DMDU SOCIETY

The Society for Decision Making Under Deep Uncertainty

OUR MISSION

The Society for Decision Making Under Deep Uncertainty is a multi-disciplinary association of professionals working to improve processes, methods, and tools for decision making under deep uncertainty, facilitate their use in practice, and foster effective and responsible decision making in our rapidly changing world. While we share interests with other societies, ours is unique in its focus on developing, disseminating, and using these new approaches.

Welcome to the newsletter of
The Society for Decision Making Under Deep Uncertainty

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http://www.deepuncertainty.org/
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Greetings from your leadership team!

We are excited by the opportunity to serve our Society and advance its mission over the next two years. We are writing to share some of our plans and highlight opportunities for you to participate.

Our Society's vision calls on us to act as a *service organization* that grows and sustains a community for knowledge sharing, training, and collaboration for its members and as a *disseminating organization* that enables best practice for decision making and managing under deep uncertainty to become widely applied, understood, and continually improved.

We are building on an exciting 2018 for the Society. Last year's highlights include our annual meeting in Culver City, California; meet ups of society members at conferences including AGU in Washington DC, EGU in Vienna, IEMS in Fort Collins, and the Global Adaptation Forum in Cape Town; and a strategic planning process that helped refine the Society's goals and activities.

In the coming year, we look forward to the release this spring of the book Decision Making Under Deep Uncertainty: From Theory to Practice, an edited volume with contributions by many Society members; to more meet ups at conferences world-wide; and our annual meeting, which will be held this fall in Delft.

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In addition, we are launching two ad hoc committees on topics of particular interest to Society members. The *DMDU Checklist* committee will develop a set of guidelines that practitioners can use while scoping or undertaking a DMDU analysis to ensure it includes all the necessary elements. The *Digital Training* committee will assemble and develop digital training and educational content for those who cannot attend the Society's training days but would like an in-depth and remotely-accessible introduction to our methods.

The DMDU Society thrives with the active participation of its members. We encourage you to organize meet ups at conferences you are attending. Contact Sadie McEvoy, our membership chair (Sadie.McEvoy@deltares.nl), for help in doing so.

We also encourage you to volunteer for the Digital Training committee, or to assist one of our leadership team members in their portfolios. Pedro Lima, Communications and Outreach (pedrolima.n@gmail.com); Steven Popper, Education and Training (swpopper@rand.org); Julie Rozenberg, Career Development (jrozenberg@worldbank.org); and Sadie McEvoy, Membership (Sadie.McEvoy@deltares.nl), have particular interest in such volunteers.

Finally, we encourage you to share blog posts and/or papers on our website and to suggest content for our future Newsletters, including notices of upcoming events, special issue announcements, and job openings. Please send suggestions to website@deepuncertainty.org. Please send information on DMDU-related job openings and proposal opportunities to Julie Rozenberg, Career Development, at jrozenberg@worldbank.org.

We are looking forward to an exciting and productive 2019 for the DMDU Society.

Open access DMDU book released

The Open Access Book "**Decision Making Under Deep Uncertainty: From Theory to Practice**" has been released by Springer (Click here to download).

This open access book focuses on both the theory and practice associated with the tools and approaches for decision-making in the face of deep uncertainty. It explores approaches and tools supporting the design of strategic plans under deep uncertainty, and their testing in the real world, including barriers and enablers for their use in practice. The book broadens traditional approaches and tools to include the analysis of actors and networks related to the problem at hand. It also shows how lessons learned in the application process can be used to improve the approaches and tools used in the design process. The book offers guidance in identifying and applying appropriate approaches and tools to design plans, as well as advice on implementing these plans in the real world. For decisionmakers and practitioners, the book includes realistic examples and practical guidelines that should help them understand what decision-making under deep uncertainty is and how it may be of assistance to them.

Decision Making under Deep Uncertainty: From Theory to Practice is divided into four parts. Part I presents five approaches for designing strategic plans under deep uncertainty: Robust Decision Making, Dynamic Adaptive Planning, Dynamic Adaptive Policy Pathways, Info-Gap Decision Theory, and Engineering Options Analysis. Each approach is worked out in terms of its theoretical foundations, methodological steps to follow when using the approach, latest methodological insights, and challenges for improvement. In Part II, applications of each of these approaches are presented. Based on recent case studies, the practical implications of applying each approach are discussed in depth. Part III focuses on using the approaches and tools in real-world contexts, based on insights from real-world cases. Part
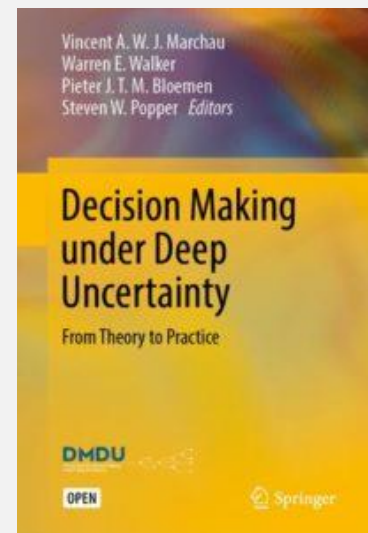
IV contains conclusions and a synthesis of the lessons that can be drawn for designing, applying, and implementing strategic plans under deep uncertainty, as well as recommendations for future work.

