A STUDY ON WASHINGTON ACCORD

K. Vinothkumar[1]

[1]Lecturer Selection Grade, 219 Valivalam Desikar Government Aided Polytechnic College, Nagapattinam, Tamil Nadu, India 611001

---***---

Abstract – *This paper is intended to study the outlines of history and development of the Washington Accord, its purpose, signatories, graduate attributes and its connection with quality of education, assurance of quality in technical education in detail.*

Key Words: IEA, Washington accord, graduate attributes, signatories, quality, quality assurance,

1. INTRODUCTION

The aim of technical education is to develop an engineer who is professional, competent to become an individual engineering practitioner. This can be achieved in two levels. One during course of study through accredited program and another is through supervising him during practice and assessing his technical competency. By these both ways one can be recognized as a competent engineer and practitioner. In other words, education and training are essential in the making of practicing engineer.

2. WASHINGTON ACCORD- AN INTRODUCTION

The International Engineering Alliance (IEA) is an organization that encompass six multi-lateral agreements which establish and enforce amongst their members inter-nationally-benchmarked standards for engineering education and what is termed “entry level” competence to practice engineering. The Alliance, which currently has lead engineering organizations from 23 nations as members is expanding.

The IEA is a global, non-profit organization, whose members belong to 36 jurisdictions in 27 countries, which administers seven international agreements. These international agreements rule the recognition of academic qualifications and professional engineering competencies.

The IEA’s vision is to:

- Improve the global quality,
- productivity and mobility of engineers by being an accepted independent authority on best practice in standards, assessment and monitoring of engineering education
- professional competence.

The IEA’s core activities:

- Consistent improvement of standards and mobility
- Defining standards of education and professional competence
- Assessment of education accreditation and evaluation of competence
- Participation in activities that are driven from the engineering profession.

3. WASHINGTON ACCORD- 28 September 1989

The Washington Accord sits under the IEA alongside the Sydney and Dublin Accords. Quality engineers are developed with an accord-recognized degree or equivalent, through experience after graduation to develop both professional and personal maturity, and by meeting an agreed competence typically measured by evaluation against 12 elements. The Washington Accord is administered by the International Engineering Alliance, IEA. The international agreements rule the recognition of academic qualifications and professional engineering competencies and it focusses mainly on careers that conclude in the professional practice of science-based engineering.

In 1989 the six-foundation signatory organizations from Australia, Canada, Ireland, New Zealand, the United Kingdom and United States observed that their individual processes, policies, criteria and requirements for granting accreditation to university level programs were substantially equivalent. They agreed to grant (or recommend to registering bodies, if different) the same rights and privileges to graduates of programs accredited by other signatories as they grant to their own accredited programs.

The Washington Accord (IEA, 2014) is an international agreement between relevant organizations of signatory countries, including Canada, such that they all recognize the substantial equivalence of programs accredited in each of these countries. That is, all signatory countries recognize graduates of accredited programs in any of them as having met the academic requirements for licensure. While these countries conform to common education standards in different ways, they all now include graduate attribute considerations amongst their criteria

The Washington Accord is a multi-lateral accord between bodies responsible for accreditation or recognition of tertiary-level engineering qualifications within their jurisdictions that have chosen to work collectively to assist the mobility of professional engineers.

The Washington Accord is a self-governing, autonomous agreement between national organizations (signatories) that provide external accreditation to tertiary educational programs that qualify their graduates for entry into professional engineering practice.

The Sydney and Dublin Accords for engineering technologists and engineering technicians were initiated in 2001 and 2002, respectively. Together with the three agreements for engineering practitioners, the IEA was formed in 2007, and the IEA Secretariat was created to assist with the administration of the accords and agreements and their development

4. ROLES OF SIGNATORIES IN THE ACCORD.

The signatories undertake a clearly-defined process of periodic peer review to ensure each other's accredited programs are substantially equivalent and their outcomes are consistent with the published professional engineer graduate attribute exemplar.

