

Tackling humanitarian challenges: interdisciplinary education and training

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What we aspire to as Engineers?

Build the tallest building in the world...?



The Burj Khalifa, Dubai
Tallest building since 2009; 828 m



Tokyo Skytree, Japan
Second tallest since 2012; 634 m

Manufacture the fastest car...?



Ferrari Enzo

650 Horse Power, Top Speed: 363 km/h



Aston Martin One-77

750 Horse Power, Top Speed: 355 km/h



Manufacture the finest smart phone...?



Samsung or Apple? Galaxy S7 or iPhone 7?





**Is this the only path Engineers can
take?**

The Shard



The Shards



The Shards

Three seminal events...

- September 11, 2001
Terror Attacks
New York, NY
- May 22, 2011
Tornado,
Joplin, Missouri
- October 22, 2012
Hurricane Sandy
New York, NY



Global Humanitarian Challenges

- ❑ Inequality;
- ❑ Pollution;
- ❑ Refugee crisis;
- ❑ Energy & Sustainability;
- ❑ Fast growing population cities;
- ❑ Culture preservation;
- ❑ Social injustice





783 million people cannot access safe drinking water



2.5 billion people have no access to proper sanitation facilities





Population growth places greater demands on energy provision



**Poor roads in Africa lead to almost as many fatalities as AIDS;
1 billion people lack access to paved roads**





Increased need for emergency relief to war refugees





Need for emergency relief after natural disasters





Over 50% of the world population lives in cities. This places stress on infrastructure, provision of water and food



Climate change will challenge the security of many coastal cities





Humanitarian Challenges



NOW



2050

7 BILLION PEOPLE



50% URBAN

10 BILLION PEOPLE



70% URBAN

The Millennium Development Goals 2000-2015



1
**ERADICATE EXTREME
POVERTY AND HUNGER**



5
IMPROVE MATERNAL HEALTH



2
**ACHIEVE UNIVERSAL
PRIMARY EDUCATION**



6
**COMBAT HIV/AIDS, MALARIA,
AND OTHER DISEASES**



3
**PROMOTE GENDER EQUALITY
AND EMPOWER WOMEN**



7
**ENSURE ENVIRONMENTAL
SUSTAINABILITY**



4
REDUCE CHILD MORTALITY



8
**A GLOBAL PARTNERSHIP
FOR DEVELOPMENT**

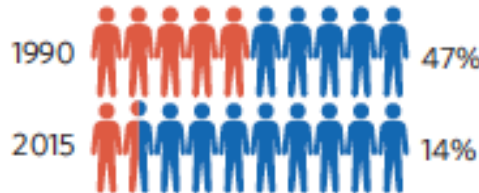
SOURCE: United Nations

The Millennium Development Goals

- Some real achievements

Goal 1

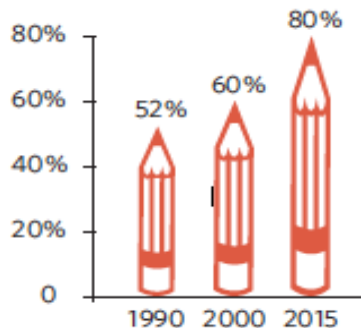
Eradicate extreme poverty and hunger



Living on less than \$1.25 per day in developing countries

Goal 2

Achieve universal primary education



Primary school enrolment in sub-Saharan Africa

Rio+20 Future We Want - Outcome document

We underscore that the **Millennium Development Goals** are a **useful tool** in focusing achievement of **specific development** gains as **part of a broad development vision** and framework for the development activities of the United Nations, for national priority-setting and for mobilization of stakeholders and resources towards common goals. **We therefore remain firmly committed to their full and timely achievement.**

We further recognize the importance and utility of a set of sustainable development goals... The goals should address and incorporate in a balanced way all three dimensions of sustainable development and their interlinkages. They should be coherent with and integrated into the United Nations development agenda beyond 2015... The development of these goals should not divert focus or effort from the achievement of the Millennium Development Goals. We also underscore that **sustainable development goals** should be **action oriented**, concise and easy to communicate, limited in number, aspirational, **global in nature** and universally applicable to all countries while taking into account different national realities, capacities and levels of development and respecting national policies and priorities.



