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A comprehensive quality academic project for a bachelor’s degree with accredited program and certified laboratories. The case of the degree of civil engineering in the FES Aragón UNAM

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Abstract

In the Decade of the 1990s, a significant decrease occurred in the number of students entering institutions of higher education in Mexico, to study the degree of Civil Engineer. The decrease in enrollment at the school of higher studies Aragon of the UNAM was dramatic, inasmuch the principal of the school according to the administrative chief considered, in 2002, the closure of one of the shifts.

One of the main reasons of this decrease was the economic crisis in Mexico in 1994, starting which a considerably decreased in the infrastructure investment, as well as the strike at the UNAM, in 1999, that kept the institution paralyzed for nearly a year.

This work mentions the actions that we carried out for the improvement of the curriculum, which led to accreditation and certification of its Labs. It also mentions the strategies followed by the academic and administrative staff which enabled substantial improvements and the achievement of favorable evaluations. It also talk about the main benefits for the students of the career, which impacted on the increased of enrollment.

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Background

The Faculty of higher studies Aragon (FES Aragón) is a multidisciplinary entity belonging to the Universidad Nacional Autónoma de México (UNAM), which is located in the northeast area of the capital of Mexico. This educational unit was created to generate an alternate campus of UNAM that would accommodate 12 degree programs, in which the infrastructure was not enough for the quantity of students. The first generation was composed of 260 students divided into four 65 student groups two of them in the morning the rest in the evening. 33 generations of civil engineers, has been prepared in the classrooms of the faculty.

Problem

During the 37 years of academic work of the faculty, Civil Engineer career has offered and with no interruption, however the career has been subject of various internal and external problems which reduced the enrolment and put in risk one of the shifts.

From 1976 up to 1990 there were a continuous increase in the enrolment; they recorded a maximum of 1189 students. From 1990 to 1993 there was decrease of students and we reached the number of 643 students. This setback was motivated, among other factors, because a good number of students were hired with engineering companies, without having completed her studies, considering that there was an important offer of jobs for projects, construction and supervision of infrastructure, due to a considerable investment in these products promoted by the federal Government. The workload was such, that companies accept young people without being entitled, even those who had barely passed only half of the credits of the career.

In 1994, in the month of December, there was a change in the administration of the country; there was a severe economic crisis. The huge investment in infrastructure over the previous years was made from requested loans from abroad offering guarantees that the country was not able to meet.

Unable to pay their obligations, the federal Government carried out budgetary restrictions, mainly with regard to the construction of infrastructure. The labor market of the construction industry shrank dramatically, causing layoffs in companies.

In the career of Civil Engineering of the FES Aragón there was a small increase in enrollment since 1995 and up to the year 1997 (768 students). The increase of 140 students with respect to 1993, largely responds to a good number of students who had left his truncated career returned to conclude it, due to there were no job offers.

The scant infrastructure investment lasted from 1994 until the end of the Decade, by which Civil Engineer career was not one of the attractive options for high school graduates.

In 1999, UNAM was paralyzed by a strike, which lasted for almost a year, which generates defections of students of the institution as well as a lack of potential candidates to enter, who looked for other educational options.

After the strike, in the years 2001, 2002 and 2003, enrollment drops dramatically from 545, 534 and 502 students respectively.

During those years, the career offered 240 places new students and received, on average, only 45% of them.

Due to such problems, the administration of the Faculty assessed the possibility of closing one of the shifts of the career, in order to take better advantage of the spaces and save resources in the recruitment of academics.
The panorama was not in any way encouraging, especially considering that the total number of civil engineers graduated from institutions of higher education in the country, accounted for only 20% of professionals in the field needed to meet the demands in terms of building infrastructure.

Considering the severe contraction of the registration, as well as the challenge of providing graduates with profile appropriate to the needs of the labor market, it was required an in-depth analysis of the necessary actions so that the academic program respond effectively under such circumstances.

There were meetings of the administrative responsible of the program with representatives of different areas of knowledge, to analyze the problem.

