

Pakistan Academy of Engineering
15th Symposium: “The Future of Engineering in Pakistan”
held on October 26, 2019 at, Marriot Hotel, Karachi.

Address of the President,
Dr. Ing. Jameel Ahmad Khan

Honourable Speakers!

Distinguished Guests!

Fellow Engineers!

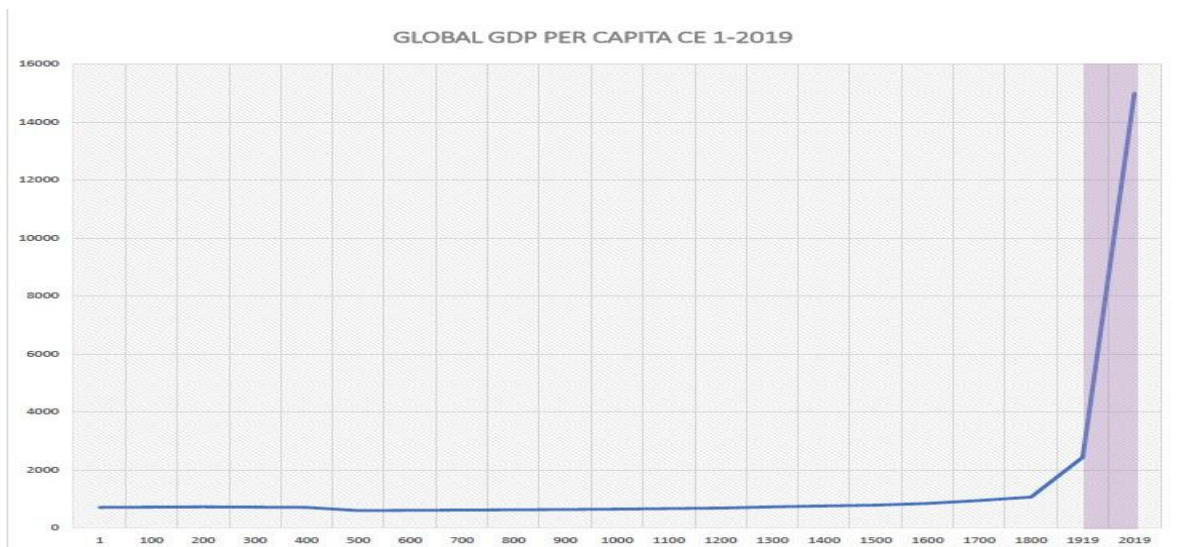
Ladies & Gentlemen!

SALAMUN ALA MANI T-TABAUL-HUDA

I am extremely happy and privileged to welcome you this morning to participate in an event that is of highest interest to us. We are grateful to acknowledge your continued cooperation.

Ladies & Gentleman!

One of the most global professions is engineering. In the CAETS Annual Conference held in June 2019, at Stockholm, Sweden, an interesting graph depicting Global GDP per Capita Growth over two millennia was presented. It is all about Engineering, contributing 30 to 40% to the GDP per Capita.



Understanding global skills for the 21st Century Engineering profession is, therefore, imperative.

We regret to acknowledge that we are starved of data. Plans cannot be prepared in the absence of necessary data. You will be able to appreciate the position if you just glance

through the contents alone of the comprehensive reports issued by the learned engineering societies.

The Engineering UK 2018 report on the state of Engineering prepared by the Royal Academy of Engineering and Engineering UK provides a comprehensive analysis of engineering's economic contribution and the composition of its workforce, as well as the extent to which the supply through education and training pipeline is likely to meet the future needs and demand for engineering skills.

