# Engineer's Capacity Building for Sustainability

**GONG Ke**

**WFEO President Elect**

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- **Sustainable Development**
  - **Duty of Engineers**
- **Sustainable Development:**
  - **Challenge to Engineer's capacity**
- **International standards of Engineer's Competency:**
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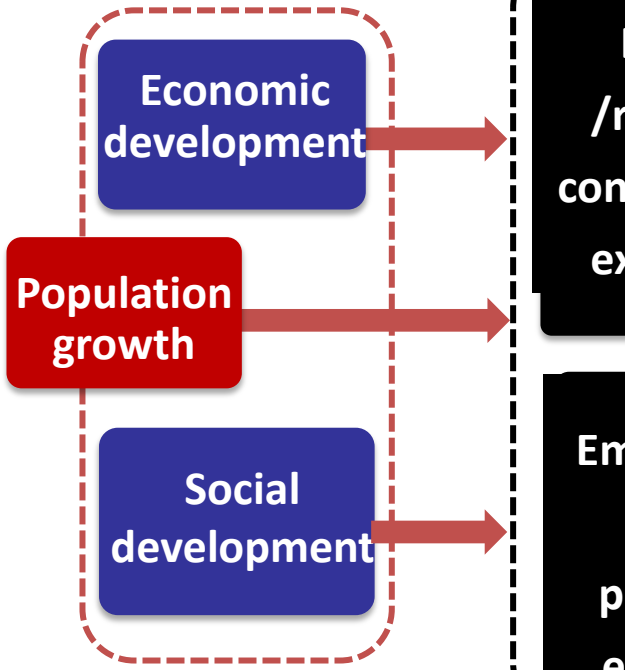
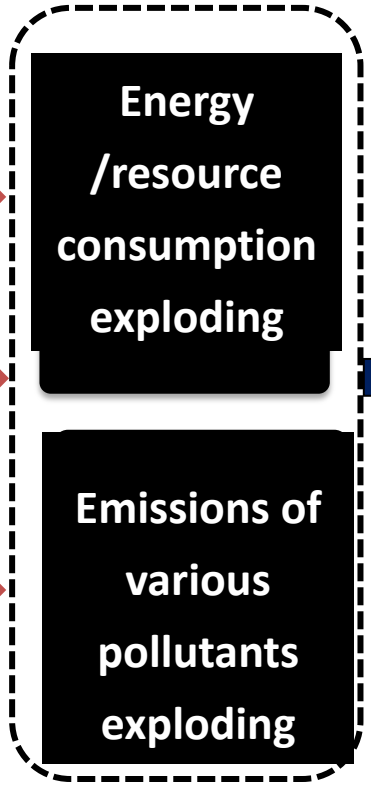

Economic development
Population growth
Social development


Energy /resource consumption exploding
Emissions of various pollutants exploding

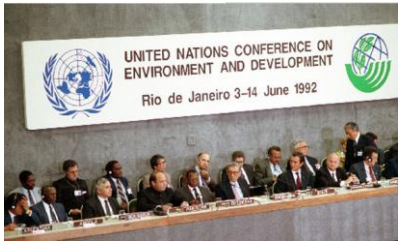

Shortage of Resource
Environment Pollution
Ecological destruction
Climate Change

# If patterns of human development don't change, the earth in 2070 will look like…

World Federation of Engineering Organizations
Fédération Mondiale des Organisations d'ingénieurs
Official partner of UNESCO (associate status)

WFEO / FMOI

**UN Conference on the Human Environment (Stockholm, 1972)**




**UN Conference on Environment and Development (Rio, 1992)**

**UN Conference on Sustainable Development (Rio+20)**
**UN 2015-2030 Sustainable Development Agenda**

1972

1992

2012/2015


# Global Agenda, Common Goals

We can be the first generation to succeed in ending poverty; just as we may be the last to have a chance of saving the planet.


The world will be a better place in 2030 if we succeed in our objectives.

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## End poverty in all its forms everywhere

- 1.5 By 2030, build the **resilience** of the poor and those in vulnerable situations and reduce their exposure and vulnerability **to climate-related extreme events** and other economic, social **and environmental shocks and disasters**


# End hunger, achieve food security and improved nutrition and promote sustainable agriculture

- 2.4 By 2030, ensure **sustainable food production** systems and implement **resilient agricultural practices that increase productivity and production**, that **help maintain ecosystems**, that **strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters** and that progressively **improve land and soil quality**.
- 2.5 By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks


# Ensure healthy lives and promote well-being for all at all ages

- 3.9 By 2030, substantially **reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination**


# Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

- 4.7 By 2030, **ensure that all learners acquire the knowledge and skills needed to promote sustainable development**, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development.


