

Implementation of Quality Process Frameworks (ISO&CMMI) in Higher Education: Opportunities, Benefits and Hindrances

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Abstract: *Washington Accord (WA) recognizes equivalence of a normally 4 years duration under graduation programs in Engineering Education of its signatory countries. The accord defines Graduate Attributes (GAs) that are to be satisfied by the member countries that are subject to verification and licensing. It insists on Outcome Based Education (OBE) that defines the different goals to be achieved during the course, soon after the course is completed, long time after graduation and lifelong learning. This gives ample opportunities for defining and implementing quality processes and procedures in the higher educational institutes by selecting proper quality frameworks/standards similar to Capability Maturity Model Integrated (CMMI) and/or (International Organization for Standardization's (ISO) ISO 9000 etc. India, as a provisional signatory to Washington Accord, represented by its National Board of Accreditation (NBA) is bound to implement the requirements of this accord. The different areas of opportunity for process improvements as per well established quality standards like ISO 9001 and CMMI are discussed in this paper for which initiation is done in a small way in some isolated pockets of higher education in different parts of the world.*

I. INTRODUCTION

There are six international agreements governing mutual recognition of engineering qualifications and professional competence. In each of these agreements countries/economies who wish to participate may apply for membership, and if accepted become members or signatories to the agreement. In broad principle, each country/economy must meet its own costs, and the body making application must verify that it is the appropriate representative body for that country/economy.

There are three agreements covering mutual recognition in respect of tertiary-level qualifications in engineering:

The Washington Accord [1] signed in 1989 was the first - it recognizes substantial equivalence in the accreditation of qualifications in professional engineering, normally of four years duration. It has 15 signatory members and 5 provisional signatories, including India.

The Sydney Accord commenced in 2001 and recognizes substantial equivalence in the accreditation of qualifications in engineering technology, normally of three years duration.

The Dublin Accord is an agreement for substantial equivalence in the accreditation of tertiary qualifications in technician engineering, normally of two years duration. It commenced in 2002

The other three agreements cover recognition of equivalence at the practicing engineer level i.e. it is individual people, not qualifications that are seen to meet the benchmark standard.

The **Asia-Pacific Economic Cooperation (APEC) Engineer agreement** is the oldest such agreement which commenced in 1999. This has Government support in the participating APEC economies. The representative organization in each economy creates a "register" of those engineers wishing to be recognized as meeting the generic international standard. Other economies should give credit when such an engineer seeks to have his or her competence recognized. The Agreement is largely administered between engineering bodies, but there can be Government representation and substantive changes need to be signed off at governmental APEC Agreement level.

The **International Professional Engineers Agreement** commenced in 2001. It operates the same competence standard as the APEC Engineer agreement but any country/ economy may join. The parties to the agreement are largely engineering bodies. There are intentions to draw IPEA and APEC closer together.

The **International Engineering Technologist agreement** was signed by participating economies/countries in 2003. The parties to the Agreement have agreed to commence establishing a mutual recognition scheme for engineering technologists.

(The material covered so far in "Introduction" section is adopted from Wikipedia and the author does not claim any originality of his own writing to this portion of introduction).

These six international Agreements recognize equivalence of educational programs among different countries. These accords enable students to be considered equivalent in educational standards that enable them to pursue higher education or job opportunities in other countries without being subjected to verification of standards of education. Out of these six agreements, the first three are for engineering education and the later three for practicing engineering technology.

Each of the signatory countries to these agreements are represented by different educational bodies nominated by the respective governments. India is represented by National Board of Accreditation (NBA) [7] which is a wing under All India Council of Technical Education (AICTE) [8] under the ministry of Human Resources Development (HRD).

II. DIFFERENT QUALITY STANDARDS AND NORMS IN HIGHER EDUCATION

Most of the quality standards on higher education in India are “Outcome Based”

1. The Washington Accord (WA) [1] that is based on GAs is implemented by NBA in India with its own interpretation suitable to local conditions and fulfilling the requirements of WA. This is done at department level (i.e., each engineering branch wise like Electrical, Mechanical, Civil, CSE &IT etc)
2. NAAC [9] accreditation is done at Institute level covering more or less the same criteria as that adopted by NBA but in its own way of assessment
3. The state higher education has mechanisms to assess the quality of education that is not fully formalized
4. UGC has its own norms and methods of assessing quality of education.

