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TABLE OF CONTENTS

Information System for Asset Management in Buildings

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***Abstract*— Since the University of Žilina is constantly expanding, we decided to develop information system, which will provide a unified environment for property, rooms and buildings management. Within my bachelor thesis I focused on the development of a web application for asset management in the buildings of the University of Žilina. The created system enables various options for working with property, its evidence, management, decommission, creation of statistics and reports.**

I. INTRODUCTION

In today´s digitalized era, we try to simplify our work by using computers or other technologies, by using various types of applications and information systems. Information systems can be in paper form or automated form. They mainly serve to collect, store and process data. Information systems ensure compliance with regulation, better storage of information and more effective management decision-making [13] [14].

The main task of automated information systems is, that their use leads to an increase in productivity and efficiency in management in the given area. Another advantage is clear record keeping or simple control [13].

The disadvantages of automated information systems are significantly less. One of the biggest shortcomings can be financial difficulty and maintenance.

Information systems are used in various areas such as industry, healthcare, education, and business [14].

The aim of my bachelor thesis was to design and develop information system for asset management in the University of Žilina premises. The system was supposed to simplify and facilitate the work of its employees. The information system was supposed to manage asset in the rooms, provide options for performing various types of statistics based on given criteria, and ensure a clear way of registering and disposing property.

Since the University of Žilina is constantly expanding, we decided to develop information system, which will provide a unified environment for property, room and building management. It will thus make it possible to improve the overview of the expenses of the university and individual faculties, it will offer a convenient way of disposing assets from register, which will ensure the maintenance of current information and the possibility of monitoring the university´s management.

Nowadays, there are several information systems available for asset management. In the following section there is description of some of them.

A. AMI (Asset Management Information)

Asset Management Information is the system designed and implemented by HIS, which is one of the most successful Czech companies providing information systems not only in the field of asset management, but also supplies geographic information systems or custom applications which are used in the industry.

The AMI system has been implemented in several companies, such as Unipetrol RPA, s.r.o., but it is also used by universities, such as the University of Pardubice or the University of Jan Evangelist Purkyn in Ústí and Labem.

This information system helps create a unified environment that contains asset management data, maintenance data, technical asset information and documents. These data are accessible for the entire lifetime of the property to people who have the reserved right to access them [6].

B. Karat

The Karat system is a powerful tool that serves for efficient business management. This system is used in several areas, such as accounting, production, sales, but also in management and payroll.

One of its functions is, that it ensures a clear asset evidence and creates accounting documents together with depreciation for a certain period. It also provides evidence of acquisition and valuation of property, its condition and all its movements within its life cycle. It also ensures the methods of asset depreciation, helps in the classification of asset for tax and accounting purposes of the given depreciation groups. Another advantage of this system is efficient inventory of asset [8].

II. ASSET CATEGORIZATION

In the text below, we will describe the categorization and life cycle of asset in more detail. We categorize asset according to [3]:

- Time
  - *Long-term asset*
  - *Short-term asset*
- The action in the operating cycle
  - *Current asset*
  - *Non-current asset*
  - *Time distinction*
- The form
  - *Intangible asset*

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- *Tangible asset*
- *Financial asset*
- *Receivables*

III. SYSTEM REQUIREMENTS

The information system for asset management in buildings covers various processes of working with asset. According to the access rights, we divided system users into two groups – logged-in users and non-logged-in users. A special type of logged-in user is an administrator and an ordinary user (an employee of the university).

A. Functionality analysis

The administrator is the person, who has the most rights in the application, next is the user and finally the unlogged person whose rights are limited.

Non-logged-in person has access to the list of buildings and rooms of the University of Žilina, this person is able to view the detail of the given building, which contains basic information about the building. Another option is to view the building on the map. The same is applied to the rooms. This kind of actor is able to register yourself to the system. It requires filling in all necessary personal data. Non-logged-in person is not able to view the property located in buildings and rooms and view statistics.

Logged-in person has the same rights as a non-logged-in person, but they are supplemented with the option to view annexes in the building and room detail.

