VRTUOSI

A Pioneer Virtual Exchange Program between Five European Universities

Andrés Redchuk, Javier M. Moguerza and Javier Cano

Department of Statistics and Operations Research, Rey Juan Carlos University, 28943 Fuenlabrada, Madrid, Spain

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Abstract: Exchange programs have been very successful in Europe at the undergraduate level. However, difficulties arise when attempting to implement it at the postgraduate level because of the ties (personal, professional, etc.) of more mature students. We describe here the organization and implementation of VRTUOSI, a pioneer virtual exchange program between five European universities. We also introduce a Six-Sigma based methodology designed and developed to improve the quality in the VRTUOSI standards. We describe its structure and web implementation, as well as its application to improve other european e-learning programs and our online Master in Decision Systems Engineering (MDSE), emphasizing its positive effects on its internationalization and popularization.

1 INTRODUCTION

It is commonly acknowledged that the exchange program ERASMUS (European Action Scheme for the Mobility of University Students http://ec.europa.eu/about/ds_en.htm) can be regarded as one of the biggest successes of the European Union (EU) educational policy. Since its launching in 1987, more than 3,000,000 students and teachers have participated in their programmes. However, the majority of the participants has been undergraduate students, being the presence of postgraduate students merely testimonial (something that the Bologna Process www.ond.vlaanderen.be/hogeronderwijs/bologna/ aims at changing). One of the main reason for this phenomenon may be that postgraduate students might have more restrictive family, professional and/or work ties being more mature.

With this motivation in mind, we have proposed the EU our VRTUOSI, http://www.vrtuosi.com, within the Virtual Campus framework of the EU Lifelong Learning Programme (LLP) http://ec.europa.eu/education/index_en.htm. Ours was one of the five proposals chosen by the EU in the 2009 call. In this work, we provide a detailed description of VRTUOSI, placing special emphasis on its more paradigmatic issues. Indeed, these might be of interest to other Higher Educational Institutions planning to implement similar programmes.

Quality is an important issue within the European educational framework, as only outstanding programs will benefit from European and national funds and will call attention of a larger number of students, ensuring their survival in a very competitive environment. In this regard, we provide details of the design, development and implementation of a Six-Sigma based methodology to assess the quality in our Master degrees (Chua, 2004; Cullen et al., 2003; Harry and Schroeder, 2000). This quality management system was first implemented in our Master in Decision Systems Engineering (MDSE) http://www.masteringenieriasistemasdecision.com/, over the five-year period 2005–2010, and has been adapted to monitor the launching of the first edition of VRTUOSI. In this preliminary work, we focus on the description of the project, its concept and the implementation framework. In future works, empirical data will be provided.

The structure of the paper is as follows. In Section 2 we provide an overall description of VRTOUSI and its basic structure. Section 3 presents the guidelines of the implementation process and legal framework of VRTUOSI. Section 4 introduces the basic theoretical guidelines of the Six-Sigma based methodology we have followed in our master degrees programmes. Following, Section 5 shows how our Six-Sigma based management system can be used in practice to improve the quality of our teaching standards. Section

6 provides some practical advices for the implementation of similar programmes. We conclude with a discussion.

2 GENERAL DESCRIPTION OF VRTUOSI

VRTUOSI allows the exchange of virtual courses between these five universities: Universidad Rey Juan Carlos (URJC, Spain), Universit Paris-Dauphine (France), Universidade de Coimbra (Portugal), Óbudai Egyetem (Hungary) and Tampereen Teknillinen Yliopisto (Finland). The company Habber Tec S.L. also participates in the program as a partner.

VRTUOSI focuses on the exchange of courses at the postgraduate level (Master and PhD degrees) for students original from these five universities in Decision Sciences. It provides open access to part of the material, being the rest of the material restricted to the students taking the courses, who will get credits after completing the proposed tasks.