Engineering UK 2018: The state of engineering Contents

Synopsis	1	3.4 – Perceptions and attitudes about engineering.....	64
The engineering sector	15	3.5 – Factors in subject and career choices.....	66
1 – Engineering in context	16	3.6 – Interventions.....	69
1.1 – Introduction.....	17	3.7 – Diversity issues.....	82
1.2 – The productivity puzzle.....	17	4 – Secondary education	87
1.3 – Evolving skills needs.....	18	4.1 – Context.....	88
1.4 – Uncertainty around leaving the European Union.....	21	4.2 – GCSEs and National 5s.....	91
1.5 – Government strategies.....	22	4.3 – A levels, Highers and Advanced Highers.....	96
1.6 – Devolved administrations.....	30	4.4 – Diversity and social mobility initiatives.....	100
2 – Engineering and its economic contributions	31	4.5 – Teacher shortages.....	103
2.1 – Context.....	32	5 – Apprenticeships and further education	107
2.2 – Defining the engineering sector: the engineering footprint.....	32	5.1 – Post-16 Skills Plan.....	108
2.3 – Engineering and UK productivity.....	35	5.2 – Apprenticeship reforms.....	109
2.4 – Engineering enterprises.....	37	5.3 – Degree apprenticeships.....	112
2.5 – Engineering enterprise turnover.....	42	5.4 – Apprenticeships in England.....	114
2.6 – Developments and emerging industries.....	45	5.5 – Apprenticeships in Scotland.....	123
2.7 – Major infrastructure projects.....	53	5.6 – Apprenticeships in Wales.....	128
The engineering pipeline	57	5.7 – Apprenticeships in Northern Ireland.....	129
3 – Harnessing the talent pool	58	5.8 – Further education colleges.....	132
3.1 – The engineering skills pipeline.....	59	6 – Higher education	137
3.2 – The importance of engaging young people.....	60	6.1 – Participation in UK higher education.....	138
3.3 – Population trends.....	61	6.2 – Entrants to higher education.....	144
		6.3 – Qualifiers.....	157

The engineering workforce

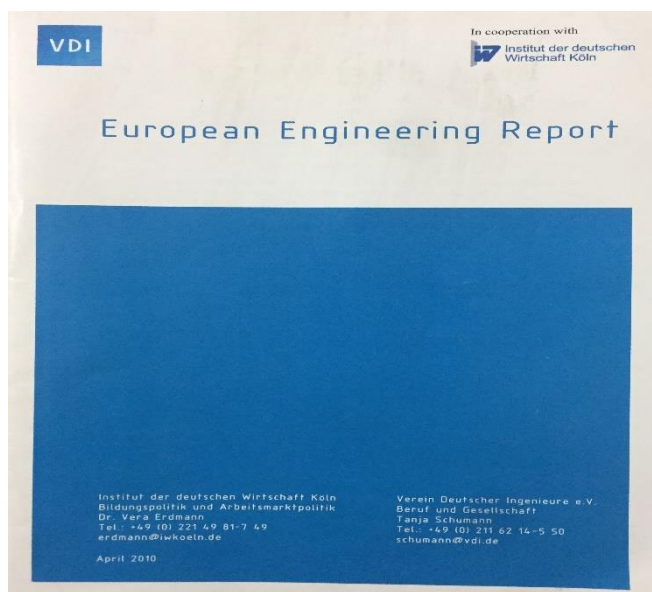
7 – The composition of the engineering workforce	170
7.1 – Population demographics.....	171
7.2 – The UK workforce.....	173
7.3 – Employment in the engineering sector.....	175
7.4 – Personal characteristics of the engineering workforce.....	180
7.5 – Engineering employment across the economy.....	183
8 – Graduate destinations and recruitment	189
8.1 – Context.....	190
8.2 – Overview of graduate destinations.....	191
8.3 – First destinations by level of study.....	193
8.4 – Occupations entered.....	207
8.5 – Industry sectors entered.....	212
8.6 – Employment within the engineering footprint.....	214
8.7 – The UK graduate recruitment market.....	217
9 – Employment and salary trends	227
9.1 – Context.....	228
9.2 – Employment demands.....	229
9.3 – Average earnings.....	232
9.4 – Salary variations by industry and region.....	241

10 – Skills supply and demand projections	249
10.1 – Demand projections for the UK workforce.....	250
10.2 – Demand projections for all jobs in the engineering sector.....	254
10.3 – Demand projections for engineering occupations.....	258
10.4 – Demand projections by region and nation.....	260
10.5 – Supply analysis.....	261
10.6 – The shortfall in engineering skills.....	269

Additional resources

Supplementary materials, including all report figures in Excel format, infographics and an annex, can be found at: www.engineeringuk.com/research

European Engineering Report was issued by the German Association of Engineering in 2010. Its contents are very comprehensive.



Institut der deutschen Wirtschaft Köln

European Engineering Report

Contents

Key Findings.....	3
1 Introduction	4
2 Indicators	6
2.1 Employed Engineering Workers.....	6
2.2 Engineer Density.....	8
2.3 Female Participation in Engineering.....	10
2.4 Part-time Engineers.....	12
2.5 Weekly Working Hours of Engineers.....	14
2.6 The Age Structure of Engineers.....	16
2.7 Employed Graduate Engineers.....	18
2.8 Graduations in Engineering.....	23
2.9 Share of Graduations in Engineering.....	25
2.10 The Scientific Ability of 15-year-olds.....	27
Literature	30

Ladies & Gentlemen!

