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GLOBAL ACCREDITATION AND QUALITY ISSUES IN INTERNATIONALIZATION OF HIGHER EDUCATION IN ENGINEERING

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ABSTRACT

Recognition of higher qualifications has become highly significant in this era of global interdependence. On the other hand, there is a recognized unbalanced development across the world that demands relocation of professionals around regions. The paper thus discusses the accreditation standards being followed in different regions of the world along with their challenges and requirements. Quality concerns due to various factors such as; internationalization, increase in number of students, number of courses and advent of multiethnic work environment has intensified in last few decades making accreditation a complex evaluation instrument. The work presented in this paper revolves around effects on quality of education due to internationalization. The understanding of avoiding the waste of engineering human resources when different regions in the world are in dire need of technical work force has led to different international accords. The necessity has therefore, led to development of benchmarks for engineering qualification and practice.

Keywords: Internationalization, Accreditation Standards, Quality Concerns, International Accords, Engineering Benchmarks

Subject area: (Please put a "X" as appropriate)

X	a)	Accreditation (In its broadest sense)
X	b)	Research (related to Internationalisation either linked to students or partnerships with international establishments)
	c)	Affiliation (with International partners involved in HE)
	d)	International students and sponsorship

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Recognition of higher qualifications has become highly significant in this era of global interdependence. On the other hand, there is a recognized unbalanced development across the world that demands relocation of professionals around regions. The paper thus discusses the accreditation standards being followed in different regions of the world along with their challenges and requirements. Quality concerns due to various factors such as; internationalization, increase in number of students, number of courses and advent of multiethnic work environment has intensified in last few decades making accreditation a complex evaluation instrument. The work presented in this paper revolves around effects on quality of education due to internationalization. The understanding of avoiding the waste of engineering human resources when different regions in the world are in dire need of technical work force has led to different international accords. The necessity has therefore, led to development of benchmarks for engineering qualification and practice along with setting up global accreditation system.

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1. INTRODUCTION

Rapid advances in technology and unbalanced development of technical workforce requires internationally recognized technical hands to tackle globalization in this era of global interdependence (Tossavainen, 2009). Globalization has stimulated a strong bond in economic, political, and cultural spheres, thus increased the agility of ideas and mobility of people in higher education. Higher Education Institutions are therefore, fast modifying in reaction to emergent geopolitical and economic commitments to become global (Wihlborg and Robson, 2018). Professionals may need license or other certifications when their work demands judgment and decision-making on issues that affect life, health, safety or environment (Khan, 2018). Internationalization is not only vital for sustainability of higher education at national level but also its subsequent impact on national development and ability to meet requirements of a global market are equally important (Yemini and Sagie, 2016).

Internationalization and globalization are often confused with each other (Altbach, 2015). Globalization comprise integration of research, use of English language for scientific communication, technology publishing, fast increasing demand for intellectuals in international market and the use of information technology, thus, worldwide mobility has complicated the existing disparities by favoring the well-developed education systems and institutions. Internationalization comprises mobility of students, mobility of programs and institutions of higher education, growing international market for qualified workforce and curriculum internationalization (Altbach and Knight, 2007) which has made accreditation a complex evaluation instrument (Patil and Codner, 2007).

Different organizations such as International Engineering Alliance (IEA), Federation of Engineering Institutions of Islamic Countries (FEIIC), Federation of Engineering Institutions in Asia and the

Pacific (FEIAP) etc. are pursuing implementation of global standards towards higher education in general and engineering education in particular for compatibility among their member countries.

2. KNOWLEDGE AND EDUCATION AS INTERNATIONAL COMMODITIES

Education has transformed to a globally traded commodity. It has deviated from being a service that develops a good citizen for a society through acquired skills, attitudes and values (Altbach, 2015). It is rather, considered a purchasable commodity comprising market required skill sets or a product tradable by a multinational corporation. Globalization is unavoidable and irresistible. Globalization effects on education are seen by some as optimistic future of economic integration whereas; others only see its negative impacts.

