The 3rd ERLEP Trans-disciplinary Forum 2019
16 – 18 October 2019, Sapporo, Japan

Statement on

"Contribution of Engineering to Sustainable Development Goals (SDGs)"

emerging through trans-disciplinary discussions

1. The 3rd ERLEP (Emerging Research Leaders Exchange Program) Trans-disciplinary Forum 2019 was held from 16 – 18 October 2019 at Hokkaido University in Sapporo. A total of 43 participants attended the forum, including 13 from The Engineering Academy of Japan (EAJ); 7 from the Australian Academy of Technology and Engineering (ATSE); 10 from the Eight-University Engineering Association (8UEA) Japan; 2 from the Group of Eight (Go8), Australia; 2 from Japan Science and Technology; 3 from the Australian Embassy, Tokyo, and; 6 from Hokkaido University.
2. This forum provided an opportunity to discuss trans-disciplinary topics critical to the field of engineering today, in order to contribute to the Sustainable Development Goals (SDGs) set by the United Nations through brainstorming sessions. The topics included 1) Contribution of engineering to Energy and Environment, 2) Contribution of engineering to New Materials and Resources, and 3) Contribution of engineering to Health Engineering and Wellbeing.

Shaping the Future: Engineering, Ethics and Education

3. Advanced technologies are having large societal and environmental impacts, the effects of which can last for decades and even permanently. We recommend that ethics becomes a compulsary component of an engineering degree.
4. Access to education helps with improving the quality of life and societal decisions. We recommend a focus on how technology can help ensure a quality education for all, e.g., AI for personalised education.
5. The biggest scientific challenges require trans-disciplinary approaches. For the SDGs considered at this workshop, we identify systems theory as the potential core component for coalescing the different disciplines required to solve each scientific challenge. Systems theory is the rigorous mathematical study of systems and networks of systems, through the use of information theory, control theory, multi-scale modelling and related disciplines.
6. Successful modelling of many problems related to SDGs particularly for engineering must account for how humans behave and make decisions. We

encourage further research into a better understanding of such behaviours; systems theory can provide a useful frame and methods to achieve this understanding. We also emphasise that widespread, accessible education will be a key factor in achieving many of the SDGs and refer back to Statement #4.

Contribution of Engineering to Energy and Environment (Statement #7 - #10)

7. We recognize the importance of engineering research and initiatives to achieve SDGs and reaffirm our commitment to addressing global environmental issues through innovations in “smart energy” that can help drastically reduce energy consumption and maximize efficiency. Challenges to innovating in “smart energy,” include the need for the parallel development of “smart grid”, “smart city/building”, “smart community”, “green energy”, and “energy network” to allow for systemic integration of ICTs.

8. We recognize that intelligent end-user-side energy management system should be developed to better utilize the increasing prevalent IoT and ubiquitous sensing facilities. Such systems can empower and assist end-users to better manage energy production and use, and contribute to increasing the efficiency of the overall energy system.

9. R&D work is needed to seek new forms of self-energy supply and environment-preserving solutions in residential sector, especially in rural areas. This will involve increased utilization of naturally renewable energy sources, adoption of advanced materials, and change of people’s lifestyles.

10. Affordable energy consumption & management solutions must be investigated to alleviate the “energy poverty” phenomenon, especially for low-income and aging households. Doing this requires efforts from diverse parties, including the government, policy makers, utility and service providers, aiming to provide households with affordable energy, and improve their life qualities. Possible solutions include: (1) installation of affordable rooftop solar panels; (2) establishing local energy trading mechanisms to make the households exchange energy locally; (3) developing lightweight expert systems to monitor the household’s energy consumption and assist in changing lifestyles by, for example, generating useful or alternative recommendations.

Contribution of New Materials and Resources (Statement #11 - #14)

11. We recognize that materials, resources, and technologies will be needed to contribute to the SDGs to ensure a sustainable and healthy society - for example, “low cost sensors”, “soft, wearable, foldable, portable devices”, “high Tc superconductors”, “wood biomass (for batteries etc.)”, “safe electrochemical batteries”, “nanotechnology”, “systems (materials as components)”, “technologies to extract Li with high efficiency”, “technologies to build human tissue artificially”, and “smart polymers mimicing biological materials”.

12. We recognize Australia has strength in materials, and is rich in natural resources (coal, Al, etc.), and Japan has strength in biomass resources. Waste management systems remain very complicated including pre-treatment, treatment and recycling, and thus requires further research and development to increase their efficiency and effectiveness.

13. Based on the strengths of Australia and Japan, we can work to achieve No.12 (Responsible consumption and production) and No.15 (Life on land) through waste engineering. For example, using mining (metal) waste in Australia and biomass waste in Japan can be synthesized to produce functional materials.

14. Further research is needed to develop waste engineering based on metal and biomass waste though collaboration with process engineers.

Contribution of Health Engineering and Wellbeing (Statement #15 - #21)

15. Strategies should be designed for the benefit of the population in the pursuit of a better, healthier, and longer life, with strong considerations for different needs and wants of individuals around major aspects of everyday life – for example, work, living environments, and sociality. Ethics, diversity and social inclusion should be the underlying pillars of the future developments in health and wellbeing.

16. Research is necessary to improve the quality of diagnosis and medical treatment solutions which should be cost-effective, personalized, and patient-centred. Chronic diseases, cancer, Alzheimer and dementia, which are more broadly observed in the aging population, should continue to remain key research areas.

17. Development of portable devices and more effective monitoring systems, application of micro- and nano- technologies, and big data analysis solutions will allow better diagnosis. Ensuring such technologies and processes remain ethical is crucial and requires transdisciplinary research collaboration.

18. Robotics provide a fertile ground for innovation in rehabilitation and high-quality medical practices.

19. Telemedicine will contribute to standardisation of medical service, beyond geographical limitations. Research into prevention and challenges surrounding standardisation will also be essential.

20. It will also be important to develop methods to measure the effectiveness of medical performance and improve the communication between medical staff and patients, taking into account the contextual diversity, including the needs and values of individuals and groups.

21. We believe that to tackle these challenges, trans-disciplinary approaches including engineering, computer science, medicine, design, social studies, law, economy, and psychology is especially essential in Health Engineering and Wellbeing.

22. As seen above, similarly to the statements summarized at the 1st and the 2nd ERLEP Trans-disciplinary Forums, we reconfirm that it is critical, generative, and beneficial to explore transdisciplinary research opportunities for tackling the urgent global issues of sustainability, leveraging the strengths of Japan and Australia in engineering knowledge and technology.

23. As such, we strongly believe that this forum as a conduit to trans-disciplinary, collaborative research should be continued under collaboration between Japan and Australia.

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