In order to contribute to the increase of mobility for professional engineers around the world, the signatories or full members of the Accord are committed to the development and recognition of good practices to carry out the process of accreditation of engineering programs. The activities of the signatories of the Accord (for example, in the development of graduate profiles) are aimed at helping the growing mutual recognition of engineering qualifications internationally.

For the Accord it is very important that engineering programs are accredited in their respective countries. The Accord recognizes that the accreditation of engineering programs is a fundamental basis for the practice of engineering at the professional level in each country or territory covered by the Accord.

The Accord establishes the mutual recognition of the graduate attributes of accredited programs in the member countries is substantially equivalent.

Signatories agree to grant (or recommend to the relevant national registration body, if different) graduates of each other's accredited program the same recognition, rights and privileges as they grant to graduates of their own accredited programs. By these provisions, the Accord facilitates mobility of graduates between signatory jurisdictions and deeper understanding and recognition of their engineering education and accreditation systems. Amongst the signatories' educational providers, adherence to local accreditation requirements that are consistent with the professional engineer graduate attribute exemplar contributes to international benchmarking of program outcomes.

The signatories committed to:

1. continue to share relevant information; allow their representatives to participate in each other's accreditation processes and attend relevant meetings of their organization
2. to refer to this agreement in publications listing accredited programs.

There are currently 15 signatories to the Washington Accord that together deliver over 7,000 programs producing graduates that are significantly similar in competencies.

- 1989- Australia Engineers, Australia-

  Canada Engineers. Canada

  Ireland Engineers, Ireland

  New Zealand Institution of Professional Engineers, New Zealand

  United Kingdom Engineering Council United Kingdom

  United States Accreditation Board for Engineering and Technology

- 1995- Hong Kong, China -The Hong Kong Institution of Engineers
- 1999-South Africa Engineering Council of South Africa
- 2005- Japan- Japan Accreditation Board for Engineering Education
- 2006- Singapore Institution of Engineers Singapore
- 2007- Korea Accreditation Board for Engineering Education of Korea Chinese Taipei Institute of Engineering Education Taiwan
- 2009- Malaysia Board of Engineers Malaysia
- 2011- Turkey MUDEK (Association for Evaluation and Accreditation of Engineering Programs)
- 2012- Russia Association for Engineering Education of Russia

The following organizations hold provisional status:

- Bangladesh - Board of Accreditation for Engineering and Technical Education
- China -Association for Science and Technology
- India -National Board of Accreditation

- Pakistan - Pakistan Engineering Council
- Philippines -Philippine Technological Council
- Sri Lanka- Institution of Engineers Sri Lanka

5. TIME-SCALE OF WASHINGTON ACCORD.

The time scale of Washington accord is illustrated in Table-1

Table-1: Time scale of Washington Accord

PERIOD	EVENTS
1989, 28 September	Washington Accord signed by six organizations, called as signatories
1990s onwards	Development of formal peer review processes
1997–2002	New accords and agreements
2001 onwards	Development of graduate attribute exemplars
2007	IEA Secretariat established
2008 onwards	Development of rules for trans-national accreditation and Accord recognition
2012	Washington Accord signatories reach 15
2013 onwards	Relationship with ENAEE

6. GRADUATE ATTRIBUTES

Graduate attributes are defined for educational qualifications in the engineer, engineering technologist and engineering technician tracks. The graduate attributes serve to identify the distinctive characteristics as well as areas of commonality between the expected outcomes of the different types of programs.

Purpose of Graduate Attributes Graduate attributes form a set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practice at the appropriate level. The graduate attributes are exemplars of the attributes expected of graduate from an accredited program. Graduate attributes are clear, succinct statements of the expected capability, qualified if necessary, by a range indication appropriate to the type of program.

The graduate attributes are intended to assist Signatories and Provisional Members to develop outcomes-based accreditation criteria for use by their respective jurisdictions. Also, the graduate attributes guide bodies developing their accreditation systems with a view to seeking signatory status.