DMDU 2019 Annual Meeting: Securing Sustainable Futures

Designing, planning, and making decisions on policies, practices, and infrastructure under deep uncertainty

Save the Date: November 5-7, 2019

Website: http://www.deepuncertainty.org/annual-meetings/2019-annual-meeting/

Hosts: Delft University of Technology and Deltares

Address:
Delft University of Technology
Faculty of Technology, Policy and Management
Jaffalaan 5, Delft, the Netherlands

Humanity is striving for a better and more sustainable future for all. Initiatives like the United Nation's Sustainable Development Goals and the European Union's focus on societal challenges or disaster-resilient societies exemplify this.

Nevertheless there remains a gap between agreeing on objectives, and translating these objectives into action. Whether the focus is on alleviating poverty, reducing hunger, promoting peace and justice, ensuring socially inclusive economic development, mitigating climate change, adapting to a changing climate, or protecting and restoring ecosystems, in moving from objectives to actions, deep uncertainty is omnipresent. Investments and policy decisions in these and other fields often have significant and often long-term consequences. At the same time, the increasing number and severity of disruptions and their cascading effects related to climate change, societal fragmentation, and instability require near-term decisions and action(s) across all scales. Making sound and coordinated near-term decisions is critical, precisely *because* we live in an increasingly unpredictable dynamic world governed by competing and changing beliefs and preferences. This year's theme is 'Securing sustainable futures'.

Annual Meeting Call for Abstracts

A call for abstracts is now open. The abstract is limited to a maximum of 250 words. Abstracts may be submitted for Oral Presentations (10-15 minutes) or Poster Presentations.

Abstracts will be accepted until **15 June 2019**. We encourage submissions to one of the session topics available. In the submission form, please select only one topic that fits your work the best.

For more information, go to the event webpage:
http://www.deepuncertainty.org/annual-meetings/2019-annual-meeting/

Local organizing committee

Jan Kwakkel (Delft University of Technology)
Marjolijn Haasnoot (Deltares, Utrecht University)
Sadie McEvoy (Deltares, Delft University of Technology)

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Bramka Jafino (Delft University of Technology)
Vincent Marchau (Radboud University)

Scientific advisory committee

David Groves (RAND Corporation)
Judy Lawrence (Wellington University)
Julie Rozenberg (World Bank)
Robert Solly (Defence Science and Technology Laboratory)
Warren Walker (Delft University of Technology)
Pieter Bloemen (Delta Programme, IHE Delft)

Upcoming Events

IEEE International Workshop on Resilience Engineering (IWRE) – Call for Papers

https://paris.utdallas.edu/iwre19/

The workshop will be co-located with the 2019 IEEE International Conference on Software Quality, Reliability, and Security (https://qrs19.techconf.org/), in Sofia, Bulgaria, July 22-26, 2019. Resilience is rapidly spreading throughout domains traditionally studied by quality, reliability, and security researchers. It is widely recognized that progressively higher levels of resilience are needed to ensure complex systems and processes can provide continuity of operations and services. Examples include military vehicles, information systems, critical infrastructure, as well as supply chains and manufacturing processes. Many of these possess cyber and physical dimensions and are interconnected via networks or compose to form systems of systems.

Despite the strong interest in resilience by defense and security organizations, the concepts are also of interest to commercial systems and processes. Recognizing that there is no universal mathematical formulation or single process capable of encompassing all domains, the Resilience Engineering Workshop seeks to convene researchers from across the spectrum of systems and process domains, ranging from theoretical to applied research for a stimulating exchange. We invite the participation of experts to share their ideas and experience to identify universal themes as well as to help define differences across domains. In doing so, we seek to bring enhanced clarity to this promising but often incompletely understood attribute and to accelerate the maturation of resilience as a discipline so that principles and best practices can be effectively disseminated to and implemented by the engineering community.

Recent Events

The The DMDU community organized a DMDU Meetup at the Scenarios Forum, in Denver.