Globalization is a vital element for the knowledge industry. Internationalization is seen in higher education since the beginning of universities in medieval Europe when both students and professors routinely moved between countries. Now, over 2 million students are studying away from their own countries and a large number of researchers and faculty are required worldwide. An education system is not only expected to develop appropriate competencies for economic success, but it also builds a foundation for civic society through national participation (Khan, 2018). History, culture and democratic values along with other components define a nation's education system, and these are difficult to be integrated in a global marketplace.

Upkeep of appropriate academic standards is a big challenge for a national higher education system. To achieve this objective most of the countries including United States rely on their accrediting systems, which provides them with appropriate information about educational institutions, their degree programs and available facilities (Prados et al., 2005). It is a real hard task to uphold a required minimal standard at national level; therefore, it becomes impractical at international level. European Union has made efforts and faced it difficult to synchronize aspects of higher education among its member countries so we can imagine the international challenges.

History reveals that major powers exerted a lot to rule the hearts and minds of the world population during cold war era. To acquire dominance on world's intellectuals and academic leaders, the efforts by these powers comprised but not limited to student exchange programs, subsidies on books, translation of reading material and institution developments. In today's contemporary world, we are faced with different challenges that are meant to ensure supremacy of multinational companies, media and some major higher education institutions. The purpose of these new neocolonialists has nothing to do with ideological or political objectives rather their intentions are pure commercial gain. The outcome of this approach is again give up of intellectual and cultural sovereignty by less powerful. Argument here is to emphasize that education is not a mere commodity but rather it is a vital fragment of culture and society thus it merits to be dealt differently with other elements of the marketplace.

Although all types of international educational transactions have always remained high, now a number of countries have opened their doors to foreign universities on their own terms, however few others are pursuing to comprehend their effect for appropriate regulation. China has slowly accepted foreign educational institutions and programs, while United States is making efforts to apply its reputed accreditation principles on its institutions and programs overseas. Australia is determined to sell its educational products across its borders whereas; the European Union is heading towards the synchronization of academic systems of its member countries. There is an unmatched scale and scope of student's travel for academic experiences during past century and there is an operative international market for highly educated personnel (van't Klooster et al., 2008). Thus, the world is stepping forward to internationalizing higher education through efforts of academia in order to respond to market needs. However, it may be clear that any pact forcing the countries with diverse academic requirements and resources to serve the interests of dominant academic systems or commercial educational providers will only generate discrimination and reliance.

3. LEARNING GAINS OR OUTCOMES

Learning gain is defined as the difference between competencies, skills, knowledge and personal trait growth authenticated in students. Curiosity in learning gain and initiative for advancement in higher education(HE) is not new, demand for accountability, equity, and transparency through international

developments has become an international subject and rising consideration being given to intended learning outcomes (Liu et al., 2012, Mountford-Zimdars et al., 2015a, Caspersen et al., 2017). There is an ever-increasing desire to establish excellence in teaching through development of learning gain indicators. Measurement of learning gain has been declared as a priority work in England, where government is in full support of the task for refinement of indicators. Significant efforts have been reported for development of learning gain measures with complicated integration of political contexts, methodologies and enhancement of learning and teaching (Mountford-Zimdars et al., 2015b).

Diverse stress on definitions of learning gain has numerous dimensions and blends such as achievement, value added or travelled distance. The challenges of these dimensions are captured in Figure 1, which comprise what and how to measure the competencies, acquisition of knowledge, understanding, application, social skill, and employment preparation. The appropriateness of methodologies for measurement of political, social, ethical and disciplinary contexts. Learning capabilities in higher education has progressively become result oriented, but for some it's still not clear that what comprises these outcomes(Allan, 1996). Published literature reveals that learning gain is regarded as advancement in psychomotor skills, cognitive knowledge, personality traits, views and ethics, work readiness, and enhancement of outcomes in specialty domain and institutional perspective (Garrison and Kanuka, 2004, Nusche, 2008, Caspersen et al., 2017).

