Improving Decision Making Process in Universities: A Conceptual Model of Intelligent Decision Support System

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Abstract

During recent years, universities have become more and more dependent on the collection, storage and processing of educational data. The dynamics and transformation of military higher education, characterized by complex processes and statuses, generate an immense volume of data, and their acquisition and storage requires the use of the innovation in the IT field. In this context, these universities have become more and more dependent on the collection, storage and processing of educational data. Decision-makers try to apply new strategies and use new tools to convert this data in useful information that would contribute to managerial problem solving. Good decisions involve using some software tools that support decision-making process to maximize the performance of universities and minimize the negative impact of faults. In this paper, we present an overview of intelligent decision support systems (iDSS), and also our own conceptual model in designing a higher education iDSS. The proposed system will be composed of three subsystems working in an integrated manner in order to provide quality services to the iDSS beneficiaries, as follows: the Data Management Subsystem (DMS) that offers the necessary data in order to develop of iDSS models, the Model Management Subsystem (MMS) which generates models on the basis of the data supplied by the DMS and the use of data mining techniques, analytic tools and reporting, the user interface (UI) this facilitates communication between iDSS and the beneficiary, in the sense that the beneficiary supplies the iDSS with data and extracts useful information for the educational process.

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1. Introduction

The effervescence regarding the concerns of building a knowledge-based society is continually growing among the European universities. Creating a common European space for the higher education by adopting the Bologna European Chart (September 1998) by the chancellors of the European universities and developing the Lisbon strategy of the European Union (March 2000) have generated the necessary environment to build a educational system based on quality. This new environment has a special impact upon the European universities which need to adopt new strategies in order to guarantee viable educational services while trying to increase the quality and efficiency of the education and research.

The series of concerns regarding the quality assurance for higher education refers both to the eclecticism removal [Señal et al., 2008] and to the improvement of the inner/related academic activities in order to develop a real network of European universities and research institutions.

The general objective of the article is to develop an in-built support system that would provide a scientific base for decision making within the higher education system and which would also contribute to HEQ improvement, to national and international collaboration of the institutions interested in HEQ by developing certain managing instruments, making the inner/inter related academic processes more efficient as they represent the base of building a real European network of research institutions and universities, thus contributing to the creation of a knowledge-based society.

2. Features of military higher education system

The economic development of a country is closely related to the development of its higher education [Gylfason, 2001]. The policies of the Ministry of Education, Research, Youth and Sports are in accordance with this statement and they especially emphasize innovation, improvement of quality of teaching and learning, the measurement of performance and learning outcomes, access to regional competitiveness.

The changes that have occurred lately in the Romanian higher education system, as in the rest of Europe, have been multiple, radical and continuous. The fundamental law on the basis of which the Romanian higher education system functions is Law no. 1/2011 according to which in Romania education is a national priority. From the beginning of the application of this law and until the present a series of other normative acts gave been elaborated having as a main objective the achievement of a performance higher education system, comparable and compatible with the existing systems in the developed countries. In this context, the recent policies adapted by the higher education institutions are oriented toward the consolidation of the quality of education with the goal to increase the academic performances in accordance with the current requirements of the national qualifications frameworks.

The military higher education institutions are open and receptive to both European and Euro-Atlantic tendencies [Frunzeti, 2010], and they accepted the challenge to play an important role in the construction of the European higher education system. Thus, the officers training is focused on responding to two type of requirements: academic requirements and military training. While academic requirements are imposed by civil standards, the military training is conducted strictly in accordance with military standards.

Military education, as defined by the Human Resources Management Department, it state education which is integrated into national education, having it’s own identity and personality, compatible with the educational systems of the armies of NATO member states.

In this context, these institutions are concerned with how to report the educational politics of military higher education institutions to the values of some famous European universities and also following the European trends of quality assurance within higher education. This is not a simple association because we want to develop an instrument which will help the military institutions to „collect, analyze and use relevant information for the effective management of their programs of study and other activities” ( according to the indications required by
the European Network for Quality Assurance in Higher Education) but also assure a scientific base in order to assist the decision-makers [Stanescu & Filip, 2011] and contribute to the improvement of the management of higher education quality (HEQ).

While gaining experience regarding implementation of new educational policies, military higher education institutions have become aware not only of how essential the storage and processing of educational data are, but also of the quick extraction of relevant information, focused and directly made available to the beneficiaries (teachers, students, graduates, managers, auxiliary teaching personnel, employers).

Starting from questions such as: Which are the elements and relations relevant to building a conceptual model that would be the base in the creation of an informatics system of assisting the decisions for the politics of assuring the quality of military education? Which information and under which form should it be presented to the decision-makers?"

3. Conceptual Model of Intelligent Decision Support System

The abundance of data makes it difficult to find the relevant, exact and useful information necessary to the higher education decision making process [Şuşnea, 2011]. The development of an integrated IT system that will assist the decision makers from the academic field in making the right decisions at the right time constitutes an important step in the implementation of the new educational policies.

