MULTISITE EDUCATIONAL INSTITUTIONS: COMPLEMENTARITY OF MODELS AND PROCESSES FOR QUALITY ENHANCEMENT

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ABSTRACT

Based on a return on experience, this work in progress paper describes and analyzes the 20 years application of an ISO standard to manage the quality of a multisite educational institution. The context of the analysis is a French private medium higher educational institution in engineering, distributed nationally in 14 sites. Both the ISO 9001 reference models and evaluation processes are described. They are discussed with some of the CDIO framework standards.

KEYWORDS

Quality assurance, quality enhancement, reference model, assessment model, assessment process, engineering education, CDIO Standard 12, ISO

THE CESI GROUP

The CESI (French Center for Industrial Postgraduate Studies) was founded in 1958 by five major industrial French companies wishing to have their high-potential technician advance and progress professionally. It is a private non-profit organization. Today, it is a group of higher education institutions and professional training of first order. It is specialized in the education of executives, supervisors, engineers, technicians and experts. Some of its educational programmes are accredited by the French *Commission des Titres d'Ingénieurs* (CTI).

The CESI has developed its activities through 5 brands: *ei.CESI, eXia.CESI, CESI entreprises, CESI alternance, CESI certification.* The training courses, titles and certifications are accessible through combined work-study training, continuing and vocational education, recognition of prior learning and professional experiences (French *Validation des Acquis de l'Experience*) and initial education. Its priority is to bring together social accessibility and excellence, thanks to its capacity for pedagogical innovation.

eXia.CESI: Informatics and Computer Science Brand

eXia was created in 2003 by CESI in order to meet the needs of the computer science field. Back then, prospective works were predicting a growth of the demand by 200,000 jobs within 10 years in the computer science field, which represented 600,000 jobs at the

time. This would make it one of the 4 major job creation fields - i.e. Employment and education prospective report from the Department of Education and Research.

This increase in the demand meant that the qualitative aspect would also have to evolve and transform radically in terms of the skills required from a computer engineer. One would not only need to be able to solve a technical issue but also to have the capacity to improve, to be more independent, to have rigorous working techniques, to use quality standards and especially to be able to communicate and fulfill the users' expectations.

In order to meet the educational needs of this new generation of engineers, CESI relied on the *savoir-faire* (ie skills) it had developed over 50 years of experience, but also benefited from the expertise offered by the University of Quebec in Montreal (UQAM) which notably mastered innovative pedagogic packages suitable for the challenge ahead.

The school was built around a 5-year-MSc program starting after secondary school graduation. First, a 2-year-course for undergraduate, and then a 3-year-postgraduate degree which allows students to specialize in a specific field, such as software engineering, network engineering or information system management. These degrees are qualifications, state-recognized, regulated by the French CNCP (Professional Certification Board, CS branches).

From its creation, the main goal of the school was to be closer both to the students and to the firms on a geographical standpoint. Today, eXia has campuses in 15 different cities in France with over 1,200 students. This enables the development of strong ties not only with partner-firms – which offer internships and employment opportunities to students – but also with the local administrations to better answer the economic needs of the region. Finally, it helps the students financially by giving them the possibility to stay in their home-region. In 2014, the school counted 588 students in the undergraduate program and 668 in the postgraduate program.

eXia.CESI a distributed school, synchronized on a semantic and temporal level

One of the distinctive characteristics of eXia in the educational community is the pedagogy put in place on a global level in its training courses: PBL (Problem Based Learning). PBL aims to place the student at the center of the educational package through various activities, allowing the development of the necessary skills to join a company and/or a PhD program. Students will acquire a wide array of knowledge and *savoir-faire* which will be strongly integrated and accessible throughout their professional career.