As a result of these meetings of analysis, it was identified the necessity to elaborate a diagnosis of the situation of the program.

**Diagnosis of the academic program**

In this evaluation exercise it was consulted to Bachelor's degree graduates, teachers of the academic program and employers, through surveys.

The most important findings of the consultation were as follows:

- The training of students of the career should continue to be the generalist.
- It was necessary to increase the number of computer tools in the subjects of Applied Engineering
- It was necessary to improve the service in the laboratories of the career because some practices were not carried out for any problem and they were not rescheduled the equipment for the practices were insufficient.
  
  There were no relationship between theoretical and practical classes; there were no coincidence with the study program, since the theory and practices were taught by different teachers.
- Insufficient and partially updated bibliographic material
- There were no formal mentoring activities in the career
- It was required to expand the range of options to get the degree.

From the diagnostic information, it was established a strategy considering the most urgent matters, establishing two lines of action:

1. **Improvement in the process of teaching in the laboratories of the career, beginning with a good system of quality management.**
2. **Works for the improvement of the academic program**

**Quality Committee**

To drive improvement in services in laboratories and work improvement of the academic program, the creation of a working group which was called quality Committee considered suitable. The Committee was formed in 2003.

Within the structure academic administration of the faculty, the academic program of Civil Engineering belongs to the Division of physical and mathematical sciences and engineering. Computer Engineering and Mechanical and Electrical Engineering also belong to this division.
The responsible for administrative and academic staff of three careers in engineering and the quality Committee worked together. With this new Committee works started with the main objective of improving the service of laboratories careers in parallel.

The Committee was formed by the Chief of the Division of engineering taking the role of President and representative of the principal of the Faculty; the academic Division Secretary, taking the role of the internal quality Committee; three heads of the three careers, four technical secretaries and three chief of laboratory.

Before starting to work, the Committee members received training, which was given by staff of the coordination of research of the University (UNAM). The topics studied were as follows:

- Theoretical principles of the quality management systems

1. The improvement of the teaching process in the laboratories of the career, beginning with a good system of quality management.

Realization of practices in the engineering laboratory is an essential part in the formation of the students. They help student to identify different parameters that subsequently will be decisive in the design.

In civil engineering academic program, a significant number of subjects requires studying and pass the laboratory.

Deficiencies in service of the laboratories were detected; those deficiencies were associated with inadequate infrastructure, lack of equipment, absence of the technicians in charge of areas and poor planning of laboratory practices, among other things, impacting on an inadequate preparation of the students.

Need for the implementation of a quality management system.

The establishment of verification mechanisms of the quality of service in teaching laboratories, as well as the determination of actions that not only allowed correction of detected problems, but the improvement of positive aspects, these are factors that favor the establishment of a process of continuous improvement in the service. On the other hand, continuous improvement of laboratories activities includes a review and permanent updating of the manuals of practices, as well as the supervision of the activities in the laboratories.

With the establishment of a system of quality management, the following objectives are pursued:

- Provide the necessary conditions for the realization of practices for practical-theoretical subjects, so that satisfy the expectations of students and contribute in obtaining a consistent profile to the needs of the labor market.
- Establish a dynamic of continuous improvement of the service in the laboratory, which even exceeds the expectations of students.

Awareness-raising and training of the staff of the laboratories

The commitment of all those involved in the quality management system is essential for the activities y the laboratory. Therefore, it is necessary a wide work of diffusion and training of all members.

Prior to the formal implementation of the quality management system, briefings were carried out with the technical academic and teachers of practices of the laboratories; such activities were scheduled in both shifts (morning and evening), in order to facilitate the attendance of all members.
In these meetings it was informed to participants about the objectives of the implementation of the quality management system, the role that each of the members of the laboratories would play, the mechanisms of evaluation and monitoring that would be subjected and the benefits that in short, medium and long terms accrue its implementation.

