

## DESIGNING THE DECISION-MAKING SUPPORT SYSTEM FOR THE ASSESSMENT AND SELECTION OF THE UNIVERSITY'S ACADEMIC STAFF

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**Abstract:** The paper deals with designing and developing the decision-making support system for the assessment and selection of the university's academic staff. It analyzes the system's requirements and its functional structure. There have been developed the system architecture, the Entity-Relationship model and software package of the database

**Key words:** decision-making support system, model, academic staff, expert.

### 1. INTRODUCTION

The rapid pace of development in information technology increases demand for its use in almost every area of people's activities, and furthermore, it is even impossible to imagine their effective functioning without the use of modern information technology.

Our work involves the creation of the Decision Support Systems (DSS) to provide assessment and selection of the University's academic staff. DSS is a special-type model- or knowledge-based information system that is designed to assist in making managerial decisions [1]. The DSS includes four main components: database (or the knowledge base); model; the graphical interface; users.

The database contains data, model and knowledge bases, collection of models, and consequently, the graphical user's interface (GUI) allows users for using the interactive between the database, model base and knowledge base.

The model uses the models for optimization, simulation, or other algorithms with calculations and analysis. These models allow the decision-making system not only for providing users with information, but they also help them to make decisions.

DSS is used to ensure the process of the assessment and selection of academic staff, increase the effectiveness and objectivity of the selection process, which is essential for selecting the most qualified staff, which who is vitally important for the university.

The university's academic staff consists of professors, including full professors, associate professors and assistant professors.

The appointment to the academic positions can only be made through an open competition, which should comply with the principles of transparency, equality and fair competition. Holding of competitions for academic positions on the principles of

objectivity, transparency, equality and fair competition is ensured by a temporary collegiate body – the Competition Commission (experts).

The Competition Commission examines and evaluates the documentation submitted by the applicants to confirm the conformity of the candidates' qualifications with the academic positions, and conducts also interviews with the selected applicants, on the basis of which, it makes the assessments, according to which, the final decision is made.

Many studies have been conducted on establishing the decision-making support system [1-4], which are used to solve various problems, including the assessment and selection of human resources. However, very little research has been done on the creation of DSS for the academic staff assessment and selection. It stands to reason that, the academic staff is a human resource, but the academic staff differs greatly from regular personnel [3]. The assessment and selection of academic staff is a specific process and differs radically different from the regular personnel assessment and selection process. Consequently, the problem of the assessment and selection of existing human resources using the DSS cannot be solved, which is a very important issue for higher education institutions. Therefore, the goal of the proposed study is to design and implement the decision-making support system to solve this problem. In line with this goal, the paper analyzes the requirements of the system, as well as its functional structure. There have been developed: the architecture based on the system's web; the database Entity-Relationship Model; the database and software.

## **2. BASIC PART**

The use case diagram was developed for visual analysis of the system's requirements that allows us for identifying the functional requirements of the system. The system's "use case" diagram is illustrated in Figure 1, which clearly shows the requirements and the functional, which are placed on the system to be designed. The system has three types of users:

- Administrator – The administrator: administers the system users, defines in the system the faculties, areas and subareas, in which there are the vacancies; determines the number of vacant jobs according to areas and positions; ensures the effective functioning of the system; based on the experts' assessments, uses the system's module, which provides the selection of applicants for vacant posts.

- Experts: provide specific competitive areas and the assessment criteria; review the competition data of the applicants in the respective area and evaluate them according to the developed criteria. Experts will have the opportunity to use all of the above functions in the system, if they are authorized in this system. For this, the expert is required to register and receive confirmation from the administrator.

- Applicants (contestants): provide entering and management of their data into the system, in particular data on education, work experience, scientific publications, teaching courses, scientific grants, membership of the academies and editorial boards, participation in the scientific conferences, languages skills and computer skills and so on.

Applicants will have the opportunity to use all of the above functions in the system, if they are authorized users of this system. For this, they are required to register and receive confirmation from the administrator.

