TIAS Quarterly

April 2008

The newsletter of *The Integrated Assessment Society (TIAS)*
http://www.tias-web.info

In This Issue:

Courtesy of J. Newig

The Society

The Integrated Assessment Society is a not-for-profit entity created to promote the community of inter-disciplinary and disciplinary scientists, analysts and practitioners who develop and use integrated assessment. The goals of the society are to nurture this community, to promote the development of IA and to encourage its wise application.

Integrated Assessment Defined

Integrated Assessment (IA) can be defined as the interdisciplinary process of integrating knowledge from various disciplines and stakeholder groups in order to evaluate a problem situation from a variety of perspectives and provide support for its solution. IA supports learning and decision processes and helps to identify desirable and possible options for addressing the problem. It therefore builds on two major methodological pillars: approaches to integrating knowledge about a problem domain, and understanding policy and decision making processes. IA has been developed to address issues of acid rain, climate change, land degradation, water and air quality management, forest and fisheries management and public health.

Feature

Transdisciplinary Knowledge Integration. Cases from Integrated Assessment and Vulnerability Assessment

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Transdisciplinary assessments (TAs) address problems that cannot be solved by a single scientific discipline, nor by science alone. People from different disciplines and from outside of science all possess unique knowledge about distinct aspects of the problem and need to collaborate on designing and implementing effective solutions. Integrated assessment (IA) and vulnerability assessment (VA) are two variants of TA which are prominent in the context of problems associated with climate change, such as how to mitigate greenhouse gas emissions and how to adapt to climate impacts.

Transdisciplinary problem solving differs from that of disciplinary research in that it is facing specific conceptual and methodological challenges. The first challenge encountered is that it is not exactly clear what the problem to be solved is; participants and contributing disciplines use alternative and sometimes incompatible concepts to describe the problem and its solution. Furthermore, in contrast to disciplinary problem solving, no standard "off-the-shelf" methods are available. Each problem addressed has unique features and requires the integration of knowledge from various scientific disciplines and from outside of science into an appropriate methodology.

Even though this integration of knowledge is *the* crucial step in transdisciplinary problem solving, it is rarely addressed explicitly; the participants of a transdisciplinary problem-solving efforts come together and *somehow* put together what they know. Concepts for speaking about the integration of knowledge are lacking.

This thesis takes first steps in filling this gap. It addresses the questions of how scholars from different disciplines can effectively integrate their knowledge for solving a given problem and what methods could be applied for facilitating this process. In the first chapter meta-concepts for speaking about knowledge integration are developed and applied to discuss four cases of knowledge integration from the domains of IA and VA. In the following chapters the individual cases are presented in greater detail.

Knowledge integration is differentiated into two subsequent phases. First, the participants of the assessment need to elaborate a *shared language* which is applicable for describing the problem and discussing potential solutions. Second, the participants must, based upon the shared language, design an appropriate methodology.

Three devices for facilitating knowledge integration are put forward:

- *semantic ascent* or the shift from speaking in a language to speaking in a meta-language about the former,
- *formalisation* or the translation of statements made in ordinary or technical language into a formal language, and
- *knowledge integration methods*, which are methods that provide a meta-language for speaking about the knowledge to be integrated and organise the process of integration.

In the first case of the "Framework for Analysing Methodologies of Transdisciplinary Assessments" (FORMETA) the general problem of methodology design was addressed. In TAs, a lot of time is spent on discussing methodologies of past assessments and the design of methodologies for new assessment. FORMETA aimed at facilitating these discussions and the design of new methodologies by providing a language to better communicate about and compare between methodologies of past assessment.

The first step in addressing this problem was to analyse the usage of the term *methodology* . In the context of TAs the term is used to refer to the specific configuration of data, methods, actors and activities involved in solving the problem addressed. The second step taken was to translate (*i.e.* formalise) the results of the analysis into the language of mathematical graph theory: a methodology is represented as a directed simple graph.

The nodes of the graph represent the involved data, methods, actors and activities. The arcs of the graph connect the activities of the methodology with their inputs and outputs, *i.e.* they show the flow of data between the activities. The output of the methodology's last activity is called *product* of the methodology.

The graphical framework developed was tested by analysing and comparing the methodologies of two recent VAs carried out by the DINAS-COAST and the ATEAM projects. It was found that the methodologies differ in three aspects:

- the product of ATEAM was data while that of DINAS-COAST was a method, *i.e.* a computer model,
- ATEAM modelled the environment and the human response separately while DINAS-COAST did this jointly, and
- ATEAM involved stakeholders while DINAS-COAST did not.

These differences have an influence on the type of result statement produced by the methodologies and the way users perceive them. ATEAM produced simple, aggregate results statements, which have been recognised by a wide audience, while DINAS-COAST produced more complex, less aggregate statements, which did not receive such a wide recognition but were welcomed by users confronted with concrete decisions.