**Determination of the processes subject to control**

The quality management system can include one or more of the processes carried out. The laboratory of civil engineering was considered the following mission:

*Support and complement the teaching-learning process of theoretical and practical subjects in Bachelor of civil engineering curriculum map, belonging to the FES Aragón UNAM, as well as give complementary courses of updating and professional training.*

All the laboratories of the academic program were considered in the scope of the management system.

**Generation of the quality management system documents**

In order to guide and give certainty to the system of management of quality, documents that will govern the activities in the laboratory must be generated.

The documents generated for the quality management system are:

- Quality manual
  It is the document that establishes the scope of the quality management system, the mission, vision and goals of the Organization, specifying the responsibilities of each of the members of the system as well as measurement and control mechanisms.

- Document Control procedure
  It establishes the guidelines of the quality management system for the control and preservation of internal and external documents related to the same.

- Control records Procedure
  It establishes the elements of identification and control that must contain a document of the quality management system, as well as the mechanisms to ensure its identification, storage, protection, retrieval, retention and disposition.

**Testing of the documentary processes and records control**

Before the implementation of the quality management system, it began the documentary control of the laboratories, using new formats during a school semester. The use of new documents purpose was to detect faults existing in them, in order to make the necessary changes.

**Implementation of the quality management system**

Once it was considered that there were solid foundations for the formal start of the work of the quality management system, it was launched under the new conditions laid down in the documents that were properly generated.
Evaluation system of the laboratory (SEL)

To evaluate the service three questionnaires were generated, they were directed to the customer (student), teachers and instructors. Each instrument consists on average of twenty closed questions.

The questionnaires were applied at least twice during the semester; the first one at the middle of the semester and the second at the end of it.

The analysis to determine the causes of the non-conforming service is done through cause and effect (Ishikawa) diagram.

Once we conclude the analysis of causes of non-conformities, the corrective actions are determined.

Internal audits

From the implementation of the quality management system, at least once a year the internal audit is conducted to know the status and to take the necessary actions to correct the causes of nonconformities. These information is also valuable for the preparation of audits of certification, surveillance or recertification, carried out by an evaluation Agency.

External audits (for certification)

Taking into account the improvement in the service to the client, thanks to the establishment of the system of management of quality, it was considered convenient that this was evaluated by an external instance by means of an audit for certification.

The system was evaluated by the Mexican Institute of standardization and certification, in November 2004, granting the certificate of quality.

2. Works for the improvement of the academic program

Evaluation of academic programs by external peers is a virtuous process, in the institutions of higher education are taking ever greater force and in which the administrations of the same will be increasingly involved, since it is a public recognition of the academic work carried out.

Based on the positive results obtained in laboratories, the central administration of the Autonomous National University of Mexico, devoted extraordinary resources to equip laboratories and expand service coverage. Taking advantage of the support received, there were also improvements in the classroom.

In order to continue with efforts to improve the academic program, actions with the intention of subjecting it to the assessment for accreditation were carried out.

A strategy was developed in order to face the process, it is described below, it is "a way" to prepare an evaluation process for accreditation, based on the idea that the generation of a strategy will strengthen the efforts to assist the process, as outlined in document "The seven knowledge necessary for the education of the future", of the United Nations Organization for education, science and culture

The strategy raised the following activities:

Before the evaluation visit

- Evaluation of the appropriateness of submitting to the process (CIPP method and analysis tow).
It was considered convenient, that there would be an evaluation of the State keeping the academic program prior to submitting it to the accreditation process. We used the CIPP method (context, input, process and product), recommended by the Joint Committee on Standards for Educational Evaluation of the United States.

To complement the evaluation, applied analysis tow (DAFO), from whose results, positive and negative aspects of the academic program is determined and general strategies for work were established.

- Adequacy of spaces and places for teachers and technical management.

It was evaluated the necessity of hiring full time teachers as well as technical academic, and it was requested to the administration before the evaluation for accreditation of the program.

An analysis of the State that kept the facilities of the academic program was made, and it was requested to the Superintendence department to carry out the necessary maintenance work.

- Selection and training of the staff (stakeholders).