Interested in participating or organizing a meet up? Contact Sadie McEvoy, our Membership Chair (Sadie.McEvoy@deltares.nl)

Call for Volunteers

Call for Volunteers for the Communications & Outreach Team

The communications and outreach team is tasked with providing timely communications services for the DMDU Society. The team maintains the Society's website and social media accounts, sends out announcements, and manages specific projects as needed. Our next goals are to increase our reach through our website and other platforms as well as to build and maintain a dashboard that will allow the Society to track relevant indicators. We are looking for volunteers that would be interested in helping us with these goals and we welcome your ideas and initiatives as well. If you would like to help, please contact Pedro, our Communications Chair (pedronl@unisinos.br).

Job Opportunities

Most of Job Vacancies have short application deadlines, so please check our website's Jobs Section often and follow us on twitter to get timely updates!

Geospatial Programmer Position at the World Bank:
http://www.deepuncertainty.org/2019/03/28/geospatial-programmer-position-at-the-world-bank/

The World Bank Group's capacity to collect, manage, analyze and distribute geospatial data is coordinated by the Geospatial Operational Support Team (GOST). GOST is looking for a qualified candidate to join the team as a Geospatial Programmer. This role requires a person with a combination of skills in geography, GIS, Remote Sensing, and spatial thinking/analysis, all anchored in a strong background in python programming.

Researcher Position in Energy-Climate-Economic Modeling at CIRED:
http://www.deepuncertainty.org/2019/02/28/researcher-position-in-energy-climate-economic-modeling-at-cired/

CIRED is looking to recruit a talented and motivated researcher to join its integrated assessment modeling team. The successful candidate will contribute to the team's research on the energy-climate-economy interface and will be in particular involved in a European H2020 project, titled "NAVIGATE".

Recent Publications

These publications have been submitted to our website by their authors. To see your publication on our next issue, please submit them here.

Testing the potential of Multiobjective Evolutionary Algorithms (MOEAs) with Colorado water managers

Rebecca Smith, Joseph Kasprzyk, Lisa Dilling (2010) Testing the potential of Multiobjective Evolutionary Algorithms (MOEAs) with Colorado water managers, Environmental Modelling & Software, Volume 117, 2019, Pages 149-163, ISSN 1364-8152, https://doi.org/10.1016/j.envsoft.2019.03.011.

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Multiobjective Evolutionary Algorithms (MOEAs) generate quantitative information about performance relationships between a system's potentially conflicting objectives (termed tradeoffs). Research applications have suggested that evaluating tradeoffs can enhance long term water utility planning, but no studies have formally engaged with practitioners to assess their perceptions of tradeoffs generated by MOEAs. This article examines how practitioners interact with MOEA tradeoffs and reports their ideas for how their agencies could use MOEA results. We hosted a group of Colorado water managers at a charrette, or structured investigatory workshop, where they directly interacted with tradeoffs, discussed how they used the information, and linked their workshop experiences to opportunities for MOEAs to enhance their agencies' planning processes. Among other interesting results, we found that managers' portfolio preferences diverged as tradeoff information increased and that structured information about the relationships between decision levers and performance would be beneficial for interpreting tradeoffs.

Robust abatement pathways to tolerable climate futures require immediate global action

J. R. Lamontagne, P. M. Reed, G. Marangoni, K. Keller, and G. G. Garner (2019). Robust abatement pathways to tolerable climate futures require immediate global action. Nature Climate Change, page 1, March 2019. ISSN 1758-6798. doi: 10.1038/s41558-019-0426-8. URL https://www.nature.com/articles/s41558-019-0426-8.

Disentangling the relative importance of climate change abatement policies from the human–Earth system (HES) uncertainties that determine their performance is challenging because the two are inexorably linked, and the nature of this linkage is dynamic, interactive and metric specific. Here, we demonstrate an approach to quantify the individual and joint roles that diverse HES uncertainties and our choices in abatement policy play in determining future climate and economic conditions, as simulated by an improved version of the Dynamic Integrated model of Climate and the Economy. Despite wide-ranging HES uncertainties, the growth rate of global abatement (a societal choice) is the primary driver of long-term warming. It is not a question of whether we can limit warming but whether we choose to do so. Our results elucidate important long-term HES dynamics that are often masked by common time-aggregated metrics. Aggressive near-term abatement will be very costly and do little to impact near-term warming. Conversely, the warming that will be experienced by future generations will mostly be driven by earlier abatement actions. We quantify probabilistic abatement pathways to tolerable climate/economic outcomes , conditional on the climate sensitivity to the atmospheric CO_2 concentration. Even under optimistic assumptions about the climate sensitivity, pathways to a tolerable climate/economic future are rapidly narrowing.