In the second case of the project "Formal Approaches to Vulnerability that Informs Adaptation" (FAVAIA) the problem of developing a shared language for speaking about vulnerability to climate change and related concepts such as risk, hazard and adaptive capacity was addressed. Even though the concept of vulnerability is widely used within the climate change scientific community it is not defined consistently through the literature and often used without definition.

The first step taken to address the problem was to analyse vulnerability statements made within ordinary language and the technical language of the climate change scientific community. The analysis revealed that vulnerability is a relative concept, in the sense that accurate statements about vulnerability are only possible if one clearly specifies the *entity* that is vulnerable, the *stimulus* to which it is vulnerable and the *preference criteria* to evaluate the outcome of the interaction between the entity and the stimulus.

In a next step, the three basic concepts identified were formalised (*i.e.* translated) into three mathematical primitives. The entity was mapped to a discrete dynamical system ($f: X \times E \rightarrow X$; f is the system's transfer function, X the set of states and E the set of exogenous inputs), the stimulus to the system's exogenous input ($e \in E$) and the preference criteria to a partial strict order relation on the systems set of states ($< \in X \times X$).

In a third step, vulnerability and related concepts were defined upon the mathematical primitives. For the simplest case of a one-step transition of a discrete dynamical system, vulnerability was defined as:

> A system f in state x is vulnerable to an exogenous input e with respect to $<$ if and only if $f(x, e) < x$.

This simple definition was generalised to more complex cases in which, *e.g.*, whole trajectories instead of one-step transitions are considered, the vulnerability of a system relative to a given reference scenario is considered and the entity reacts or adapts to the *stimuli*. Finally, the resulting framework was related to the IPCC definition of vulnerability and to those operational definitions applied in the aforementioned ATEAM and DINAS-COAST projects.

In the third case of the project "Potsdam Integrated Assessment Modules" (PIAM), an important special case of methodology design, the integration of computer models in the context of modular IA modelling was addressed.

In the past, IA models were hardly modularised, which made it difficult to reuse parts of them in order to be able to quickly respond to new questions raised by the decision makers. The next generation of IA modelling is envisaged as a modular process, in which modules are developed independently by different institutes and plugged together afterwards in accordance with the questions raised.

PIAM considered this problem by means of an example case: the integration of an economic model that optimises inter-temporal welfare and thereby outputs an emission trajectory and a climate model that is driven by an emission trajectory and computes the resulting global mean temperature rise. The task was to find the optimal emission trajectory while keeping temperature rise below a certain threshold.

The first phase of knowledge integration, the elaboration of a shared language, was trivial in the example case considered because the models were only connected via two shared concepts: the emissions trajectories and the temperature rise.

The second phase of knowledge integration, methodology design, means in the context of model integration that the models formulated in the shared language must be integrated numerically. It is important to note that it generally does not suffice to just couple the input and output of the computer models. Computer models are approximate (*i.e.* numerical) solutions of mathematical problems; coupling the approximate solutions of several individual problems does not necessarily give an adequate solution of the overall problem; additional coupling algorithms might be needed.

In the example case considered, finding an efficient coupling algorithm was, in fact, a major challenge. A trade-off between computational efficiency and placing little requirements on the output of the models had to be reached. It was decided to make the welfare gradients of the economic model available to the coupling algorithm, but not the gradients of the climate model, even though this would have enabled a more efficient coupling algorithm. However, the wish was to minimise the work needed to be able to (re-)use existing climate models, which generally do not output the gradients.

In the fourth case of the EU-funded project "Dynamic and Interactive Assessment of National, Regional and Global Vulnerability of Coastal Zones to Climate Change and Sea-Level Rise" (DINAS-COAST), a further case of integrating computer models, this time in the context of a global assessment of vulnerability to sea-level rise, was addressed. The task was to integrate computer models of different coastal sub-systems that are built by distributed participants and to make the integrated model available in the form of the user-friendly tool DIVA (Dynamic and Interactive Vulnerability Assessment), which allows the simulation of the effects of climate scenarios and adaptation strategies on all coastal nations.

The first phase of knowledge integration, the elaboration of a shared language, turned out to be a challenge due to the fact that ten models and around 200 concepts needed to be respected. This challenge was addressed by the introduction of a formal meta-language consisting of the concepts of geographical feature (*i.e.*, the "real world" entities; *e.g.* rivers or countries), property (*i.e.* the quantitative information about the features; *e.g.* a river length) and relation (*e.g.* a river might belong to several countries). With the help of these meta-concepts, the project participants were able to elaborate a shared language, that is a list of geographic features, properties and relations that make up the coastal world modelled by DINAS-COAST.