An element fundamental, prior to the accreditation process, was the formation of a compact team of specialists in each of the areas of the academic program.

- Self-diagnostic of the program (Delphi technique).

Before the evaluation visit, as a requirement of the accrediting body, responsible for the program sent a self-assessment document, previously provided by that instance. In order to have valuable elements that serve as support for a collegiate assessment, and whose evaluation parameters allow objectively qualify the status of the academic program, applied the Delphi technique.

- Preparation of the logistics for the assessment visit.

During the evaluation visit, there are different needs to be covered. It is necessary to anticipate them.

**During the evaluation visit**

- Participation of the entire team.

Everybody was involved in the process, so it was obvious that all of them worked which on a common goal.

- Assuming a positive attitude of open-minded

It was Emphasized the advisability of staying with an open mind and assuming an positive attitude, considering the comments of reviewers as valuable contributions to generate improvements in the academic program.

- We sought to satisfy those aspects that would not have been clear to the evaluators, considering that, while the visit is not concluded, evidences to clarify could be used.

- We asked the evaluators for their pinion at the end of each day and at the end of the visit (such information, even if it is unofficial, allowed us to anticipate a reaction plan).

**After the visit**

- Human and material resources were handled.
• The Accreditation Council members were contacted to clarify doubts with respect to the requirements set out in the certificate of evaluation.
• In the plan of reaction we established actions that benefit human and material resources and that could be shared with other programs of the faculty.
• A reaction plan was developed and submitted, unofficially, to the revision of the accrediting body.

Main dividends of the continuous improvement process

The continuous improvement process initiated in 2004, with the creation of the quality Committee, allowed to establish orderly work dynamics, with clearly defined goals and indicators of efficiency. From the improvement works carried out in the laboratories, it was requested a review of the quality management system by an external instance. At the end of the process, it was obtained the certificate of quality.

From the improvement of laboratories, we reviewed other aspects of the academic program, as the infrastructure, study programs, evaluation mechanisms and forms to get the degree.

From the analysis, the form to get the degree grow from 1 to 9 options, study programs were reviewed, and updated as well as the bibliography of the subjects of the program.

The quality of the classrooms was improved, preparing them for the use of projection equipment.

Once the program was considered strong enough to undergo an evaluation by external peers, it was requested the evaluation for accreditation to the Council for the Accreditation of Engineering Education, obtaining the certificate in August 2007.

Perspectives of the academic program of Civil Engineering of the FES Aragon

From the creation of the internal Committee of quality, the improvements carried out in the academic program without a doubt have been factor in the gradual increase of the number of students, as well as the favorable opinion from graduates and employers.

In recent years, from 2008 to 2012, the program has been rated among the top ten of the country (surveys of newspapers of national circulation "El Universal" and "Reforma").

As shown in the following table, enrollment has increased consistently over the last years.

<table>
<thead>
<tr>
<th>YEARS</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
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<td>751</td>
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<td>981</td>
<td>1139</td>
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* Source: Unit of planning from the school of higher studies Aragon of the UNAM
Conclusions

The generation of a quality system for teaching in laboratories is a process that involves the commitment of all members of the Organization: Division Chief, heads and Secretaries of the careers, technical, academic and laboratory teachers.

The quality of the profile of the students will be more in keeping with the needs of the labor market.

The members of the quality management system are also part of the academic programs in engineering. That is why the dynamics of continuous improvement will also benefit other programs.

The activities of planning prior to the evaluation process for the accreditation are decisive to anticipate the Evaluation Committee’s observations, allowing establishing the plan of reaction based on the resources available to the academic program. The strategies planned with such resources allow us to face the mid-term review of the accreditation body (2.5 years), without compromising the Faculty and with the certainty of accomplishing the established commitments.

The dynamics of the work of the members of the academic program, generated from the activities of planning, contributes to the efficient use of human and material resources, for the benefit of students and academic institutions.

Continuous improvement of academic programs allows you to maintain high standards of quality of educational services and offer graduates according to the profile required by the labor market.

References