Most of the accreditation bodies assess the quality of education in broad terms of

- Curricular Aspects
- Teaching-Learning and Evaluation
- Research, Consultancy and Extension
- Infrastructure and Learning Resources
- Student Support and Progression
- Governance, Leadership and Management
- Innovations and Best Practices as mentioned in NAAC criteria.

The Outcome Based Education (OBE) [4] translates the Requirements of Washington Accord into concrete steps of Program Educational Objectives (PEOs) which provide the abilities to students for lifelong learning and what the students can achieve much later after graduation. PEOs and Graduate Attributes together help in achieving Program Outcomes (POs) which help in judging what the student can do soon after education. POs in turn help defining in Unit Learning Outcomes (ULOs) (Course Outcomes) (COs) at each subject level.

The national bodies representing the member countries of WA, have to achieve these COs, POs and PEOs to meet their countries Vision through the means of Mission which determine these three factors.

NBA, that represents India as Provisional Signatory has formalized the relations between these different objectives as shown in fig-1 that shows the tree structure of how COs are derived based on POs and GAs, POs from PEOs, PEOs from Mission which in turn is derived from the Vision. The Vision and Mission can percolate down from higher level body (like a society/group having a group of colleges) to the lowest level of Department as a unit. The detailed requirements, means of assessing the achievement of these different aspects are captured in detail in the different formats for different institutes, which are called Self Assessment Reports (SAR).