Transforming our world: The 2030 Agenda for Sustainable Development

This Agenda is a plan of action for people, planet, prosperity, peace and partnership.



25-27 September 2015, United Nations Headquarters, NY, 70th anniversary.



Goal 3. Ensure healthy lives and promote well-being for all at all ages

3.4 By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being



Goal 5. Achieve gender equality and empower all women and girls

5.5 Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life



Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes



UN Dialogues

- ❑ Lots on explicit and implicit talk about resilience and transformative change
- ❑ The importance of humanitarian intervention and 'digital humanitarianism'
- ❑ A focus on learning and education



UN World Conference on
Disaster Risk Reduction
2015 Sendai Japan



COP21 • CMP11
PARIS 2015
UN CLIMATE CHANGE CONFERENCE

Why setting goals is useful

- ❑ Provides benchmarks for government
- ❑ Mobilises the community
- ❑ Mobilises partnerships

Business, Civil Society, Governments

- ❑ Spurs networks of expertise into action

Universities, experts

- ❑ Really good “To Do” list



Humanitarian Challenges require...

Interdisciplinary approach to develop innovative & realistic solutions:

- ☐ Engineering;
- ☐ Social Sciences;
- ☐ Natural Sciences;
- ☐ Health and Medical Sciences;
- ☐ Business



Humanitarian Challenges require...

Diversity and inclusiveness of partners/participants from:

- ❑ Academia;
- ❑ Industry;
- ❑ NGOs
- ❑ Policy makers



... to contribute to education and research in Humanitarian Engineering



Humanitarian Challenges require...

International platforms for intercultural dialogue that examines where and how we should act...



Tackling Global Challenges



Scientists, engineers and practitioners from across academia, industry, and NGOs to share and promote current research and developments across all aspects of engineering, from science to practical applications, which have a global Humanitarian Engineering impact.



Why Humanitarian Engineering?

- ✓ **Engineering** has a pivotal role to play in the solution of global humanitarian challenges.
- ✓ **Engineering** can be used as the catalyst for the change that the world needs.

*From water supply to renewable energy provision, from efficient transport systems to digital infrastructure, from constructing resilient cities to the provision of sanitation facilities and from resource protection to effective agriculture, **engineering** underpins the responses needed for us all to pursue a sustainable future [EWB UK, 2016].*



Humanitarian engineering is the use of science and engineering to:

- ✓ invent,
- ✓ create,
- ✓ design,
- ✓ develop, or
- ✓ improve

technologies which promote the well-being of populations facing grand challenges.



	Scientist	Engineer	Artist
Answers the question	Why?	How?	Who?
Purpose	Explains the existing	Invents the non-existent	Stimulates the emotions
Models	Rational, complex, statistical	Rational, simple, mathematical	Irrational, psychological, aesthetic
Scale	Large, general, wide-reaching	Small, prototype, one-off	Individual, personal, one-off
Method	Discovery-based (Hypotheses)	Design-based (Objectives)	Emotion-based (Challenges)
Motives	Altruistic (Planet)	Selfish (Prosperity)	Selfish (People)

Putting it all together

- Be open – look for non-traditional research collaborators.
- Be thoughtful – listen and learn from others.
- Be flexible – pivot when needed. Don't dig in.
- Be educated – read the “great books” of sustainability and international development.
- Be mindful – it's about people, after all.



Jan Egeland, former UN undersecretary-general for humanitarian affairs and emergency relief coordinator, said [ACT International, 2009]:

“There were instances where the response was untested, chaotic, amateurish, doubled up, overlapping, done by “Mom and Pop” operations...

