

INFORMATION SYSTEM OF THE INSTITUTE OF INFORMATICS: IS FOR STUDENTS BY THE STUDENTS

Vangel Ajanovski

Institute of Informatics, Saints Cyril and Methodius University
Skopje, Macedonia

ABSTRACT

After the introduction of the curricula in accordance to the ECTS recommendation in 2005, the Institute of Informatics was confronted with the mismatch of speed, agility and effectiveness of the administration office required for the sudden growth of the Institute and the change to the more dynamic style of studying. The process of keeping student records was still paper-based and static, while the new ECTS regulations enabled the students to take a more dynamic approach to studying, by choosing their own pace.

Pressed with the need for a solution for student records, tracking the students' progress and eliminating some of their complaints, the Institute of Informatics has turned towards development of a department-level transactional information system. This system was envisioned to have placement at the department and to be an implementation of the requirements of the department. These requirements, in fact, eventually would lead to a system that is broader than the requirements of a generic student administration office.

This paper presents the ideas and rationale behind this development and how the process of development of a new system took place, from the inception of the system, to the transition in a production environment.

INTRODUCTION

The Institute of Informatics is a constituting department of the Faculty of Natural Sciences and Mathematics at the Saints Cyril and Methodius University in Skopje. The primary responsibility of each institute is the organization and realization of studies and research in their field of competence. The Institute of Informatics is responsible for organization of studies in several study programs in the field of informatics (academic studies in computer science, information systems, software engineering, computer architecture and networks, education in informatics and e-learning; and professional studies in internet and mobile technologies and administration of computer networks).

Although the law treats the universities as integrated universities, at this moment, each of the faculties is almost completely independent. For example, each faculty has its own administration office dealing with student services and affairs. Each of the departments at one faculty (institutes or centers) is served by the same office at the level of the faculty. So from administrative point of view, the work is not integrated and centralized at one point - the university, but at approximately 30 points - all the faculties and other institutions, some of which work in a completely different way.

At the Faculty of Natural Sciences and Mathematics the process of informatization and computerization of its services and administration has begun in the beginning of the 1990s

and was led by prof. dr Margita Kon-Popovska from the Institute of Informatics through several projects with a final goal to establish an integrated information system consisting of several applications and databases dealing with various process of the administration. Unfortunately, due to lack of understanding of the problem from a competent, systemic and especially from a visionary point of view, the process was severely undermined by the top management of the faculty and at the very beginning of the 21st century (2000-2002) all the projects related to students services went to full stop.

At that moment the management rejected continuation of all efforts in this area and crossed fingers expecting some eventual solution from the upper level - the University. The author of this paper was proposed as a member of a committee for evaluation of a software solution offer due some months after, but this committee never even met and although some solution was tested at the administration office personnel, it was never officially evaluated and accepted through a competent board. (Even at time of writing of this paper, neither the previous application nor some new solution is in use.)

Gradually the administration office personnel turned towards paper work and unstructured electronic office-type documents. They old databases become a legacy burden and without new development the old applications became useless. The personnel more and more renewed their forgotten skills of managing their work without an electronic database of student records.

GENERAL REQUIREMENTS OF THE INSTITUTE OF INFORMATICS

In 2005 the Institute of Informatics introduced new curricula in accordance to the ECTS (European Credit Transfer System) recommendations. As it is well known, the ECTS introduces the mobility of students which is only possible on the principles that the choices made by each individual student on her own should be the ones leading the progress of that student. On the other hand the administrative staff of the Faculty still tried to manage the students' demands at the level of larger groups and still with the presumption that such groups act as whole, taking courses year after year strictly adhering to the accredited study programs. Obviously this was not factual reality any more. Still, the process of keeping student records was static and paper-based, while the new ECTS regulations enabled the students to take a dynamic approach to studying, choosing their own pace and study-load throughout their studies.

