CAETS

International Council of Academies of Engineering and Technological Sciences

Delta Technology for a Sustainable and Habitable Planet

A CAETS Statement

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The 30th Annual Meeting of the International Council of the Academies of Engineering and Technological Sciences (CAETS) took place in Delft and The Hague (Netherlands) from 25-27 June 2008. The accompanying technical symposium focused on sustainable development of the world's deltas, which will accommodate an estimated 70% of the global population by 2050. Presentations focused on the effects of climate change and land subsidence in these regions and their interaction with "Delta Technology."

CAETS is the International Council of Academies of Engineering and Technological Sciences, Inc. It consists of those national academies of engineering and technological sciences that have satisfied an agreed set of criteria for membership. It was established in 1978 and was incorporated as a charitable non-profit corporation in the District of Columbia (US) in 2000. Its Articles of Incorporation, Bylaws and Operating Procedures set down its objectives and governance arrangements. These documents and its membership and achievements are posted on the CAETS website, www.caets.org.

Delta Technology

"Delta Technology" is a recent term of art that refers to a cluster of disciplines that deal with living in vulnerable delta regions, river banks and coastal zones.* These disciplines focus on the socio-economic and environmental processes and on their uncertainty. Delta Technology establishes links in and between traditional engineering disciplines such as hydraulic engineering, dredging engineering, geo-engineering, and eco-engineering, and seeks to advance technology at the interface of civil engineering with 21st-century breakthrough technologies such as bio-, nano-, and sensor technologies and ICT (information and communication technology). Delta Technology envisions embedding technology in the societal decision-making processes relevant to sustainable development of and adaptation to global change in delta and coastal areas – *high-tech, high-touch.* Delta Technology considers water quality; river basin and coastal design for flood protection; subsurface water and underground space; and construction of infrastructures on soft soils consistent with the impact of agricultural, industrial and urban activities and soft soil behavior. Successful outcomes include enlightened management and use in order to provide healthy water, sustainable soil and materials systems, and building with nature, using the natural resilience of water systems.

** For brevity, frequently referred to collectively as "deltas" in the following.*

Findings

Delta areas have major economic potential because of their strategic location close to seas and waterways. The ground is fertile and rich in minerals and raw materials. But their vulnerability is increasing because of rising sea levels, extreme river levels, subsiding soft soils, and increasing pressure on space and environment.

Delta zones are frequently subject to intense human intervention, including pressures derived from activities of productive sectors with great economic impact, such as agriculture, fishing, tourism and energy. Living in delta zones means living with uncertainty. In many instances, it is desirable to forego initial development or further development of such regions, but the reality is that many people currently live in delta regions, and their number is increasing every day.

Thus, management of the natural and manmade systems in these areas and of their adaptation to global change requires an integrated application of all aspects of delta engineering.

Socioeconomic and environmental developments related to safety, transportation, nature and living in deltas reflect complex interrelations with different spatiotemporal scales. In such a dynamic environment, achieving a sound balance between the various interests is a major technological feat. Prior to implementing technological solutions, societal implications must be considered, taking into account all the spatial, economic and administrative consequences of the use and management of water and soil that will lead to the most sustainable solution.

Recommendations

1. **Building with Nature**

   Living in deltas has always required human intervention. Often, this intervention conflicts with the natural environment, requiring constant maintenance and further intervention, which in turn leads to degradation of the overall conditions in these areas. The aim of Building with Nature is integrated delta development making use of the forces, interactions and materials present in nature. New design methods are elaborated to optimize the opportunities offered by natural ecosystems. New materials – *"smart soils"* – are eco-designed. Sand is transformed into sandstone by bio-organisms, saltwater seepage is blocked by activating natural processes, and the effects of land subsidence may be reduced by preserving soft soils such as peat. Knowledge of this kind will contribute to the balanced assessment of ecological, economic and societal values and may even lead to a redesign of the civil engineering discipline as we now know it.

   Recommendation 1: We recommend a sustainable development of deltas in accordance with naturally occurring forces, interactions and materials, in order to preserve the environment and to meet the future requirements of the global population.

2. **In Control**

   (Measurements, models, predictions)

   Effective management of natural and manmade systems in delta areas requires an understanding of 'normal' conditions, but extreme scenarios should be anticipated.

The living environment in many deltas is at risk of major impact by flooding and changes in natural conditions. Economic or other gaps in our knowledge mean that it will never be possible to exclude these risks totally or to anticipate their consequences fully. However, new approaches to monitoring, surveillance and forecasting, as well as advances in simulations, will enable us to make sensible choices to develop more accurate warning and forecasting systems that have greater influence on the effects of these events.

By simulating the effects of interventions in delta areas, one can address environmental sustainability and safety issues, assess risks, and show how different systems are linked in terms of hydrology, ecology, and so on. Such analyses illuminate the impact and need for an integrated approach. In this way, complex knowledge, including technical and ecological, can be made accessible so that it is comprehensible and easily applicable for decision-makers, stakeholders and the general public, with the final goal of environment preservation.

Recommendation 2: We recommend full development of simulation, forecasting and sensor technologies in the context of Delta Technology, including introduction of local- and global-scale monitoring and diagnostic systems applicable to real-time warning systems.

3. **The Knowledge Base**
(Use of information technology for knowledge sharing at the global scale, new learning systems)
Traditionally, civil engineering is highly empirical. Modern ICT development allows for the integration of theoretical knowledge, computer simulations, empirical models and practical experience into new expert systems. Artificial intelligence can be used to develop 'third-generation' design environments. Web-based methods subsequently facilitate knowledge sharing worldwide and thus accelerate the application of new insights.

Future Delta Technologists will benefit from interactive learning tools such as serious gaming. Their skills should include the assessment of uncertainties in decision-making processes, risk management, communication and spatial planning.

Recommendation 3: We recommend the development of a worldwide system of knowledge sharing for application to delta-region decision making; and an advanced risk management framework to include risk assessment, risk mitigation and risk-based communications.

4. **Technology Embedded in Societal Processes**
(high-tech, high-touch, in touch)
In water and soil issues, technological standards matter, as do natural developments, spatial policies, and governance and legal processes. By implication, control over water is a social issue *(delta life)* that is becoming more pressing as a result of the impact of climate change on the weather and on sea levels.

The integrated management of river banks and basins, estuaries, deltas and coastal areas requires experts, managers and researchers trained to have a multidisciplinary vision of physical and biogeochemical processes and their legal, environmental and socio-economic foundations.

The engineering sciences in the broad sense should make their full impact on the challenges that humanity is facing. Communication between the public and the professionals is vital, as is educating the public about possible risks and countermeasures. To do that, it is vital to bridge the gap between society's needs and expectations, the potential of technological developments in the engineering profession and in the education of future engineers.

Recommendation 4: We recommend that social and technical sciences should work closely together to increase awareness of the challenges humanity is facing in the enlightened use of deltas; to inform and educate the public and to find support for the necessary research, development and data collection to promote design of innovative solutions; and to shorten the time lag between availability and application of new technologies.

Conclusion

The interplay between the technical, social and human issues related to living in and protecting fragile deltas, river basins and coastlines is complex, but the engineering community – as exemplified by the CAETS academies – is well prepared to present objective data for facilitating debate by governments and national communities on the tradeoffs this interplay demands. Worldwide cooperation is necessary to face the impact of the new climate change uncertainty and ever-increasing population pressure. CAETS members recognize the need to promote policies to encourage the avoidance and mitigation of human impact on the delicate natural environments of deltas and pledge to promote the wise utilization of these gifts of nature.

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