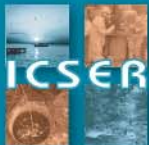


Delivering Sustainable Infrastructure that Supports the Urban Built Environment

Carol Boyle, Director

International Centre for Sustainability Engineering and Research

The University of Auckland



INTERNATIONAL CENTRE FOR
SUSTAINABILITY ENGINEERING & RESEARCH

Urban systems

- Over 50% of the global population now lives in urban areas
- Urban areas are expanding at a greater rate than population growth
- Urban societies have also changed, with a greater diversity of cultures, high population densities and rising demand for services, resulting in an increasing complexity of human urban systems
- Urban systems influence and are influenced by infrastructure systems, which affect the design and management of the built, social, and natural environments, including future infrastructure decisions

Sustainable infrastructure

- Sustainable infrastructure that supports the built environment is essential for the survival and health and wellbeing of a society
- The built environment includes buildings, engineering works, and infrastructure such as roads, wastewater and water treatment plants, stormwater management systems, power generation facilities, railways, bridges and even natural systems such as rivers and harbors.
- Infrastructure systems provide the basic physical structures needed for the operation of a society and facilitate access to goods and services.

Workshop

These are the results of a multidisciplinary, international workshop that identified challenges in developing and managing sustainable infrastructure which need to be addressed by research into the urban built environment that are necessary to achieve sustainable infrastructure



Urban Infrastructure Challenges

Improving Understanding of Sustainability

Increasing Age and Risk of Failure in Urban Infrastructure

Increase in Consumption in Developing Countries

Resource Availability: Energy, Water, and Construction Materials

Global Warming

Increased Urbanization



Transitioning to sustainability

Sustainability is a global challenge but many of the solutions must be implemented at the local level.

Research is needed to :

- establish the fundamentals of the science of sustainability as a foundation for infrastructure
- enable a greater understanding of the risks inherent in the large, multiple-scale, complex, dynamic systems which comprise infrastructure systems
- assist in developing better responses to climate change, increased urbanization, increasing use of limited resources, and aging urban infrastructure

Research Themes

Two main research themes were identified:

- (a) to better understand sustainable systems and
- (b) to develop sustainable infrastructure systems

Fundamental elements in addition to sustainability included:

systems thinking,
complexity, and
resilience



Research Themes

Short-term requirements - assessment of the sustainability of mixed scale infrastructure systems

(e.g., provision of water through a combination of small-scale rain tanks, medium-scale community underground storage tanks, and large-scale reservoirs)

Medium term needs - including development of infrastructure to address global warming concerns by 2020

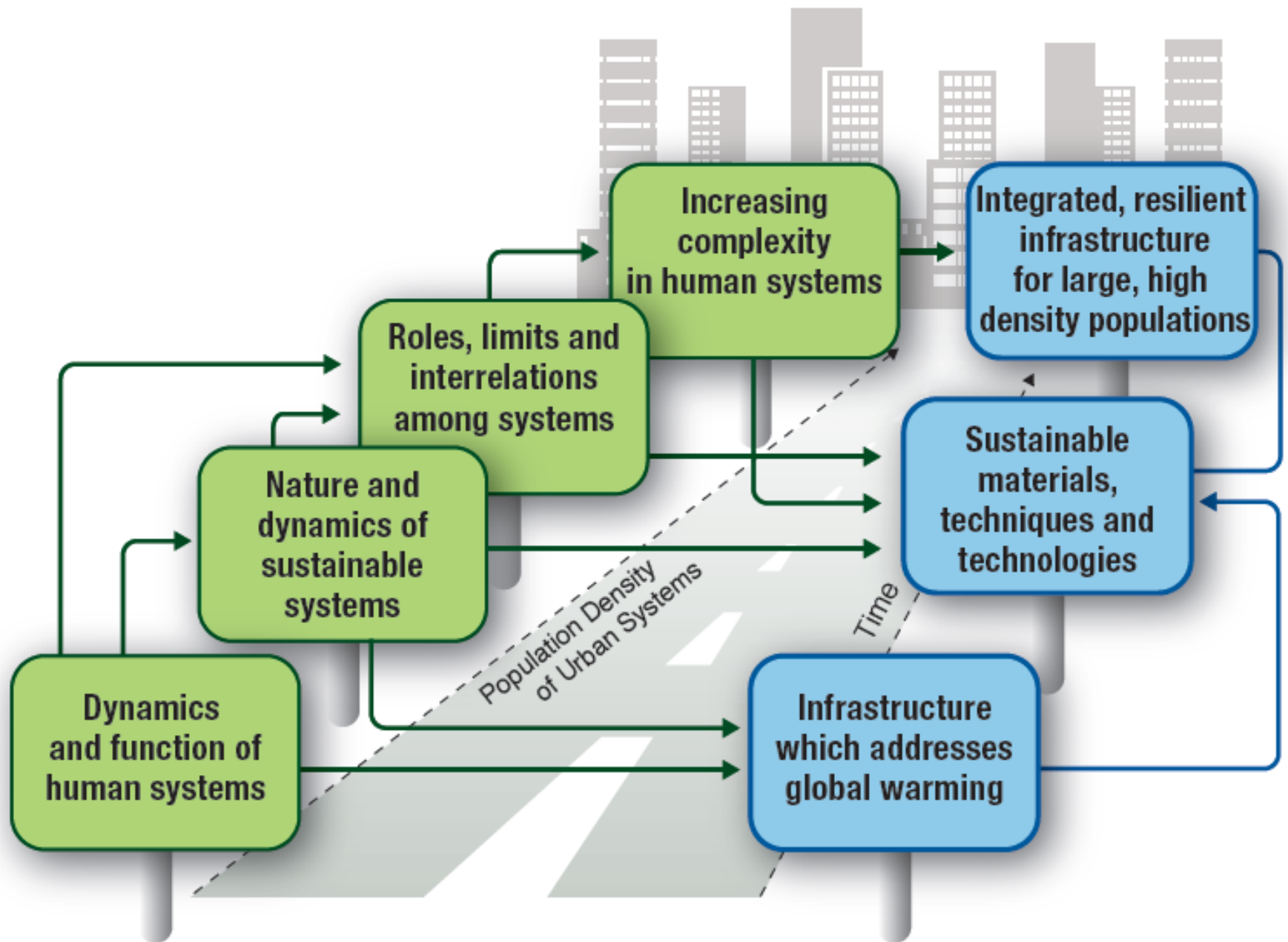
Long-term aspects - development of sustainable infrastructure for megacities by 2100