# Achieve gender equality and empower all women and girls

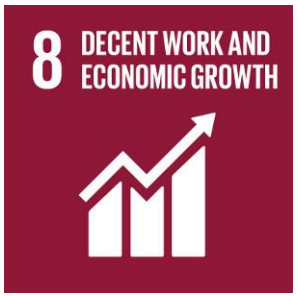
- 5.4 Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate


# Ensure availability and sustainable management of water and sanitation for all

- 6.3 By 2030, **improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials**, halving the proportion of untreated wastewater and substantially increasing **recycling and safe reuse** globally
- 6.6 By 2020, **protect and restore water-related ecosystems**, including mountains, forests, wetlands, rivers, aquifers and lakes


# Ensure access to affordable, reliable, sustainable and modern energy for all

- 7.1 By 2030, ensure universal access to **affordable, reliable and modern energy services**
- 7.2 By 2030, increase substantially the **share of renewable energy in the global energy mix**
- 7.3 By 2030, **double** the global rate of improvement in **energy efficiency**




# Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

- 8.4 Improve progressively, through 2030, global **resource efficiency in consumption and production** and endeavour to **decouple economic growth from environmental degradation**, in accordance with the 10Year Framework of Programmes on Sustainable Consumption and Production, with developed countries taking the lead


# 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**, with all countries taking action in accordance with their respective capabilities
- 9.5 **Enhance scientific research, upgrade the technological capabilities of industrial sectors** in all countries


## Reduce inequality within and among countries

- 10.2 By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status


# Make cities and human settlements inclusive, safe, resilient and sustainable

- 11.5 By 2030, **significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses** relative to global gross domestic product caused **by disasters, including water-related disasters**, with a focus on protecting the poor and people in vulnerable situations
- 11.6 By 2030, **reduce the adverse per capita environmental impact of cities**, including by paying special attention to air quality and municipal and other **waste management**


# Ensure sustainable consumption and production patterns

- 12.4 By 2020, achieve the **environmentally sound management of chemicals and all wastes throughout their life cycle**, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment
- 12.5 By 2030, substantially **reduce waste generation** through prevention, reduction, recycling and reuse


# The goal 13 requires to take urgent action to combat climate change and its impacts

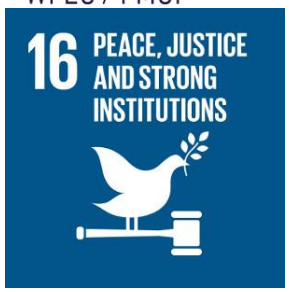
- 13.1 **Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters** in all countries
- 13.2 Integrate climate change measures into national policies, strategies and planning
- 13.3 **Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning**


# Conserve and sustainably use the oceans, seas and marine resources for sustainable development

- 14.1 By 2025, prevent and significantly **reduce marine pollution of all kinds**, in particular from land-based activities, including marine debris and nutrient pollution
- 14.2 By 2020, sustainably **manage and protect marine and coastal ecosystems** to avoid significant adverse impacts, including **by strengthening their resilience**, and take action for their restoration in order to achieve healthy and productive oceans
- 14.3 **Minimize and address the impacts of ocean acidification**, including through enhanced scientific cooperation at all levels


**Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss**

- 15.3 By 2030, **combat desertification, restore degraded land and soil**, including land affected by desertification, drought and floods, and strive to **achieve a land degradation-neutral world**
- 15.4 By 2030, ensure the **conservation of mountain ecosystems, including their biodiversity**, in order to enhance their capacity to provide benefits that are essential for sustainable development




**Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels**

- 16.5 Substantially **reduce corruption and bribery in all their forms**
- 16.6 Develop effective, accountable and transparent institutions at all levels
- 16.7 Ensure responsive, inclusive, participatory and representative decision-making at all levels
- 16.8 Broaden and strengthen the participation of developing countries in the institutions of global governance


## Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development

- 17.7 Promote the **development, transfer, dissemination and diffusion of environmentally sound technologies** to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed
- 17.8 Fully **operationalize the technology bank and science, technology and innovation capacity-building mechanism** for least developed countries by 2017 and enhance the use of enabling technology, in particular information and communications technology

