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DECISION SUPPORT SYSTEM FOR BABES-BOLYAI UNIVERSITY

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Abstract. Babes-Bolyai University is considered from an enterprise perspective in order to build a business intelligence solution that would improve decision-making process in order to achieve a better performance, on both academical and economical level. Our initial proposed design takes into account an enterprise business model, identifying the main processes structured according to Zachman's enterprise architecture framework. A preliminary approach of the multidimensional design is also presented. Some of the possible entities to be considered in the decision process improvement are described in the paper. A collaborative business intelligence approach is inspected as a possible solution for the proposed model.

1. Introduction

Babes-Bolyai University is considered to be the most important employer and one of the most important economical agents in the Cluj-Napoca city. We try to view the university from an enterprise perspective and model its processes accordingly. We focus on some of the core processes and propose a data warehouse design as basis for a Business Intelligence (BI) solution.

The activities that are performed in a university can be seen and modeled as a set o individual business processes. There are business processes that involve a single department with a specific target and there are processes that span across the university. As the university can be perceived as an enterprise from business process perspective, the goals and current economical environment presses the executive board to optimize the activities, improve cost savings and improve services to their clients, no matter if they are the students, industry partners or some other entities.

This paper is organized as follows: the second section describes the nine building blocks of the business model and presents an enterprise architecture

2000 *Mathematics Subject Classification.* 68P15, 68U35.

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framework that we consider suitable for Babes-Bolyai University. The next section presents the multidimensional data model for the BI solution of the educational and research activity. Last section presents the business intelligence solution from its users point of view, proposing a collaborative approach.

This paper presents a preliminary approach for the design part of the BI solution. We intend to implement our data model, load it with data and apply data analysis and data mining techniques to help decision.

2. Business Model's Building Blocks

According to [3] "A business model describes the rationale of how an organization creates, delivers, and captures value". In their work they formulated the building blocks for a business model as follows:

1. Customer Segments: An organization serves one or several Customer Segments. - In our case, Babes-Bolyai University has as main "customer" the student, but it is not limited to that; there are projects having the industry or governmental units as beneficiary and some other cases like projects for professional retraining or life long learning for non student categories.
2. Value Propositions: It seeks to solve customer problems and satisfy customer needs with value propositions. As the society evolves, the knowledge transferred to students needs to be aligned accordingly, the result being the frequent updates in the University curricula and specializations offered to students.
3. Channels: Value Propositions are delivered to customers through communication, distribution, and sales channels. For the university case there are direct channels through courses, online channels through course materials provided, sometimes widely accessible, conferences, seminars, reviews and magazines.
4. Customer Relationships: Customer relationships are established and maintained with each Customer Segment through specific entities inside university: secretarial and academic staff for students, public relations department, research department for external projects, and so on.
5. Revenue Streams: Revenue streams result from Value Propositions successfully offered to customers. The revenue has many forms, from direct taxes collected from students, governmental budget received per student, funds raised, revenues from scientific research projects and other projects, sold magazines, etc.
6. Key Resources: Key resources are the assets required to offer and deliver the previously described elements and our university has a highly

respected teaching and research staff, a good infrastructure and various collaborations with other entities in the country and abroad.

7. Key Activities: The main focus is on teaching and research but also there is an administrative and maintenance department that facilitates teaching and researching in good conditions.
8. Key Partnerships: As the industry is the main beneficiary from the perspective of students as future employees, university developed partnerships with various leading players that share their knowledge early in this stage so that the students acquire more experience.
9. Cost Structure: The business model elements result in the cost structure.

In order to create a complete picture of the enterprise model for the university, we can use an enterprise architecture framework like Zachman's were we can identify and note [7] all the goals, people and technologies that support achieving the goals (see Figure 1, taken from [6]). When building the business

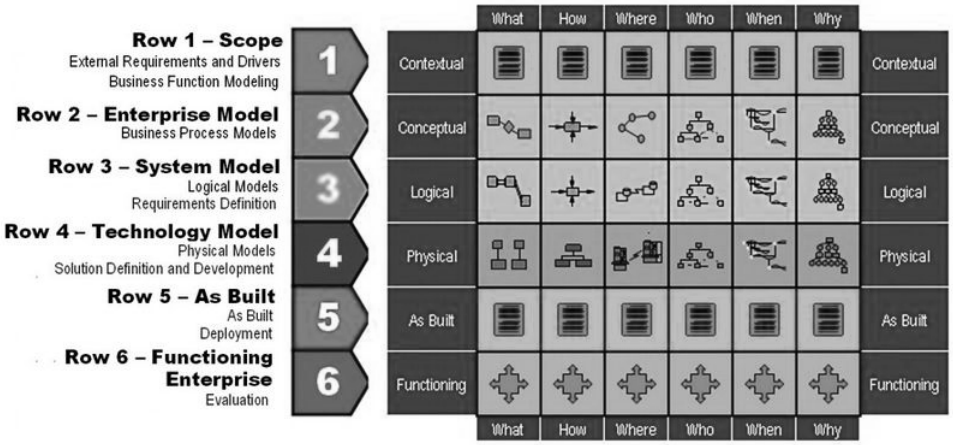

FIGURE 1. Zachman Framework [6]

