Requirements and Modeling for a Studies Orientation and Recommendation System (SORS)

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Abstract: The attainment of requirements and modeling -from the point of view of business and system- to achieve a first approach to the real context of a Studies Orientation and Recommendation System (SORS) is proposed. Based in this proposal, the develop of a working prototype will be possible, using the Object Oriented Paradigm (OOP), following the methodological approach proposed by Rational Unified Process (RUP), by which is possible to develop software iteratively and incrementally, focusing on system architecture and Use Case driven, with preference for Business Modeling with the active participation of each of the stakeholders in the implementation.

Key-Words: Higher Education Institutions (HEIs), Recommender System, Object Oriented Paradigm (OOP), Rational Unified Process (RUP), professional education opportunities.

1 Introduction
In order to respond to educational demands of the student population and to fulfill needs to development of the various regions of Venezuela, Higher Education Institutions (HEIs) offer courses in several areas of knowledge. To make a selection applicants must apply through the various mechanisms established by the University Sector Planning Office (OPSU - Oficina de Planificación del Sector Universitario) and/or comply with additional regulations and procedures established by every HEIs. The OPSU is the technical office of the Universities National Council (CNU - Consejo Nacional de Universidades), that has responsibility for implementing policies and strategies for counseling and support to HEIs in the performance of their functions, as well as rules and procedures for operation.

In this context, for any candidate that wishes to attend to the high education level, choose a career implies to take in consideration a large number of variables. If there are inadequate resources and tools to support the applicant through this process, that do not take care several factors as the numerical possibilities, social, economic, financial, vocational, family, institutional, geographical and biopsychological characteristics of applicant, then it can be explained the dropout rates, the various switching careers (mobility), the extension in time to achieve career and personal, and even family, frustration that must cope an individual. This is the situation in Venezuela, but may be present in greater or lesser extent in many other countries, especially in Latin America, where the dropout reaches alarming rates in some countries. For example, Guatemala reaches 82%, Bolivia 73.3%, Uruguay 72%, Brazil 59%, Costa Rica 54%, Chile 53.7%, Panama and Colombia 49% and Argentina 40%; Venezuela has a lower rate of 30%, as found in a study on retention and dropout [1], as in statistical studies related to this subject in individual countries [2] [3] [4].

In this paper, section 2 presents the problem formulation; Section 3, refers previous research and reference definitions, Section 4, presents the bases that support the modeling, and finally, Section 5, the conclusions and future research, followed by references.

2 Problem Definition
It is noticeable how difficult it is for students in general and particularly for those who are about to begin high education level, the choice of a career, given the number and complexity of variables to be evaluated to get an answer that is closest to their tastes or expectations [5] [6].

The consequence, logical and immediate, which generates this problem in the student is the resistance to use information available through various means, in the official reports of study and career
opportunities offered (available in Venezuelan “Study Opportunities Book” (LOE - Libro de Oportunidades de Estudio)). This lead to make a choose with insufficient information, without assessing the various factors and variables related to offer and selection of a career. This situation could lead the student to select and initiate studies that subsequently do not meet his / her expectations, he / her could not estimate the cost / benefit study certain fields or opt for study at institutions where their academic profile is not suited to a career or institution of higher education, among other considerations that may be taken into account when choose in a conscious, free, informed and reasoned way.

With the intention of providing a tool to provide recommendations and guidance on study opportunities at university level is proposed Studies Orientation and Recommendation System (SORT), which aims to:

- Retrieve and integrate information from the Higher Education Institutions (HEIs) and the official reports on study and career opportunities offered.
- Collect information on the user profile (applicant).
- Make recommendations of studies according to different variables considered for election.
- Retrieve recommendations made to other users.
- Promote guidance from experts, strengthening the National Orientation Systems (NOS).

With this new system, which relies on the synergy of technologies, is expected to meet formal requirements identified during the investigation, such as:

- Improve OPSU management information.
- Get information needs (offers HEIs).
- Obtain a candidate profile and use it to customize a recommendation.
- Assist the applicant in the decision-making process.
- Generate statistics, which allow analysis and projections and recommendations for improving public policy.
- Generate new study recommendations not only for vocational aspects, but also for economic development issues, at country or regional level.
- Promote the guidance that undoubtedly underpins the objectives of the NOS.
- Provide information that links study opportunities (educational opportunities) and occupational needs (labor demand), helping to balance the personal aspirations of the candidate with the real needs of the labor market.

3 Background and Definitions

There are some previous studies that support the conceptual modeling SORS, moving progressively from simple vision of a system that draws on the domain ontology, could make content recommendations [7], [8], to a vision of greater complexity on which the system is modeled in interaction with more complex ontological structures and domain-user-profile, supported by agent technology and methodological resources related to data mining and semantic Web [9], [10]; in particular, with the latter proposal improvements of SORS preliminary version that has been developed are implemented, encouraged by the synergy that provide semantic technology (ontologies) and intelligent agents.