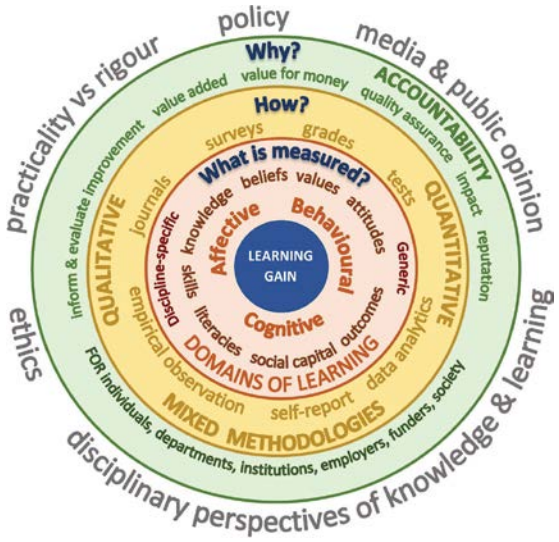

Figure 1. Learning Gain (Evans et al., 2018)

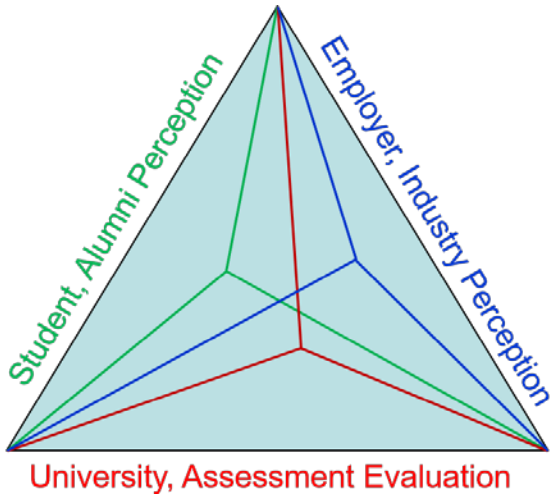

Figure 2: Different Perception of Stakeholders

3.1 Stakeholders' Perceptions

Internal and external stakeholders for learning gain comprise students, teachers, educational institution, potential employers, industry, alumni, parents and regulatory body and all are expected to have different perceptions as shown in Figure 2. As result of expanding student community and varying prerequisites of labor markets associated with rise of Artificial Intelligence application and fourth industrial revolution, value of HE is under global scrutiny to address escalating cost of education. In UK one tenth undergraduates drop out in first year while one third leave education in US at the same stage (Evans et al., 2018). Accomplishment rates for higher education in Europe vary significantly with 81% in UK and 59% in Denmark (Vossensteyn et al., 2015). Whereas in Australia it is reported from 51% to 88% (AEN, 2018). Therefore, along with demonstration of significance to learning outcome race, it is expected to be particularly cautious about resources and their purpose of use.

Measurement of learning gain is complicated, demanding solution to philosophical and scientific questions of what and how to measure. It is not possible without compromises between robust methodologies and real deliverables, all of this is trapped with debates and resistance from reputed institutions to contest what was being done in the past. Therefore, such arguments frequently divert us from main purpose of HE (Peseta et al., 2017). Integrative instructional scheme is important to study the complete journey of student's learning process, this defines the learning prospects generated in curriculum, integrated with assessment and constructive feedback(Evans, 2013).

As argued above a single scheme may not be able to solve the issue. Therefore, a common global measure for learning gain is useless as it may not be able to provide effective evaluations of learning through specific situations. It is concluded that a distinct solution is improbable therefore; educational institutions may design outcome measurements to fit particular desires. Therefore, efforts may focus on defining meaningful methods to assess learning and teaching, in order to ensure equal learning opportunities and their results for all students with diverse backgrounds and levels of understanding.

4. ACCREDITATION SYSTEMS FOR ENGINEERING EDUCATION

Accreditation of programs is a key practice to sustain the quality in engineering education. The idea came into practice with the dawn of 20th century, received an expeditious acceptance by 50s and today almost every country has its own accreditation council/agency. Accreditation in Europe can be traced back in the law of 1934 implemented through "Commission of the Titles of Engineers" describing circumstances for delivery and award of Qualified Engineer title. Most of these procedures employed worldwide are typically influenced by Accreditation Board of Engineering and Technology (ABET) guidelines. In past two decades quality concerns have increased in higher education due to various causes e.g., increase in student enrolment, growing trend of internationalization, growth of e-learning and distance education and advent of multicultural work environment. Hence these quality requirements can be completed at different stages e.g., internally at university or departmental level and externally at professional bodies, regulatory or international agencies level.