Very soon, the Institute of Informatics, as one of the departments of the Faculty of Natural Sciences and Mathematics with the largest number of students was confronted with the mismatch of speed, agility and effectiveness of the support and administrative staff required for this innovation and the resulting sudden growth of the Institute. When the first

generation of students have finished their first year, the first symptoms of a systemic problem became visible. Unable to cope with the demand, the administrative staff offloaded their “ballast” towards the ECTS advisers at each Institute, having them perform all administrative and book-keeping tasks required to enable the students in making their choices, while enrolling courses and semesters instead of classes and study years. Being chosen among the teaching staff, the ECTS advisers had a dual and at times conflicting role – teaching the student in the morning and advising the student on the weight of courses he was about to enroll in the afternoon.

The offloading of the book-keeping process and keeping it on paper (and several Excel documents) created an effect that the student administration office staff no longer had the information on the factual status of the student and her progress, which was buried among tons of paper. Hence the further shortening of the list of services they were in position to provide and more transfers of the burden to the ECTS advisers.

This behavior peaked after just 2 full semesters of the first ECTS generation, and especially when the next generation of freshman entered the loop. At that moment the ECTS adviser was solely responsible for the semester and course enrollment of each student, while the student services only served as a document archive. Even more, in the exam periods it was evident that the exam applications were not processed at all, and that more often than not, students were showing up at exams that they had not the right to take at all. Student grades became unmanageable and nobody was in clear position to easily evaluate the status of a student and decide whether she will be granted or denied her enrollment application. The start of the 3rd semester was prolonged and ridden with problems for almost a month with hundreds of students repeatedly circulating the doorstep of the ECTS adviser office every day. Many student applications were overlooked and granted despite containing invalid requests.

In January 2007 the author of this paper took motion and as being responsible for the function of manager of the computing center, proposed to the Institute of Informatics that a decisive action should be taken and move towards a modern solution encompassing the requirement of the Institute itself. A special committee (also led by the author of this presentation) was formed to investigate the situation and propose a solution. The committee decided to start the implementation of an integrated information system with the first primary priority – help the enrollment process and work towards integration of several other electronic services that were planned for the future or were already under implementation: student grades, documentation and archive management, keeping students' in course track record, exam applications and management of teaching work force (especially management of leave of absence). This project was to be with help from several other projects dealing with the management of curriculum, workflow and document management, and teaching staff academic career management.

This system was envisioned to have placement at the department and to be an implementation of the requirements of the department. These requirements, in fact, eventually would lead to a system that is broader than the requirements of a generic student administration office. The reason for this is

that this time it is not only the final grades and status of the student that matters, but the whole process as a series of events from the beginning of interest towards the studies, through entering the studies, the whole process of learning, finishing the studies, finding jobs, connection with fellows with similar interests. So this is a system with a broader social context but should be supported by a transactional-type low level system component, used for registration, monitor and control of all important events and decisions related to the students.

In the meanwhile, a simple web application targeting a subset of the enrollment use-cases was created by the author of this presentation and all the special cases were dealt with manually. This application was based on the original Excel tables that were previously maintained manually by the ECTS adviser. The tables were analyzed and normalized to some level and a mini database was formed. This database model was not elaborate enough and was only static in nature and did not hold data for the various processes a student went through, nor the variety of cases that could possibly happen. In fact there was not even enough structure and enough data to control the enrollment applications and it worked mainly similar to a generic survey-type application. It was up to the student to honestly fill the data and up to the ECTS adviser to carefully control the data. Of course, such an application was not even considered a solution, but merely a transition vessel.

REQUIREMENTS MODELING AND DATABASE DESIGN

After the initial agreement and analysis of the situation, the general consensus was that the staff of the Institute of Informatics is short-handed and there was an evident need of at least several programmers to help accomplish the planned first phase of the project – student records and enrollment process. As the Institute was not prepared to undertake such financial burden it was immediately understood that the envisioned time-frame of the first phase of only 4 months was not going to be met even in years. Having no other options, the project was presented to a group of students as an *an information system for students made by students* and they were asked for volunteer work throughout an integrated case study lasting through several courses. This was not a new idea at all, since such project-work was offered to students continually every year since the middle of the 1990s. The difference this time was that this was going to be a real project that would be truly in use and the usage would be controlled by the Institute of Informatics and its needs.