As currently designed, the product of this research aims to develop an application for use in educational institutions Venezuela's second and third level, as a valid instrument to support decision-making related to career choices and Query results as valid for vocational guidance, thus, the SORS happens to have-well-entrenched legal basis in the State's current regulations. As part of the development of a prototype test SORS, it is essential to "... ensure the production of high quality software that meets the needs of your end users with a predictable cost and schedule." [11] Hence it will guide the system's progress under the Object Oriented Paradigm (OOP), following the methodological approach proposed by Rational Unified Process (RUP), through which it is possible to develop software iteratively and incrementally, focusing on system architecture and directed Use Case, giving preference to Business Modeling with the active participation of each of the stakeholders in the implementation.

3.1 Studies Orientation and Recommendation System (SORS)

SORS is a tool that helps users to get the information that they need according to their preferences, making their decisions based on available information, which must have some method of filtering [12]. Such applications are excellent tools for gaining knowledge without having to search and analyze information on all possible alternatives [13], and can even get personalized recommendations, according to their interests and preferences.

3.2 SORS: Guiding principles

The essence of the SORS is in the estimation of the multidimensional nature of the applicant [5] [6] to begin high education and mismanagement of
information that may affect decision-making. This has given rise to a simple first approach to model the critical processes of the system, its actors and the interrelationships between them, effectively using Unified Modeling Language (UML) as the basic language to structure the most representative diagrams with the idea of modeling objects business and understand all the definitions of the ontological structures (knowledge bases) and database, and to understand the behavior of the system.

4 Conceptual Model
As a first approach to solve the problem of providing stakeholders in making decisions about study opportunities, relevant, timely, more meaningful information and better articulate on their context, in changing scenarios where act multiple variables, it is proposed to implement the use of a tool to provide recommendations and guidance related, such as the Studies Orientation and Recommendation System (SORS), characterized by [14]:

- The use of domain ontologies and user profile, as well as intelligent agents, to provide recommendations to those applicants that wish to enter the higher education system.
- The semantics built into the application is an important foundation for software agents to infer knowledge from the axioms present in the ontology, which gives it the potential to enrich them and more self-generating knowledge by using a common language sufficient expressive power and reasoning to represent the semantics of ontologies.
- Using the knowledge base and user profile, the SORS be empowered to recommend the best options for choosing a study for a degree, adjusted to the multidimensionality of the applicant.
- The Semantic Web, as integrated interface will ensure the use of Web documents marked ontology-based annotation or equivalent stored in a database or similar, which helps solve problems or limitations of a meaningless Web and substantially improve the search.

As a preview of the prototype, it is appropriate to model the application using a methodology for object-oriented design, such as RUP [11], [15], [16] for the purpose of describe, in the first instance, the reality of the business and domain application.

4.1 SORS Design: Information Management Logic

The design of the middle layer of SORS brings implicit appreciation of different points of view of those involved in the process of offer and demand study options and state intervention as information manager.

As can be seen in Fig.1, in Venezuela each of the actors in the system has a particular requirement: applicants need recommendations, the OPSU/CNU as information manager must manage the system, advisers and experts require an expeditious mean to give their guidance, the HEIs, as suppliers need to improve access to information, the applicant that has already surpassed the career selection process, wants to contribute his / her experience.

4.2 Modeling Concepts

In the first phase of RUP it is estimated a business modeling, determining aspects of this process, such as: What is the business goal?; What are the objectives to achieve?; What information must it have?; What must it show?.

Depending on the analysis it was determined that the business goal is: to provide recommendations and guidance on study opportunities. The objectives to be achieved are:

- Retrieve and integrate information from the HEIs / OPSU / CNU.
- Collect information on the user profile and on the recommendations to other users.
- Make recommendations.
- Register guidelines.

To meet this objectives it is require:

- Information Bases (LOE / HEIs).
- Contact the agency that handles domestic supply (CNU / OPSU).
- Contacts with Higher Education Institutions (HEIs).
- Knowledge bases.
This could be useful in providing a portal to display:
- Career catalog.
- Assistance to applicants (formulation of questions and answers).
- Domain Management.
- User Profile Management.
- User Registration.

In this phase, obtaining the requirements (lifting, treatment and refining) is also useful to clarify the functionality of the system and better define the use cases.

4.3 Context Process: Requirements in six stages
Within the scope of business processes pertaining to SORS six stages were identified:
- The business goal (GOAL): to formulate recommendations / management guidelines.
- Processes (PROCESS): hybrid filtering (collaborative recommendation + based on content + based on profile = hybrid filtering), use of agents, algorithms implementation.
- Events that hinder the process (EVENT): applicant’s requirements and information integrity.
- Information processes inputs (INCOME): Ontologies (domain and profile information, expert’s opinion).
- The resources to be "processed": profile data, careers list, expert referrals, other recommendations.
- The outputs of the process (OUTCOME): Hybrid Recommendation: personalized, content-and collaborative, expert guidance.