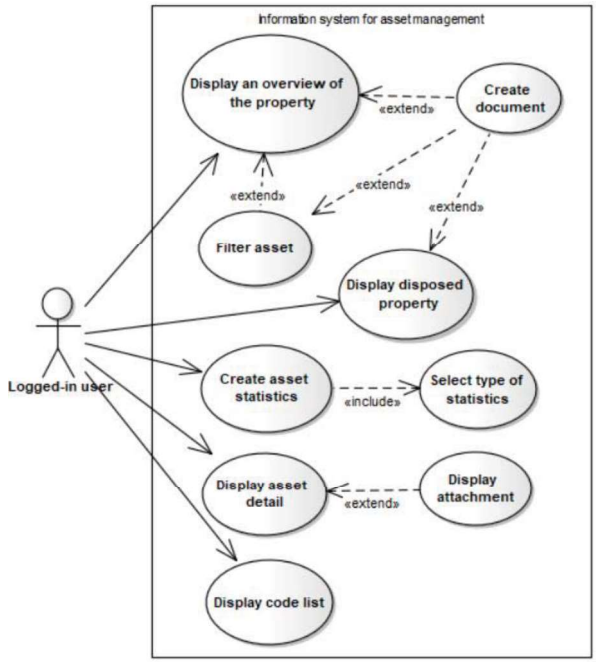

Figure 1: Use case diagram for logged-in person and his access to asset

Other rights of the logged-in user include the ability to view asset, whether registered or disposed property. The possibility of accessing the asset includes viewing the detail of the property, which contains of basic information about the property, its inclusion in the chart of accounts and depreciation group, and the ability to view attachments, photos, documents, and instructions for using the property. Furthermore, there is the option of creating a PDF file, that the user is able to download at any time or create an excel file with the given data. If necessary, the user can filter the property according to various criteria and view various kind of statistics that the system allows him to perform. A code list is also available in the system. Fig. 1 shows a use case diagram for logged-in person and his access to asset.

The administrator is the last type of user that occurs in the system. The administrator is able to use all the functionalities of the logged-in person, but his rights are extended by other options. The admin can add, edit, and delete buildings, rooms in buildings and asset. There are other activities associated with property that the admin can do. That is the possibility to dispose any number of pieces of property, to add attachments to the property for example photos, documents, or user manual. Fig. 2 shows a use case diagram for admin and his asset manipulation options.

