A Computational Framework For Academic Accreditation And Assessment In Higher Education (A3-HE) – Part 1 Academic Processes

ABOUBEKEUR HAMDI-CHERIF (1)
Computer College
Computer Science Department
Qassim University
PO Box 6688 – 51452 Buraydah
SAUDI ARABIA

(1) Permanent Address : Université Ferhat Abbas Setif (UFAS)
Faculty of Engineering
Computer Science Department
19000 Setif
ALGERIA

(1), email: shrief@qu.edu.sa, elhamdi62@gmail.com

Abstract: - Academic accreditation is, before anything else, an acknowledgement by the community that a given academic institution, program or service meets a prescribed set of expected quality standards issued from common good practice, and codified over the years. As a result, the by-products of such an entity, like its students, its research production, and its service involvement are de facto trusted and authoritatively accepted by the community and considered as a reference. As a lead member in the implementation of a program accreditation in computer science, an ongoing process for the past three years, we have heavily relied on stressful, tedious, slow, lengthy and sometimes unreliable paper work. Hence this paper which represents an early attempt to identify the main computational technologies and methods capable of making the accreditation processes easier, more flexible and more objective - for the best of all parties. For so doing, we first begin here, in Part 1, by discussing the main academic processes implemented by prominent accrediting bodies worldwide. The highlighted ideas pave the way to the description of the main computational technologies susceptible to enhance the academic processes, as described in Part 2 of the paper.

Key-Words: - Academic accreditation, Accreditation bodies, Quality assurance, Accreditation mills, Degree mills, INQAAHE, ABET, CSAB, NCAAA.

1. Introduction
Literally speaking, accreditation means to give credit, to pay tribute, to someone or something for the achievement of some prescribed task with an acceptable degree of proficiency. Formally speaking, academic accreditation is a type of official certification based on quality assurance processes under which services and operations of academic institutions or programs are evaluated by an external accrediting body to determine if prescribed standards are met; in which case, accredited status is granted by the external body. The aim of academic accreditation is both to acknowledge quality and to monitor continuous assessment - for a lifetime. Accreditation bodies are themselves either nominated by government organization or accredited by other external bodies. Academic accreditation and assessment in Higher Education (A3-HE) is a complex lengthy, tedious set of intertwined processes involving people at different levels of responsibility within the community, costly machines, various artifacts, and more often than not, heavy clerk work and expensive resources in terms of time, money in addition to other unquantifiable elements [7]. On the other hand, the reviewing processes made by accrediting bodies, in general, are prone to errors, biases and subjective actions because they are largely based on human rules of thumb judgments. In most countries of the world, academic accreditation processes are conducted by a government organization such as a Ministry of Education / Higher Education. Most academic institutions or programs seeking accreditation are required to conduct a periodical review, at least once in every five years, or so, in order to determine transparency, specificity, validity, reliability, consistency, and homogeneity for measuring quality of education and training, and relevancy to type of program and training needed by the community. All parties concerned by the A3-HE, whether they are students, parents, employers, or members of the
community should gain complete confidence that what has been learned by students, the research conducted by faculty, and the services provided are equivalent to good international practice. Accreditation of a program will give an official and public recognition that these standards have been achieved. As a result, accredited qualifications should be unquestionably accepted anywhere in the world.

Our aim is to contribute to a unified view of the processes involved in A3-HE as actually requested by accrediting bodies around the world. The understanding of the processes will pave the way to the definition of the main computational technologies destined to the enhancement of the processes involved in A3-HE. These technologies are expanded in Part 2. The paper is organized as follows. Section 2 gives an overview of A3-HE processes. Section 3 describes the international concern about A3-HE. In Section 4, special attention is given to A3-HE for computing disciplines. The paper ends with a conclusion summing up the main results.

2. Overview of A3-HE

For many years A3-HE has been an international concern. Many international networks, involving countries, regions and multinational organizations took form in order to address the issues raised by A3-HE at a global level. These networks have been aggregated, commonly in regions, and usually in the presence of other geo-political mechanisms associating relevant countries, such as the Arab Countries, the European Commission in Europe or AQAN in the Association of Southeast Asian Nations (ASEAN) or CARICOM in the Caribbean countries. Some of the networks that have been established are as follows [4].