After an informal presentation which happened in March 2007, a group of students was formed from the ones involved in the Database course and the Advanced Databases course. This group was led by the author of this paper and started with gathering requirements from many people involved in this process at the faculty level throughout the years. As a starting point for the requirements for the database model they were given a physical database model that had previously evolved from the ones at use at the Faculty, but which had never gone to life and which was now obsolete due to the changes in the system introduced with the ECTS.

The database group worked in pairs and analyzed the gathered documentation on curricula structure, student and

enrollment records, time-schedules, student finances and grades and produced two alternative conceptual level database designs.

After several meetings and discussions with relevant staff, the most open and dynamic-natured proposition was pursued and finished down to physical level. The final version of the designed database model is mainly interesting from the following points:

- it collects data on each person in all of his studying efforts no matter if at undergraduate, master or doctoral level
- the students can be mobile and there whole history is recorded and can be seen by relevant personnel, meaning that the student can have one file shared among several institutions
- all events related to the studies can be recorded and can be presented to groups of students depending on interest
- all relevant steps in the process of studying are recorded, and the database model encompasses three levels of records - generic study plans, their implementations and finally their current specific realizations in relation to students
- the structure of the study programs is recorded with all their histories in the past and with possibilities of grouping courses, setting inter-dependencies (Fig. 1 and 2), automatic recognition of previous efforts and credits and offering students an informed choice between courses
- a document archive with records on all documents related to event in the process of studying

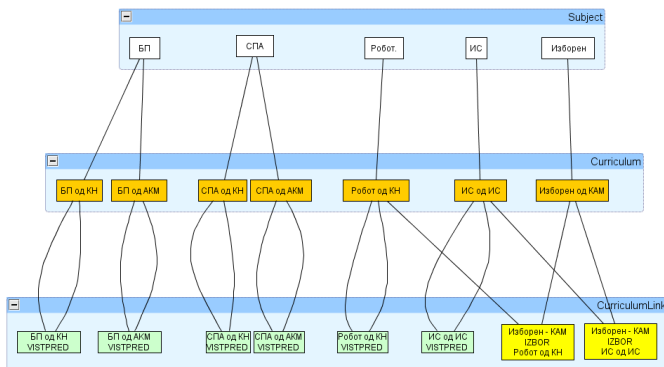


Figure 1: Subject, curriculum and curriculum link

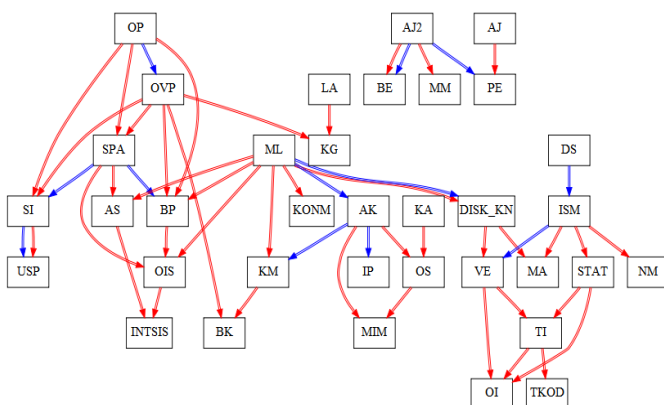


Figure 2: Graphviz generated dependency graph

FROM PROTOTYPES TO IMPLEMENTATION

After the finalization of the database model the group discussed several options for rapid development of a prototype in order to check the fulfillment of the requirements. Two prototypes were started as part of diploma works - one based on the domain-driven development framework Trails with a PostgreSQL database, and another one based on the Oracle Application Express over an Oracle XE database.