4.4 Vision System and Needs Assessment
In this part of modeling SORS also was reused some of the information provided by OPSU/ CNU in the official book LOE) [17], [18], which, coupled with the Requirements Model and Actors, allowed obtain a representative of the domain which shows a first approach of reality to represent the elements in the Model Business Use Cases.

In Figure 2 we can distinguish the actors who interact with the system and its key processes.

For this model it was raised the following statement in the document that shows SORS Vision (Tables 1 and 2):

| Problem Declaration | The absence of a System for Studies Orientation and Recommendation prevents:
| Quality | To satisfy the needs of information related to the selection of a university career, inside the abundant national offer that the HEIs make.
| Quantity | To support the applicants to make a better decision for, what career to choose?
| Impact | To help OPSU to know the actual demand that exists in high education, by means of related information.
| Affects... | To help advisers, parents and carers to give the applicants suitable and opportune suggestions.

Table 1: Problem Declaration

- A successful solution would be ... A system that recommend the best options to the applicant using an important volume of information, on which good directionality can be archived for the career decision choose in high level education. This system must have friendly and simple interfaces to access the bases of knowledge and references.
In Order To

The OPSU’s, CNU dependent office, supply the applicant’s software that orients their decisions in relation to the career to be chosen at the high level education.

Who

The OPSU’s, CNU dependent office, responsible for management of the policies and strategies for the high level education subsystem, as stated in the nation’s plans.

Denomination

Studies Orientation and Recommendation System - SORS.

What

A system that guides the decisions of the users within complex and uncertain information environments.

Table 3  System Vision – Needs

<table>
<thead>
<tr>
<th>Needs</th>
<th>Priority</th>
<th>Worry</th>
<th>Present Solution</th>
<th>Proposed Solution</th>
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<tbody>
<tr>
<td>Improve information management to obtain information</td>
<td>High</td>
<td>Information to the</td>
<td>Each HEI has its Web page, and there is an option in the CNU’s page that</td>
<td>Use information from the HEIs and the LOE to build a domain ontology that</td>
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<td>from different HEI’s offers related to the user needs</td>
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<td>applicants is not</td>
<td>integrates this information through the LOE.</td>
<td>relates directly to the recommendation</td>
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<td>opportune and isolated</td>
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<td>dissociated from the</td>
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<td>general applicant</td>
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<td>To obtain an applicant profile that can be used to</td>
<td>High</td>
<td>The information on the</td>
<td>A vocational test is applied (National Vocational Exploration Test) and</td>
<td>Create a user profile to conform a profile ontology directly related to the</td>
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<td>personalize a recommendation</td>
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<td>diverse academic offers</td>
<td>application in an admission registry is required (Unifad Register of the</td>
<td>recommendation</td>
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<td>does not contemplate</td>
<td>National Higher Education Entrance), but the results are associated from</td>
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<td>the personal data</td>
<td>contextual information</td>
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<td>applicant), as</td>
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<td>To supply recommendations to the applicant that helps</td>
<td>High</td>
<td>The applicant can</td>
<td>The recommendations are made orally and comes from advisors, parents, careers,</td>
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<td>the decision-making process</td>
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<td>request and obtain</td>
<td>friends, etc.</td>
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<td>valid recommendations</td>
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<td>decision making</td>
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<td>To manage statistics and new recommendations</td>
<td>Medium</td>
<td>Use the recommendations</td>
<td>Statistics are extracted from mathematical references</td>
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<td>Compile references</td>
<td>Medium</td>
<td>Achieve the participation</td>
<td>The references are made orally and come from advisors, parents, careers, friends,</td>
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<td>of experts, advisers,</td>
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Fig. 3 Use Case Model initial of SORS (UCMi - SORS)

5 Conclusions and Future Work

In order to make a robust conceptual model that represents the reality of the Studies Orientation and Recommendation System (SORS), and to further determine the requirements clearly and concisely, this research uses the RUP approach.

In this regard, business modeling has played a pivotal role in ensuring that the developed product will be useful, because it reaches the level of details required by the organization, while providing a common framework for communication among stakeholders.

Similarly, the lifting of requirements has allowed the establishment in a clear and precise way what SORS should do, in this research it was very helpful the implementation of the use cases to specify actors, functions and relationships.

On the other hand, the Vision document helped to collect, analyze and define needs and high level features of the system.

Regarding future work, it may be noted that there is still way ahead in terms of analysis and design to set the appropriate architectural basis for the SORS functional prototype, while advancing the documentation and evaluation as axes for development. Overall, this approach will develop high quality applications, more stable and easy to maintain.

References:


