Affecting societies, economies, and environments, the global transformations of the 21st century require integrated solutions informed by systems thinking. Sectorial and disciplinary approaches, methods, and tools of systems analysis, while rapidly advancing, must thus be interlinked and scaled up to enable holistic and global outlooks. The conference Systems Analysis 2015 responds to this challenge by highlighting recent advances, current lacunas, and untapped transdisciplinary potentials in the field of systems analysis, with the aim of demonstrating the unique prowess of systems thinking for navigating a swiftly changing and increasingly complex world.

1 Systems Analysis in the 21st Century

Today's major transformations are characterized by increasing globalization, shifts of economic and political power, taxing environmental challenges, and unpredictable social conflicts, as well as by massively broadened and accelerated flows of information. Systems analysis helps identify smart pathways through the complex nexus of these processes to reach a world that accommodates the needs and aspirations of different groups and respects the limits imposed by the planet itself.

Narrowly focused single-disciplinary sciences alone cannot adequately address these challenges. Systems analysis therefore strives to develop integrated, interdisciplinary, multi-scale approaches that consider social, economic, and environmental aspects, to look across borders and sectors in order to identify feedbacks, tradeoffs, and synergies. In a world with tightening connections and accelerating turnarounds, demands for scientific advice based on systems thinking are mounting.

This sets the stage for an enhanced societal significance of systems analysis. Realizing this potential requires new scientific methods, tools, and approaches that move apace with the rising levels of data availability and problem complexity underlying contemporary policy challenges and interventions. Addressing these needs, the field of systems analysis itself is undergoing an essential transformation.

2 Systems Analysis 2015

The conference Systems Analysis 2015 will bring together leading researchers from around the world to discuss the current state and future directions of systems analysis. Building on the key strengths of systems analysis in providing a common language for dealing with the complex global transformations of the 21st century, the conference will focus on the con-
temporary challenges, emerging opportunities, and innovative applications of systems methods, and identify the most promising directions for their future development.

The methodological (i.e., methods-oriented) challenges confronting contemporary systems analysis are multifold. The growing complexities of policymaking processes require careful analyses. Mounting integration of economic sectors must be matched by growing methodological integration of the associated modeling frameworks. Nexus studies must address interdependencies among the implications of policy interventions across ecosystem services and economic sectors. Impacts of human behavior ought to be captured in a way going beyond overly stylized optimization assumptions, towards respecting apparent irrationalities, a plurality of social norms, and collective phenomena.

Nonlinear dynamic responses of the environment to anthropogenic drivers must be addressed. Avalanches of unprocessed data necessitate innovative algorithms for assimilation and analysis. Hidden uncertainties have to be revealed and tackled. Regional models must be scaled up to enable global predictions, and regional predictions must be scaled down to guide local actions. New methods are needed for approximating complex dynamics. Mounting computing power has to be used intelligently, limiting a proliferation of unvalidated model complexity.

Systems Analysis 2015 aspires to meet four interconnected objectives: to appraise the present state of the art of methods of systems analysis, to showcase recent methodological advances with high future potential, to identify gaps in current approaches that need to be overcome for meeting the new challenges, and to create a platform for transdisciplinary inspiration and the transfer of methodological knowledge among different applications of systems analysis.

3 Conference Program

The conference program will feature 30-40 invited speakers, who will typically be allocated 25 minutes for their presentations followed by 5 minutes of discussion.

Each of the envisaged nine conference sessions could be moderated by a researcher who presents the overall scope of the session, introduces each talk in the context of the session and of the conference as a whole, calls for questions from the audience, and offers concluding remarks at the end of the session.

Each of the three conference days will concentrate on a theme, enabling a natural progression from identifying the contemporary methodological challenges of systems analysis, to reviewing methodological innovations that help address these challenges, to implementing system-analytical solutions informed by such innovations. All conference themes are developed from a unifying focus on the underlying concepts, methods, and tools of systems analysis.
The following schematic provides an overview of the planned structure of the conference program:

![Schematic diagram of conference program]

**Day 1 — Wednesday, 11 November 2015**

**Opening Session**

Welcome by IIASA’s Director General and CEO, Pavel Kabat

Welcome by representatives of the partner institutions

Welcome by the Vice-Chairs of the conference’s Scientific Committee

This session sets the stage for the conference by – ideally – covering the following four aspects: reflect on the current revival of systems thinking, highlight a major new challenge for systems analysis that requires methodological advances, showcase a recent application of systems analysis that has been enabled by methodological advances, and discuss the plurality of contemporary systems-analysis approaches among disciplines and along the traditional continuum between reductionism and holism.

**Theme 1 — Contemporary Challenges**

The conference’s first theme focuses on identifying the contemporary methodological challenges of systems analysis.

