achieved by using an application server wherein business logic and data processing logic are realised. As a rule, the data layer must not communicate with the user interface layer, and vice versa communication is also not allowed.

The user interface layer is achieved thorough a web browser on the user's computer with a simple logic of data checking. When the user accesses the information system via a web browser, he in fact accesses the user interface layer which forwards the request to the business logic layer. This layer processes the request and, if necessary, downloads the data or sends it to the data layer. After this, it generates a reply

to the user and again, if necessary, accesses the data layer and sends the reply to the user interface layer.
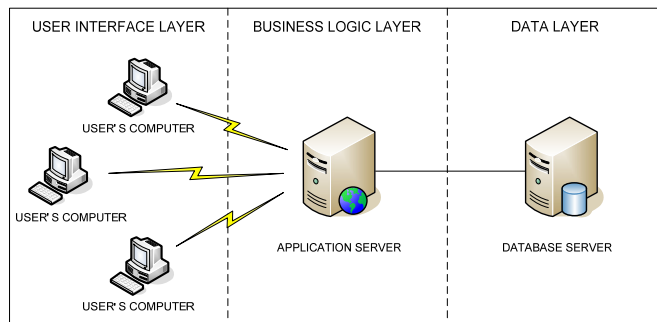

Figure 2 - Three-layer architecture of the classified electronic documents information system

Implementation and verification of the information system for classified electronic documents has been executed by applying the following steps:
- database creation,
- creation of a dynamic web application,
- entering data and testing the information system.

The execution of the steps above has been preconditioned by the choice of the information system architecture. Defining the above-mentioned systems' model of architecture has been described in detail in the previous paper [4]. The dynamic web application uses the data stored in the database, thus the creation of the database represents the first logical step. Upon the creation of the database, the following step is the creation of a dynamic web application for carrying out operations on the data in the database and implementation of business logic for managing classified electronic documents. After creating a web application, the following step is creating a user interface for communication with the user. This user interface allows the information system users to present data stored in the database, to update it and to enter new data. The user interface forwards the requests for processing to the web application and also presents the processing results. System testing begins with the creation of the user interface in the manner that classified electronic documents are entered into it and defined activities for work with classified documents are started.

The following program systems and tools have been used for the implementation of classified electronic documents information system:
- Microsoft SQL Server 2005 Management Studio,
- Microsoft .NET Framework 2.0,
- Microsoft Visual Studio 2005 Professional Edition,
- Microsoft Visual C# 2005,
- Dynamic HyperText Markup Language (DHTML),
- Microsoft Internet Information Services (IIS) 6.0,
- Microsoft Internet Explorer (IE) 7.0 web browser.

Database implementation has been achieved using the Microsoft SQL Server 2005 Management Studio program package which offers an integrated environment for accessing, shaping, managing, administering and developing a SQL Server 2005 database. This database has been implemented on a server with the Microsoft Windows Server 2003 operating system. All security rules for managing classified electronic documents have been entered in to the database. User groups have been defined with the help of which access to individual objects has been allowed only for executing built-in procedures and overview of individual tables. Every built-in procedure that enters, modifies or deletes data from the database invokes the built-in procedure responsible for monitoring the modifications. In this manner each modification is recorded, allowing for monitoring of user activities.

Implementation of a dynamic web application has been achieved using the technologies such as the Microsoft .NET Framework 2.0, and Visual Studio 2005, Visual C# 2005 and Dynamic HyperText Markup Language program tools. Dynamic web application has been implemented on an application server with the Microsoft Windows Server 2003 operating system, and is run via the Microsoft Internet Information Services (IIS) 6.0 web server. Microsoft Internet Explorer (IE) 7.0 web browser has been used for user access to dynamic web application.

The choice of the .NET technology as the framework for the development of the application solution in the case of the information system for classified electronic documents imposed itself as a logical solution seeing as the above-mentioned technology enables a simple, secure and high-quality development environment for dynamic web application. A dynamic web application is created by using a set of development tools: Visual Studio 2005, wherein the object-oriented program language Microsoft Visual C# is used for generating the .NET applications. Figure 3 shows the use of the C# program language in the process of creating a dynamic web application for managing classified electronic documents on the example of creating a function for determining the degree of secrecy of a classified document.

```
private void dohvativrstetajnosti()
{
string patic, upit = "", tekst = "";
patic =
WebConfigurationManager.ConnectionStrings["PutanjaDoBaze"].ConnectionSt
ring;
SqlConnection cn = new SqlConnection();
cn.ConnectionString = patic;
int zapis = 0;
vrstetajnosti.Items.Clear();
ListItem popistajnosti = new ListItem();
popistajnosti.Value = "0";
popistajnosti.Text = "-- Odaberi tajnost --";
vrstetajnosti.Items.Add(popistajnosti);
cn.Open();
upit = "SELECT convert(varchar, idtajnosti), naziv from vrste_tajnosti
where idtajnosti in (SELECT idtajnosti from primanje_po_roli inner join
korisnici kor4 on kor4.idrole=primanje_po_roli.idrole where
kor4.idkorisnika="+Session["idkorisnika"].ToString()+")";
SqlCommand com = new SqlCommand(upit, cn);
SqlDataReader dr;
dr = com.ExecuteReader();
while (dr.Read())
{
vrstetajnosti.Items.Add(new ListItem(dr.GetString(1),
dr.GetString(0)));
}
cn.Close();
}
```

