Requirement Analysis For A Higher Education Decision Support System. Evidence From A Romanian University

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Abstract

In recent years, under the impact of social needs development and labour market transformations, universities have begun to increasingly realize that they are involved in a fierce competition. They also begin to accumulate significant amounts of student-level data that could help them to obtain useful information, including far more detailed benchmarking than is currently available and that they can use to better position themselves in the market. In this context there is an obvious need of tools that support decision making processes and offers highly accurate information. On the other hand data driven decision support system are mature technologies that have proven their effectiveness in business and management. Starting from the premise that almost everyone from a university is feeling pressure to measure, analyze and report on various aspects of the educational process, our study aims by using interviews as research methods to identify decision-making process, knowledge sources, information needs and the extent to what these information needs are currently satisfied by the information systems of a university from Romania. These requirements will serve as starting point for the development of a data driven decision support system for higher education.

Keywords: data driven decision support system, higher education

1. Introduction

During recent years a paradigm shift occurred in the higher education system where universities have begun to increasingly realize that they are involved in a fierce competition and in order to succeed in their activity they must
adopt an entrepreneurial approach (Petruzzellis, D’Uggento, & Romanazzi, 2006). A paradigm shift occurred in the higher education system where market-type mechanism have been introduced even in countries previously characterized by a high degree of government control (Hemsley-Brown, 2006; Maringe & Gibbs, 2009). On the other hand universities begun to accumulate significant amounts of student level data showing significant potential for analysis (by aggregating and analyzing them effectively). Therefore, there is the possibility to obtain valuable information including far more detailed benchmarking than is currently available and that they can use to better position themselves in the market (Foster, 2011). Under these circumstances universities need systems that support decision making processes that could offer them highly accurate information and assist all managerial processes (Bresfelean & Ghisoiu, 2009). Decision support systems are software based systems that supports business or organizational decision-making activities. Although they are mature technologies that have proven their usefulness in business, their use in academic environment is only in an incipient phase. A data driven decision support system for higher education could help universities to (Lachlan, 2013):

• Understand recruitment trends and analyze the degree of success for its programs for attracting students
• Clarify student enrollment trends to different programs and assess the effectiveness of the courses offered
• Better track the financial transactions between students and university for a more efficient management of funds from tuition fees
• Disclose the right information, in the best possible manner, to government bodies in order to increase their comparative rankings, meet compliance requirements and secure the required funding level
• Synchronize marketing strategies with student feedback and take advantages from demographic, psychographic and geographic trends within student population
• Align student courses to labour market requirements in order to increase successful job placement upon graduation
• Offer to university decision makers the possibility to easily analyze operational data, from across faculties and functional areas

Data driven decision support systems is the category of information systems that focuses on the access to and analysis of a time series of data coming from both from inside and outside the company (Power, 2002). The most common data driven DSS is built using a central data repository called data warehouse where data are gathered in a consistent and non-redundant form from all operational systems of the organization and sometimes from external sources with the purpose to provide the ideal „single version of the truth” and tools to query and report data included in the data warehouse (Giovinazzo, 2000).

The success of a data driven rely on straightforward and rapid access to a large volume of accurate, well organized multidimensional data. Data driven DSS together with On-line Analytical Processing (OLAP) is the state of the art solution to analysis of large collections of historical data (Codd, Codd, & Salley, 1993). The main features of a data driven DSS are summarized below (Power, 2007):

1. Ad Hoc Data Filtering and Retrieval. According to this feature the system must offer the user the possibility to systematically search for and retrieve data from a central repository. Queries are often predefined and the system allows navigation through different level of aggregation (from most summarized to most detailed data and back) operations known as drill-down and roll-back.

2. Alerts and Triggers. Rules can be established allowing users to be notified when a certain key performance indicator value reaches a threshold value. Users can be notified through email or other communication channels and also other actions can be taken as a response to the trigger event.

3. Create Data Displays. According to this feature user can choose between different predefined displays like bar and pie charts, these displays can be used to analyze historical data in a time sequence.

4. Data Management. This feature require that users work only with a subset of data and sometimes can change data formats or even can request changes to data models.

5. Data Summarization. One of the most powerful feature of data driven DSS, this feature endows the user with the possibility to view or create pivot tables and cross tabulations. A pivot table shows summarized data in tabular format, the user being able to choose field whose values are displayed. Data can be analyzed from different perspectives, the level of aggregation can easily be changed from most summarized to most detailed data and back (drill-down and roll-up operations), and also a subset of data can be choose for analyze (slicing operation) (Jukic, Jukic, & Malliaris, 2008).
6. Excel Integration. Given the popularity of spreadsheet processors (Excel primarily), the DSS can allow the user to extract data from central system and further analyze it using this familiar environment (Excel). Some systems offers the facility to upload data in a user’s “working storage” for the purpose of analysis.

7. Metadata Creation and Retrieval. Metadata are date about data (an explanation of the data from the DSS data store) helping users to understand the data they analyze. The system should allow users to add metadata to analyses and reports they create.

8. Report Design, Generation, and Storage. Users should be allowed to create their own reports and save them for further use with different sets of data. Reports can be distributed using email, web pages or other formats.

9. Statistical analysis. System should provide tools that allow the user to create and display descriptive statistics but also to use more complex algorithms like „data mining” that allow them to discover patterns in large data sets.

10. View predefined data displays. Users can access complex displays that resemble the dashboard from automotive industry and that includes different types of diagrams and several panels of multidimensional analysis.