Accreditation started as a simple notion to recognize the higher education institutions and programs on well-defined principles and benchmarks but over the period of time has transformed into a compound appraisal mechanism (Young, 1983, Hagerty and Stark, 1989, Patil and Codner, 2007). It is considered as an influential monitoring process for quality assurance, which not only augments the advancement in international recognition in academic and professional engineering practices but also empowers state's quality assurance system. It supports refining lecture theatre and workshop/Laboratory services through quality programs and advances institutes reputation and standing worldwide. Detail of different stakeholders in the process has been provided in the earlier text and Figure 2.

4.1 Purpose of Accreditation

The following are some of accreditation's significant resolves in engineering education:

(a) Accountability
(b) Quality Assurance
(c) National and International Academic repute
(d) Professional registration and recognition
(e) Global movement
(f) Educational development;
(g) Educational advertising and attractiveness

Some of the existing and renowned models being globally used are tabulated with the strengths and weaknesses in Table 1. The programs for acceptance of technical workforce and their qualifications began voluntarily with the support of ABET in US, which were accepted by other nations and later transformed into different international accords. Brief description of the major existing accreditation systems reveal that there is worldwide exponential advancement in engineering education to graduate excellent technical workforce. Furthermore, changing environment of global financial arrangements, audits of higher education and growing competitiveness demands high standard and quality of engineering graduates for use of progressive technology. In order to meet the requirements of changing times, advanced countries have lately moved to Outcome/Output based system for their accreditation process. Laboratories/Workshops distinguish engineering and technology education from other disciplines. These are considered as necessary learning instruments and need a critical look at procedures to accrue maximum benefits towards learning. Engineering has grown beyond national boundaries and has become a global profession. As seen above there are a number of evaluation models to standardize engineering courses/modules, however, these appear to be neither identical nor organized. Moreover, most of these are believed to be complicated and non-transparent.

Table 1: Reputed Accreditation Models

Region	Association/Board	Purpose and Scope	Strengths / Weaknesses
United States	Accreditation Board of Engineering and Technology (ABET)	o Established in 1932 to function for development and progression in engineering education, computing, applied science and technology. o Appraises engineering programs at Institutions based on Outcome Based Education. o Knowledge, Skills and Attitudes competency model defined for accreditation panel.	**Strengths** • Eight criterion: Program Educational Objectives, Program Outcomes and Assessments, Students, Faculty, Professional Component and Program. • Continuous updating of accreditation criteria. • Several bi-lateral and multi-lateral agreements. • Recognition agreements and workshops. **Weaknesses** • Frustration of constituents due workload, documentation and assessment tools. • Inconsistent evaluation of objectives/outcomes by evaluators. • Importance desired at program level.
Europe	European Association for Quality Assurance in Higher Education (ENQA)	o Established on Bologna Declaration 1999, for a system for comparable degrees in higher education. o Defines undergraduate and graduate education cycles. o National systems as Engineering Council of UK and German Accreditation Council also exists. o Engineering Council UK has licensed 35 Professional Engineering Institutions (PEIs) to assess candidates for inclusion in national register of Professional Engineers and Technicians, Accredits programs and professional schemes.	**Strengths** • Movement of professionals internationally and in Europe. • Common approach as Thematic Network Project and European Accredited Engineer Project (EUR- ACE). • Sustainable development for job creation. **Weaknesses** • Considerable variations in system. • Countries applying their criteria for second cycle. • Countries emphasize on national needs, fail to meet industrial wants. • No focus on soft skills and changing industrial needs for workplace. • Differences in accreditation procedures.
Asia-Pacific	Federation of Engineering Institutions of Asia and Pacific (FEIAP)	o To ensure quality education due to economic progression and industrialization. o Regions fast development resulted in extensive advancement of higher and technical education.	**Strengths** • Significant progress in engineering education. • Development of accreditation procedures for engineering programs. • Engineers Australia promotes international accords. **Weaknesses** • Slow rate of execution, non-uniformity and collaboration. • Variation and deficiency of maturity in accreditation. • Necessitates identical accreditation procedures. • Huge number of programs awaiting accreditation. • Region has both established as well as evolving accreditation systems.