2.1 International networks for A3-HE

Among the main existing international networks operating in the field of A3-HE, we find the following bodies. All sites have been accessed and are operational, as of January 2011.

- Arab Quality Assurance Network for Higher Education (ANQAHE), 2007
  http://anqahe.kasralainy.com/
- International Network for Quality Assurance Agencies in Higher Education (INQAAHE) 1991, starting with 12 initial founding quality agencies. INQAAHE counts over 200 member agencies and bodies worldwide, as of January 2011.
  http://www.inqaahe.org/index.php
- Africa (AQANet), 2004,
  http://www.aquanet-services.com/
- Francophone Africa: Conseil Africain et Malgache pour l'Enseignement Supérieur (CAMES), 2000
  http://www.lecames.org/index.php
  http://www.enqa.eu/
- Eurasian Education Quality Assurance Network (EAQAN), 2004,
  http://www.nica.ru/eng/nau/activity/international/networks/ecoko/

2.2 Basics of A3-HE

We first begin by explaining the basics of A3-HE irrespective of the country and the accrediting body.

2.2.1. A3-HE policies

For institutional accreditation, the first step is that an institution requests an evaluation of some of its programs that have produced at least one graduate. Each program then conducts an internal evaluation and completes a self-examination process. The self-study describes the actual status of the institution / program and describes to what extent students, curriculum, faculty, administration, facilities, and institutional support meet the established criteria. In some countries, e.g. the United States, accreditation is a peer-review, non-governmental set of processes that assures the quality of the postsecondary education [3]. Educational institutions or programs undergo this review periodically to determine if requested criteria or standards are being closely followed.
In all other countries, accreditation is neither necessarily voluntary nor non-governmental. The United Nations Educational, Scientific, and Cultural Organization (http://www.unesco.org) gives the required information on the world's postsecondary education systems and their quality assurance mechanisms. In any case A3-HE is not to be confused with ranking systems such as the Academic Ranking of world Universities (ARWU, http://www.arwu.org), for instance.

2.2.2 Types of A3-HE
There are three types of A3-HE: institutional, specialized or program-based, and hybrid.

(i) Institutional accreditation
Institutional accreditation evaluates overall institutional quality. One form of institutional accreditation is regional / national / international accreditation of colleges and universities.

(ii) Specialized or program accreditation
Specialized or program accreditation examines specific programs of study, e.g., Bachelor of Science in Computer Science, rather than an institution as a whole, e.g. University or College. This type of accreditation is granted to specific programs at specific levels such as undergraduate, postgraduate, professional, or other specialized academic training. Architecture, nursing, law, medicine, and engineering programs are often evaluated through program accreditation. In this case, A3-HE is granted by specialized bodies, usually incorporating professional societies. For instance, for computing disciplines, there is a strong interaction between the Accreditation Board for Engineering and Technology (ABET) (http://www.abet.org), on the one hand, and the Institute of Electrical and Electronics Engineers (IEEE) (http://www.ieee.org) and the Association of Computing Machinery (ACM http://www.acm.org), on the other hand.

(iii) Hybrid Accreditation
Hybrid accreditation examines both types of accreditation expanded above. In this case programs are accredited on the condition that institutional accreditation is initially granted by the same accrediting body. For example, the National Commission for Academic Accreditation and Assessment (NCAA) (http://www.ncaaa.org.sa) grants accreditation for both institutions and programs. However, program accreditation is conditioned by that of the institution.

2.3 A3-HE generic processes
2.3.1 Documented evidence
The key to successful academic accreditation and assessment is documented evidence. Although difficult to fully implement in practice, this documented evidence should obey the following procedure:

- collect data from different sources;
- use multiple assessments to create as many data points as possible;
- evaluate both alumni and employer satisfaction once students graduate;
- undertake periodic program reviews;

The previous steps roughly describe a whole culture to be instilled and installed in the institution / program. For this accreditation and assessment culture to be effective, it is important to make sure that:

- faculty have a central role in planning and evaluating programs;
- standards clearly align with each other;
- standards clearly align with accreditation requirements; and
- all implemented measures are internally consistent.