The courses are taught in English, including the following courses, all of them of 3 ECTS (European Credit Transfer and Accumulation System units):

- Universidad Rey Juan Carlos (Spain)
  - (VR_MAD001) Simulation;
  - (VR_MAD002) Quality Control: Six-Sigma;
- Université de Paris-Dauphine (France)
  - (VR_PAR001) Tools for public policy evaluation;
  - (VR_PAR002) Game Theory and Practice;
- Universidade de Coimbra (Portugal)
  - (VR_COI001) Multiobjective Meta-Heuristics;
  - (VR_COI002) Multicriteria Decision Analysis;
- Óbudai Egyetem (Hungary)
  - (VR_BUD001) Operational Research Methods;
  - (VR_BUD002) Computational Intelligence;
- Tampereen Teknillinen Yliopisto (Finland)
  - (VR_TAM001) Many valued similarities;
  - (VR_TAM002) Data Mining.

Each university teaches two courses and sends six students to each course. Therefore, each course is undertaken by 30 students, and the whole master is attended by 300 students in this first edition 2010–11, which covers 30 ECTS. Each student is allowed to register in a maximum of 6 ECTS (the usual academic load is 60 ECTS per year for postgraduate students).

3 IMPLEMENTATION OF VRTUOSI

The implementation of VRTUOSI has required specific actions from each participant university, as well as a common coordinated action. In this section, we outline the most important issues regarding the implementation of VRTOUSI.

3.1 Legal Framework

One of the most difficult tasks in the implementation of VRTUOSI was to provide it with a legal framework. An initial agreement was signed by the coordinating university (URJC), and the EU. An *ad hoc* agreement was issued by the six members of VRTUOSI, based on the standard agreements of the FP7-type projects http://ec.europa.eu/research/index.cfm . Such agreement may be useful for future similar programs. See the VRTUOSI webpage for specific details.

3.2 A First Insight on the Virtual Campus

Our initial idea was to launch a Metacampus over the virtual campuses of the five participating universities. However, due to the different maturity of these virtual campuses, we eventually opted to create a new website offering information about VRTUOSI, containing open-access material and facilitating access to the URJC Virtual Campus. All the VRTUOSI courses are then hosted at the URJC Virtual Campus, http://www.campusvirtual.urjc.es, supported by a WebCT platform, see www.blackboard.com, http:// courses3.webct.com/webct/public/home.pl for details.

A username and password was provided for teachers and students not belonging to the URJC. The user interface giving access to VRTUOSI is shown in Figure 1.

Once we have chosen a specific course, we can access all the related information and materials, which are organized as shown in Figure 2.

3.3 Virtual Campus e-Learning Tool

Through the VRTUOSI webpage, and once identified by the system after introducing his/her unique login and password, a student can access his/her assigned courses.

The Virtual Campus is the main tool for e-learning purposes. It hosts basic information, materials and
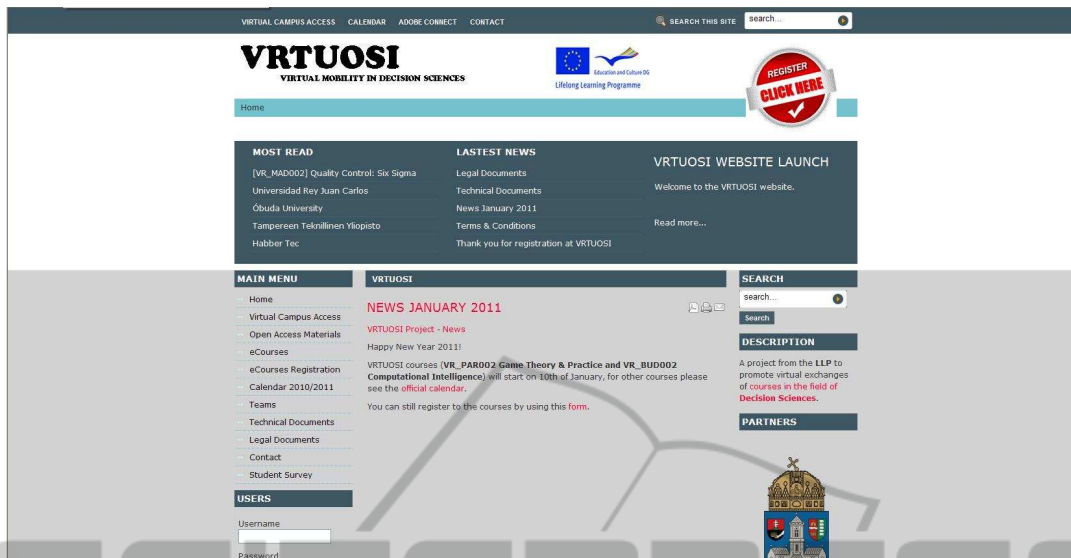
Figure 1: Entering VRTUOSI.