Incorporating the social context of sustainability in developing sustainable infrastructure was vital

Stocktake

- There is a need to better understand
 - the components of a sustainable system
 - how to incorporate these into infrastructure development, either on a transitional path or as a final goal
- There was also discussion regarding the validity of incremental improvements in achieving sustainability
- A number of researchers postulated that only path-breaking designs could achieve such a goal





**Fundamentals of
Sustainable Infrastructure**

**Developments in
Sustainable Infrastructure**

Dynamics and Functions of Human Systems

- Understanding complex human systems including feedback mechanisms, system fluctuations over space and time, synergistic, antagonistic, and cumulative interactions and complex system failure modes
- Understanding the function of the community in delivering sustainability, particularly in reducing infrastructure burdens through changes in human behavior and consumption patterns,
- The influence of infrastructure systems on urban development, function, management, and growth over short, medium, and long term

Nature and dynamics of sustainable systems

- Low impact, decentralized, or mixed decentralized-centralized infrastructure systems need to be assessed against existing systems to identify potential risks and resilience and identify appropriate options for development or redevelopment.
- Features of sustainable systems are still under debate, and a greater understanding of the factors that contribute to sustainability is needed

Roles, Limits, and Interrelations Among Environmental, Social, Technological, Institutional, and Economic Systems

- Interrelationships within human society and between that and the environment influence societal sustainability
- The focus on economics is a barrier to sustainability and to engaging society in a meaningful dialogue for sustainable lifestyles and communities
- Too much emphasis has been placed on technology with little consideration of appropriate technology and the resource and economic costs to future generations to maintain and upgrade infrastructure

Increasing Complexity in Human Societies

- Increasing population, consumption, density, diversity, globalization, and communication and current trends indicate increasing human societal complexity
- Pathways for delivering sustainable infrastructure will need to be carefully developed
- Megasystems (megacities and megabuildings) will require development and management of increasingly complex infrastructure systems that exceed existing capabilities

Increasing Complexity in Human Societies

- Megabuildings were defined as mixed-use buildings over 300 m in height
- Functioning of megabuildings, or “vertical urban villages”, may pose significant new challenges and require novel solutions because of the scaling issues



Developments in Sustainable Infrastructure

- Developing infrastructure that addresses global warming, in both reducing global warming and addressing changing climatic conditions
- Developing sustainable materials, techniques, and technologies for construction of sustainable infrastructure
- Designing and managing integrated, resilient, infrastructure for large, high density populations

Summary

- Systems thinking, complexity, and resilience are fundamentals in understanding and delivering sustainability.
- Short-,medium-,and long-term thinking at varying scales is also needed to understand the complex social systems that drive and develop infrastructure systems and protect the environmental systems which provide many of society's resources
- An understanding of the social infrastructure and its interaction with the physical infrastructure was considered essential

Summary

- There was consensus that new perspectives, technologies, and behaviors were needed to drive the innovations required to meet the needs of an expanding society for the future
- While incremental changes were necessary, disruptive, path-breaking changes may be essential to developing sustainable infrastructure systems that may require 10-20 years before implementation
- The research directions developed in this workshop were seen as only the beginning of a long pathway to sustainable infrastructures, cities and societies