2.3.2 A3-HE – The test in itself
Any A3-HE test, whether institutional or addressing a specific program, roughly follows the same steps, as below.

(i) Self-examination
Once eligibility requirements are fulfilled (e.g. one graduate at least for a program), an institution or program has to produce its own self-evaluation. This latter consists in describing the actual settings, corroborated by documented and measurable evidence – neither personal, biased opinions nor wishful thinking.

(i) Evaluation team visit
Team evaluators from the accrediting body pay a visit to the institution/program. The team is composed of at least one chairperson and one or more program evaluators. Team members are in general volunteers from academe, government, and industry, as well as private professionals. While on-campus, the evaluation team reviews various students’ documents like course materials, student projects, sample assignments, and exams. Other documents such as written policies and regulations, meetings minutes might
also be consulted. The team undertakes interviews with students, faculty, administrators, perhaps employers, alumni, and any other party whose contribution is judged important by the team. The main purpose of the visit is to investigate whether the criteria are met and tackles any questions raised by the self-examination.

(iii) Result of the visit
Following its campus visit, the team provides the institution/program with a written report of the evaluation. The information the institution / program receives identifies strengths, concerns, weaknesses, deficiencies, and recommendations for improvements. This allows the program to correct any misrepresentations or errors of fact, as well as address any shortcomings in a timely manner.

(iv) Final decision
The final evaluation report is presented by the evaluation team to the accrediting body. Based on the findings of the report, the accrediting body members decide on the final action, and the institution / program is officially notified.

(v) After accreditation
Accreditation is granted for a given period of time, usually in the range of five to six years. To renew accreditation, the institution / program must request another evaluation.

2.4 Motivations for implementing A3-HE
2.4.1 Competition-related issues
The motivations for implementing A3-HE processes can be summarized as follows.

(i) From the students/parents perspective:
- Experience ease in transferring credits from one school to another.
- Gain greater access to competition-based loans, scholarships, postsecondary education and specialized programs that require students attend accredited institutions.
- Benefit from their institution or educational system’s commitment to raising student performance and accountability.

(ii) From the institution/program perspective:
- Gain a reputation in the community ensuring authority, trustworthiness, and academic reference.
- Stay competitive in a rapidly-changing academic landscape.

2.4.2 The threat of degree and accreditation mills
In many higher education and training institutions around the world, we may encounter dubious providers of educational offerings or operations that offer certificates and degrees that may simply be considered as fake. These are usually referred to as “degree mills”. At a higher level, we may also encounter “accreditation mills”, i.e. bogus A3-HE bodies that may offer a certification of quality to institutions with no proper basis. Fake accreditation from an accreditation mill misleads the community as a whole about the quality of an institution. Degree mills and accreditation mills are both misleading and harmful to all parties – students, parents, institutions, programs, and the community. In many countries, degrees and certificates from mills are not acknowledged by other institutions in case students seek to transfer or go to graduate schools. Employers do not recruit this type of graduates and do not acknowledge these degrees and certificates when providing tuition assistance for continuing education. In the presence of degree mills and accreditation mills, the community may spend much money but, as a counterpart, receives neither an acceptable education nor a recognized credential for the end-products – the students. It is therefore a must for the community to identify both degree and accreditation mills and take action against them. For more details refer to the Website of the Council for Higher Education Accreditation (CHEA). [http://www.chea.org/degremills/].

3. International A3-HE bodies
Within the multinational networks described above, there exist accrediting bodies operating nationally and internationally. We will stress only those we think are prominent and are close to our computing discipline settings.

3.1 Business Education – AACSB/EQUIS
3.1.1 AACSB
The Association to Advance Collegiate and Schools of Business (AACSB) is an A3-HE agency for Bachelor, Master and Doctoral degree programs in business administration and accounting. AACSB accreditation requires the specification of learning goals and demonstration of their achievement for key general, management-specific, and/or appropriate discipline-specific. AACSB is not an international network or consortium. It is therefore a mechanism for international consistency and comparison. As of January 2011, 607 member institutions hold AACSB Accreditation. Overall, 38
countries are represented by AACSB-accredited schools. [http://www.aacsb.edu]