6. a) Limitation of Graduate Attributes

- Each signatory defines the standards for the relevant track (engineer, engineering technologist or engineering technician) against which engineering educational programs are accredited.
- Each educational level accord is based on the principle of substantial equivalence, that is, programs are not expected to have identical outcomes and content but rather produce graduates who could enter employment and be fit to undertake a program of training and experiential learning leading to professional competence and registration.
- The graduate attributes provide a point of reference for bodies to describe the outcomes of substantially equivalent qualification. The graduate attributes do not, in themselves, constitute an "international standard" for accredited qualifications but provide a widely accepted common reference for bodies to describe the outcomes of substantially equivalent qualifications.

- The term graduate does not imply a qualification but rather the exit level of the qualification, be it a degree or diploma.

7. GRADUATE ATTRIBUTES AND QUALITY OF PROGRAM

The Washington, Sydney and Dublin Accords -recognize the substantial equivalence of programs satisfying the academic requirements for practice for engineers, engineering technologists and engineering technicians respectively.
The Graduate Attributes are assessable outcomes, supported by level statements, developed by the signatories that give confidence that the educational objectives of programs are being achieved.

The quality of a program depends not only on the stated objectives and attributes to be assessed but also on the program design, resources committed to the program, the teaching and learning process and assessment of students, including confirmation that the graduate attributes are satisfied.

The Accords therefore base the judgement of the substantial equivalence of programs accredited by signatories on both the Graduate Attributes and the best practice indicators for evaluating program quality listed in the Accords' Rules and Procedures.

8. THE 12 GRADUATE ATTRIBUTES:

1. (KB) A knowledge base for engineering: Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.

2. (PA) Problem analysis: An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions

3. (Inv.) Investigation: An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data and synthesis of information in order to reach valid conclusions.

4. (Des.) Design: An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.

5. (Tools) Use of engineering tools: An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.

6. (Team) Individual and teamwork: An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.

7. (Comm.) Communication skills: An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.

8. (Prof.) Professionalism: An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.

9. (Impacts) Impact of engineering on society and the environment: An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.

10. (Ethics) Ethics and equity: An ability to apply professional ethics, accountability, and equity.

11. (Econ.) Economics and project management: An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.

12. (LL) Life-long learning: An ability to identify and to address their own educational needs in a changing world in ways enough to maintain their competence and to allow them to contribute to the advancement of knowledge.

Content Instructional Level

I = Introductory

At the introductory level, the students learn the working vocabulary of the area of content, along with some of the major underlying concepts. Many of the terms need defining, and the ideas are often presented in a somewhat simplified way.

D = Intermediate Development

At the intermediate development level, the students use their working vocabulary and major fundamental concepts to begin to probe more deeply, to read the literature, and to deepen their exploration into concepts. At this level, students can begin to appreciate that any field of study is a complex mixture of sub-disciplines with many different levels of organization and analysis.

A = Advanced Application

At the advanced application-level the students approach mastery in the area of content. They explore deeply into the discipline and experience the controversies, debate, and uncertainties that characterize the leading edges of any field. An advanced student can be expected to be able to relate course material to different courses, to begin to synthesize and integrate and achieve fresh insights. Students at this level are working with the knowledge very differently, perhaps even creating new knowledge through independent investigation.

The key features of the graduate attributes are summarized in the following tables. A defining characteristic of professional engineering is the ability to work with complexity and uncertainty, since no real engineering project or assignment is the same as any other (otherwise the solution could simply be purchased or copied). Accordingly, the attributes place as central the notions of complex engineering problems and complex problem solving.

The Washington Accord Knowledge Profile has eight elements:

WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline.
WK2	Conceptually-based mathematics, numerical analysis, statistics and formal aspects of computer and information science to support analysis and modelling applicable to the discipline.
WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline. WK5 Knowledge that supports engineering design in a practice area.
WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
WK7	Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the professional responsibility of an engineer to public safety; and the impacts of engineering activity – economic, social, cultural, environmental and sustainability.
WK8	Engagement with selected knowledge in the research literature of the discipline.