Figure 3 – Example of using the C# program language for creating a dynamic web application

The dynamic web application ensures access to the database, performs operations on the data stored within it, presents the data to the users and allows new data to be entered. By using the said application, communication between the end user and the information system is enabled. It is possible to divide a dynamic web application for managing classified electronic documents into smaller unified modules that together enable the functioning of the entire application [5]. The execution of individual modules is shown in Figure 4. Individual modules of the dynamic web application for managing classified electronic documents are the following:

- user identification,
- overview of classified documents and possible activities,
- creating a new classified document,
- approving a classified document,
- sending a classified document,
- forwarding a classified document,
- searching the classified documents database.

After authorisation on the operating system layer, users are signed in for work in the classified electronic documents information system by entering a unique user name and password. Upon entering the said data, the user is verified and it is then determined to which individual user group he belongs. Depending on the determined affiliation with a certain user group, the user is allowed access to individual information system modules while the rules for carrying out certain activities are set.
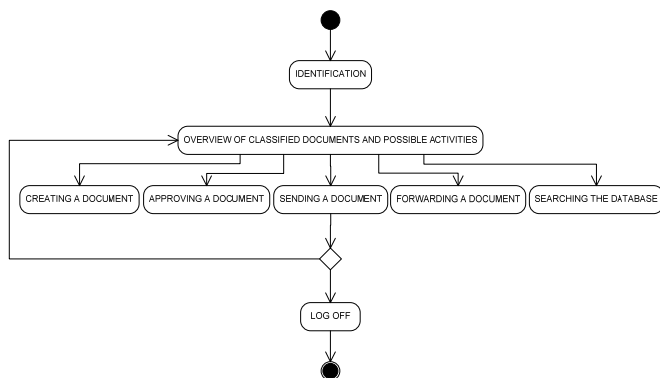

Figure 4 - UML activity diagram of the dynamic web application for managing classified electronic documents

After successful authorisation, the user is allowed insight into classified electronic documents that require his attention, and the activities that are possible to carry out (Figure 5). The Home Page is divided into four segments. The "Documents" segment contains data on the documents created by the user himself. With every classified document, certain data is shown which defines the document further, as well as the activities the user can undertake on the said document. The segment "Last confirmations of my documents" contains data on activities carried out on user documents by superior user groups. The segment "Need to confirm" contains data on classified documents created by subordinate user groups waiting for user approval. The segment "Documents on

confirmation" contains information on user documents which are currently being approved by superior user groups.

After creating a database and the dynamic web application, the third step in the implementation and verification process of an information system for classified electronic documents is entering data and testing the information system. The test results are then compared with the expected behaviour defined by the discussed operation model for classified electronic documents. In this manner, the degree of fulfilment of the set goals when developing an information system is determined.
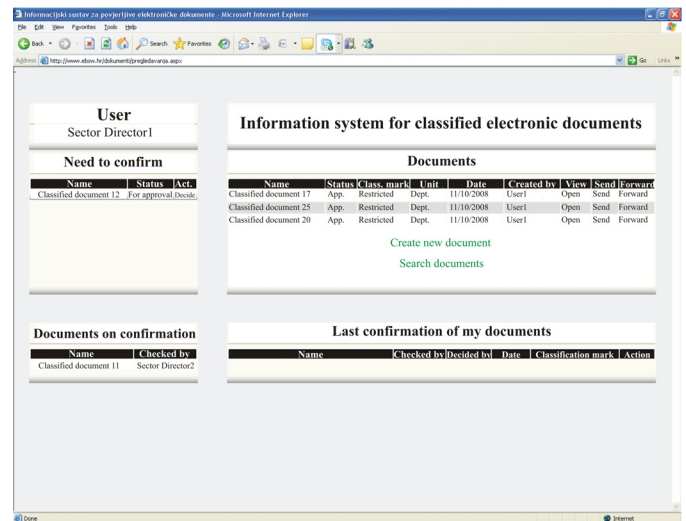

Figure 5 – Home Page of Sector Director1 with classified documents being approved

IV. CONCLUSION

Classified electronic documents require implementation of strict security measures and mechanisms to retain their confidentiality, integrity and availability at all times. We believe it to be necessary to develop special information systems that would serve exclusively for work with classified documents, independent of other, unclassified information. Thus, this paper presents the development of such an information system that would enable secure and reliable handling of classified electronic documents.

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