3.1.2 EQUIS
The European Quality Improvement System (EQUIS) is a leading international A3-HE in management and business administration. EQUIS is a member of the European Foundation for Management Development (EMFD), a global organisation devoted to the continuous improvement of management development (http://www.efmd.org/). Operating internationally like AACSB, EQUIS grants accreditation for first degree in business and management, MBA and PhD. In 2010, EQUIS has accredited two additional institutions in China and one in Thailand, and granted re-accreditation to ten other institutions. Overall EQUIS has accredited 129 schools in 36 countries. [http://www.efmd.org/index.php/accreditation-/equis]

3.2 Architecture Education - RIBA/NAAB
AACSB and EQUIS are not the only ones operating at international level. Other examples of such agencies is the UK-based Royal Institute of British Architects (RIBA) http://www.architecture.com/ and the US-based National Architectural Accrediting Board (NAAB) http://www.naab.org/.

4. Computing disciplines bodies
Perhaps as a result of publicity reported in news media about software disasters, some countries and state legislatures have considered regulating the practice of computing disciplines and software engineering, in particular. Many professionals believe that accreditation in higher education is inevitable to curb forthcoming software catastrophes. The accreditation will ease further (personal) certification of graduates. The issues associated with A3-HE of computer science/software engineers are, or at least should be, a high-priority concern to the computer science/software engineering community. Despite the fact that the ACM/IEEE2008 Curriculum [2] is clear about the content of a typical computer science course, precisely delineating 14 knowledge areas, the debate has been going on for years as to the universally accepted body of knowledge for software engineering on which to base A3-HE, thus entailing a difficult implementation [8].

4.1 ABET
4.1.1 ABET worldwide activities
Like the accrediting bodies AACSB/EQUIS, RIBA/NAAB, the Accreditation Board for Engineering and Technology (ABET) is one of the US-based agencies operating internationally. ABET, Inc. (or ABET for short) is a recognized A3-HE body in applied science, computing, engineering, and technology. ABET draws its recognition from the Council for Higher Education Accreditation (CHEA). In the U.S., ABET has provided quality assurance in higher education for over 75 years. To date, ABET accredits over 3,100 programs at more than 600 colleges and universities worldwide [http://www.abet.org].

4.1.2 ABET Structure
As of January 2011, ABET represents a federation of 29 members and one associate member of professional and technical societies. Among these societies, we find IEEE (http://www.ieee.org) and CSAB (Computing Sciences Accreditation Board, Inc., http://www.csab.org). Most member societies within ABET have curricular responsibilities. They recruit and assist in training qualified Program Evaluators who, along with Team Chairs, comprise the teams assigned to accreditation visits. ABET member societies also nominate individuals to the four ABET Accreditation Commissions representing Applied Science, Computing, Engineering, and Technology. Member societies also appoint individuals to the ABET Board of Directors.

4.2 CSAB
4.2.1 CSAB Structure
Computing Sciences Accreditation Board, Inc. (CSAB) is a US-based non-profit professional organization, handling quality of education in computing disciplines. CSAB is the lead society within ABET for accreditation of programs in computer science, information systems, software engineering, and information technology, and is a cooperating society for accreditation of computer engineering, biological engineering, and information engineering technology. The Association for Computing Machinery (ACM, http://www.acm.org) and the IEEE Computer Society (IEEE-CS http://www.computer.org/portal/web/guest/home) are the member societies of CSAB. The Association for Information Systems (AIS http://home.aisnet.org/associations/7499/files/IndexMarkup.cfm) was a member society between 2002 and September 2009. For a brief history of CSAB refer to [9].

4.2.2 CSAB Objectives
CSAB has responsibility for selection and training of Program Evaluators and for the development of
accreditation criteria. Accreditation activities are conducted by one of the four commissions within ABET namely the Computing Accreditation Commission (CAC). Within ABET, the CAC is responsible for the accreditation of programs in computer science, information systems, and information technology, while the Engineering Accreditation Commission is responsible for the accreditation of programs in software engineering and computer engineering (http://www.csab.org).