Although the original database group dissolved, these two efforts resulted in two successful diploma work submissions, but were not really successful in terms of the project requirements. The Oracle Application Express had many limits that lead to a need to circumvent in many ways it's internal components and rebuild them from scratch in a new way in order to build a user-friendly solution. The Trails framework looked promising but over the course of several months of experimentation with it, it had never developed enough community to feel secure with it and to have enough support for continuing efforts. The positive impact of the Trails prototype was that this framework was used to implement an administrator's view of the transitional web application, which eased the process of setting up the application with the requirements for each next semester.

The following two years the project development process continued as part of the core courses in the Information Systems study program (Information Systems, Analysis and Logical Design of IS, Team-work, Physical Design and Implementation of IS). A less-formal rendition of the Rational Unified Process was simulated throughout these courses with a group of 10 students.

In the first course – Information Systems, the RUP Inception phase was undertaken and the artifacts of Vision, Problem Statement, Product Positioning Statement, feature lists and use-cases were discussed and documented.

In the second course – Analysis and Logical Design of IS, the process continued through the RUP Elaboration phase and elaborate use-case documentation was produced, accompanied by UML model produced in IBM Rational Modeler with use-case diagrams, activity diagrams for most important scenarios, and a first iteration of a realization was designed with class diagrams and sequence diagrams.

The development continued in the Teamwork course, where a mixed group of students started implementation of the realization designs using open-source technologies, while in parallel in the Physical Design and Implementation of IS course, a construction level physical design of use-case realizations was modeled and integration-tests were developed.

Also as part of Physical Design course, a single use-case was chosen and several new prototypes of that use-case were made with the help of various domain-driven development software platforms. As a result of this effort the platform OpenXava emerged as the best candidate for the administrators views of the new system.

The implementation of the front-office architecture was based on a three-layer model (UI, business services and data access object layer) where the UI was built around Tapestry, Hibernate was used for object-relational mapping and implementation of the DAO, while Spring framework was used to create a (some-what) loose integration between the three layers and the authentication services based on JA-SIG CAS.

The project implementation used directly or indirectly many other open-source technologies and after the import of the data from older databases, it was finally up to alpha level release in September 2009.

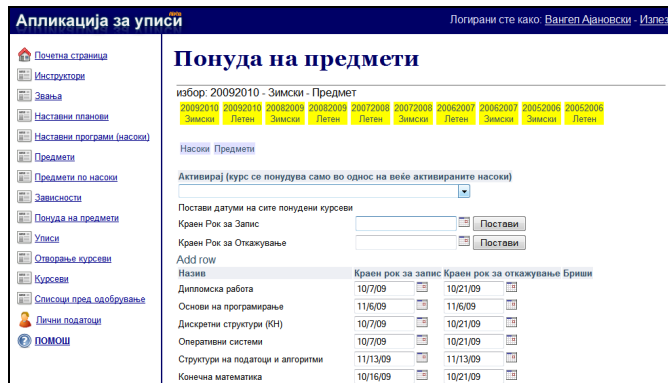


Figure 3: Editing subject offerings per term

The current solution consists of more than 90 web pages, 30 business level services and more than 20 DAO-s backed by 80 database tables.

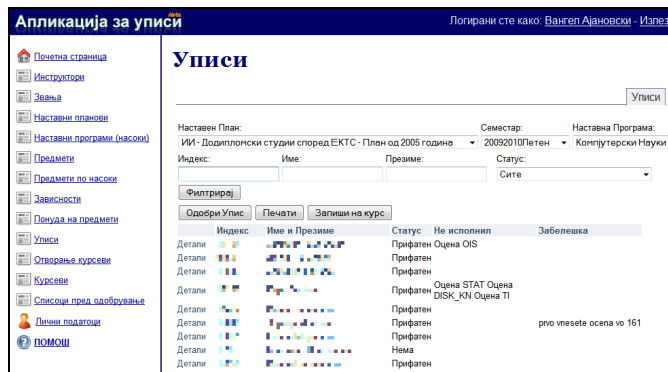


Figure 4: Enrollment office dashboard

The solution is currently running on a virtual machine equipped with an Ubuntu operating system, PostgreSQL database, Apache Tomcat server and endured at least 120 concurrent browser sessions (highest recorded number of concurrent Tomcat sessions). The current version of the developed web application can be seen in the snapshots in Fig. 3, 4, 5 and 6.