4.2 Professional Bodies in Oman

As per Royal Decree, Oman Academic Accreditation Authority (OAAA) has been assigned to regulate Institutions and programs through accreditation. Institutional Accreditation involves the process of Quality assessment, Standards assessment and reassessment so that institutions pursue their distinctive missions and plans, ensuring achievement of minimum standards. Similarly, the program accreditation process encompasses assessment and reassessment against national standards. OAAA is currently revisiting its accreditation strategy and devising its generic national program standards.

Another important active professional body is Oman Professional Engineers Network (OPEN), which acts as front end for UK PEIs and provides platform for their members to collaborate. OPEN works under the ambit of Oman Society of Engineers (OSE) aiming at promotion of engineering profession and advancement of engineering knowledge. The network also supports young engineering professionals in their growth and attainment of recognized qualifications.

5. INTERNATIONAL ACCORD FOR HIGHER EDUCATION

The internationalization of higher education has potential benefits but it costs and necessitates the standardization through accreditation. Different accords such as Washington, Dublin and Sydney accords, to distinguish the considerable uniformity of systems, programs and professional competence of technical workforce have been signed in the last few decades.

5.1 Washington Accord

International recognition, equivalence of proficiency is vital in this modern epoch of interdependence. Therefore, International Engineering Alliance (IEA) have tied its member countries through international accords. To avoid wastage of technical resources/education, owing to lack of technical workforce in different regions, a multi-lateral agreement, "Washington Accord" initiated and signed by a group of advanced countries. The Accord primarily focuses on engineering programs' mutual recognition among members, thus it deals with standardization of engineering practice. Accord has developed graduate attributes to keep pace with globalization and ensure international compatibility among engineers. Over last few decades, accord has grown from six to twenty full signatories and eight provisional members pursuing full member status, details are shown in Table 2.

A multi-lateral agreement widely known as "Washington Accord" signed in 1989 between accreditation bodies of six countries has grown in three decades to twenty members while there are other eight countries aspiring to become full signatory by achieving the required standards. The members mutually recognize the good practice in accredited engineering programs at tertiary level to ensure the mobility of students and acceptance of their engineering graduates.

Table 2: Washington Accord Members (Khan, 2018)

Full Signatories		Provisional
Australia	Engineers Australia (*1989*)	• Bangladesh • Costa Rica • Mexico • Chile • Indonesia • Myanmar • Philippines • Thailand
Canada	Engineers Canada (*1989*)	
Ireland	Engineers Ireland (*1989*)	
New Zealand	Engineers New Zealand (*1989*)	
United Kingdom	Engineering Council UK (*1989*)	
United States	Accreditation Board for Engineering and Technology (*1989*)	
Hong Kong China	Hong Kong Institution of Engineers (*1995*)	
South Africa	Engineering Council South Africa (*1999*)	
Japan	Japan Accreditation Board for Engineering Education (*2005*)	
Singapore	Institution of Engineers Singapore (*2006*)	
Chinese Taipei	Institute of Engineering Education Taiwan (*2007*)	
Korea	Accreditation Board for Engineering Education of Korea (*2007*)	
Malaysia	Board of Engineers Malaysia (*2009*)	
Turkey	Association for Evaluation and Accreditation of Engineering Programs (2011)	
Russia	Association for Engineering Education Russia (*2012*)	
Sri Lanka	Institution of Engineers Sri Lanka (*2014*)	
India	National Board of Accreditation (*2014*)	
China	China Association of Science & Technology (*2016*)	
Pakistan	Pakistan Engineering Council (2017)	
Peru	Instituto de Calidad Y Acreditación de Programas de Computación, Ingeniera Tecnología (ICACIT) (2018)	

6. GLOBAL ACCREDITATION MODEL

An engineer is required to work independently thus needs to develop essential engineering competencies as per competency model as shown in Figure 3 (Prelewicz, 2003 - 2018). A detailed version of the global competencies divided into three categories is shown in Figure 4 (Patil, 2005).

