AEPM Kyoto Declaration

Statement of the Academies of Engineering Presidents' Meeting (AEPM)
at the 15th STS *forum* 2018

The Academies of Engineering Presidents' Meeting (AEPM), established as part of the Science and Technology in Society *forum* (STS *forum*), held its eighth conference in 2018. At the 6th, 7th and 8th AEPMs, discussion on engineering education and engineering ethics continued, with each country sharing its actual situation. We hereby present the declaration based on a summary of the discussions at the conference as described below.

I. Engineering Education

1. Engineering was not included in the subjects taught at prototype universities such as *Università di Bologna* (Italy, 1088~), the University of Oxford (United Kingdom, 1096~) and *Université de Paris* (France, 1150~), but rather originated in apprenticeship and specialty schools. The teaching of mainstream modern engineering has been led by *École Polytechnique* (France, 1794~), *Karlsruher Institut für Technologie* (Germany, 1825~), *Eidgenössische Technische Hochschule* (ETH) (Switzerland, 1855~), the Massachusetts Institute of Technology (MIT) (United States, 1865~) and other universities of engineering. Later, engineering emerged at regular universities. However, in the 20th century, as scientific technology-based innovation contributed significantly to industry and the overall economy, supporting nations' prosperity, society began to recognize the need for reviewing the traditional methods of engineering education.
2. In Japan, after the Meiji Restoration, or the Meiji *Ishin* (1868), to develop industrial technologies to catch up with advanced countries quickly, the Imperial College of Engineering was established in 1871. Inviting Henry Dyer from the United Kingdom, six engineering subjects were initiated. In 1877, the University of Tokyo was established, which later combined with the Imperial College of Engineering in 1887 to form Tokyo Imperial University. Considering the chronological order, it is not an overstatement to say that engineering was the first academic discipline taught at the earliest Japanese universities. Engineering education initiated by Dyer with an emphasis on basic academic abilities became an underlying fundamental source of Japan's industrial promotion.
3. Today's engineering education has two opposite requirements: learning in extremely diverse engineering fields due to the rapid development of scientific technologies and deep learning in basic disciplines. To address such a situation, new methods of engineering education and textbooks need to be created as soon as possible. A new faculty of engineering started, for example, at Huazhong University of Science and Technology (China), which invited a dean of the faculty from Germany.
4. New engineering textbooks need to ensure the capability both to ensure accurate learning of the essence of basic fields and to nurture the practical application of such learning to engineering fields.
5. The origin of innovation lies in enthusiasm and passion. We need education that nurtures such enthusiasm and passion from early childhood. Early education needs to be reviewed as well.

II. Engineering Ethics

1. Science refers to the activities that unravel the world of nature, including humans, at a deeper level and as accurately as possible, and rarely touches on ethical issues. However, engineering, as shown by the word stem "gin," refers to activities that produce things that do not exist in the world of nature. Therefore, engineering involves important ethical issues in introducing human artifacts into the world of nature.
2. Japan had a concept of ethics even before the Meiji Restoration. Baigan Ishida (1685–1744) developed *Sekimon Shingaku*—ethics for merchants and more widely for the general public. Such a tradition remains in place today at major trading companies. Today, engineering ethics faces a serious phase due to the remarkable development of innovation-driven engineering.
3. Biological and medical ethics directly linked to bioengineering is an immediate issue. Gene-editing engineering already has provided the technology to edit genes easily and at a low cost. The stem cell technology represented by iPS cells has advanced to the level of artificially creating human oogonia (precursors of egg cells) without using embryonic stem cells (which was announced just before the AEPM in 2018). It might not be long before the ability to edit genes from manmade reproductive cells and to produce an android designed for certain purposes become a reality. There is an immediate need to plan a methodology and systematic approach to ensure engineering ethics before promoting such research and development.
4. Given today's unforeseen development of information technologies (IT) represented, for example, by artificial intelligence (AI), the Internet of Things (IoT) and big data, unprecedented and unexperienced developments for humans are spreading. Prior assessments are essential just like those for pollution and other environmental issues.
5. Innovative IT technologies enable everyone to dispatch information freely. Although they are extremely useful, at the same time, there is another aspect that involves risk. Actually, "post-truth," "post-fact" and "fake news," etc., have begun proliferating worldwide. Because of anonymous posting on the Internet and the lack of peer reviews, many people are losing the ability to judge whether something is right or wrong, and we need a compass to better direct our future.
6. Scientific technologies always have a positive side and a negative side. For such technologies, it is essential to enhance the beneficial effects (bright side) and to control the risks (dark side).

In a world full of serious social problems, the significance of engineering academies is rapidly increasing. Now is an era when academies of engineering, which maintain neutral positions independent of the three prime areas of authority—government, legislation and justice systems—should contribute to society directly. The members of engineering academies who are equipped with profound knowledge, accurate judgment and superior insight are selected and recommended as academicians after rigorous screening by seniors and colleagues. The engineering academies ensure the highest level of neutrality—higher than any other currently existing organization. Especially, the members of engineering academies have the immediate duties to work hard on research, to become a compass for society given the overflowing amounts of scientific technologies and to make their utmost efforts to show the correct direction to help society move forward. To contribute to an increasingly

confused society, the academies of engineering and we, the members of academies, hereby declare that we will engage in aggressive activities to achieve these goals.

November 25, 2018

Hiroyuki Abé (Chairman)
President of EAJ

Hideaki Koizumi (Co-chairman)
Executive Vice President of EAJ

List of Participants

Hiroyuki Abé (Chairman, Japan)	President, The Engineering Academy of Japan
Hideaki Koizumi (Co-chairman, Japan)	Executive Vice President, The Engineering Academy of Japan
Hiroshi Nagano (Japan)	Executive Director, The Engineering Academy of Japan
Hideo Tanaka (Japan)	Associate Executive Director, The Engineering Academy of Japan
Kenji Oeda (Japan)	Associate Executive Director, The Engineering Academy of Japan
Hugh Bradlow (Australia)	President, The Australian Academy of Technology and Engineering
Yves Bamberger (France)	Fellow, National Academy of Technologies of France
Ursula Gather (Germany)	Member, National Academy of Science and Engineering, Germany
Tony F. Chan (Hong Kong)	President, The Hong Kong University of Science and Technology
Oh-Kyong Kwon (Korea)	President, National Academy of Engineering of Korea
Kunwoo Lee (Korea)	Vice President, National Academy of Engineering of Korea
Magnus Breidne (Sweden)	Vice President, Royal Swedish Academy of Engineering Sciences
Edvard Fleetwood (Sweden)	Secretary General, Sweden-Japan Foundation
Willy R. Gehrer (Switzerland)	President, Swiss Academy of Engineering Sciences
Rolf Hügli (Switzerland)	Managing Director, Swiss Academy of Engineering Sciences
Sakarindr Bhumiratana (Thailand)	President, Thai Academy of Science and Technology
Paritud Bhandhubanyong (Thailand)	Vice President, Engineering Academy of Thailand
Richard Parker (United Kingdom)	Fellow, Royal Academy of Engineering
Miyuki Tanaka (Secretary, Japan)	Deputy Secretary General, The Engineering Academy of Japan

Note: Those who participated in the meeting at least once during 2016-2018 are included and the affiliations are those at the time of participation.