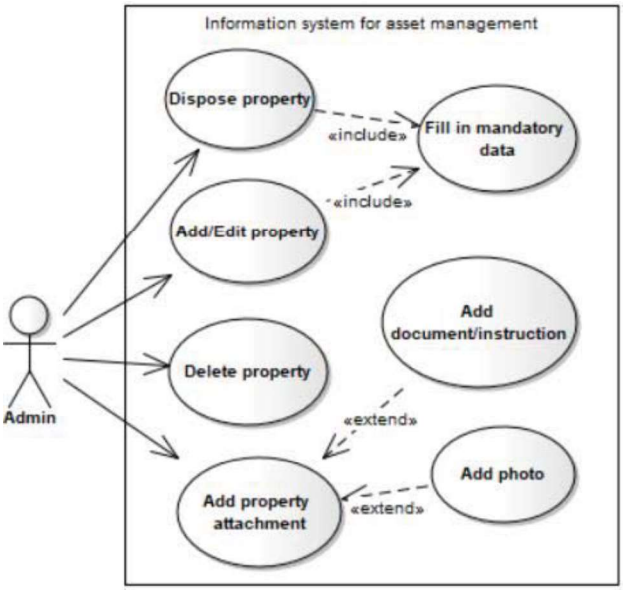

Figure 2: Use case diagram for admin and his asset manipulation options

B. Asset life cycle

Each organization owns different types of assets. Fig. 3 shows the state diagram of different states the asset can be in, during its life cycle. Firstly, after the purchase of the property, it is in the purchased state. Then the process of valuation of the property follows. It means that its monetary amount is determined, in which it will be registered. It might not necessarily be the amount for which the asset was purchased, but it is usually the amount for which the asset was acquired, together with the transport and installation costs. After this process, the asset reaches the state evaluated, and subsequently, after adding the asset to the register, it is in the state registered. As soon as it is registered and put into operation, its status changes to used. After a certain period, depreciation is deducted from the acquisition amount for each registered asset, so it becomes depreciated. After asset depreciation, it is necessary to make sure whether the asset is still in condition that it can be used. If so, it goes back to the state used, otherwise it is disposed from evidence and reaches the state disposed, where its life cycle ends [4].

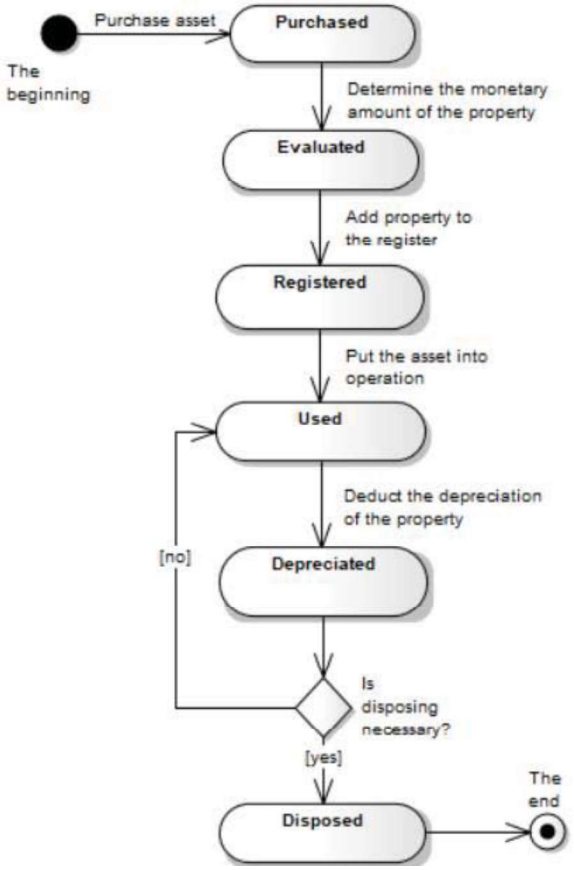

Figure 3: State diagram of different states of the asset

C. Data model design

In general, information systems work with a large amount of data, which must be efficiently stored, modified, and selected [10]. The database system enables us to do this. The design of the data model mainly influences how the system will behave. The data model design is the key factor in system creation. Its goal is to ensure data independence, data consistency and also minimize data redundancy, which is related to multiple occurrences of the same data in the system [7] [9] [11].

The data model of information system for asset management is design to ensure the storage of all necessary data in the system. Fig. 4 shows asset-focused part of the data model. It consists of data objects and relationships between them.

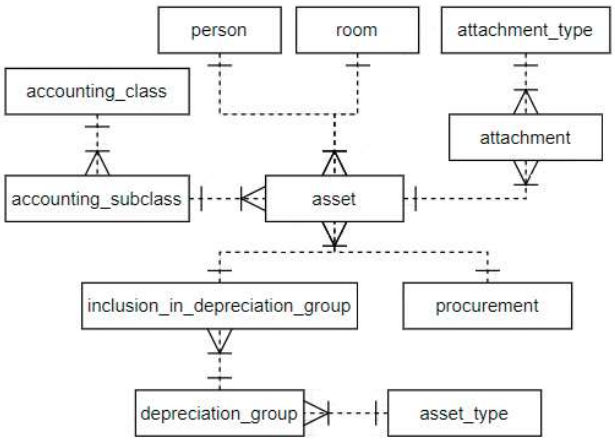

Figure 4: Part of the data model

The *asset_type* database table stores information about various types of assets. The *depreciation_group* table stores information about individual depreciation groups. Each depreciation group consists of name and depreciation time. The table contains reference to *asset_type* table. The *inclusion_in_depreciation_group* table stores items, which are in the given depreciation group.