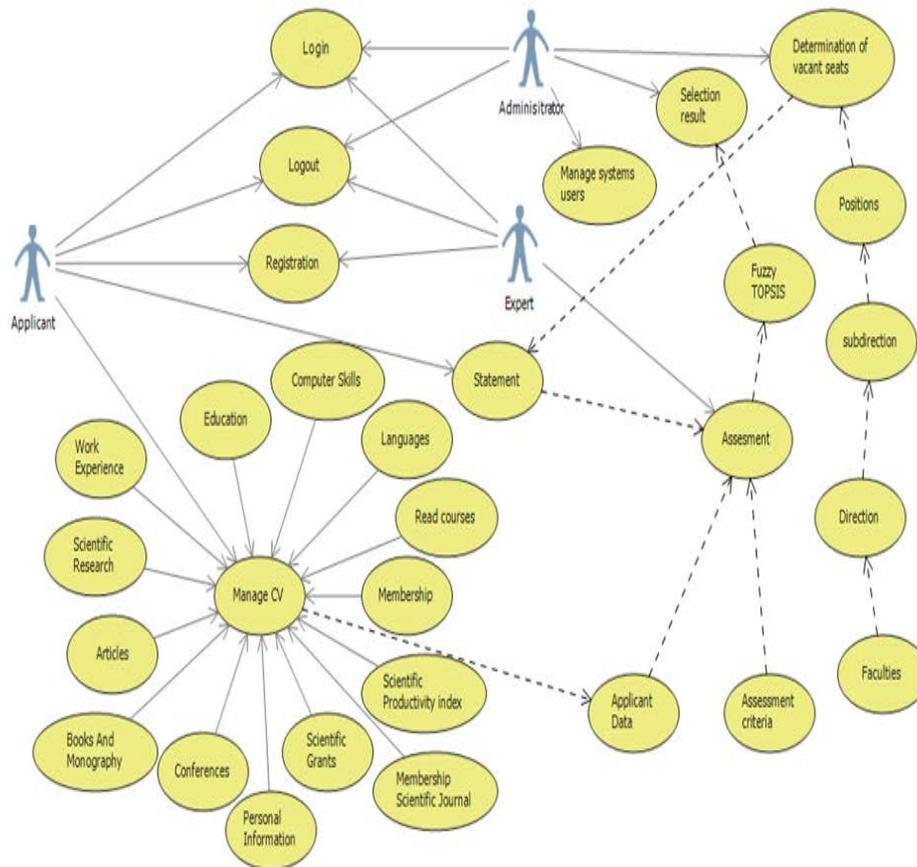


Fig. 1. Use Case diagram

**2.1. Database of DSS**

As noted above, one of the most important components for the decision-making system is a database [1], which contains data, on the basis of which the entire system works. The Entity Relationship (EER) model of the database is presented in Figure 2 below, which is designed using the visual studio 2017 Ado.Net Entity Data Model. The database is implemented on SQL server.

**2.2. Model of DSS**

The assessment and selection of academic staff is a multi-criterion problem, and accordingly, the model of the proposed the decision-making supporting system is based on the Fuzzy Topsis method [6-7], which is a multi-criterion expert method based on the fuzzy sets theory. This method is based on a matrix of decisions, which is formed on the

basis of the experts' assessments. The work [5] performed by the authors dwells on a model of the assessment and selection of academic staff.