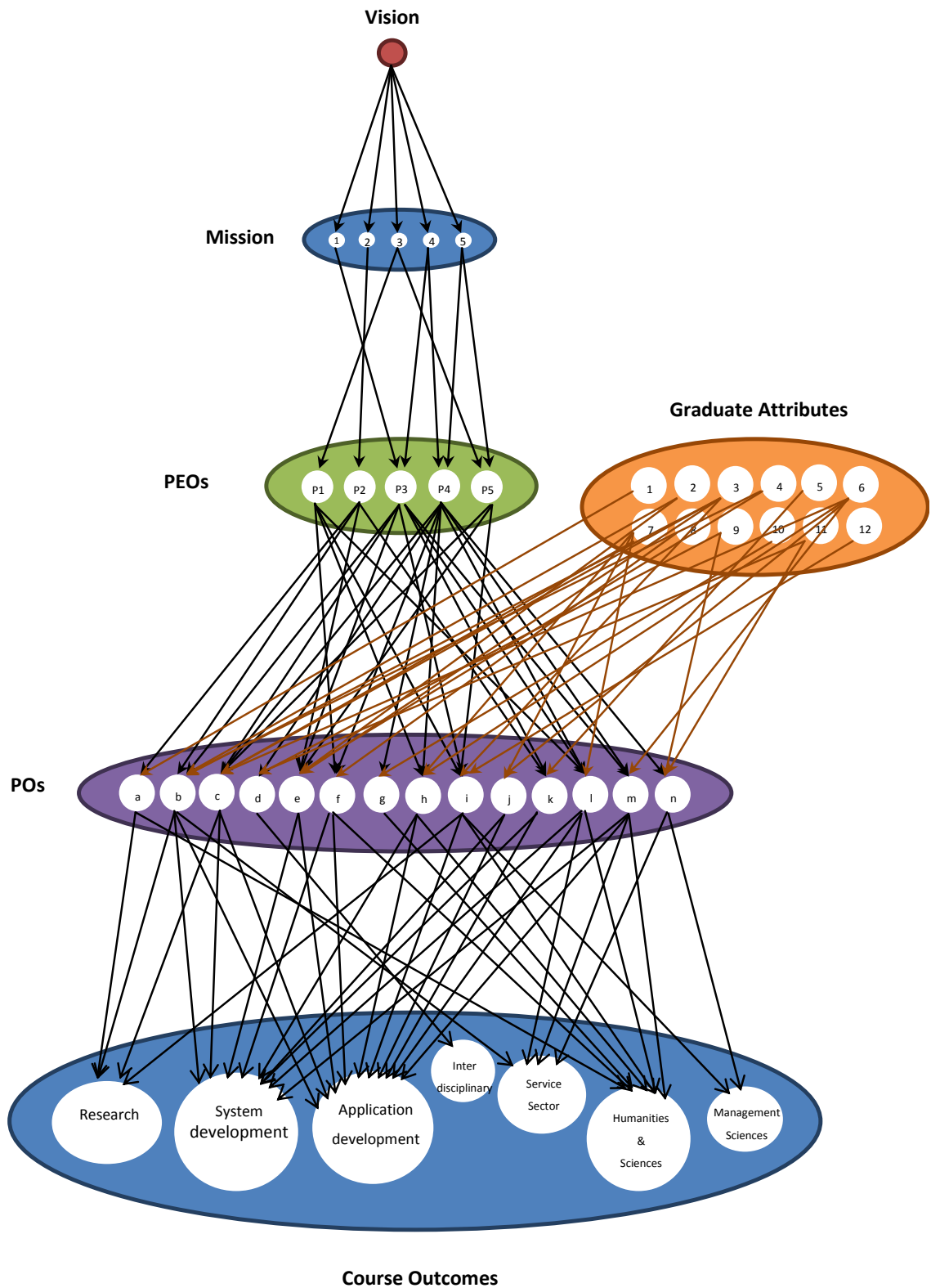


Fig 1. Relationships of Cos-Pos-PEOs-Mission-Vision and GAS

III. THE OPPORTUNITIES FOR IMPLEMENTING THE QUALITY FRAMEWORKS

The broad level processes defined by the different goals of OBE provides ample opportunities to develop detailed quality management systems as per one or more quality frameworks like CMMI[2] and standards ISO 9000 [3]

A Need to define the quality system:

The processes defined by above criteria are at much broader level than the working (detailed) level. When these requirements are to be met they have to be translated into sustainable and maintainable detailed procedures at working and reference level, this is the place where the role of different quality standards like ISO 9000 and CMMI come into play. The importance of these standards can be noticed by observing that the WA contains almost at least one reference to “process (es)” per page on the average in Section B (“Rules and Procedures”) to be adopted by the member bodies and wherever the word “Process (es)” appear in the context of quality ISO 9001 and CMMI have a role to play.

B. The role of quality frameworks

ISO 9000 and CMMI help in defining the detailed quality management system, translation of organizational processes into detailed procedures and sustaining them in the long run.

C Opportunities for Process Automation

Further there are plenty of opportunities to develop simple tools to automate many of the processes in educational institutes that are labor intense. These manual mechanisms make many kingpins on which the management becomes dependent and makes these kingpins very loyal to the management. This results often in hotspots in the system where these kingpins show their authority and their will often becomes the practice. An established quality system eliminates any such undeclared centers of power. The development of simple software tools can be taken as internal projects by undergraduate and post graduate students applying all the quality frameworks and software engineering techniques taught in the curriculum. Maintaining these tools and quality processes can be done utilizing the continuous stream of students year after year. Few junior faculty members can achieve this under the guidance of senior faculty members.

These processes help students in giving real time project development and implementation experience boosting their confidence to face the real world of working in industries, which is one of the core aims of all the OBE and that of the many international accords like WA.

D. Software Frameworks as enablers to achieve and sustain high accreditation ratings

Moreover, many of the college managements have to go for accreditations one time or other for their survival. This needs huge data to be maintained over years to demonstrate continuous improvements. Development of software tools and establishing a well defined quality management system can help immensely in achieving the objectives of accreditation without much effort or difficulty.

IV. FEASIBILITY OF IMPLEMENTATION OF QUALITY FRAMEWORKS IN EDUCATION, THEIR BENEFITS AND EXPERIMENTAL EXPERIENCES:

Different people have experimented with the implementation aspects of the quality frameworks in higher educational institute, independently in different parts of the world with different environments by adopting different strategies.

Urs Andelfinger [5] tried to implement CMMI Services framework in his Department of Computer Science of Darmstadt University of Applied Sciences and shares his experiences, benefits, pitfalls and his suggestions. His method of approach has been elaborately explained and the scope of implementation is kept minimum so as to convince the stakeholders with the substantial benefits of implementing these frameworks.

Ramakrishna [6] shares his experiences of implementing CMMI through implementation of a single process by automating the attendance system throughout the institute. It was demonstrated that with proper preparation, initial effort and management willingness it is possible to implement the quality frameworks like CMMI and ISO 9000 in higher educational institutes without much tears and reap the rich benefits. The requirements of frameworks need proper interpretation and the documentation work needs to be minimized. It was demonstrated through practical implementation of internally developed tool called Student Attendance Record Updation” (SARU) that nearly 96% of specific process areas can be implemented without much effort, provided the documentation work is minimized to bare necessity and evidence of carrying out the activities can be treated as proofs of implementation.