- All these goals set higher requirements to engineering capacity and engineer's competency in different engineering fields.
- All these goals include common requirements to all engineers in all engineering fields, such as
  - higher social responsibility and technical ethics
  - deeper understanding to sustainability as well as climate change
  - better skills of ICT especially of using big data, AI, etc.
  - good ability of interdisciplinary team working and international/intercultural collaboration
  - stronger learning and innovation capability

# To shift the thinking of engineering

- Sustainability is not a specific technical issue addressing some engineering, but an strategic issue to whole engineering and all engineers.
- Sustainability should be integrated into all engineering practice, to address the changing environmental, social, and economic conditions ethically and responsibly.
- The focus of engineering efforts must shift from the work product - the water systems, the bridge, the building - to the needs and benefits of humanbeing.

# To reform engineering education

- Applying the principles of sustainability to expand engineers' knowledge and capacity beyond the currently accepted professionalism and technical skills is necessary and important, so that engineers have confidence and are capable to identify, understand, navigate, and manage the new risk and uncertainty properly.
- This requires expanded approaches, courses, study methods—even new bodies of knowledge—for pre-college, college, and postgraduate training and new advanced certifications, accreditations, and standards.

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# Think Global and Act Local

1. Maintain and continuously improve awareness and understanding of environmental stewardship, sustainability principles and issues related to your field of practice.
2. Use expertise of others in the areas where your own knowledge is not adequate to address environmental and sustainability issues.
3. Incorporate global, regional, indigenous and local societal values applicable to your work, including local and community concerns, quality of life and other social concerns related to environmental impact along with traditional and cultural values.
4. Implement sustainability outcomes at the earliest possible stage employing applicable standards and criteria related to sustainability and the environment.
5. Assess the costs and benefits of environmental protection, eco-system components and sustainability in evaluating the economic viability of the work, with proper consideration of climate change and extreme events.

6. Integrate environmental stewardship and sustainability planning into the life-cycle planning and management of activities that impact the environment, and implement efficient, sustainable solutions.

7. Seek innovations that recognize environmental, social and economic factors while contributing to healthy surroundings in both the built and natural environment.

8. Develop locally appropriate engagement processes for stakeholders, both external and internal, to solicit their input in an open and transparent manner, and respond to all concerns – economic, social and environmental in a timely fashion in ways that are consistent with the scope of your assignment. Disclose information necessary to protect public safety to the appropriate authorities.

9. Ensure that projects comply with regulatory and legal requirements and endeavor to exceed or better them by the application of best available, economically viable methodologies, technologies and procedures for stakeholders.

10. Where there are threats of serious or irreversible damage but scientific certainty is lacking, implement risk mitigation measures in time to minimize environmental degradation.

# social responsibility

An engineer shall not only be responsible to the technical specifications, but also responsible to the sustainability of human society

E.g. Data center design should not only meet the requirements of data volume, access speed, temperature level, operation comfort, maintaining feasibility, cost, etc. but more important considerations should given to the ENERGY consumption and CARBON emission.

# Responsible conduct of engineering understand of social issues

- *Integrate environmental stewardship and sustainability planning into the life-cycle planning and management of activities that impact the environment, and implement efficient, sustainable solutions.*
- *Incorporate global, regional, indigenous and local societal values applicable to your work, including local and community concerns, quality of life and other social concerns related to environmental impact along with traditional and cultural values.*

# ICT skills

- Internet ( Mobile Internet – Internet of Things – Internet of Every Things)
- Big Data
- Artificial Intelligence
  - **Working in an connected world**
  - **Taking advantages of internet and big data**
  - **Working with Artificial Intelligence**

# cooperation ability

- Inter-disciplinary
- Inter-national
  - *Use expertise of others in the areas where your own knowledge is not adequate to address environmental and sustainability issues.*

# learning ability

- High requirements to
  - New scientific findings (theories)
    - combustible ice （methane hydrate)
  - New social (legal) requirements
  - New technical inventions
- *Where there are threats of serious or irreversible damage but scientific certainty is lacking, implement risk mitigation measures in time to minimize environmental degradation*.