Digital transformation is a neat term at explaining a doctrine of modernising older IT infrastructures. But it goes well beyond simply adopting technology, it is a shift in corporate culture as well. Since 2016, the international engineering community has been discussing the theme “Industry 4.0”, its demands and procedures in respect of the education and training of engineers.

Are we producing industry ready graduates?

If we want to discuss the **Future of Engineering in Pakistan**, we would need data on the stock of engineers and its characteristics such as age structure, salary structure, future demand of engineering workforce, and **Profile of the Future Engineer**. In fact a comprehensive study on the Utilization of High Level Engineering Manpower has to precede planning for the **Future of Engineering in Pakistan**.

The US National Academy of Engineering has come up with reports on the **Frontiers of Engineering** in 2019. The list of contents is exhibited on the slide for your review.

Frontiers of Engineering: Reports on Leading-Edge Engineering from the 2018 Symposium

Contents

QUANTUM COMPUTERS: ARE WE THERE YET?

Introduction <i>Grace Metcalfe and Jerry Chow</i>	3
Quantum Computing - What It Is, Why We Want It, and How We're Trying to Get It <i>Sara Gamble</i>	5
Quantum Algorithms: Promise and Perspective <i>Shelby Kimmel</i>	9
Quantum Computing with Noisy Qubits <i>Sarah Sheldon</i>	13
Quantum Simulation: Advances, Platforms, and Applications <i>Norman Ibo</i>	19

THE ROLE OF ENGINEERING IN THE FACE OF CONFLICT AND DISASTER

Introduction <i>Francesca D'Arcangelo and Mira Olson</i>	27
---	----

Frontiers of Engineering: Reports on Leading-Edge Engineering from the 2018 Symposium

CONTENTS

Engineering for the People: Putting Peace, Social Justice, and Environmental Protection at the Heart of All Engineering <i>Darshan Mukesh Arivinda Karwat</i>	29
Combining Formal and Informal Structures in Crisis Response <i>Willow Brugh, Gali Sorokin, and Gerald R. Scott</i>	37
USAID Approaches to Engineering Innovation and Disaster Relief <i>Marissa Jablonski</i>	49
RESILIENT AND RELIABLE INFRASTRUCTURE	
Introduction <i>Julie Pietrzak and Iris Tien</i>	57
Communicating Advanced Infrastructure Resiliency Analytics to Diverse Groups of Stakeholders <i>Josh Vertalko</i>	59
Climate Change and Infrastructure Resilience <i>Firas Saleh</i>	65
THERANOSTICS	
Introduction <i>Rebekah Drezek and Darrell Irvine</i>	75
Developing Targeted Therapeutic Nanoparticles: Challenges and Potential Solutions <i>Andrew Zioukas</i>	77
Synthetic Biomarkers for Cancer Detection and Diagnosis <i>Ester J. Kwon</i>	83
Immune Therapeutics <i>Evan A. Scott</i>	87

Frontiers of Engineering: Reports on Leading-Edge Engineering from the 2018 Symposium

CONTENTS

APPENDIXES	xi
Contributors	95
Participants	99
Program	109

Ladies & Gentlemen!