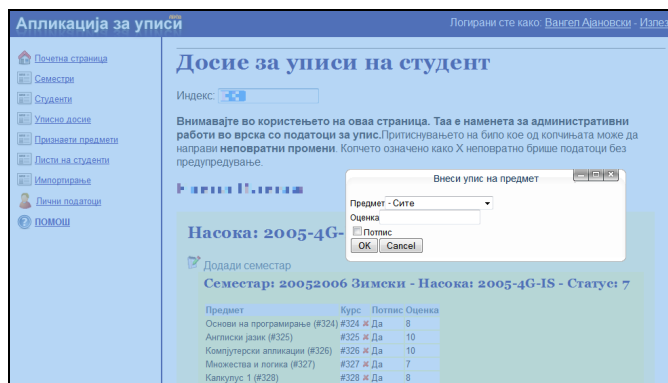


Figure 5: Editing the enrollment dossier of a student

Unfortunately until the time of writing, due to lack of time and shifting focus of interest, the prototype for the administrators' view was not developed any further and the administrator (at the moment the author of the paper) is still coping with SQL queries and direct modification of normalized database tables.

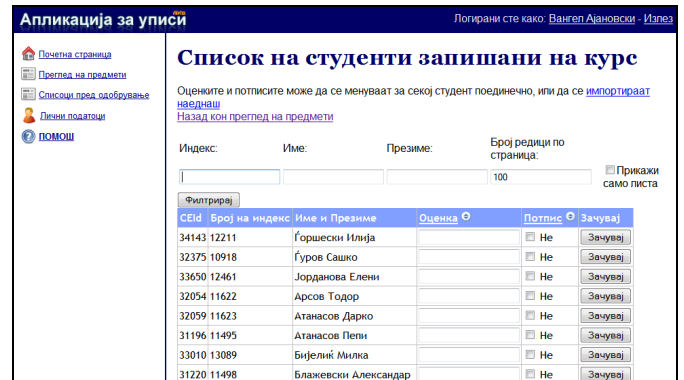


Figure 6: Students' course grade-book

TRANSITION TO THE NEW SYSTEM

The transition to the new system is a complete story on itself. During the implementation phase in 2009, yet another reconstruction of the curriculum happened. This reconstruction prevented the usage of the transitional web application that was merely serving the last few semesters.

Because of the urgent need to introduce the new system, it went in production at alpha level of quality and it took over 600 support ticket reports by users – of which 400 were in the enrollment period in September 2009, and 200 in the enrollment period in February 2010, and more than 200 bugs were resolved in the whole study year 2009/2010. It must be mentioned that this is the overall numbers of tickets, some of which are not related to the software itself but to the lack of full data-set corresponding to the factual student records and which were corrected on the fly.

Nevertheless, a general trend of reduction of number of overall support tickets was seen and there was a total depression of 50% in the last session and only few of the new tickets in the last week of the term were related to the software itself. This means that finally the system has gone from alpha to production level quality.

CONCLUSION

As a final note, it can be said that although the Institute of Informatics had a 10% raise of total number of fresh-man students in the study year 2009/2010 and although a new curriculum was introduced in parallel to the previous one and despite of the tremendous effort required for the system transition, we are already seeing some early benefits of the usage of the system. For the first time in 10 years the class schedule has been published ahead of the actual deadlines, and all the students had their first class at the very first working week. In addition to that, the on-line courses system was fed with the up-to-date enrollment records and automatically gave access to students and teachers to the on-line course materials for the courses they have applied for.