4.3 CSAB/ABET (CAC) Criteria
4.3.1 General criteria
General Criteria apply to all programs accredited by one of the four ABET commissions cited above. Each program accredited by an ABET commission must satisfy every Criterion that is in the General Criteria for that commission. These criteria are effective for evaluations during the 2011-2012 Accreditation Cycle. For more details refer to [1] and ABET Web site. For the present Accreditation Cycle, ABET General Criteria are:

Criterion 1. Students
Criterion 2. Program Educational Objectives
Criterion 3. Student Outcomes
Criterion 4. Continuous Improvement
Criterion 5. Curriculum
Criterion 6. Faculty
Criterion 7. Facilities
Criterion 8. Institutional Support

4.3.1 Program criteria for computer science (CS)
According to CAC, programs must show that they satisfy all of the specific Program Criteria implied by the program title. Any overlapping requirements need be satisfied only once. The Program Criteria for computer science provide computer-specific accreditation criteria. The Program Criteria for computer science are:

Criterion 3. Student Outcomes
Irrespective of the accrediting body, Student Outcomes have represented one of the most important facets in A3-HE [5], [6], [10]. As far as ABET/CSAB/CAC are concerned, the program must enable students to attain, by the time of graduation:
- An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
- An ability to apply design and development principles in the construction of software systems of varying complexity.

Criterion 5. Curriculum
Students must have the following amounts of course work or equivalent educational experience:

(i) Computer science coverage
One and one-third years that must include:
- Coverage of the fundamentals of algorithms, data structures, software design, concepts of programming languages and computer organization and architecture.
- An exposure to a variety of programming languages and systems.
- Proficiency in at least one higher-level language.
- Advanced course work that builds on the fundamental course work to provide depth.

(ii) Science and mathematics
One year of mathematics and science:
- Mathematics: At least one half year that must include discrete mathematics. The additional mathematics might consist of courses in areas such as calculus, linear algebra, numerical methods, probability, statistics, number theory, geometry, or symbolic logic.
- Science: A science training that develops an understanding of the scientific method and provides students with an opportunity to apply this mode of inquiry in courses for science or engineering majors that provide some exposure to laboratory work.

Criterion 6. Faculty
Some full time faculty members must have a Ph.D. in computer science.

4.3.2 Program criteria for information systems (IS) and information technology (IT)
Both of these programs rely on criteria similar to those for computer science described above. They both rely on the criteria of Students Outcomes, Curriculum, and Faculty but with relevant corresponding contents.

4.4 Example of a national body NCAAA
4.4.1 NCAAA Objectives
The National Commission for Academic Accreditation and Assessment (NCAA http://www.ncaa.org.sa/english/default.aspx), based in Riyadh, Saudi Arabia, is a governmental body acting under the auspices of the Higher Council of Education. NCAAA is vested with the responsibility for determining standards and criteria for academic accreditation and assessment and for accrediting both post secondary institutions and the programs they offer. The Commission encourages, supports and evaluates quality assurance processes of post secondary institutions to ensure that quality
of learning and management of institutions are equivalent to the highest international standards. These high standards and levels of achievement are aimed to be widely recognized both nationally and worldwide. The only exception is for military education which is administered under different arrangements.

4.4.2 NCAAA Standards
NCAAA accreditation is based the following 11 standards for both institutions and programs:

- S1. Mission and Objectives
- S2. Governance and Administration
- S3. Management of Quality Assurance and Improvement
- S4. Learning and Teaching
- S5. Student Administration and Support Services
- S6. Learning Resources
- S7. Facilities and Equipment
- S8. Financial Planning and Management
- S9. Faculty and Staff Employment Processes
- S10. Research
- S11. Institutional Relationships with the Community

4.5 Unifying perspective
As a summary, we give a brief comparison between ABET and NCAAA with the projection of all standards/criteria on three main activities related to Learning/Teaching, Research, and Community Involvement. Special emphasis is put on CSAB/CAC component of ABET.

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Table 1 – Comparative components between ABET and NCAAA

5. Conclusion
We have described the main academic processes involved in academic accreditation and assessment in Higher Education (A3-HE). The prominent world accrediting consortia have been reported. As an example of accrediting process, emphasis has been made on the computing discipline and on its corresponding accrediting bodies. It is only after academic processes have been defined that it becomes possible to present the computational technologies for enhancing them. These computational issues are discussed in the second part of the paper.

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