Saving human lives is no place for amateurs.

Why is that? Because the poor, dispossessed and disaster-prone should have at least one basic right left to them: to be, protected from incompetence”



Finding humanitarian experts is not easy...

Most of the humanitarian employees:

- ❑ are on short-term contracts due to lack of long-term budgets of non-governmental organisations (NGOs);
- ❑ abandon their involvement to humanitarian action because they seek a more long-standing career or because they cannot stay for long far from home;
- ❑ are usually locals who are employed by the NGOs after local training. However they lack skills to respond to global challenges on international scale.



There is need to...

- ❑ Improve the perception of science and engineering in the developing world, beyond 'charity and volunteering'
i.e. as mainstream, long term, and highly skilled profession, and for which a vast market exists;
- ❑ Cover a skills gap for Scientists/Engineers in managing complex interdisciplinary projects, and in adapting their skills to the developing world.



Joined-up approaches

- The issues of humanitarianism are not just engineering problems
- There is need to engage with other professions and stakeholders
- We need to break down previous siloed approaches and obdurate practices
- There is need for interdisciplinary education and training to enhance combinational expertise





Humanitarian Engineering at Warwick



Warwick Humanitarian Engineering Centre (WHEC)

- ❑ Paving the way to WHEC
- ❑ WHEC; Creating Shared Value

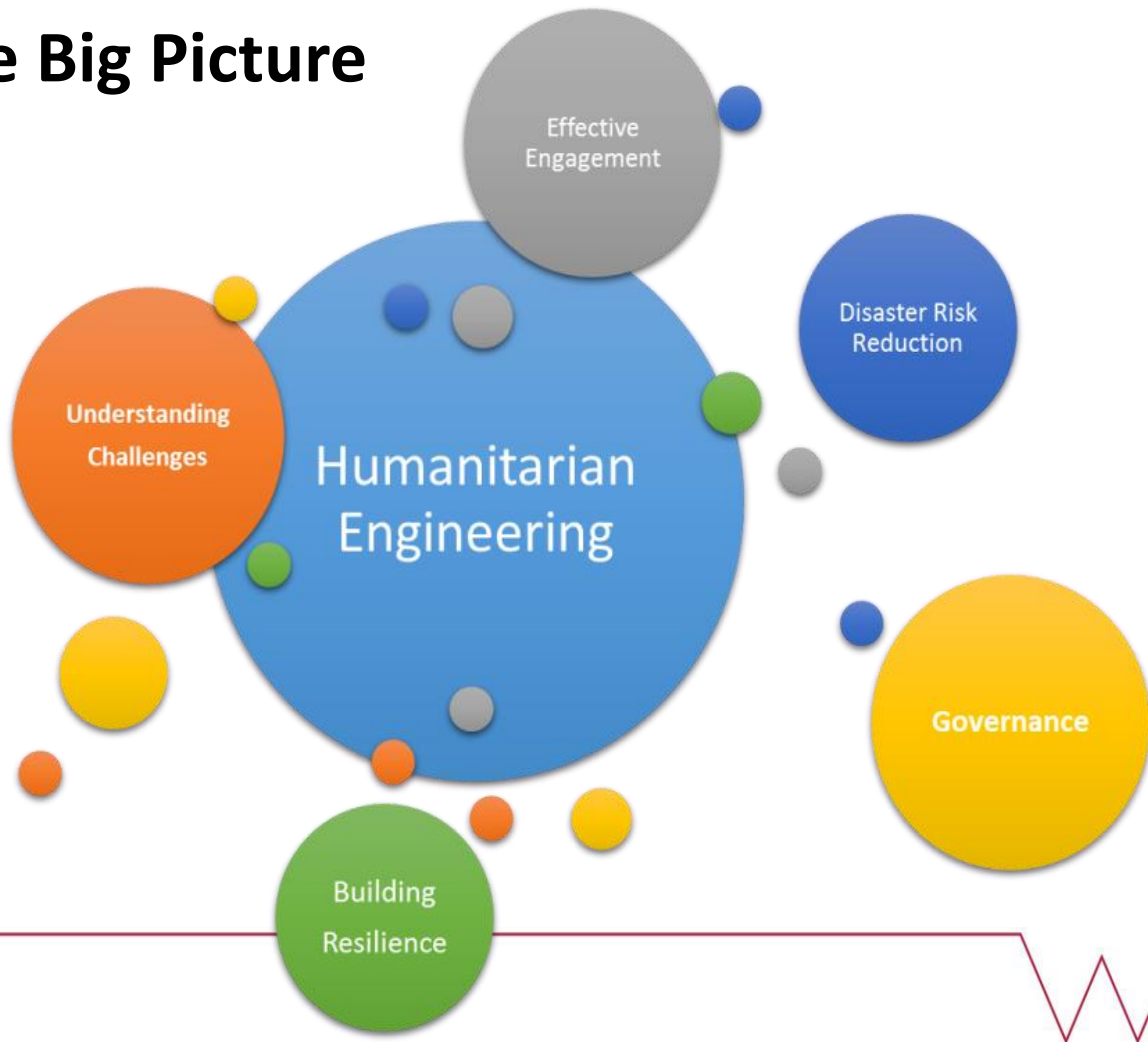


Objectives of the new PG course

- ❑ Provide an educational programme to meet the needs of a diverse multi-disciplinary student population;
- ❑ Develop an educational programme that defines the professional standards for Humanitarian Engineers;
- ❑ Establish Humanitarian Engineering as an academic field of study within the University of Warwick.



The Big Picture



Who can take the course?

The course is offered to students, professionals and practitioners from a range of disciplines:

- ☐ Engineering (Civil; Chemical; Electrical/Electronic; Mechanical; Systems);
- ☐ Natural sciences (Chemistry; Physics; Computer and Information Science; Materials);
- ☐ Health and Medical Sciences;
- ☐ Social Sciences (Law; Economics; Sociology; Politics and International Studies);
- ☐ Business (Management)



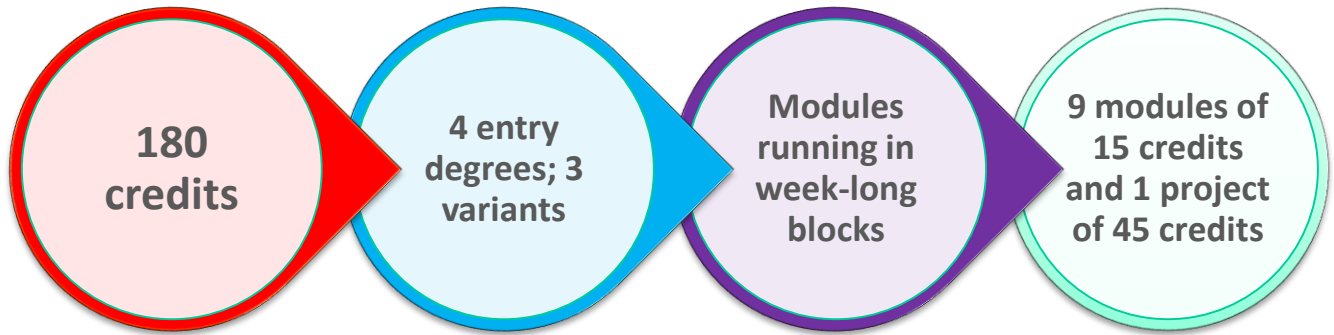
Which departments are involved?

The course has input from the following Departments:

- ☐ School of Engineering
- ☐ School of Law
- ☐ Medical School
- ☐ Business School
- ☐ Institute for Advanced Teaching and Learning (IATL)
- ☐ Centre for Interdisciplinary Methodologies (CIM)



Course structure



The course is offered for full-time, part-time and CPD studies.