All the educational activities are synchronized on the semantic level (same content, same medium) and worked on at the same time in every eXia centers. Hence, these activities are conceived by expert-tutors distributed throughout the eXia centres. This singularity has enabled the creation of a body of learning practices that communicate thanks to the school's information system for the facilitation, conception and evolution of the activities. Moreover, synchronization also applies to the weekly knowledge evaluations. This organization fulfills various purposes:

1. Synchronization of the courses in order to deliver the training in every center with the same learning outcomes;
2. Encourage students' mobility;

3. Facilitate geographical proximity to their families.

A QUALITY MANAGEMENT SYSTEM FOR SYNCHRONIZED ENHANCEMENTS

The CESI first implemented the ISO 9001 (87-version) in 1991 on the initiative of the Director of the Normandy Region. The ISO model demonstrated the ability of the CESI to satisfy the requirements of its clients, the regulatory and legal requirements and the external requirements. The purpose was also to show that the CESI was using the same industrial language as its clients for which Quality management was mandatory. At CESI, the Quality system is linked with the organization, and has evolved according to the development of CESI to include new orientations or expectations.

History of ISO implementation at CESI

- **1991 :** ISO 9001 V87 is implemented in the Normandy region, followed by the East Region in 1992;
- **1994 :** CESI Normandy and CESI East obtains ISO certification. CESI is one of the first training organizations to be certified for ISO 9001 V94. In the same year, CESI Normandy wins a regional Quality award in (France Movement for Quality and Ministry for Industry);
- **1995 :** CESI CEO proposes to all the other CESI regions to go toward CESI certification. That is achieved between 1996 and 2000;
- **1999 :** Beginning of the project for national ISO procedures at CESI;
- **2000 :** A unified management system is settled all over CESI;
- **2000 :** A national Quality Director (?) is created, with a National Quality Manager. In each region, a Regional Quality Manager was appointed;
- **2002 :** Each region obtains the ISO 9001 V2000 certificate with the National Quality Management System. All CESI centers obtain the OPQF label (OPQF : Professional organization for Qualification of French training companies) as well in February 27th;
- **2003 :** CESI obtains a unique certificate for all its centers for ISO 9001 V2000;
- **2005:** CESI Normandy region wins the French Price for Quality. It is a 3 stars level – 600 points;
- **2009** CESI is certified for ISO 9001 version 2008.

CDIO: A COMPLEMENT TO QUALITY MANAGEMENT FOR THE DEVELOPMENT OF EXIA'S COURSES

In the context of HEI in engineering, the CDIO (Conceive, Design, Implement, and Operate) framework (Crawley et al. 2014) is often used as a continuous complement to meet accreditation expectations.

Implementing the evaluation and evolution system of the school's program

The French CTI body, in place since 1934, recently revised its requirements for accreditation by including Quality Assurance sections (i.e. Internal quality assurance policy, Internal quality assurance implementation, continuous improvement cycle, external

quality assurance). In 2014, after 10 years of experience, the CESI decided to submit eXia.CESI to the official French certification body (i.e. CTI-or French accreditation board for engineering degrees). To be accredited, it was necessary to update eXia's program to meet the CTI's requirements. The choice was made to include the process the Quality Management System (QMS) and to combine it with the self-evaluation and enhancement system proposed by the CDIO Standard 12 (i.e. Program Evaluation). This hybrid models and evaluation processes is to be put in place.

Setting up the CDIO evaluation process, identifying the stakeholders involved, inventory of quality evaluations (QMS)

Each CDIO Standard is defined by a description, a rationale, and a rubric, which is a six-point rating scale for assessing levels of compliance with a Standard. The CDIO Standards, with the associated rubrics can be considered as an Assessment Model in the context of Engineering Education systems. The CDIO framework provides useful guidance for continuous improvement of an educational system on aspects such as strategy, curriculum development, pedagogical activities, learning experiences and workspaces.

The CDIO approach has been implemented since 2008 at Telecom Bretagne, a French graduate engineering school and the first French member of the CDIO initiative. Several CDIO self-assessments have been carried out (Rouvrais & Landrac, 2012) in this accredited *Grande Ecole*, by deans, teachers, and a group of students. On their side, at eXia, during the first stage, the quality assurance managers created a monitoring system composed of:

- Professionals (e.g. Legrand, CISCO)
- Alumni
- Students in training (from centers of Rouen, Pau and Bordeaux)
- Faculty and School's managers divided in 3 groups:
    - National board
    - Center's boards
    - Specialty managers

Two groups were first identified for the quality evaluations:

- Evaluation of the courses by the students
- Evaluation of the Companies' satisfaction

Evaluation of the syllabus (aka CDIO Standard 2)

The evaluation of the courses' content took place from December 2013 to June 2014. It followed the model proposed by in the Rethinking Engineering Education (Survey Results at MIT). In the next Figure are shown the results of the evaluation.