The *accounting_class* database table stores information about account groups, to which account classes are divided. The *accounting_subclass* table represents table, that stores information about accounts of the given account group.

Each organization is able to procure asset through tender. The *procurement* table represents database table, which stores information about public procurements, which are the part of asset purchase. We include the number, description, and date among the basic information of the public procurement.

The *attachment_type* is the database table, which stores various kind of attachments. The *attachment* is the database table, which represents all attachments of the asset.

The *room* table represents rooms in the buildings, where the asset is situated. The *person* database table represents employee of the university, who is responsible for given asset.

The *asset* database table is one of the most important tables of the data model. It represents purchased asset of the university. Each asset is clearly identified by identification number. It is necessary to store information about the asset´s name, asset´s purchase price, date, when the asset was purchased. Other stored attributes are room, in which the asset is located, personal number of an employee, who is responsible for asset, number of a procurement, number of account subclass, number of depreciation group, the asset serial number, the current value of the property, etc.

Each acquired property must be registered for a certain period. During this time, the asset is used and devaluated. Subsequently, the asset is depreciated in the same interval. The asset is removed from evidence, when it is completely depreciated or can no longer be used. We wanted to preserve the information of the asset after removal, so it was necessary to create the *disposed_asset* table, which stores information of the disposed property after removal from register. This table uses one more table named *disposal_method*, which contains information about the possible methods of asset disposal. Fig.5 represents database tables of disposed asset.

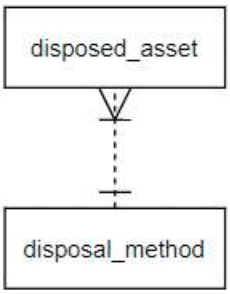

Figure 5: Data model of disposed asset

D. Client-Server architecture

The information system for asset management is web application based on client-server architecture. The client role is played by the user´s computer, which sends requests and waits for a response. The server is represented by the computer, on which the information system is installed. Its task is to wait for requests from the client side and respond to them [2].

IV. Implemented solution

After analysis and design of the information system we started with the implementation. In this phase, we chose a suitable programming language, web, and database server.

A. Programming language

Information system for asset management is programmed in PHP script language because it is one of the most widespread technologies on web application creation. It is platform independent, it supports many database systems, supports dynamic web application development. It is the language used to create client-server application.

B. Database server

This information system works with large amount of data, which is necessary stored. This service provides many database servers. MySQL is one of them. It is supported by multiple platforms, and it is open-source server.

C. Other technologies

There are some other technologies, which were applied in this information system. HTML5 (HyperText Markup Language) is one of them. It is technology which describe structure of web page. It uses tags, through which the browser displays the web page. The main advantage is support from all browsers. HTML is combination of three technologies: HTML, CSS (Cascade Style-Sheets), and JavaScript [1] [16]. CSS is next technology applied in the system. It serves to define appearance of the web page. Beside that, it allows the page to be adapted to different devices, so it enables a responsive design. We used the front-end web framework named Bootstrap version v3.3.7. for better work and implementation. Bootstrap was one of the most widespread frameworks using elastic design. It provides several predefined styles that can be used. It is possible to define the layout of elements on the page using the grid structure [12].

JavaScript is technology, which is used to create interactive websites. It allows importing of various libraries from which we used jQuery [5] [15]. AJAX (Asynchronous JavaScript and XML) is the next technology, which we used in development of the system. Its main advantage is, that the loading of the entire page is not necessary. This technology is used in forms, where it is necessary to dynamically change the content of the following selection based on the previous selection [15].

For convenient usage and storage of data outside the system, it is advisable to download data from the database tables to the computer in the form of PDF file or XLS file. Therefore, system provides option to generate these two types of files.