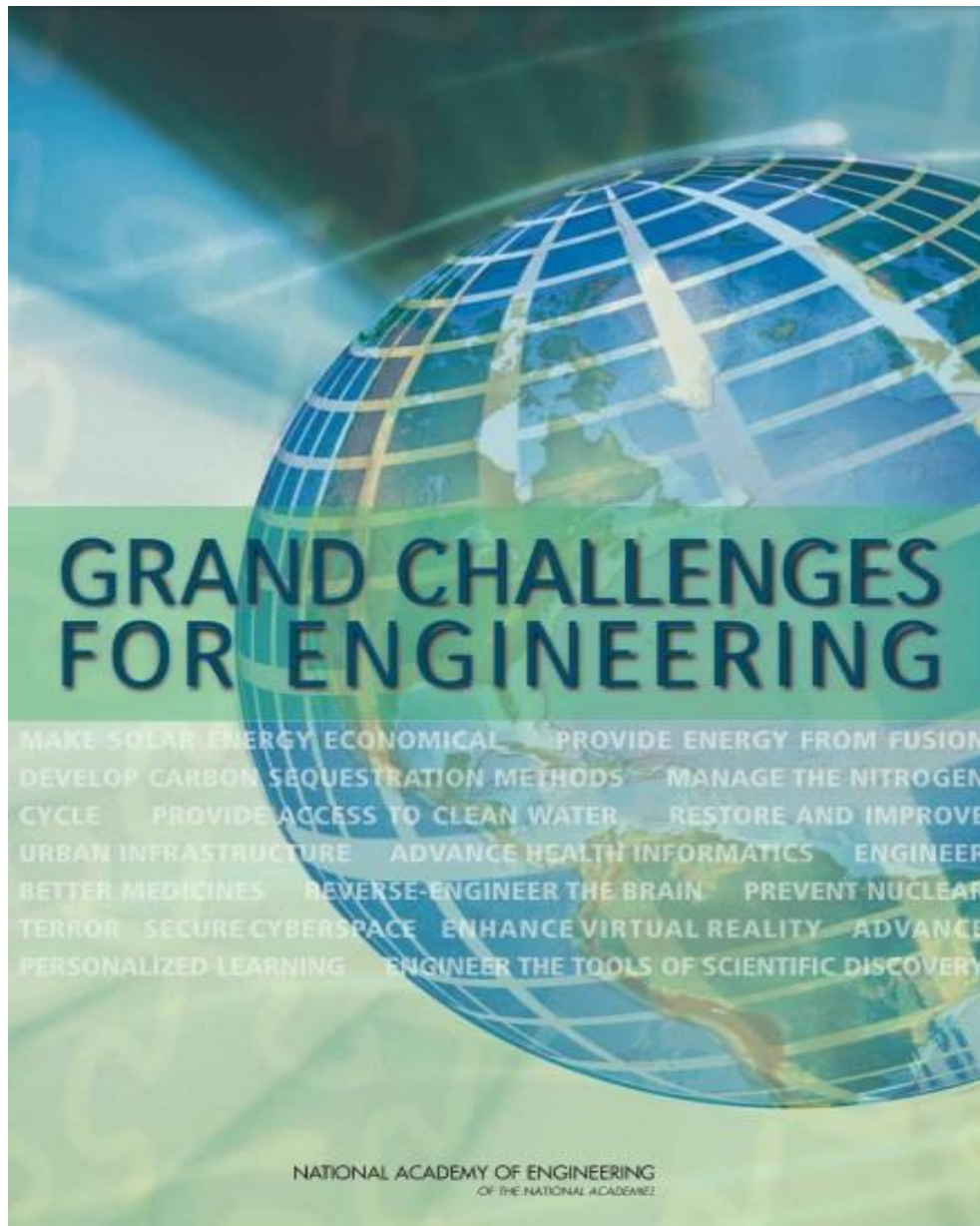
Engineering profession has been globalized. The immediate implication is that parity has to be maintained in undergraduate engineering education. A fundamental step was taken in 1999 in Europe with the **Bologna Declaration**, initiating a process of harmonising the validation and recognition of university degrees. The European Commission recognizes FEANI, the European Federation of National Engineering Associations, as the official representative of the engineering profession in Europe. FEANI

grants the professional title of EUR ING to facilitate the mutual recognition of engineering qualifications in Europe.

Pakistan became the full signatory of “Washington Accord” on June 21, 2017, to render our undergraduate qualifications in engineering globally recognized as professional qualifications in engineering. Originally signed in 1989, the Washington Accord, is a multi-lateral agreement between bodies responsible for accreditation or recognition of tertiary-level engineering qualification within their jurisdiction who have chosen to work collectively to assist the mobility of professional engineers.

Ladies & Gentlemen!

Throughout human history, engineering has driven the advance of civilization. Our sister academy, the US National Academy of Engineering convened a panel of diverse experts from around the world, some of the most accomplished engineers and scientists of their generation, which proposed the 14 Grand Challenges outlined in the following slide.