Complex engineering problems have a range of attributes. At least some of the following may be encountered within a professional engineering education program:

Depth of knowledge required	**WP1:** Cannot be resolved without in-depth engineering knowledge at the level of one or more of WK3, WK4, WK5, WK6 or WK8 which allows a fundamentals-based, first principles analytical approach.
Range of conflicting requirements	**WP2:** Involve wide-ranging or conflicting technical, engineering and other issues.
Depth of analysis required	**WP3:** Have no obvious solution and require abstract thinking and originality in analysis to formulate suitable models. Familiarity of issues WP4: Involve infrequently encountered issues.
Extent of applicable codes	**WP5:** Outside problems encompassed by standards and codes of practice for professional engineering.
Extent of stakeholder involvement and needs	**WP6:** Involve diverse groups of stakeholders with widely varying needs.
Interdependence	**WP 7:** High level problems including many component parts or sub-problems.

The attributes of complex engineering activities, some of which might reasonably be encountered by a professional engineering undergraduate (e.g. during capstone design or a period of industry experience):

Range of resources	**EA1:** Involve the use of diverse resources (and for this purpose resources include people, money, equipment, materials, information and technologies).
Level of interactions	**EA2:** Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues.
Innovation	**EA3:** Involve creative use of engineering principles and research-based knowledge in novel ways.
Consequences to society and the environment	**EA4:** Have significant consequences in a range of contexts, characterized by difficulty of prediction and

	mitigation.
Familiarity	**EA5:** Can extend beyond previous experiences by applying principles-based approaches.

The Washington Accord Graduate Attribute Profile has 12 elements, supported by a Knowledge Profile, WK1-WK8, and a definition of the Level of Problem Solving, WP1-WP7, both given below:

Engineering knowledge	**WA1:** Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to the solution of complex engineering problems.
Problem analysis	**WA2:** Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences (WK1 to WK4).
Design/ development of solutions	**WA3:** Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health, and safety, cultural, societal and environmental considerations (WK5).
Investigation	**WA4:** Conduct investigations of complex problems using research-based knowledge (WK8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
Modern tool usage	**WA5:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations (WK6).
The engineer and society	**WA6:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems (WK7).
Environment and sustainability	**WA7:** Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts (WK7).
Ethics	**WA8:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice (WK7).
Individual and teamwork	**WA9:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
Communication	**WA10:** Communicate effectively on complex engineering activities with the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
Project management and finance	**WA11:** Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work as a member and leader in a team, to manage projects and in multi-disciplinary environments.
Life-long learning	**WA12:** Recognize the need for, and have the

	preparation and ability to engage in, independent and life-long learning in the broadest context of technological change.

8. CONCLUSION

From this study, the history and developments, signatories of this accord, graduate attributes and skill sets are learnt. This study will be an eye opener towards the necessary knowledge and skill requirements as per Washington Accord for an engineer to become a practitioner.

ACKNOWLEDGEMENT

I thank and dedicate this work to my parents, wife and children for their cooperation and support for completing this task successfully.

REFERENCES

[1] Engineers Canada (2015). Accreditation Criteria Procedures 2015 [PDF]. Pg.13. Retrieved from https://www.engineerscanada.ca/sites/default/files/accreditation_criteria_procedures_2015.pdf

[2] Engineers Canada (2015). Questionnaire for Evaluation of an Engineering Program. Pg. 2. Retrieved from http://www.engineerscanada.ca/accreditation-resources.

[3] 25 years of Washington Accord- 1989–2014-Celebrating international engineering education standards and recognition- A booklet by International Engineering Alliance.

BIOGRAPHY

The author is a POST GRADUATE in Manufacturing Engineering with M.B.A. Doing research in the field of corrosion. Acting as resource person for TNOU, IGNOU in the branches of Engineering and Management. Has guided many PG and UG students of TNOU, IGNOU, respectively. Conducted seminars in various colleges. He is teaching Mechanical Engineering to Diploma students for past 18 years and has published three papers in an international journal. He is a lifetime member of ISTE. He is a chartered member in international lions' clubs association and has chaired many official responsibilities and recipient of international lions clubs -president awards for services.