The second phase of knowledge integration, the methodology design, also turned out to be a challenge. It was not possible to define the linkages between the models to be integrated at the beginning of the assessment, because at this point the interactions between sub-systems were not fully understood; instead they were a result of the interdisciplinary learning process during the course of the assessment. This second challenge triggered the development of the DIVA method. The method consists of the above-mentioned meta-language and a development process that allows for iteratively refining the shared language and the linkages between the individual models. The DIVA method was then applied to develop the DIVA Tool.

From the cases considered, three general conclusions are drawn. First, semantic ascent is a useful device in those cases of transdisciplinary knowledge integration in which no direct agreement on a shared language or a methodology for solving the problem can be reached. In the case of FORMETA, the usage of a meta-language for representing methodologies of TAs improved the communication about methodologies of assessments and made important differences between the methodologies of ATEAM and DINAS-COAST transparent. In the case of DINAS-COAST, the introduction of a meta-language resolved the difficulties that the participants could not agree on a shared language and the model linkages at the beginning of the assessment.

Second, formalisation can contribute to the development of shared languages, in particular in those cases which involve complex relations between concepts and in which concepts overlap non-trivially in meaning. The formal mathematical language developed in the FAVAIA case has helped researchers at PIK, members of the FAVAIA project, workshop participants, and members of the ADAM and NEWATER projects to communicate more precisely about the common issue of vulnerability to climate change.

Third, it is important not only to support knowledge integration by providing adequate languages through semantic ascent and formalisation, but also to organise the actual process of integrating knowledge through knowledge integration methods. This is particularly true in cases in which many participants, concepts and methods are involved and the shared language and methodology are bound to change during the course of the assessment. The DIVA method developed in the DINAS-COAST project has helped the participants of the assessment to iteratively elaborate a shared language and the linkages between models and thus to take advantage of the mutual learning process during the course of the assessment.

This article is a summary of: Hinkel, Jochen, 2008 **Transdisciplinary Knowledge Integration. Cases from Integrated Assessment and Vulnerability Assessment.** Ph.D. thesis, Wageningen University, Wageningen, The Netherlands. ISBN 978-90-8504-825-1 The full thesis may be downloaded from http://www.pik-potsdam.de/~hinkel/pubs/hinkel2008a.pdf
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News

IHDP announces two new training seminars
The International Human Dimensions Programme will run two training sessions as part of its annual Open Meeting in 12-15 October 2008 in New Delhi, India "From Research to Social Change: The Case of Ecosystem Services"
"Capacity Development in Adaptive Water Management"
Each seminar will be led by selected organizations. The two seminars will run in parallel and encompass a three and a half- day training session on the topics listed above, which are related to the larger theme of the 7th IHDP Open Meeting "Social Challenges of Global Change." The seminars, which will commence with a common plenary session convening all workshop participants, will introduce the workshop participants to a variety of global change related concepts and methodologies from a wide range of disciplines. The seminars will end with another group plenary session focusing on science-policy interaction.
For more information visit www.openmeeting2008.org

EPOS Summer School on Methods and Tools for Impact Assessment
The EPOS Summer School on Methods and Tools for Impact Assessment, Berlin, Germany, 16-20 June 2008. Ecologic, together with IÖW - Institute for Ecological Economy Research, will host a summer school on Methods and Tools for Impact Assessment 16 - 20 June 2008 in Berlin. The summer school is designed for young scientists and consultants from European institutes who are involved in sustainable development and environmental research and want to improve their knowledge and skills in impact assessment. The programme combines input lectures with practical training sessions on relevant methods, such as stakeholder participation, scenario building, multi-criteria analysis, and cost-benefit analysis. Deadline for applications 30 April.
http://www.ecologic.eu/soef/epos/events.html

Conference on Climate Change and Adaptation, Sept. 29 - Oct. 3, Amsterdam
A conference on climate change and adaptation has been organized under the auspices of ECSN, the European Climate Support Network (a programme of the European Meteorological Network). The main themes and topics of the conference are:
Current Understanding of Climate:

- Climate change assessments - trends and variability
- Climate prediction and scenarios
- Climate -monitoring, -mapping and -data management
- Climate reconstructions
- Synoptic climatology

Adaptation to Climate

- Applications for decision support and spatial planning
- Urban environments, tourism, health, agriculture, energy, transport and safety and rescue
- Climate proofing of water systems
- Risk management for (re)insurance and financing
- Environment

A panel session will be dedicated to the communication on adaptation in Europe.
Abstracts may be submitted before 16 May to ems-sec@met.fuberlin.de.