model we have to take into consideration that the organization is not new on the market, but has long and successful history. Also, the customer is not a client entering a shop for an everyday goods shopping, but a student that invests time and money in developing a profession or employees needing to upgrade the skills in a dynamic economy. In order to compute the profit in a university, we need to visualize more than monetary figures. The numbers of students enrolled might be another success factor, along with the number of graduated students that were employed right after their graduation in a field related to their studies.

The number of research studies successfully finished and implemented have the same importance. Solving problems that increase the standard of living is also a good measure of the success. With all these processes, it is difficult to determine what processes to optimize and where to reduce costs.

In order to make it easier for the executive board, we propose a data warehouse model that would collect all data related to processes inside the university and serve as basis for a business intelligence application that would help in taking appropriate decisions in the optimization process. Our proposed model intends to provide means (at least) to:

- Manage corporate performance
- Provide analytical insight into data
- Allow users to analyze data in a self service manner
- Achieve a balanced academic structure and class schedule
- Support and manage processes for student life-cycle
- Improve admission and grading

3. Modelling the Data Mart

Universities obtain a part of their financial support from student taxes. Therefore, one of the fact tables will be FactStudPayment, which stores the taxes collected from students. Universities have a hierarchical structure consisting of faculties, departments and specializations. The academic staff is organized in departments; students are enrolled to one specialization within a faculty. Usually students are grouped in some formations (DimStudentGroup). Teaching resources are classified into position groups (e.g., professor, lecturer, etc.). Curricular activities are referred as courses. For the data mart these will constitute *dimensions*. Time dimension cannot be missed from a data warehouse. Dimensions usually are not in third normal form. Nearly every dimension has a DateFrom and DateTo attribute, they are not visible, because of space consideration. A student type (StudentType) will change in time, he begin as undergradute, them becomes graduate, he can be a PhD student. This is a Slowly Changing Dimension, which gives us the possibilty to follow student's career. The academic processes can be considered in terms of educational supply with faculties as suppliers of educational services and students as their consumers.

The FactStudPayment fact table has the following dimensionality: student (with the next hierarchy: faculty, specialization, student group), time, taxes.

Students' results at different curricular activities are stored in Catalogs. This is considered fact table, students' graduation at different courses in different faculties, specializations, different semesters can be measured. See the data mart for curricula activities and students payment in Figure 2. The third