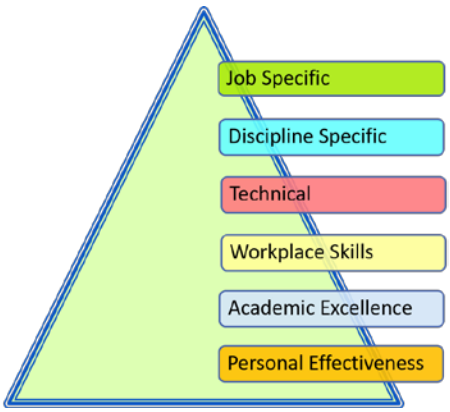

Figure 3: Engineering Competency Model

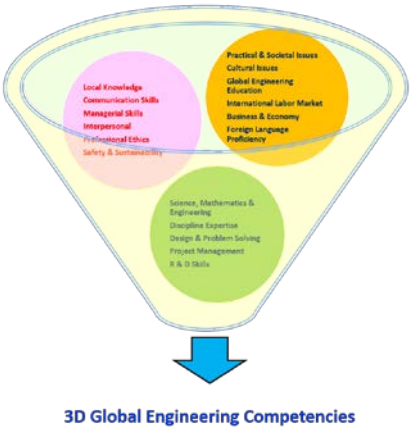

Figure 4: Global Competencies for Graduates

6.1 Educational Process Cycle

Engineering cycle comprises of three parts as shown in Figure 5. In order to improve the engineering education quality most of the published work focuses on *Output* part of the process with no attention on other two parts. To acquire the desired *Output*, not only resources and infrastructure are important but teaching/learning plays a vital role in the complete process. Therefore, it is important to give due importance to all three parts of the education process.

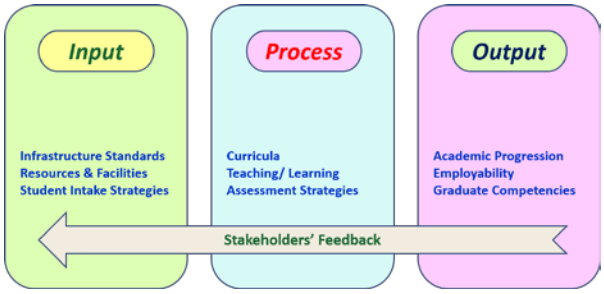

Figure 5: Educational Process Cycle

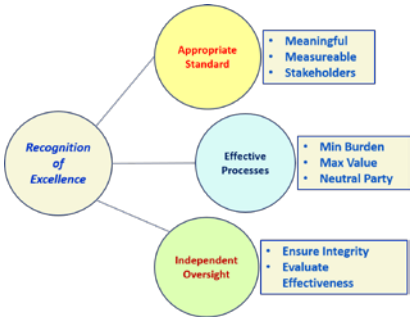

Figure 6: Global Accreditation Requirements

6.2 Global Accreditation

Global accreditation model shown in Figure 6, provides a broad tool to ensure uniform criteria and standards worldwide. The process either national or international has to be secure and aim at improving quality of engineering education through fostering of adequate study of all the three parts of the process. The success of the model would promote mobility of technical force and enable the sanction of international engineering memberships and honors.

7. CONCLUSION:

The literature review shows that a number of national and international accreditation models have been developed to improve the quality of engineering education. These models are not only complex and non-transparent but lack uniformity and scientific integrity. The necessity has therefore, led to the development of a global accreditation model and set and international benchmark for engineering qualification and practice. Brief guideline for development of global accreditation model has been defined in this paper. It is anticipated that standardization of curriculum and following of good international practices would not only improve the standards of the institution's output but would also play a vital role in acceptance and mobility of engineering graduates. This also paves the way for induction of students from across the borders, which is linked with generation of economic activity and desired by every developing country.

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