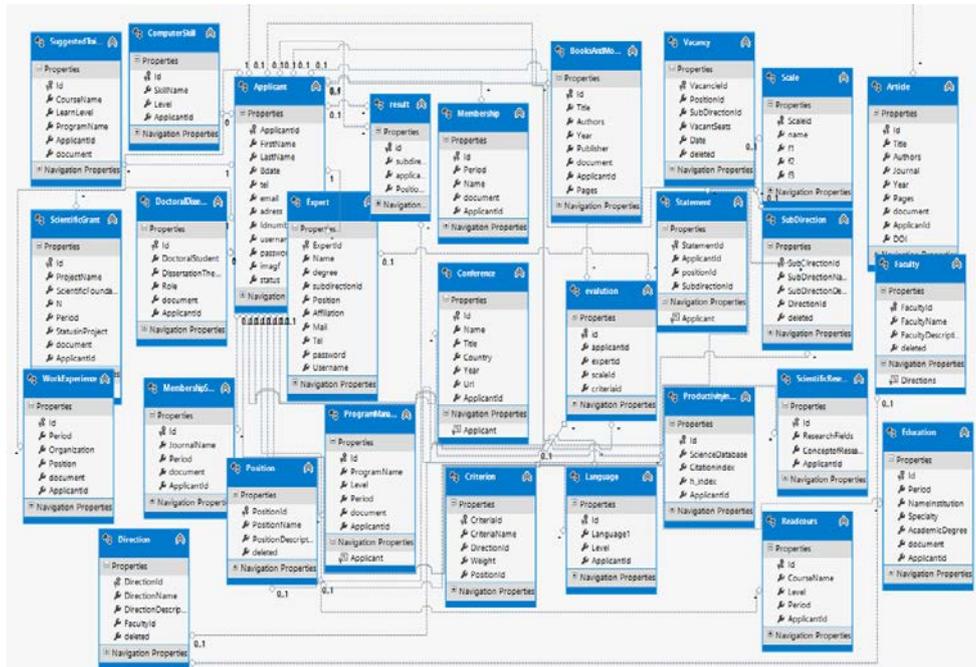


Fig. 2. Entity Relationship (EER) model of the database

### 2.3. System architecture

The generalized architecture of the system is illustrated in Figure 3, which shows clearly that system architecture is based on the web. The main part of the system is a three-level architecture. As Figure shows, the system consists of four main components:

1. Application Server – on which, the web-server is located (which provides communication with a web browser and provides clients with a web-page of the dynamic context) and the program's business logics.
  2. Database Server – the database server, on which the database management system is located.
  3. Client – the system's users (administrator, experts, applicants) using this system.
  4. Network - the network, which provides communication with a user's system.
- The network can be global, local and regional, which makes this system flexible, since it can be introduced in all types of computer network.

### 2.4. DSS's software package

System's computer software is implemented in the integrated space Visual Studio 2017 of the development of programs, using the programming language C# and ASP.Net MVC technologies, which are modern enough and popular technologies, the most convenient and friendly user's interface designed for the system's users. The software

consists of three modules: Administrator’s Module, Expert’s Module, and Applicants’ Module, which are equipped with the functions which comply with the requirements imposed to user of the appropriate role. The Applicants’ Module is maximally equipped with functions that prevent them from entering incorrect information into the system, in order to verify the data entered into the system, they are required to upload supporting documents into the system (in PDF format). Some fragments of system software are given below figures 4-7.