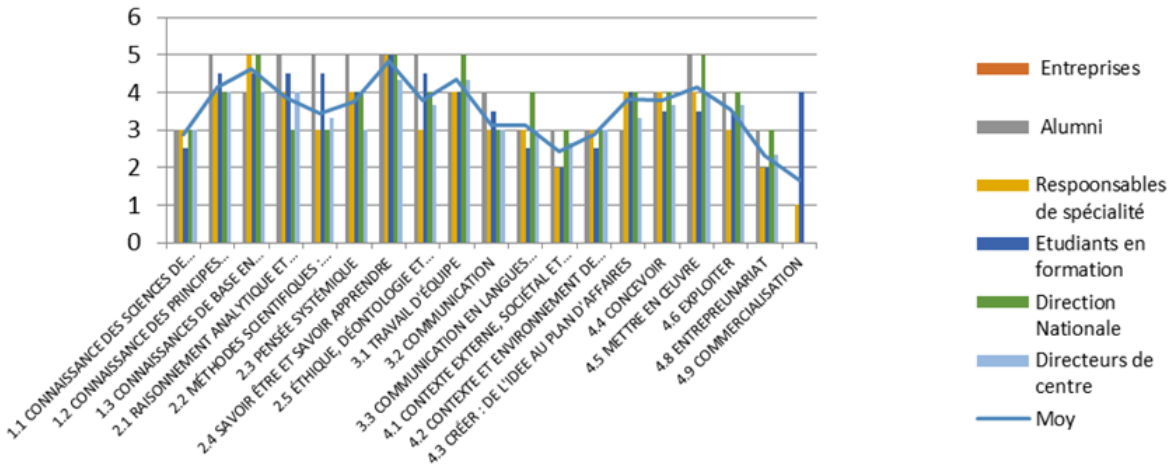

Figure 1. CESI Survey result of CDIO syllabus (In French)

Analysis - the evaluation put forward

- Firstly, a strong alignment of the parties involved on the second level evaluation. It confirms that the new courses' evolution matches the expected requirements.
- Secondly, the analysis of the study's results of the third level allowed the identification of the necessary improvements to be made regarding the syllabus, especially in the matters of sustainable development, company involvement and the role of the engineer in the company.

Thanks to this evaluation, the school's program was improved to take the training objectives into account.

Creation of the new curriculum

In order to create the new curriculum the school brought together all the educational activities developers for a conception seminar. The evaluation of the first stage and the evaluation of the QMS were the key stones for this stage (cf next Figure).

During the seminar, for each item of the syllabus, training objectives were identified (technical, scientific, professional skills…). These goals were written using Bloom's taxonomy and cognition levels. The cognition levels of each objective were determined according to their evaluation. Finally, all the training objectives and the level expected by the students were written in the Rubrics evaluation grid.

Setting up the program of courses evaluation

This process is still in progress. The program was deployed in September 2014 throughout the centers. It is periodically evaluated using the QMS system. A review of the program is set for February 2015.