MAKE SOLAR ENERGY ECONOMICAL
PROVIDE ENERGY FROM FUSION
DEVELOP CARBON SEQUESTRATION METHODS
MANAGE THE NITROGEN CYCLE
PROVIDE ACCESS TO CLEAN WATER
RESTORE AND IMPROVE URBAN INFRASTRUCTURE
ADVANCE HEALTH INFORMATICS
ENGINEER BETTER MEDICINES
REVERSE-ENGINEER THE BRAIN
PREVENT NUCLEAR TERROR
SECURE CYBERSPACE
ENHANCE VIRTUAL REALITY
ADVANCE PERSONALIZED LEARNING
ENGINEER THE TOOLS OF SCIENTIFIC DISCOVERY

GRAND CHALLENGES FOR ENGINEERING

www.engineeringchallenges.org

THE NATIONAL ACADEMIES™

Advisers to the Nation on Science, Engineering, and Medicine

The nation turns to the National Academies—National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and National Research Council—for independent, objective advice on issues that affect people's lives worldwide.

www.national-academies.org

How to capture new knowledge?

There is another dimension to enrich the engineering environment of a developing nation. Launched in December 2000, The “Thousand Talents Program” of China aimed to bring 2,000 key personal home in the next 5 to 10 years. The importance of shifting from **factor-based** to **knowledge-based strategy** was high lighted by the World Bank in its report entitled “**Chinese Development Strategy: The knowledge and Innovation Perspective**” submitted to the Chinese Government in September, 2000 as an input into the development of China’s **10th Five Year Plan**. A decade later in July, 2018 there were 340,000 students studying in the US, 80% of them in the **institutes of higher education**.

Engineering education is in a period of rapid change:

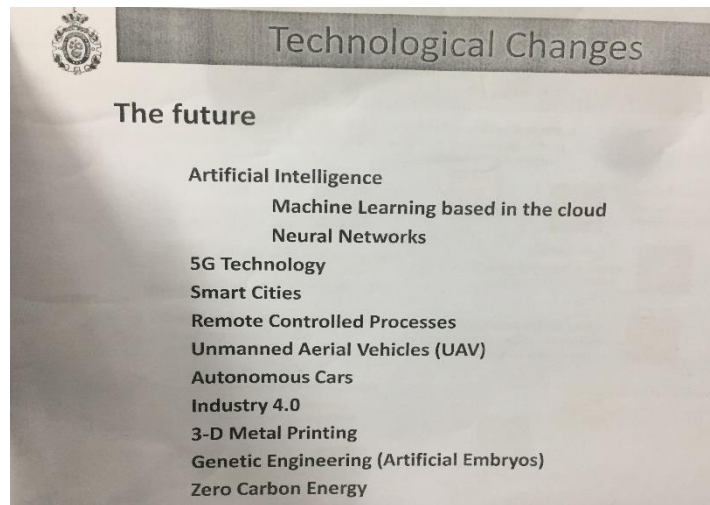
The challenge now is to change our engineering education to match the changes in the World at large. The embrace of innovation and entrepreneurship by engineering education has been a slow process. Employers of engineering graduates now want students who demonstrate an ability to understand and translate customer needs to technical solution (Gnert Editorial, Journal of American Society for Engineering Education, 2016). In addition to technical knowledge, the new models scale to mixture skills and mind sets, including innovation, creativity, flexibility Communication, multidisciplinary, collaboration in diverse teams, problem solving.

The changing face of global engineering education:

The Future of Engineering is intimately related to the betterment of our national life. Global Challenges were on the agenda when engineers and scientists from all over the world met at the CAETS 2019 Conference (International Council of Academies of Engineering and Technological Sciences) hosted by the Royal Swedish Academy of Engineering Sciences (IVA). CAETS floated the theme “**Engineering a Better World-the next 100 years**”.

Contribution of engineering to health care has resulted in a full fledged discipline of highly respected Medical Engineering. It is surprising to note that the Institution of Mechanical Engineering UK has come up with “Engineering Innovation to Enhance Quality of Life” in respect of Incontinence, which affects nearly one in three people at some point in their life.

At CAETS 2018 Conference held at Montevideo, Uruguay, the future technologies were identified (Slide):



From “**Technology- driven**” to “**Human Centred**”

It would be educative to examine the actions planned by Japan in Key Focus Areas (Slide):



We should not overlook the facts reported by SIPRI (Stockholm International Peace Research Institute) in its Yearbook 2019. Total World military expenditure in 2018 is estimated to exceed US \$1.8 trillion. SIPRI also estimates that the total value of the global arms trade in 2017 was at least US \$95 billion. The question arises: What is the impact of these transactions on “**The Future of Engineering in Pakistan**”.

I fervently hope you will fully enjoy the presentations made by our learned speakers.

Thank you.