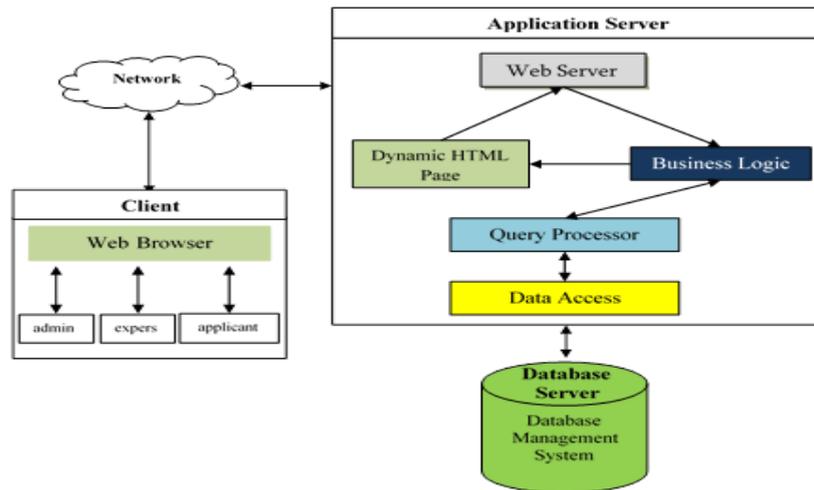


Fig. 3. The generalized architecture of the system

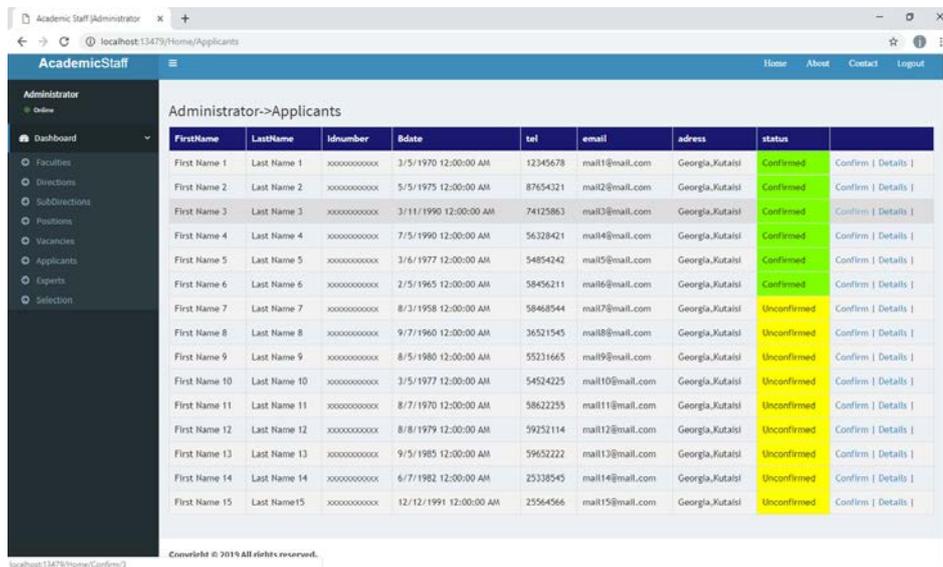


Fig.4. Administrator’s module fragment - Manage Applicants' Accounts

Figure 4 illustrates the user interface of the System User-Administrator Module consisting of the main vertical menu with the list of options that are envisaged for the role of system administrator.

Figure 5 illustrates the user interface of the system user (applicant) module, the main vertical menu of which consists of the options that allow the applicants for: entering and managing their own data, making an application for the competition position, receiving information on the final decisions on the assessment and selection.

The screenshot shows the 'MyAccount' page for an applicant. The left sidebar contains a menu with options like Profile, Articles, Education, and Work Experiences. The main content area displays the following information:

**MyAccount**

FirstName: First Name 7  
 LastName: Last Name 7  
 Bdate: 8/3/1958 12:00:00 AM  
 tel: 58468544  
 email: mail7@gmail.com  
 adress: Georgia\_Kutaisi  
 Idnumber: xxxxxxxxxxxx

**Education**

| # | Period    | NameInstitution           | Specialty    | AcademicDegree     | document |
|---|-----------|---------------------------|--------------|--------------------|----------|
| 1 | Period(1) | Name of the University(1) | Specialty(1) | Academic degree(1) | file.pdf |
| 2 | Period(2) | Name of the University(2) | Specialty(2) | Academic degree(2) | file.pdf |
| 3 | Period(3) | Name of the University(3) | Specialty(3) | Academic degree(2) | file.pdf |

**Work Experience**

| # | Period    | Organization         | Position            | document |
|---|-----------|----------------------|---------------------|----------|
| 1 | Period(1) | Organization name(1) | Working position(1) | file.pdf |
| 2 | Period(2) | Organization name(2) | Working position(2) | file.pdf |
| 3 | Period(3) | Organization name(3) | Working position(3) | file.pdf |

Fig.5. applicant's module fragment – Main Page

The screenshot shows the 'Assessment Form' page for an expert. The page includes a sidebar with a menu and a main form area. The form contains the following fields and a table:

**Assessment Form**

Faculty Names: Faculty Name 1 \* Direction: Direction Name 1.1 \* SubDirection: SubDirection Name 1.1.1 \* Position: Full professor \*

Applicant: FirstName LastName(1)

Criteria: Criteria 1

Value: Very Good (VG)

Save

| Applicant             | Criteria 1       | Criteria 2       | Criteria 3 | Criteria 4       | Criteria 5 |
|-----------------------|------------------|------------------|------------|------------------|------------|
| FirstName LastName(1) | Medium Poor (MP) | Medium Poor (MP) | Good (G)   | Fair (F)         | Good (G)   |
| FirstName LastName(2) | Fair (F)         | Medium Poor (MP) | Good (G)   | Fair (F)         | Good (G)   |
| FirstName LastName(3) | Medium Good (MG) | Fair (F)         | Good (G)   | Medium Good (MG) | Good (G)   |

Fig. 6. Expert's module fragment – Assessment form

Figure 6 shows the user interface of the system user (expert) module, which is equipped with functions enabling the experts to work in the system in accordance with their duties.