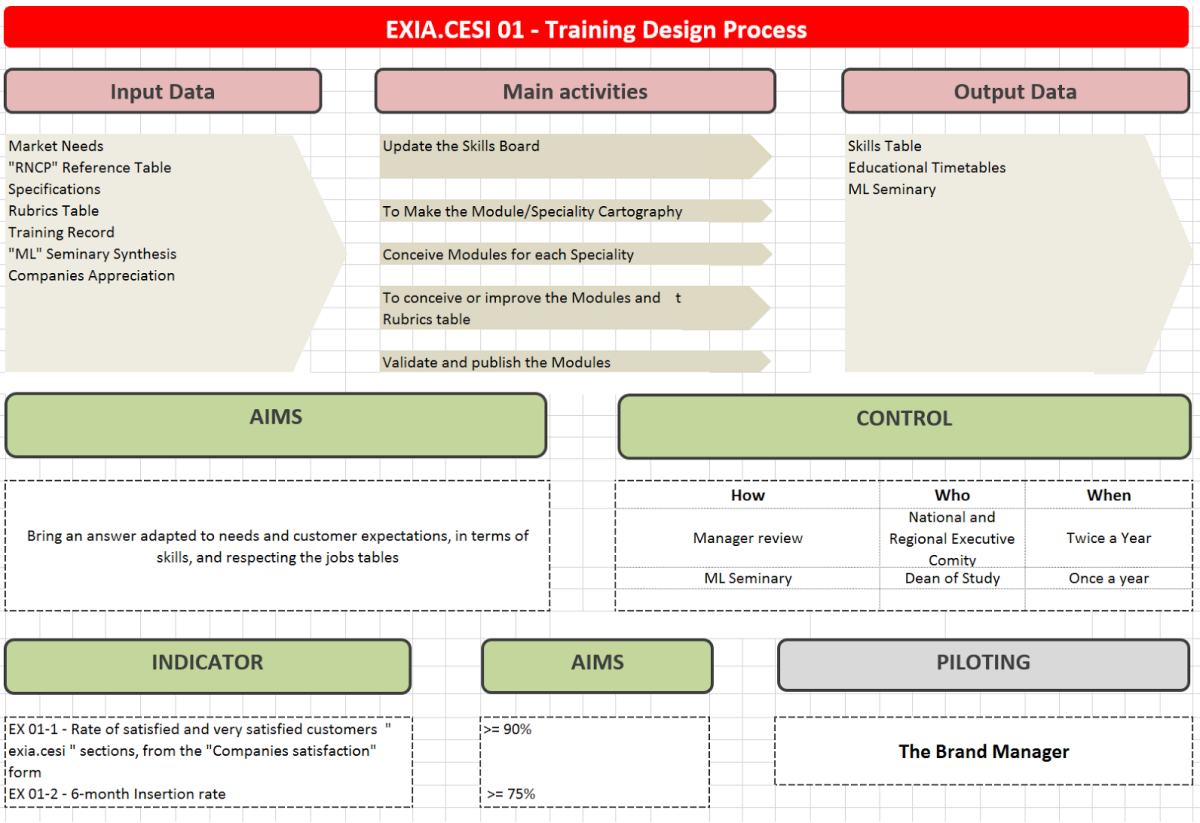

Figure 2. Training Design Process (In French)

DISCUSSION AND CONCLUSION

According to ISO 9000, quality is defined as a “degree to which a set of inherent characteristics fulfils requirements” (ISO 9000:2005). Quality allows to satisfy demands of societal and public accountability thanks to reference models. But “one concern regarding the advancement of Engineering Education Quality Assurance is the lack of uniformity in Accreditation standards and practices” (Gray, Patil and Codner, 2009, p.20).The flexible approach proposed by the CDIO initiative, especially the evaluation process, can be completely integrated and synchronized with the ISO 9001 standard in a distributed context, such as a multi site institution, as discussed in this work in progress paper. The main strength of the CDIO framework is its usability and that it can be used to share good practices.

The setting up of the CDIO system at eXia.CESI has improved the conception and evaluation processes of the program courses by bringing a higher level of precision to the training objectives expectations. Moreover, it helps focus the actions of the community of practices towards the training, as well as the positive alignment between training objectives, training activities and evaluation. CDIO addresses several standards, i.e. twelve, which may be adapted to a particular context. For future work, eXia will investigate a more systematic and complete evaluation of its programs and sites, going far beyond course student evaluation, orthogonally but complementary with its ISO SMQ. As ISO 9001 is implemented in a distributed context with internal CESI sparring-quality managers,

the CDIO evaluation models and process may be implemented at CESI in cooperation with French or European CDIO institutions, as cross-sparring partners in a distributed context, more external (as proposed in the QAEMP Erasmus+ KA2 project (Kontio et al. 2015)).

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