Entry degrees

- ☐ PG Award (30 credits)
- ☐ PG Certificate (60 credits)
- ☐ PG Diploma (120 credits)
- ☐ MSc (180 credits)



Degree variants

- ❑ MSc in Humanitarian Engineering
- ❑ MSc in Humanitarian Engineering with Sustainability
- ❑ MSc in Humanitarian Engineering with Management



Course content



Humanitarian
Engineering: Ethics,
Theory and Practices



Urban Resilience,
Disasters & Data



Renewable
Energy



Water &
Environmental
Management



Sustainable Cities &
Infrastructures for
emergencies



Sustainable
Operations



Introduction to
Global Health



One Humanity;
Shared Responsibility



Humanitarian Law



Project



Modules

1. Humanitarian Engineering: Theory and Practices

- ❑ An introduction to humanitarian engineering from ethical, cultural, and practical perspectives;
- ❑ Basic concepts and history of humanitarianism and humanitarian action; How humanitarianism might be related to engineering history, education, and practice;
- ❑ How humanitarian (ethical) constraints interplay with engineering practices and standards of professional conduct;



Modules (cont.)

2. Urban Resilience, Disasters and Data

- ❑ An introduction to disaster management and urban resilience with an emphasis on the use of innovative digital media;
- ❑ Disaster management and the way in which social media, mobile technologies and the web are related to our experience of disasters and crisis events;
- ❑ Use of innovative methods for gathering and analysing information to support urban development goals, such as disaster risk reduction and urban resilience;



Modules (cont.)

3. Renewable Energy

- ❑ The module addresses the:
 - ✓ Lack of access to basic, modern energy services for developing countries, and
 - ✓ the global transition to clean, low-carbon energy systems in cities
- ❑ Increased efficiency, de-carbonization, greater fuel diversity and lower pollutant emissions are discussed;



Modules (cont.)

4. Water and Environmental Management

- ❑ The students are expected to get knowledge in the choice, design and implementation of a range of environmental management tools and methods including:
 - ✓ environmental impact assessment,
 - ✓ integrated catchment management and
 - ✓ environmentally sensitive water management.



Modules (cont.)

5. Sustainable Cities and Infrastructures for Emergencies

- ❑ In many developing countries, basic infrastructures-housing, power, water, sanitation, information and communications technologies, and roads-are insufficient, or non-existent.
- ❑ Inadequate access to infrastructures is a key barrier to economic growth. It inhibits access to health care, education, and markets.



Modules (cont.)

6. Sustainable Operations and Humanitarian Supply Chain Management

- ☐ An introduction on the key concepts of humanitarian logistics and supply chain management;
- ☐ The main categories of disasters will be presented and disaster-relief operations will be described;
- ☐ Key actors in the humanitarian system will be identified, and their role in disaster relief will be discussed;



Modules (cont.)

7. Humanitarian Law

- ❑ An introduction on the increasingly complex inter-relationship between law and humanitarianism;
- ❑ The module addresses the evolution of the International Humanitarian Law and the specific regimes that are supposed to govern the conduct of warfare, 'humanitarian' intervention and post conflict occupation and reconstruction;



Modules (cont.)

8. Introduction to Global Health

❑ The module will include:

- ✓ International Health Policy (introducing the UN, the World Health Organisation and the Sustainable Development Goals);
- ✓ Outbreak investigation;
- ✓ Health response in an emergency (natural disaster, war, terrorism, pandemic);
- ✓ Healthy cities (including urbanisation, 'slum' health, active travel, city design to improve mental health and wellbeing);
- ✓ Universal coverage, accessibility to health services and medical tourism.



Modules (cont.)