Figure 2: Six-Sigma VRTUOSI course structure.

rules about the courses. But it also allows participants to communicate within a secure environment.

The main modules from within Campus Virtual are: Control Panel, Guide, Materials, Calendar, Teachers, Students, Marks, Progress, Resources, Assignments, Exams, Communications and e-Talk, as shown in Figure 2. A sample course which shows the basic structure of a hypothetic course is available through the Virtual Campus for didactic purposes for intervening lecturers. We outline now the general structure of the most important modules:

- At the **Control Panel** there is a File Manager, which allows the user to manage his/her files during the course. It is possible to upload, delete, move, zip, unzip files to the system, among other actions;

- The **Guide** module provides a small description of the course, and contains the planning for the course;

- The **Materials** module hosts all files needed for the course, except assignments and exams, which are placed in separate modules. It is possible to display an organized hierarchy of documents;

- The **Calendar** module is a very useful tool in order to synchronize the teachers and students. It is possible to publish special dates on it;

- The **Teachers** module provides a small description of the profiles and CVs of the teachers of the course;

- The **Students** module shows the profiles and records of the students;

- The **Marks** module manages the students' marks. It is possible to edit each mark or assignment from there;

- The **Progress** module allows students to track their evolution during the course;

- The **Resources** module stores relevant information regarding the course as e.g. links to external contents;

- The **Assignments** module allows teachers to set assignments for the course. It also manages submissions of students and their eventual evaluation by teachers;

- The **Exams** module is an interactive tool that allows teachers to prepare and launch on-line and off or on real-time exams and tests for the stu-

dents, who may be remotely connected while accomplishing it;

- At the **Communications** module, the user can find different tools. The most important one is the Email service, through which students can communicate the teachers and *vice versa*;

- The **e-Talk** module works as a forum, where students can post questions to other students and/or the teachers, or debate about them.

It is important to note that any of these components can be hidden or revealed to the students. For example, it could be interesting to hide part or all the files in the Materials module until the beginning of the course, depending on the pedagogical strategy.

3.4 Training

Given the different maturity degrees in the development of the virtual campuses of the five universities, we undertook three training courses for the teachers taking part in VRTUOSI. The first session took place in the classroom in Madrid. Two others were online sessions using Adobe Connect© for that purpose. Sixteen teachers attended the courses.

3.5 Diffusion and Registering

The VRTUOSI program was advertized in various ways: through VRTUOSI website, and through the deliverance of brochures and posters in the areas of influence of the five universities. Besides, additional diffusion was achieved by including it in different seminars, conferences, websites, distribution lists, etc.

The registration process is implemented through VRTUOSI website. After validating the origin of the applicant students, we grant them an accreditation, username and password to gain access to the selected courses.

3.6 Courses

Within the Virtual Campus, the ten courses follow the same methodology, based on that of the URJC Virtual Campus, acknowledged with the quality certificate EFQUEL (http://www.qualityfoundation.org/). The main part of the teaching material, except the tests and the exams, are available in the open-access area of the Virtual Campus. In general, the courses are taught sequentially, in three-weeks slots (plus the time needed by the students to accomplish and deliver the tasks). The time length needed to implement VRTUOSI is 36 weeks, being the overall time length of the program two years.