1) PDF file

PHP can be extended with several features. One of the extensions is package, which enables to create PDF files. Since the information system for asset management could create PDH files from various reports, we decided to use PHP class tFPDF, which modifies the FPDF class. It also supports UTF-8 encoding and allows the selection of multiple fonts. There are implemented various functions for example Cell(), MultiCell(), SetFont(), etc. These functions allow us to lay out the PDF file according to our needs.

2) XLS file

The process of creating the XLS file was as follows: First of all, we determine report type, whether it is a discarded property, or whether the user wishes to generate a building report or something else. Subsequently, we selected the names of the columns from the given table in the database and sequentially wrote then down in the excel file cells. Then the record of the data from given table follows. Setting the file type, extension, and UTF-8 encoding was also necessary.

D. Application functionality

The information system for asset management is system, which offers to users clear and simple environment supplemented with functions and methods according to their rights.

1) Home page

After starting the web application, the home page is displayed. The navigation panel, that provides various functions to user, is in the left side of the page. Non-logged in user has the opportunity to view the buildings list and rooms list of the University of Žilina. The user has also the possibility to view the detail of the buildings and rooms. The user can register himself or if already registered, he can log in. The home page contains information about the University of Žilina and links to all faculties.

2) Asset manipulation

After login to the information system, the user has the right to view lists of buildings, rooms, asset and their details together with attachments. Asset is divided into three sections as can be seen in the navigation panel displayed on the Fig. 6:

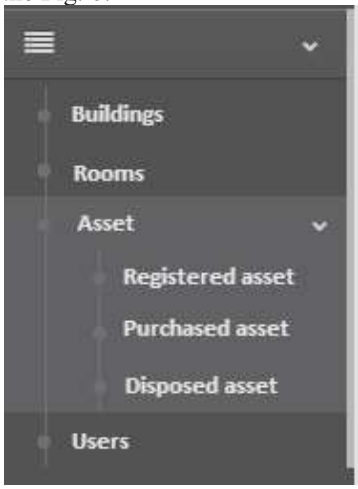

Figure 6: Navigation panel

It is possible to filter the property according to buildings, rooms, or download the given list of assets in the form of the PDF file or as the excel file. It is also possible to filter asset according to purchase time or price.

It also possible to dispose asset. After clicking on the option to dispose property, the use is able to mark one or more pieces of property, that have to be disposed. Then the disposal date and the disposal method have to be filled in. The asset disposal form is displayed in the Fig 7.

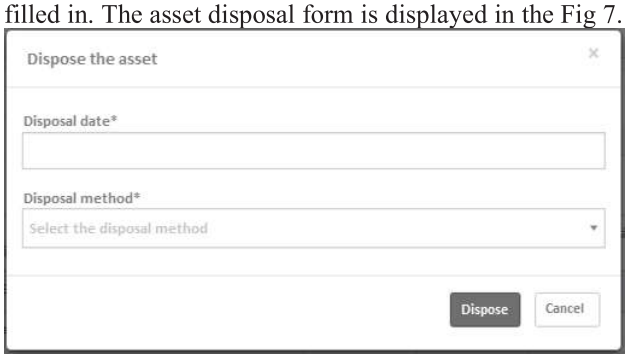

Figure 7: Asset decommission form

After confirmation, the asset is removed from evidence and moved to the list of disposed assets, which the user can view by clicking on the *Disposed property* item.

3) Statistics

On the Statistics page, there is the possibility to create statistics according to options, which offer our system. Statistics can be created at different levels. It is at level of faculties, buildings, workplaces, rooms, and type of asset.