9. One Humanity; Shared Responsibility

- ❑ The module focuses on building awareness of the impact that the role of scientists has in tackling global humanitarian challenges;
- ❑ This module will be devoted to the involvement and empowering of specific voices in humanitarian engineering, i.e. policy makers, industry, non-governmental organisations, volunteers, women and students;



Modules (cont.)

10. Project

- ❑ Students will be required to undertake a project which seeks to integrate the material studied in the other core modules. The project will be championed from an Industrial/NGO partner and will prepare students for professional practice.
- ❑ The project will be shaped around demonstration of learning through articulation of critical analysis and reflection to produce a reasoned 'argument' or decision.



Main features of the course

- **Student-driven curriculum**

Will allow students' interests to shape issues of application.

- **Open-ended, problem-based learning**

Will shift the curriculum from mastery of disciplinary content to the critical integration of disciplinary knowledge relative to a specific problem.

- **Collaborative learning**

Gained value from interaction with multiple groups.

- **Experiential learning**

Students will be offered the opportunity for theory to practice understanding, gained through application.



Skills to be developed...

- **Contextual skills**

i.e. humanitarian sector, international development, developing countries, humanitarian standards;

- **Specialist/discipline specific**

Overlapping competencies among disciplines; engineering, health, law, business management, humanities and arts;

- **Functional skills**

In the humanitarian sector three levels roughly exist: field practitioners, project managers, national/international managers/directors



Overview

- ❑ The programme will engage students in analytical and critical thinking, creativity, global awareness, social and ethical perspectives for science and technology;
- ❑ The education programme will be driven by industrial and societal needs;
- ❑ The education programme will engage different stakeholders, beneficiaries and users (e.g. policy-makers, actors within humanitarian and development organisations, local communities).





An inside look at WHEC

WHEC will promote appropriate, sustainable, and holistic solutions to global challenges by integrating science into a broader practical scheme.



WHEC will be committed to...

- ☐ Education and Training (inclusive educational environment)
- ☐ Research (technologies for clean water and sanitation, renewable energy generation, healthcare technologies, infrastructures of immediate response to disasters, urban resilience)
- ☐ Industry partnership
- ☐ Knowledge exchange



WHEC will foster solutions for ...

- ❑ Disaster mitigation, relief, and recovery
- ❑ Renewable Energy
- ❑ Water and Sanitation
- ❑ Health
- ❑ Humanitarian Law
- ❑ Community Engagement, Diversity and Inclusiveness



Similar Centres elsewhere?

- ❑ Penn State University; Humanitarian Engineering and Social Entrepreneurship
- ❑ Colorado School of Mines; Humanitarian Engineering Program
- ❑ Ohio State University; Humanitarian Engineering Centre
- ❑ Arizona State University; Global resolve
- ❑ University of Cambridge; Centre for Global Equality



WHEC's vision

- ❑ To be a dynamic, interdisciplinary and enterprising Centre;
- ❑ To enable students and professionals to create their place in the world by providing a life-changing education and training with a global perspective;
- ❑ To enhance public perception of the value of science and engineering through a broader social engagement





Recent news

HEFCE Catalyst Fund A project

**‘Developing a student-driven educational model between,
beyond and across disciplines’**

The project will develop a conceptual model for exploring the ways in which students act as co-producers of learning, and how they might work beyond traditional disciplinary boundaries.

Total budget £99,490; Duration 18 months

The logo for HEFCE (Higher Education Funding Council for England) is displayed in a blue, stylized script font.

In collaboration with the Royal Academy of Engineering and the University of Dar el Salaam

‘Problem-based learning and Challenge-based learning in engineering education’

November 2017



ICWES 18 in 2020

September 2020

On the theme

‘Global Humanitarian Challenges’



ICWES

means

International Conference of
Women Engineers and Scientists



Women's Engineering Society Annual Student Conference 2017

Autumn 2017

On the theme

'Engineering for Changing the World'



Thank you for listening!

warwick.ac.uk/humeng