4 METHODOLOGY FOR QUALITY ASSURANCE BASED ON SIX-SIGMA

We give now an insight of the most relevant issues we have encountered in the implementation of our Six-Sigma based methodology. As it is well known, Six-Sigma improves any existing process by a constant revising and returning of the process. To achieve this, Six-Sigma uses a methodology known as DMAIC (Brassard et al., 2006), which is the acronym of:

- **D**efine opportunities;
- **M**easure performance;
- **A**nalyze opportunity;
- **I**mprove performance;
- **C**ontrol performance.

Six-Sigma incorporates basic principles and techniques used in Business, Statistics, and Engineering. These three elements form the core part of our methodology. Six-Sigma improves the process performance, decreases variation and maintains a consistent quality of the process' output. This leads to better results and an improvement of students and stakeholders' satisfaction.

The main objective of our implemented methodology is to assure the quality of the exchange scheme, and identify potential enhancements for future editions of the exchange scheme, the implemented virtual Master and the developed courses.

4.1 Quality Principles Adopted in the Project

For the deployment of the project, we have selected and adopted the following quality principles:

- Focus on our students;
- Understand expectations of interested parties (stakeholders);
- Involve our organization's people (administrative staff, teachers, etc.);
- Use a process management approach;
- Adopt a systems approach for management;
- Encourage continuous improvement;
- Grasp the facts before deciding;
- Work with our organization's stakeholders (companies, other universities, students, etc.).

Table 1: Project road map.

Define	Measure	Analyse	Improve	Control
Develop a vision	Collect baseline data on mistakes and possible causes	Create focused project statement	Create possible solutions for root causes	Develop and document standard practices
Map the process	Analyse for special causes	Explore potential causes	Select solutions	Train staff teams
Understand students needs	Create Pareto analysis Calculate starting level Create detailed process maps	Organize potential causes Collect Data Use statistical methods to quantify cause and effect relationships	Develop plans Pilot plans Implementation Measure results Evaluate	Monitor performance Create process for updating procedures Summarize and communicate results Recommend future plans

4.2 Six-Sigma Project Road Map

The project follows the DMAIC sequence displayed in Table 1.

4.3 Process Selected for Measuring, Analysing, Improvising and Controlling

As we have mentioned before, the core process of the project is the DMAIC cycle. After defining the aim of the project (letter "D" of the acronym) we have selected the following processes for each stage of the remaining of the cycle (MAIC):

- Normative Framework;
- Course development methodology;
- Six sigma based quality assurance methodology;
- Platform final timing;
- Course development;
- Exchange scheme implementation;
- Scheme quality assessment evaluation;
- Dissemination.

4.4 Accomplished Tasks

During the project we have completed the following tasks:

- Review of the European University Quality in e-Learning (UNIQUe) self-assessment and evaluation protocol http://unique.europace.org/p34.php, under a DMAIC approach;
- Develop a guide of good manners and best practices under a DMAIC approach.

5 IMPROVING QUALITY USING SIX-SIGMA

To ensure satisfactory quality levels in the rendered service to the potential users of VRTUOSI, we have developed and implemented a Six-Sigma based quality management system, which allows us to identify the weaknesses of our program or its courses (Pizdek and Keller, 2009; Pande et al., 2007).

5.1 Background

Various methodologies aimed at improving the quality of postgraduate degrees have been and are still being used, either in the design phase, or in its development and implementation stages. The most remarkable ones are: Factor analysis; Clustering analysis; Multidimensional scale analysis; Conjoint Analysis; Legal or referential guidelines, as e.g. those given by the International Organization for Standardization (ISO), www.iso.org; Excellence models, as e.g. those recommended by the European Foundation for Quality Management (EFQM), www.efqm.org.

However, we have opted for Six-Sigma, because it is a more flexible methodology whose stages are, in addition, based on the principles of the scientific paradigm. The key point within this approach is to use the scientific method for the design and implementation of the VRTUOSI project. In this way, the whole project can be afforded as a scientific problem and, as a consequence, the scientific method can be used to solve it. Therefore, we have used characteristic techniques of the Six-Sigma methodology on the design and development of the processes within VRTUOSI. We outline the most relevant ones in the following list:

- DMAIC cycle;
- Failure Mode and Effects Analysis (FMEA) (Stamatis, 2003);

- Anticipation and Fool Proof techniques, like Poka-Yoke (Shimbun, 1988), see http://www.poka-yoke.org.uk for further details;

- Processes Mapping, like the Suppliers, Inputs, Process, Outputs, Customers (SIPOC) standard (Damelio, 1996);

- Advanced Data Analysis, like multivariate statistics, Multivariate Analysis of the Variance (MANOVA), and others (Spicer, 2005).