V. HINDRANCES:

In the existing scenario there are many hindrances for adopting the quality frameworks/standards in higher educational institutes. The points discussed are the ground realities at least in India and especially with higher education institutes (especially engineering education) in private sector in general, which excludes some exceptions that are always present in any system.

A Management Support

Unlike in software industry, where implementation of quality frameworks is a key business strategy to prove to the customers, in education field, this is essentially an enabler to establish institutional quality culture and the non-monetary benefits of improving quality of education that matters. This in turn requires the vision of the management for such a system. Hence, the management's active initiative, involvement and support are must for defining the quality management system, its implementation and sustenance in the long run.

Unfortunately privatization of higher education in India is the biggest hindrance in starting any such initiatives as majority of these institutes are run purely on commercial basis and seen as cash cows that pull as much revenue as possible in the shortest period of time rather than having vision of establishing a good education system that will ultimately result in higher yield in the long run. The managements look at any effort in this direction as waste if it is not bringing immediate financial gains.

B Attrition:

In any organization initial establishment of a working system and achieving a level of quality is a tough task, but sustaining it over long run after the initial establishment is herculean task and requires continues support from all stakeholders. Sustenance of standards over long time needs people with long association to reduce the effort of continuing the organizational culture which needs people to be associated with the organizations for longer time. But, especially in countries like India, employment in educational field is considered as inferior compared to that in industry and people try to change their line of employment as early as possible making the employment in education as a last-resort stop gap arrangement, this often results in large attrition rates and hence greater pressure in maintaining the established organizational culture. Very few institutes of higher education, especially in private sector have the benefit of less attrition. Hence, each year, training new comers and familiarizing them with the processes, procedures and practices becomes herculean task.

C Lack of practical wisdom in Higher Education

In most of the private institutes, the faculty are mostly from academic background and are not exposed to industrial environment and do not possess practical aspects of theory they learnt in their academics, without which it is difficult to appreciate any quality initiative and the relevance of processes and subject depth. In many cases, even the industry-institution interaction mostly is limited to few projects for students after which most of the students may not join academics.

D Interdisciplinary exposure and experience considered as bane instead of an asset:

In most of the higher education institutes (especially engineering education) those who have long experience in one field (like say mechanical or computer science) are considered as more desirable rather than those who have experience in more than one field. Even the educational specifications by regulating bodies like AICTE, UGC etc do not give importance to these aspects though they talk about interdisciplinary exposure in their quality requirements.

E Regulatory Bodies want the cake and eat it too at the same time

Practical Experience in industry is considered as inferior rather than higher academic qualifications: Most of the regulator bodies make PhD mandatory to be qualified as professor with 10 years of teaching experience compared to even 25 to 30 years of outstanding practical experience and high teaching abilities with Post Graduate degrees and excellent academic records. The private educational institutes exploit such loop holes to keep the morale of the experienced low and the educational institutes are denied the much needed exposure to practical world. Even though the regulatory bodies like AICTE make provisions to consider 10 years of industrial experience equivalent to PhD, mostly it remains as a guideline and ignored for all practical purposes. Thus the regulatory bodies themselves make the situation of having the cake and want to eat too and deny the golden opportunity of utilizing the vast manpower available from industry with rich back ground of experience, qualifications and teaching ability.

F. Selecting an appropriate Quality Framework for Process Definition and Improvements:

Ramakrishna S [10] has discussed the limitations in selecting a proper quality framework for a given industry/organization as well as the constraints and beyond the requirements overhead imposed by selecting a pre-defined international quality standard. Ramakrishna has further suggested ways and means of selecting a proper mix of different and relevant sections of quality frameworks on an a-la-carte basis and make a suitable quality framework particularly suited to that industry/organization. As the quality requirements of most of the institutes are more or less same, with minor deviations in particular requirements to meet very specific quality goals (if any) of a particular organization, a quality framework can be easily worked out by combining appropriate sections from more than one framework and making it as international standard in Higher education.

An example can be selection of some sections from ISO 9001:2008 and some process areas in CMMI Dev/CMMI Services and make a tailor made framework for higher educational institutes that cover all the academic and administration aspects.

Similarly and simultaneously it is essential to develop a verification (audit) framework to ensure adherence to the newly formed framework.

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