Events

11-24 April 2008. Environmental (In)Justice: Sources, Symptoms, and Solutions EcoRes Forum Online E-Conference Series, http://www.eco-res.org

22 April 2008. Sustainability Symposium. **"The World's Future is Now!" Science and policy for sustainable development**. Maastricht University, Netherlands. Hosted by the International Centre for Integrated Assessment and Sustainable Development and Research School for Socio-Economic and Natural Sciences of the Environment (SENSE). More information: www.icis.unimaas.nl 3-6 June 2008. Chaotic Modeling and Simulation International Conference (CHAOS2008), Chania, Crete, Greece.
http://www.asmda.net/chaos2008/

26 -27 May 2008. The Reuse of Contaminated Sites in Sustainable Development Strategies. European Science Foundation Workshop. Venice, Italy.
http://www.esf.org/activities/exploratory-workshops.html

7-11 August 2008. The International Society for Ecological Economics (ISEE) Tenth Biennial Conference: "ISEE 2008 Nairobi: Applying Ecological Economics for Social and Environmental Sustainability" Nairobi, Kenya.
http://www.ecoeco.org/conference08/

1-5 Sept. 2008. Fifth Conference of the European Social Simulation Association. Brescia, Italy.
http://www.eco.unibs.it/essa/

Courses

Master of Science (1 yr) in Environmental Assessment at McGill University, Canada
http://www.mcgill.ca/nrs/graduate/environment/

15 - 16 May 2008. Honing your Facilitation Skills. Hosted by the NeWater Project. Montpellier, France.
http://www.newater.info/everyone/3219

16-20 June 2008. EPOS Summer School on Methods and Tools for Impact Assessment, Berlin. No fee.
Deadline for applications: April 30.
http://www.ecologic.eu/soef/epos /events.html

23 June - 1 July 2008. Euroloc Summer School in Local Government Studies. Ghent University, Belgium.
http:// www.eurolocsummerschool2008.ugent.be/

23 -27 June 2008. Summer course on River restoration: Fluvial-geomorphic & ecological processes. Provence, France.
www.institutbeaumont.com

09 - 19 July 2008. NeWater - GWSP Summer School 2008: "Managing Change: Tools and Methods for Adaptive River Basin Management" Königswinter, Germany.
http://www.newater.info/ everyone/3112

24-31 August 2008. PhD Summer School on Earth System Governance. Vrije Universiteit Amsterdam.
http://glogov.org/

3 - 7 November 2008. METIER Graduate Training Course: Remote Sensing and the Hydrosphere. Helsinki. Organized by the Finnish Environmental Institute. No course fee. Registration deadline: 15th June 2008
http://peer -initiative.org /html/obj357.html

Job openings

Assistant Professor in Development Studies and/or Globalization 0,8 fte, 32 hours per week, Centre for Development Studies (CDS), University of Groningen. Closing Date: 14 April 2008. www.rug.nl/cds

Faculty of Environmental, Regional and Educational Sciences at Karl-Franzens-University of Graz, has a vacancy for the position of Full Professor of Systems Sciences. Applications accepted until 21 April 2008. http://systems -sciences.uni -graz.at

Links

The Forum for Sustainable Development of German Business has published a web-based tools that allows users to generate climate maps according to individual preferences:
http://www.climate-policy-map.econsense.de/

GWSP's online Digital Water Atlas: http://atlas.gwsp.org

Tool for collecting, managing and citing research sources. Zotoro is a free, easy-to-use Firefox extension: http://www.zotero.org

Water Footprint Website
Water Footprint website www.waterfootprint.org
produced by the University of Twente and the UNESCO-IHE Institute for Water Education, in the Netherlands.

Integrated Approaches to Participatory Development: Collection of community mapping and participatory GIS multimedia.
http://www.iapad.org/multimedia.htm

Open Ocean: a suite of tools that enable the integrated ecological and socioeconomic assessment of fishery policy and marine conservation, and their effects on coastal communities - the Ocean Communities "3E" Analytical Network. The E stands for economy, ecology and equity, the balancing of which in a conservation economy captures Ecotrust's mission.
http://trac.infodrizzle.org/openocean/

New Publications

GAIA - Ecological Perspectives for Science and Society (transdisciplinary journal for scientists and other interested parties concerned with the causes and analysis of environmental and sustainability problems and their solutions)
www.oekom.de/etc/gaia.html

The new journal, Water Alternatives, will be published three times per year. The inaugural issue will be released on the June 1, 2008. Submissions are welcome:
http://www.water-alternatives.org/

Lahart, J., P. Barta and A. Batson. New Limits to Growth Revive Malthusian Fears: Spread of Prosperity Brings Supply Woes. Wall Street Journal. March 24, 2008. Page A1.
http://online.wsj.com/

Call for Submissions

TIAS Members are encouraged to submit feature articles and/or news items for future issues of TIAS Quarterly. Contact Caroline van Bers cvbers@usf.uos.de

The TIAS Quarterly

The *TIAS Quarterly* is the newsletter of The Integrated Assessment Society.
Editor: Claudia Pahl-Wostl
Associate editor: Caroline van Bers
Layout: Georg Johann

TIAS Membership information: www.tias-web. info/
€ 40/year (students € 10/year)