5.2 Initial Objectives

At the early stages of the implementation of VRTU-OSI, we had several objectives in mind, which can be summarized in three main ideas:

- Launching an online and international master, designed to fulfill as much as possible the preferences, needs and motivations of our potential students;

- Developing an internal quality management system for an online and international master, based on the "do it well at the first try" and "paper-free" mottos;

- To create a Six-Sigma based work methodology which could take advantage of its intrinsic techniques to remove errors and defects, and to improve quality.

These initial objectives have been monitored throughout the implementation of VRTUOSI.

5.3 Activities

The implementation of the Six-Sigma quality management system has been accomplished in the usual way, i.e., following the guidelines of the DMAIC cycle:

- Stage 1. Development and implementation of the internal quality management system (students management, teachers management, courses management, etc.);

- Stage 2. We collect data from, at least, students and teachers;

- Stage 3. We improve the quality of the project by incorporating the actions established at previous stages;

- Stage 4. We monitor the process, making sure that the accomplished actions have been successful and have fulfilled their goals. Results are elaborated and published using different means of diffusion.

5.4 Validation

Final validation is done in a similar way to that of the "transcript and keeping records" of the ERASMUS program. In order to reduce the bureaucracy burden, we will deliver a single report for each course. After its reception, each university will make their own ECTS validation process.

6 RECOMMENDATIONS AND BEST PRACTICES

In this section, we provide some recommendations and best practices for potential institutions wishing to elaborate and develop similar programs:

- Regarding the Virtual Campus

  - For each course within the program, compose a "student's guide" describing the course, the slides in the PDF file, and a short oral embedded presentation;

  - Use exclusively the Virtual Campus communication tools in order to contact your students. In particular, avoid using your personal email address;

  - Make the students aware that there are scheduled slot times for posting and answering questions, submitting assignments files, and for solving tests and exams. All these time and work structures must be respected and followed by both parts, students and teachers;

  - It is expected that the teachers use the Assignments module tools as part of the evaluation process. This tool facilitates continuous evaluation.

7 CONCLUSIONS

VRTUOSI is a pioneer online program for the international exchange of virtual courses. Our university is favoring the internationalization of our postgraduate programs, allowing our students to access high-quality courses of other European universities, and giving access to 24 foreign students per course. The interaction between teachers from different universities is facilitating the launching of new similar joint programs. In this way, apart from various research programmes we have in mind, we are planning to launch a joint Virtual Master based on the VRTUOSI courses.

All the procedures that have been developed can be used as a paradigm for other similar programmes

that different consortia of universities aim at launching. Our main contributions are the establishment of a detailed legal framework, the access and registering system, the validation system and the quality management and improvement system.

The open-access area is arousing some interest among the teaching community, and we are preparing a professional training model business based on VRTUOSI courses

Regarding the implementation of the Six-Sigma methodology, it has been a great success both in the MDSE and VRTUOSI, allowing us to:

- Remove redundant activities;
- Remove systematic errors;
- Perform a better analysis of the recorded data.

In summary, we have managed to remove most sources of uncertainty and errors, as well as to reduce the unfulfillment of the academic and administrative rendered services.

Besides, we have also accomplished some additional features:

- The encouragement, intensification and optimization of the use of Information and Communications Technologies (ICT) and of the Virtual Campus in the lecturing and learning areas;
- Favoring autonomous learning in the students;
- The optimization of the students' performance, leading to reduction of the academic failure and absenteeism.

Since 2010-11 is the first academical course in which VRTUOSI is being implemented, we are currently recording our first empirical results, which will be included in future works.

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