The iDSS system will assure the requirements mentioned in the „ENQA report on Standards and Guidelines for Quality Assurance in the European Higher Education Area”, as follows: student progression and success rates, employability of graduates, students’ satisfaction with their programs, effectiveness of teachers, profile of the student population, learning resources available and their costs, the institution’s own key performance indicators. In addition to academic requirements we need to ensure that military standards are achieved.

In order to assure these services, the system will be composed of three subsystems working in an integrated manner in order to provide quality services to the iDSS beneficiaries as follows:

- the DMS subsystem (Data Management Subsystem) – offers the necessary data for the elaboration of iDSS models.
- the MMS subsystem (Models Management Subsystem) – is a software package which, on the basis of the data supplied by the DMS and the use of data mining techniques, generates models.
- the user interface (UI) – facilitates communication between iDSS and the beneficiary, in the sense that the beneficiary supplies the iDSS with data and extracts useful information for the educational process.

The DMS subsystem allows access to the data stored in iDSS own database with reference to the organizational structure, types of relations and work fluxes, the allocation of teaching and auxiliary teaching personnel, work and communication procedures between the system and the beneficiaries. The database will contain the following entities:

- ALUMNI – described by attributes: name of employer, activity field (the position requirements are in accordance with the training and specialization level), wages etc.
- MILITARY STUDENTS – described by two types of attributes: attributes describing the personal data of each student; attribute describing the educational activity.
- EMPLOYERS - described by attributes: name of company, dimension, field of activity etc.
- TEACHERS – described by three types of attributes: attributes describing the personal data of each teacher: name, surname, date of birth, address, sex, marital status, education, date of employment, academic title etc; attributes describing the teaching activities: diversity and quality of educational materials, taught subjects, number of hours allocated to each subject, number of resulting conventional hours and their quota, number of allocated credits etc; attributes describing the research activity (publication of books / articles: title, authors,
abstract, name of the publication, index, the web address where the article can be found; participation in projects: name of the project, value, position within the project (director/member).

- **FACULTIES** – described by the attributes: name of study program, level (degree, master, doctoral), specialization etc.
- **FINANCIAL RESOURCES** – state budget, own income, personnel expenditure, cost of utilities, investments etc.
- **EDUCATIONAL RESOURCES** – described by two types of attributes: didactic materials: book, manual, tests, reviews etc.; facilities: classrooms, technical means, medical and sport facilities etc.
- **SPECIFIC RESOURCES FOR MILITARY TRAINING** – included military technology and equipment necessary for the proper conduct of military exercises.
- **E-LEARNING** - included interactive and virtual resources can support authentic learning where students can relate to and experience real world contexts in their learning [Roceanu, 2012].

The MMS subsystem especially contributes to the reduction of errors and the growth of efficiency in the decision making process, but also to the faster data processing through the use of innovative methods from the data mining field (interrogation, reporting, statistics and artificial intelligence – neurotic networks, detection of anomalies, decision tress, clustering etc) [Şușnea, 2009]. These methods allow the extraction of information from the iDSS database system through the descriptive modeling of data, exploratory analysis, predictive modeling, anomaly detection, discovery of association patterns and rules.

The user interface (UI), intuitive and easy to use, together with its functionality / technology, constitutes an important element in the iDSS increasing the feeling of real control of the educational manager. The information supplied by the application will be dynamically created and the pages will only display the information accessible to the current user. End users will access the iDSS system only through the Web iDSS interface, thus solving problems related to: different physical and administrative location of the users, client software that should be installed and available on the workstation of each user, the Web interface will allow access to the iDSS to any authorized user with an ordinary web browser.

The iDSS application will have a modular architecture base on Web, allowing thus the gradual improvement of the technological infrastructure which in its turn contributes to the increase in the efficiency of the management decisions [Stoean, 2012]. The iDSS system will be developed using the web-base technology and will be organized on three architectural levels: client level, application level, database level.

### Conclusion

The development of an integrated IT system that will assist the decision makers from the academic field in taking the right decisions at the right time constitutes an important step in the implementation of the new educational policies. This conceptual model allows users to access data from many sources and choose a different level of data aggregation (high - top management, low – students and teachers). The discovered models and patterns allow beneficiaries to analyze data on academic and military perspectives, as follows:

- evolution of each military student along the semester / year / program duration for every subject or for all subjects;
- distribution of marks to students of the same group and their comparison according to the Gauss distribution;
- identification of groups of students prone to drop out on the basis of existing recordings in the databases of the students who already dropped out;
- identification of groups of students with close cognitive characteristics in order to form the groups of students;
- determination of the relation between the number of physical ours and the number of conventional hours taught by each teacher during a semester / year / program;
- identification of rules of association between the results of learning and research;
• identification of the degree of absorption of the graduates in the field for which they have certified competences;
• identification of the specializations required by the labor market;
• quantification of the quantitative and qualitative variables of the results of research (books, articles, studies) during certain periods of time.

Also, it developing the contribution capacity, knowledge transfer and communication between the military universities and the civil environment. In addition, it assists the decisions-makers by monitoring, modeling and predicting of HEQ and contributes to knowledge transfer and communication increasing capacity among the universities at national and European level regarding the domain of quality assurance.

![Fig. 1. iDSS components](image)

References