**Session 1: Requirements for Methodological Advances in Systems Analysis**

This session focuses on the methodological advances required for the successful future development of systems analysis as an approach to address the 21st century’s major transformations. These advances need to expand the prowess of systems analysis in addressing chal-
lenging features of complex adaptive systems, such as nonlinearities and path dependence, surprises and tipping points, process uncertainty and model uncertainty, macroscopic patterns emerging from microscopic processes, massive availability of highly multivariate yet often unstructured and imprecise data, bounded rationality driving exchanges among social and economic actors, and impacts cascading across extended and interconnected networks.

Session 2: Trans-disciplinary Inspiration in Systems Thinking

This session showcases the diversity of conceptual approaches that different fields of natural and social science have developed for defining and analyzing systems. Elucidating alternative systems perspectives across research areas as disparate as neuroscience, quantum theory, engineering sciences, ecology, economics, psychology, sociology, and computer science, key ideas concerning system elements, system interconnectedness, system boundaries, and systemic dynamics will be introduced and compared, with the goal of promoting trans-disciplinary inspiration in systems thinking.

Poster Session – Systems Analysis in 2015

The conference will feature a dedicated poster session, through which participants can scope and share a diversity of perspectives on innovative methodologies, applications, and future challenges of systems analysis.

About ten particularly interesting posters may be selected for 3-minute blitz talks at the beginning of the poster session.

Day 2 — Thursday, 12 November 2015

Theme 2 — Methodological Innovations

The conference’s second theme provides a review of methodological innovations that help address the contemporary challenges of systems analysis.

Session 3: The Art and Craft of Systems Analysis

Both art and craft are involved in all major steps of systems analysis – from posing a specific research question, to specifying the assumptions underlying a model, to transforming those assumptions into mathematical or computational form, and to representing and communicating the results. These features are making systems analysis an exciting and creative process.

This session considers the creative tensions inherent in this process by touching on the following questions. What modern approaches can be recommended for model selection, calibration, and validation? How are systems boundaries best to be defined, emergent phenomena tackled, robustness checks designed, and validity limits delineated? How can multi-
ple models be compared, interfaced, and integrated? How can a proliferation of false positives be avoided as the pool of data that can be correlated explodes? How can big data be used while skirting a temptation to construct big models in which a plethora of nonlinear interactions defies understanding and associated uncertainties cannot be assessed? In any of these regards, are best-practice recommendations becoming available that help delineate a safe operating space for systems analysis?

The session could feature a panel discussion, preceded by several introductory presentations.

Session 4: New Methods for Understanding Complex Systems

As the challenges of systems analysis develop, so must its methods. The system analyst’s tool chest can be expanded in three ways: by taking advantage of as-yet untapped advances in mathematics and computer science, by the gradual honing of tools applied and developed in a disciplinary context, and by transdisciplinary innovation and cross-fertilization.

This session will provide an extensive horizon scan of new methods and approaches that have potential for strengthening systems analysis in the 21st century.

Day 3 — Friday, 13 November 2015

Theme 3 — Implementing Solutions

The conference’s third theme addresses how to implement system-analytical solutions informed by recent methodological innovations.

Session 5: Addressing Stakeholder Diversity

Scientific insights into global transformations invariably require accounting for a plurality of stakeholder groups and interests. Contemporary applications of systems analysis are breaking new ground by explicitly accounting for such diversity, as well as for the associated complexity of human behavior. Participatory processes engaging stakeholders and policy makers in the whole cycle of designing and implementing research have proven invaluable for promoting a wider acceptance of scientific analyses. The interfacing of science with art is also increasingly recognized as a powerful conduit for reaching broader audiences.

This session focuses on methodological approaches that facilitate stakeholder involvement and promote accounting for stakeholder diversity.

Session 6: Devising Integrated Solutions

Systems analysis strives to capture crucial connections within a domain. When impacts cascade through systems, policy interventions affect multiple sectors, and stakeholder utilities
are intertwined, capturing such connections becomes crucial. Integrated assessments are devised to meet these challenges. On the one hand they reveal synergies and co-benefits, leading to particularly cost-effective solutions, while on the other hand they can highlight conflicts among stakeholders or mutual exclusions among policy options. By accounting for interconnections, integrated assessments can also promote the robustness of solutions and enable predictions over longer time horizons.

This session features methodological approaches underlying cutting-edge nexus studies and highlights methodological challenges that need to be overcome for devising future integrated assessments of increasing scope and reliability.

**Closing Session: A New Generation of Systems Analysis**

In this session, conference participants share their vision on the future of systems analysis, offering personal views on the most promising directions and on methodological advances needed to pursue these directions.

The session opens with four researchers who have not yet spoken sharing their reflections on the conference proceedings in the form of 10-minute statements, followed by a closing panel with conference speakers opening up to questions that can be submitted by all conference participants to the session moderator.