Figure 7 illustrates the fragment of the Administrator Module, which generates a matrix of decision based on the assessments already made before, and makes the selection in accordance with the Faculty specialties and number of vacant positions.

AcademicStaff Administrator

Selection

Faculty Name: Faculty Name 1 | Direction: Direction Name 1.1 | SubDirection: SubDirection Name 1.1.1 | Position: Associate Professor | Vacancies: 2

|        | Criteria 1        | Criteria 2           | Criteria 3           | Criteria 4           | Criteria 5           |
|--------|-------------------|----------------------|----------------------|----------------------|----------------------|
| Weight | { 0.83, 0.97, 1 } | { 0.57, 0.77, 0.93 } | { 0.23, 0.43, 0.63 } | { 0.57, 0.77, 0.93 } | { 0.37, 0.57, 0.73 } |

| Applicant             | Criteria 1           | Criteria 2           | Criteria 3           | Criteria 4           | Criteria 5           |
|-----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| FirstName LastName(1) | { 2.67, 5.67, 7.67 } | { 2.33, 4.33, 6.33 } | { 6.33, 8.33, 9.67 } | { 2.33, 4.33, 6.33 } | { 6.33, 8.33, 9.67 } |
| FirstName LastName(2) | { 4.33, 6.33, 8.33 } | { 1, 3, 5 }          | { 6.33, 8.33, 9.67 } | { 6.33, 8.33, 9.67 } | { 2, 5, 7 }          |
| FirstName LastName(3) | { 4.33, 6.33, 8.33 } | { 3, 5, 7 }          | { 6.33, 8.33, 9.67 } | { 4.33, 6.33, 8.33 } | { 6.33, 8.33, 9.67 } |
| FirstName LastName(4) | { 2.67, 4.33, 6.33 } | { 3, 5, 7 }          | { 6.33, 8.33, 9.67 } | { 4.33, 6.33, 8.33 } | { 4.33, 6.33, 8.33 } |
| FirstName LastName(5) | { 0.67, 2.33, 4.33 } | { 3, 5, 7 }          | { 6.33, 8.33, 9.67 } | { 3.67, 5.67, 7.67 } | { 7, 8.67, 6.33 }    |

| Applicant             | d+          | d-          | cc          |
|-----------------------|-------------|-------------|-------------|
| FirstName LastName(1) | 2.843587621 | 2.628099965 | 0.480308815 |
| FirstName LastName(2) | 2.812947554 | 2.673371299 | 0.487279608 |
| FirstName LastName(3) | 2.596797525 | 2.925350115 |             |
| FirstName LastName(4) | 2.804766619 | 2.739641987 |             |
| FirstName LastName(5) | 3.058350723 | 2.359911373 | 0.435547659 |

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Fig. 7. Administrator's module fragment – Selection

### 3. CONCLUSION

The paper describes the web-based decision-making support system that has been developed using modern technologies and methods of research, which can be implemented and effectively used in higher education institutions to ensure the process of the assessment and selection academic staff.

The implementation of the assessment and selection of academic staff by means of the proposed system has many advantages compared to the traditional assessment and selection process, in particular:

- All phases of the selection and assessment are implemented electronically;
- There is no need for setting up the registration commission (that would be economically beneficial to the university), which is created for collecting and organizing the documents submitted by the applicants, since the applicants themselves enter their data and certifying documents into the system;
- Users of the system can work in the system from anywhere through the Internet;
- Experts are more independent in their assessments compared to the traditional assessment process, which is essential for the selection of qualified academic personnel.

- Due to this system, the academic staff assessment and selection process is much more flexible and transparent.
- The level of access to information is high; the result of the selection is objective and highly reliable, and so on.

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