Starting from the premise that almost everyone from a university is feeling pressure to measure, analyze and report on various aspects of the educational process, our study aims to assess the need for a decision support system for higher education and to determine the requirements of such a system.

2. Research methodology

As research methodology the present study rely on a semi structured interview. The interviewees are members of the teaching staff of the Bucharest University of Economic Studies. Some of them (6) are members of faculty and university administration: department chairs, dean, vice deans, vice-presidents. Sixteen interviews were conducted during December 2014. A first objectives of the interview was to determine if there were situations in which the interviewees had to accomplish tasks that required complex analysis involving large volumes of data covering a long period of time (e.g. the analysis of trends in student recruiting and enrollment, the analysis of time evolution of students’ results at exams etc.). In addition they were asked if they thought they would benefit from the use a specialized computer based tool to perform the tasks mentioned above and if the current systems they have access to, offers enough support in accomplishing those analysis. Another objective of the study was to determine which of the main features of the data driven decision support systems are thought to be most important from the perspective of a potential user of such a system built for higher education field. The interviewees were asked to assess the importance they give to each of the following features: 1) Ad Hoc Data Filtering and Retrieval, 2) Alerts and Triggers, 3) Create Data Displays, 4) Data Management, 5) Data Summarization, 6) Excel Integration, 7) Metadata Creation and Retrieval, 8) Report Design, Generation, and Storage, 9) Statistical analysis, 10) View predefined data displays. A five point Likert scale was used to capture the importance given to each feature. This served as starting point for further discussion on the subject. Finally, the interview tried to capture the decisional situations that would become subjects of analysis in a data driven decision support system for higher education. A list with potential subject analysis was presented to the interviewees and they were asked to indicate the extent to which those are of interest for them. The list of potential decisional situations to be included in a DSS for higher education is presented below:

- Student Recruitment/Enrollment
- Interruption of studies
- Students’ transfer
- Students’ expelling
- Extension of studies
- Scholarships
- Tutorial activities
- Career development opportunities
- Curriculum and teaching resources
- Course schedule
- Evaluation of teaching staff
3. Results and discussions

A first objective of the study was to determine if members of higher education staff have faced situations in which they had to accomplish tasks that required complex analysis involving large volumes of data covering a long period of time. An opinion on the extent to which current systems offer support to perform those analyses were also inquired. The results of the interview show that most of the staff members of the university encounter situations where they have accomplish such tasks but there were also two cases where no such situations were present. In the majority of cases they had to prepare reports required by university management or analysis performed at their own initiative especially to analyze the exam results of their own students and scientific production trends. In relation to analytical support provided by current systems the opinion are slightly different among category of users. While there is a general opinion that there is a lack of analytical oriented instruments, members of administrative staff said they can access a series of predefined reports using the operational information system but there are areas of activity that are not covered by these reports and there are not tools that could allow them to create these reports ad hoc. On the other hand some of the interviewees said they were able to perform some analysis by extracting data from operational system and process it in Microsoft Excel. All of the previously mentioned persons appreciate themselves as experienced user of Microsoft Excel and owner of other skill in Information Technology field.

In relation to the second objective, the importance given to each feature of the data driven decision support system from the perspective of a potential user of such a system built for higher education, the results show no noticeable difference among categories of users. All the features seem to be well appreciated by all the interviewees. The most two appreciated features for all categories of users are: 1) Excel integrations and 2) Ad Hoc Data Filtering and Retrieval. The next features in the descending order of their appreciation are distinct for each category. While teaching staff seems to put more value in Data Summarization, Data management and Statistical analysis (in this order) administrative staff prefer the following features: Alerts and Triggers, Data Summarization and Statistical analysis. This distinction between the two categories of user seems to be right as the informational need are different.

The third objective of the study was to identify the decisional situations that are of interest for the persons involved in a university activity, these decisional situations being the starting point in defining the requirements of a DSS for higher education. The interviewees were asked to show their interest in each of the items of a predefined list and also to propose their own items. Results of the interview revealed that all the items are of interest, the most appreciated being: Exams Student Results, Bachelor final exam results, Exams results review or appeal, Research grants and Curriculum and teaching resources. Less appreciated were: Scholarships, Interruption of studies, Students’ expelling, Students’ transfer and Extension of studies. There seems to be no noticeable difference between teaching staff and administrative staff and this situation is caused by the fact that members of administrative staff are chosen from teaching staff and this seem to predict their preference for items that pertain primarily to educational issues. During the interviews few other topics were thought to be important from the perspective of their inclusion in a DSS for higher education: Student attendance, Staff continuous training, Courses held by foreign teachers and Courses held by business experts. The distribution of these topics (requirements) over the different level of university management, resulted after the analysis of the responses to the interview, is captured in the Figure 1.
4. Conclusions

In the context of increased competition between universities the present study starts by presenting the potential benefits of using a data driven decision support system for higher education. Further, using interview as research method the study tries to assess the need for a decision support system for higher education and to determine the requirements of such a system.

The results of the study show that almost everyone in a higher education institution is feeling pressure to analyze and report on different aspects of student population and although some analytical capabilities are offered by current operational systems (leveraged by spreadsheet skills of some users), there is lack of tools specially oriented towards analysis. All of the features of a data driven decision support system were well appreciated by the interviewees. Another result of the study consist in a list of topics (decisional situations) which actually defines the requirements of a data driven decision support system for higher education.

Limitation of the study resides in the limited context of respondents of the interview who come from only one university and limitations induced by research method (interview) which imply a dose of subjectivity.

Further research will target the refinement of the list of requirements and the development of a model of data driven decision support system for higher education.
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