# innovation ability

- The given scientific theory and technology are not sufficient for sustainability
- *Seek innovations that recognize environmental, social and economic factors while contributing to healthy surroundings in both the built and natural environment.*

# International Standards of Engineer's Competency

- **Fundamental requirements** to engineer based on consensus for engineering profession
- **Guidance** to different level of engineering education and practices
- **Ensuring** competency of engineer to meet the social, technical and environmental needs
- **Demand** of international engineering cooperation, especially cross-boundary engineering projects, and engineers mobility in the globalized era

# Taking the International Standards of Engineer's Competency as a key approach to

- a systematic **review to the guidelines of engineering education and reflecting SDGs into it**
- a **framework of requirements of engineer's capacity for sustainability**
- a **framework to measure the engineer's capacity development for sustainability**
- an **international collaboration network for engineering capacity building for sustainability**, especially for developing countries

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# WFEO: A leading international organization for engineering profession

Algeria
Argentina
Australia
Bahrain
Bangladesh
Belize
Bolivia
Brazil
Bulgaria
Cameroon
Canada
Chile
China
Colombia
Costa Rica
Cote d'Ivoire
Croatia
Cyprus
Czech Republic
Dominican Republic
DR Congo
Ecuador
Egypt
El Salvador
Fiji
France
Germany
Ghana
Greece
Honduras
Hong Kong
Hungary
India
Iraq
Italy
Japan
Jordan
Kenya
Korea
Kuwait
Lebanon
Libya
Madagascar
Malawi
Malaysia
Malta
Mauritius
Mexico
Moldova
Montenegro
Morocco
Nepal
New Zealand
Nigeria
Pakistan
Palestine
Peru
Poland
Portugal
Puerto Rico
Romania
Russia
Saudi Arabia
Senegal
Serbia
Sierra Leone
Singapore
Slovakia
Slovenia
South Africa
Spain
Sri Lanka
Sudan
Switzerland
Syria
Taiwan
Tanzania
Tunisia
Turkey
Uganda
United Arab Emirates
United Kingdom
United States
Uruguay
Yemen
Zambia
Zimbabwe

# WFEO: Major Group of Science & Technology

- **Founded in 1968**
- **Under the auspices of UNESCO**
- **90+ national engineering institutions**
- 10 International engineering organizations
- 10 x Standing Technical Committees
- **Representing tens of million engineers world wide**

# WFEO – UNESCO Declaration

World Federation of Engineering Organizations
Fédération Mondiale des Organisations d'Ingénieurs

United Nations
Educational, Scientific and
Cultural Organization

## Paris Declaration

### Advancing the United Nations Sustainable Development Goals through Engineering

SUSTAINABLE DEVELOPMENT GOALS

The World Federation of Engineering Organizations (WFEO) is the main body for engineering globally, representing nearly 100 nations and some 30 million engineers.

The members of WFEO are the national and regional professional engineering institutions of the world. WFEO is a member of the United Nations Scientific and Technological Community (UN STC) Major Group and has an official Associate status with UNESCO.

UNESCO, as the United Nations agency for education, science and culture, supports engineering through its Natural Sciences Sector, and acknowledges engineering as a powerful means to achieve sustainable development, capacity-building in engineering education and gender equality in developing countries, as well as the safeguarding of world heritage.

# WFEO – Code for Sustainability

WFEO / FMOI

WORLD FEDERATION OF ENGINEERING

### Professional Judgment

**Model Code Principle # 1**: Integrate Adaption into Practice

**Model Code Principle # 2**: Review Adequacy of Current Standards

**Model Code Principle # 3**: Exercise Professional Judgement

### Integrating Climate Information

**Model Code Principle # 4**: Interpret Climate Information

**Model Code Principle # 5**: Work with Specialists and Stakeholders

**Model Code Principle # 6**: Use Effective Language

### Practice Guidance

**Model Code Principle # 7**: Plan for Service Life

**Model Code Principle # 8**: Use Risk Assessment for Uncertainty

**Model Code Principle # 9**: Monitor Legal Liabilities

# WFEO Engineering 2030 Plan

- A Plan to develop **engineering capacity** for a sustainable world through partnerships with educators, government, industry and professional engineering institutions
- A strategic initiative to address the gap in **engineering capacity** and the quality of engineering professionals
- Recognises that engineers are essential for achieving the UN Sustainable Development Goals with effective cooperation of engineer's society globally

**"We are determined to mobilize the means required to implement this Agenda through a revitalized Global Partnership for Sustainable Development, based on a spirit of strengthened global solidarity, focused in particular on the needs of the poorest and most vulnerable and with the participation of all countries, all stakeholders and all people.**

**.....If we realize our ambitions across the full extent of the Agenda, the lives of all will be profoundly improved and our world will be transformed for the better."**

# Let's work together to shoulder the engineers' responsibility to shape a sustainable future

**THANKS**