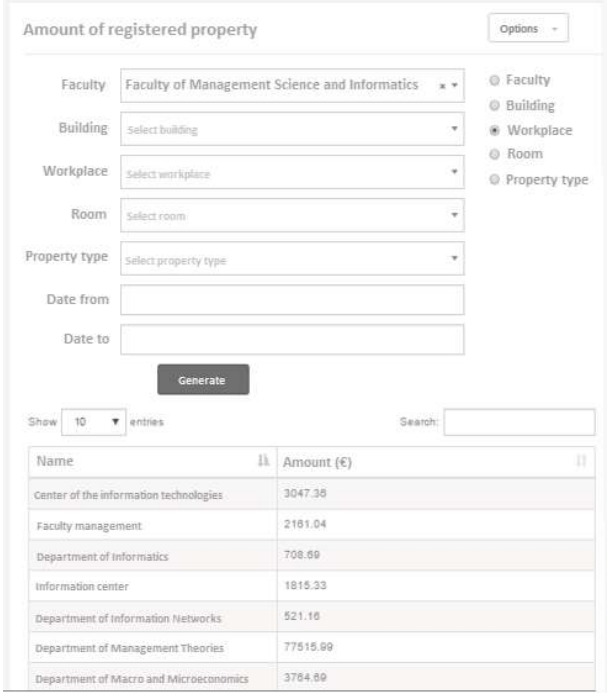

Figure 8: Statistics

Statistics are created based on the price of the property. The use can define the statistical options in more detail. There is an option to define a specific faculty, building, workplace, room, type of property and date. The result of the generated statistics is the table containing the asset amounts according to the selected statistics. For example, the use can find out the expenses of individual faculties for a given time period or expenses individual workplaces for a given faculty for a given date, etc. The statistics page is displayed in the Fig.8.

4) Adding asset

The administrator can do all operations with asset. It covers insert operation, edit operation, and clear operation. There are two options how the asset might be added to the system. First option is to add property through form, which is available to the administrator. There is necessity to fill in all mandatory fields. This method is suitable when the administration adds a small number of assets.

However, in many cases asset is purchased in larger quantities and therefore the administrator has the right to insert asset via a CSV file, which can be easily retrieved from excel file. It is essential that the asset data have to be in the correct order and all mandatory data have to be filled. Otherwise, the asset will not be inserted to the system.

5) Asset attachments

After displaying the details of the property, the user has the opportunity to view various photos, manuals and documents of the given property in the *Attachments* tab. Documents can only be added in the PDF format. All management operations such as add, edit, or remove attachment of the property can be done by administrator.

6) Codebook

Next item, which the navigation panel contains is *Codebook* item. In this tab, the codebook of villages, municipalities, districts, regions, account classes, account subclasses, and depreciation groups are located. All these codebooks are valid within the Slovak Republic.

7) Backup

The navigation panel contains *Backup* tab. This tab serves to backup all system data and load all backed up data into the system. The advantage of this functionality is that the system can be restored at any time in case of system failure or inconsistency.

8) Actuality

The *Actuality* tab is next tab located in the navigation panel. After clicking on this tab, all actualities are displayed to user. Actualities are sorted from the newest to the oldest. It is also possible to add, edit or remove actuality by user.

E. System testing

The information system was tested on real data, that was provided to me for the purpose of developing this web application. After programming each functionality, I tested the system, if the developed functionality is correct. If no I had to remove the errors and test it again.

V. CONCLUSION

The main aim of this information system was to create user-friendly and clear environment for the evidence and management of asset in the premises of the University of Žilina. This system will help and facilitate the work of its employees.

Each application can be extended, or some functions can be improved. The issue of asset management is extensive. The method of recording, depreciation, and

disposal differs depending on the type of asset (short-term asset, long-term asset). This bachelor thesis provides the same method for both long-term asset and short-term asset. Therefore, one of the possible extensions and improvement could be to separate these two categories. Another system extension could be the connection of this information system with the Sofia information system, which the University of Žilina uses for the registration and asset management. The connection could mean the automatic import of the purchased asset between these systems and automatic sending of information and data from our system to the Sofia system. The integration of this information system into the UNIZA information system or some service, which could provide to create presentations and reports of the required data for faculties could be other extensions of the system.

In this paper, I have described state of the art, in which I focused on existing systems and asset categorization. I have continued by describing the analysis and design of our developed information system. Subsequently, I have focused on the technologies used by the system and finally, in the Implemented solution chapter, I have described the developed web application. The possible extensions of the information system I have described in this chapter.

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