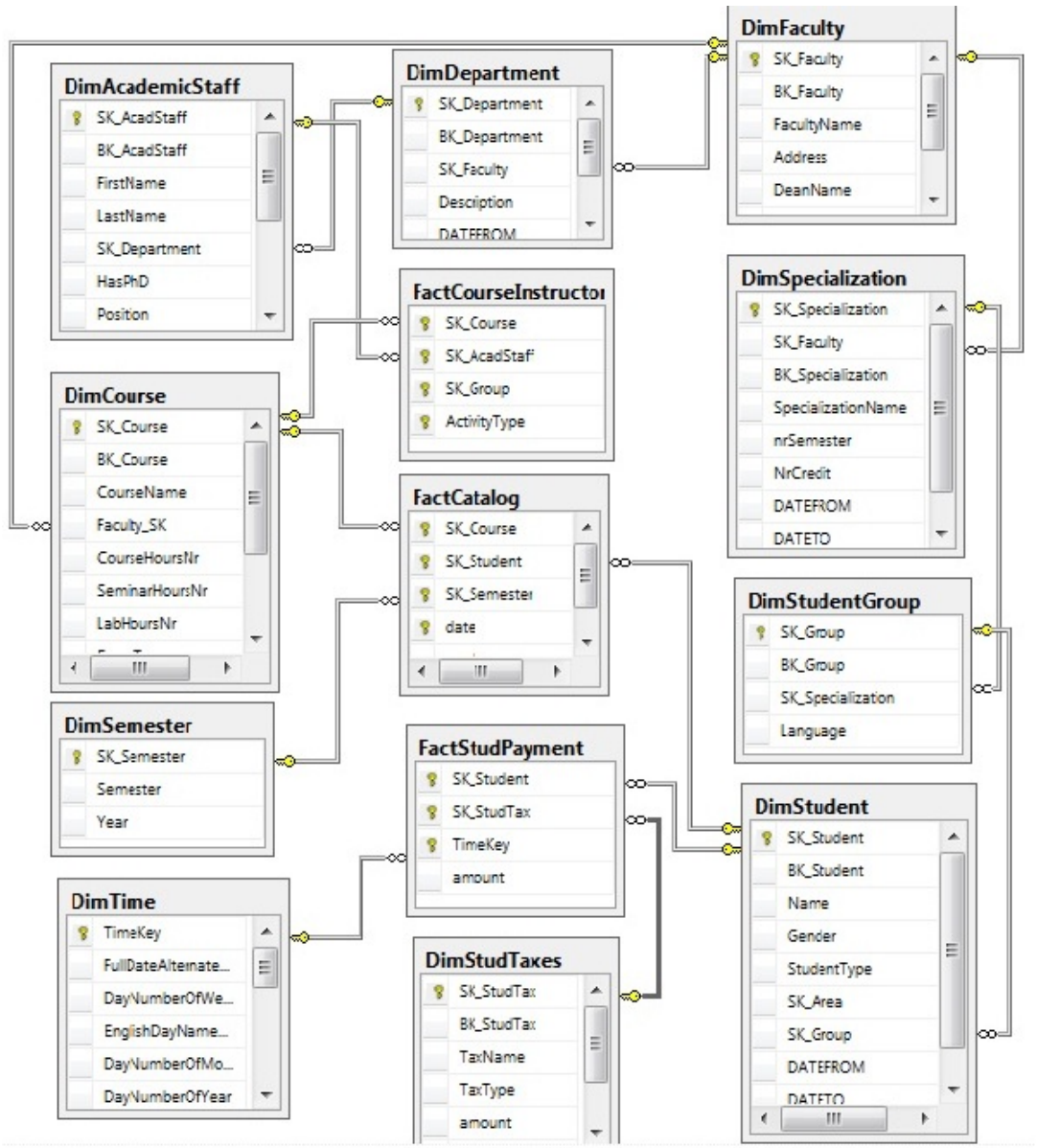

FIGURE 2. Data Mart for Curricula Activity

fact table in the constellation model is FactCourseInstructor. This table stores which course by which instructor for what student group is presented.