Investments under non-stationarity: economic evaluation of adaptation pathways

Haasnoot, M., van Aalst, M., Rozenberg, J., Dominique, K., Matthews, J., Bouwer, L. M., … Poff, N. L. (2019). Investments under non-stationarity: economic evaluation of adaptation pathways. *Climatic Change.* https://doi.org/10.1007/s10584-019-02409-6

Investment decisions about capital-intensive, long-lived infrastructure are challenging due to uncertainty about their future performance, particularly if the performance is sensitive to climate change. Such investments, like those made for water infrastructure, are rarely evaluated over their total operational lifetime, during which socio-economic and environmental changes can cause potential lock-ins and reduced options for future choices that lead to high costs to transfer to other options. We propose an economic evaluation framework to explore adaptation pathways, or sequences of strategic investments options, that can be implemented if needed due to changing conditions. A novel feature is the inclusion of "transfer costs" associated with a switch to alternative pathways to allow adaptive decision-making and to minimize the cost of adjustment over time. Implementing a pathway-driven approach represents a

break with most institutional decision-making processes and can significantly improve decision-making under uncertainty compared to the conventional single-investment perspective. We present a case study on flood risk management in the Netherlands to show the long-term socio-economic consequences of short-term decisions by going beyond the project cycle horizon.

Dynamically optimizing the strategic plan of mining complexes under supply uncertainty

Del Castillo, M. F., & Dimitrakopoulos, R. (2019). Dynamically optimizing the strategic plan of mining complexes under supply uncertainty. *Resources Policy*, *60*, 83-93. https://www.sciencedirect.com/science/article/pii/S0301420718302307

Mining complexes are comprised of multiple mines and mineral processing streams, each governed by internal (mineral deposit, operation) and external (commodity prices) uncertainties, and must be optimized jointly to manage technical risk and maximize economic value. This study presents a method that optimizes annual production scheduling of an open pit mining complex by developing a solution that provides a unique strategic mine plan that integrates feasible alternatives over investment decisions along the life of the asset. Accordingly, the long-term optimization is presented as a dynamic plan, which allows planning up front for possible configuration transitions due to new capital investments, facilitating change. This method uses an adapted multistage stochastic programming model which expands upon the two-stage framework by performing multiple recourse stages that are solved iteratively, allowing feasible mine designs in a scenario-tree structure. In this model, dynamic investment decisions are made sequentially over the mine production schedule of related mines, based on new information that becomes available in each time period; these decision variables activate costs and effects over the model, letting the optimizer choose the capital investments to be considered at the mining and/or processing components of the mining complex. A copper open pit mining complex is used to test the proposed model, with options to invest in the truck and shovel fleet, and a secondary crusher to increase related capacities. Results show a substantial probability that the mine design should branch, presenting an increased expected net present value of over US$170M compared to the two-stage stochastic formulation.

Advancing disaster policies by integrating dynamic adaptive behaviour in risk assessments using an agent-based modelling approach

Haer,T. Botzen, W.J.W, Aerts, J.C.J.H. (2019) Advancing disaster policies by integrating dynamic adaptive behaviour in risk assessments using an agent-based modelling approach. Environmental Research Letters 14 044022 https://doi.org/10.1088/1748-9326/ab0770

Recent floods in the United States and Asia again highlighted their devastating effects, and without investments in adaptation, the future impact of floods will continue to increase. Key to making accurate flood-risk projections are assessments of how disaster-risk reduction (DRR) measures reduce risk and how much risk remains after adaptation. Current flood-risk-assessment models are ill-equipped to address this, as they assume a static adaptation path, implying that vulnerability will remain constant. We present a multi-disciplinary approach that integrates different types of adaptive behaviour of governments (proactive and reactive) and households (rational and boundedly rational) in a continental-scale risk-assessment framework for river flooding in the European Union. Our methodology demonstrates how flood risk and adaptation might develop, indicates how DRR policies can steer decisions towards optimal behaviour, and indicates how much residual risk remains that has to be covered by risk-transfer mechanisms. We find that the increase in flood risk due to climate change may be largely offset by adaptation decisions. Moreover, we illustrate that adaptation by households may be more influential for risk reduction than government protection in the short term. The results highlight the importance of

integrating behavioural methods from social sciences with quantitative models from the natural sciences, as advocated by both fields.

Thank you for reading the newsletter of the Society for Decision Making Under Deep Uncertainty!

The newsletter is brought to you by the Communication & Outreach Team:
Pedro Lima and James Derbyshire

You can contribute to this newsletter and to our website by suggesting content to
website@deepuncertainty.org