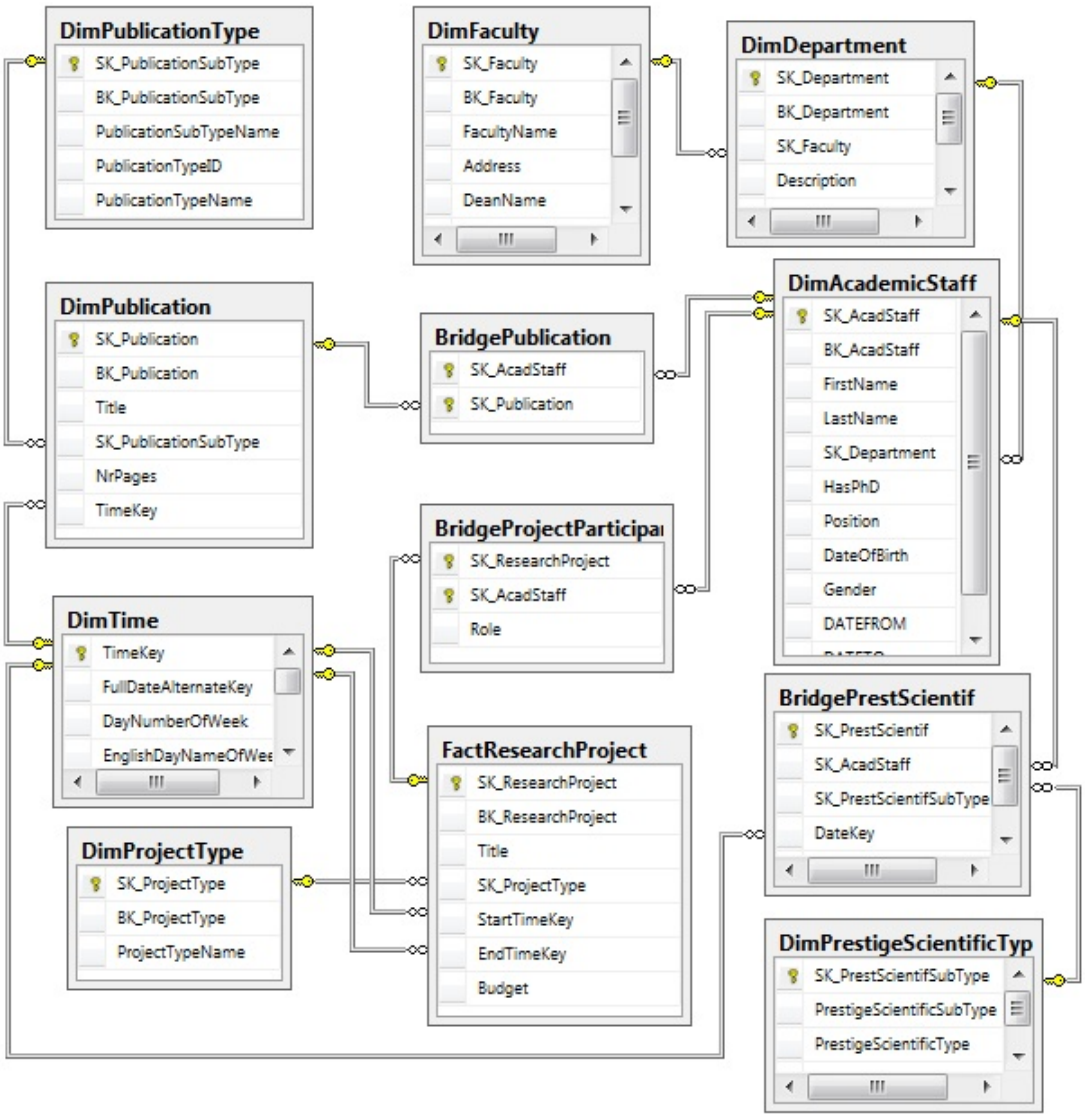

FIGURE 3. Data Mart for Research Activity

The data model for research activity is in Figure 3. Academic staff is involved in research activity which is measured by publications and participation in research projects. Research projects have a budget, so this can be

considered *fact* table. Aggregation functions can be applied for this fact table in the faculty, department hierarchy.

The quality of publications and the number of them are a very important measure of research activity. There is no measurable attribute, so we design a bridge table to store the authors of the publications in BridgeProjectParticipants.

There are other activities, which are important in the scientific prestige of the university, like reviewer in an international journal, getting an international prize, etc. These are stored too in the data model.

4. Sharing and exchange of information

Information offered by the described BI solution has to get to the right people in the organization, so that they can analyze data and make valuable decisions based on that. People that could improve the decision system are not always at the top level of the organization. There are often people at different levels that could bring valuable knowledge in the process of data analysis.

The concept of *Collaborative Business Intelligence* is a quite new trend that refers to such a collaboration between different users in order to improve the decision making system. It represents a merge between business intelligence and social media tools in order to facilitate BI solution users interaction so that they can choose the most relevant data and share it [5].

The BI solution proposed in this paper will transform raw data into meaningful and useful information, but due to the complexity of the organization, analyzing this data and deciding which is the most relevant and the most valuable will require cooperation between different users. Collaborative BI brings the human component next to the organizational information. The process of irrelevant data rejection will be therefore enabled by rating, commenting and sharing.

Some of the advantages of enabling users to interact and provide feedback on reports and dashboards are therefore:

- choice of relevant data
- improved decisions
- taking decisions in a shorter period of time

BI products are being integrated with collaborative platforms like Microsoft SharePoint and IBM Lotus Connections. There is also a development towards cloud based technologies which represent a good approach for collaboration. Mobile technologies also sustain integration of collaborative BI.

Another meaning of collaborative BI is given by data warehouse integration. This comes from the need of interaction with other organizations in the

process of decision making. Indeed, cooperation with other Romanian universities could result in better decisions with high level impact. This would require that each university has its own data warehouse which is to be integrated.

There are three approaches found in the literature for enabling collaborative BI [4] in the sense of data warehouse integration:

- *warehousing approaches* where the integrated data are physically materialized
- *federative approaches* where the integration is only virtual
- *peer-to-peer approaches* when there is no global schema to rely on when integrating different datawarehouses

The first two approaches require the existence of a general schema under which data warehouses coming from different sources could be integrated. In the cited paper [4] there is a new proposed peer-to-peer framework called Business Intelligence Network where peers expose querying functionalities aimed at sharing business information for the decision-making process. The main features of this framework are decentralization, scalability, and full autonomy of peers.

Collaborative business intelligence seems therefore to be a good solution, from both perspectives, for our university BI model. Different tools will be investigated in order to find the most suitable approach for our study case.

5. Conclusions and Future Work

A preliminary research has been done for building a BI solution that could help improve decision-making process for Babes-Bolyai University. This could lead to a better performance of the university at both academical and economical level. We started by identifying the main processes that take place in the university from an enterprise perspective. A preliminary model for the multidimensional design is described. A collaborative approach have also been proposed for the information sharing and exchange in order to improve the decision making system.

The authors intend to study the impact of this solution for the university and to implement the proposed model. The multidimesional model will be extended to graduate students employment, in order to see which are the specializations with the highest employment rates and which is the impact of students' practice for their employment. Also, we intend to apply data mining [2] and data analysis techniques like Formal Concept Analysis for the constructed data warehouse.

6. Acknowledgement.

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