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# First EWG-BOR winter meeting @ Eawag 29./30. January 2018

## Résumé

The meeting started on Monday morning with the keynote from Detlof von Winterfeldt. He talked about *Biases in Judgment and Decision Making: History and Relevance for Prescriptive Analysis.* His impressive account of all the work that has been done over many decades is highly relevant for the new field of Behavioral OR. We also enjoyed the talk thanks to the many entertaining personal stories. Before the sandwich lunch and poster session, seven participants pitched their research in very short (4mins) presentations in the review session. This condensed format provided interesting insight into the respective research projects, which were then discussed in more detail over lunch. At lunch, intensive discussions took place and the beginnings of new research projects were marked.

In the afternoon, participants had the chance to observe the work of four facilitators. Each one of them tried to find structure the wastewater problem for the town of Cowvillage. Every facilitator worked with four stakeholders and used a certain method to get to the bottom of the problem.

- Alberto L. Franco and Ashley Carreras used *Cognitive Mapping.*
- Etienne Rouwette used *System dynamics / group model building.*
- Bertrand Mareschal used *PROMETHEE GAIA.*
- Gilberto Montibeller used *Value focused decision analysis.*

In a plenary discussion, the stakeholders, observers and facilitators themselves talked about their experiences in the workshops. Altogether the workshops were perceived as very diversified and interesting even though there was one big issue: the limited time.

For the dinner on Monday, the whole group transferred to Zurich, where a traditional Swiss Cheese Fondue was served.

Tuesday was filled with talks on *Behavioural Organisational Research / Methods* and *Environment & Practice Interventions*. Again, every opportunity and break was used for answering questions, discussion, and exchanging research ideas. Over lunch, the formal EWG-BOR board meeting also took place.

In the final plenary BOR business meeting, everyone reflected on the two days, including the feedback from a small online survey among the participants, and discussed the things that worked well vs the things that could be done better next time. Everyone liked that the meeting offered more than just talks. Since the time for the workshops was very short, it was proposed, that the facilitators would present a tutorial for their method as another approach to demonstrating the method. Also, participants wished to have more time for discussion about the methods. The review session with the very short 4 minute pitches with the posters met with the approval of the audience, who thought that the pitches provided a very good and entertaining overview. However, for the presenters themselves this format seems to be less attractive. One proposal was, that all participants should present their research in a three minutes pitch and then the audience would choose, which ones they want to hear in a long talk. Another idea was, to have conventional parallel sessions so that everyone could choose which talk one wants to attend to. So there is room for creative improvement of the format in the upcoming meetings. The fact that everyone was urged to strictly adhere to the schedule was very well received. Overall, the meeting was a success and everybody is looking forward to the next EWG-BOR event.

# Program

## Monday, 29. Jan. 2018

| Time | Topic | Room |
|---|---|---|
| **08.00 – 08.30** | **Registration / setting up posters**<br>Forum Chriesbach, Ueberlandstrasse 133, 8600 Dübendorf | Registration: in front of FC C20 / Posters: main hall |
| **08.30 – 08.45** | **Welcome, introduction** | FC C20 |
| **08.45 – 09.45** | **Keynote** | FC C20 |
| | **Detlof von Winterfeldt**; *Biases in judgment and decision making: History and relevance for prescriptive analysis,* Tiberti Chair for Ethics and Decision Making; Viterbi School of Engineering; Univ. of South. California, US | |
| **09.45 – 10.15** | **Coffee break** | in front of FC C20 |
| **10.15 – 11.15** | **Introduction to workshops and task**<br>Different problem structuring approaches applied to same decision problem. | FC C20 |
| **11.15 – 12.00** | **Session 2: review session (plenary);** 3 mins. review pitch (see page **Error! Bookmark not defined.**)<br>Session chair: Judit Lienert | FC C20 |
| **12.00 – 12.20** | **Group foto** | Staircase to main hall (level B) |
| **12.20 – 13.30** | **Sandwich lunch and poster session** | Main hall |
| **13.30 – 15.00** | **2 parallel workshops** (25 persons each; choose when registering):<br>**Bring your laptop for online feedback!** | |
| | **a) Cognitive mapping**<br>**Alberto L. Franco & Ashley Carreras**, Loughborough University, UK | FC C24 |
| | **b) System dynamics / group model building**<br>**Etienne Rouwette**, Radboud University, NL | FC D24 |
| **15.00 – 15.30** | **Coffee break** | in front of FC C20 |
| **15.30 – 17.00** | **2 parallel workshops** | |
| | **c) PROMETHEE-GAIA**<br>**Bertrand Mareschal**, Université Libre de Bruxelles, BE | FC C24 |
| | **d) Value focused decision analysis**<br>**Gilberto Montibeller**, Loughborough University, UK | FC D24 |
| **17.00 – 18.00** | **Plenary discussion, feedback; results online survey**<br>Moderator: **Raimo Hämälainen**, Loughborough University, UK | FC C20 |
| **19.30** | **Dinner** in Zürich: Cheese fondue at Le Dézaley, Römergasse 7+9, 8001 Zürich<br>https://www.le-dezaley.ch/en/ | |

## Tuesday, 30. Jan. 2018

| Time | Topic | Room |
|---|---|---|
| **08.30 – 09.50** | **Session 3 talks: BOR / Methods;** 4 talks à 20 mins (plenary)<br>Session chair: Raimo Hämäläinen | FC C20 |
| 08.30 – 08.50 | **Mousseau, V.; Pirlot, M.** *A new form of intransitivity of indifference: experimental evidence and formal analysis*. Université Paris Saclay, CentraleSupélec, LGI, Gif sur Yvette, FR | |
| 08.50 – 09.10 | **Siebert, J.; Kunz, R.** *What can you do to be more satisfied with your life? Answer: Be more proactive in your decision making!* Management Center Innsbruck, Innsbruck, AT; University of Bayreuth, Faculty of Law, Economics and Management, Bayreuth, DE | |
| 09.10 – 09.30 | **Engin, A.; Vetschera, R.** *Optimistic overconfidence in bidding behavior with differently represented cost feedback in electronic reverse auctions*. University of Vienna, Vienna, AT | |
| 09.30 – 09.50 | **Lahtinen, T. J.; Hämäläinen R. P.** *Behavioral effects in two procedures for creating a strategy portfolio for climate change mitigation*. Systems Analysis Laboratory, Aalto University, FI | |
| **09.50 – 10.20** | **Coffee break** | in front of FC C20 |
| **10.20 – 12.00** | **Session 4 talks: BOR / Methods;** 5 talks à 20 mins (plenary)<br>Session chair: Alice Aubert | FC C20 |
| 10.20 – 10.40 | **Krejčí, J.; Siebert, J.** *Debiasing belief perseverance in the context of fake news*. Department of Industrial Engineering, University of Trento, IT | |
| 10.40 – 11.00 | **Mustajoki, J.; Marttunen, M.; Rytkönen, A.-M.** *Risk attitudes and behavioral biases in operative regulation of water courses*. Freshwater Centre, Finnish Environment Institute, Helsinki, FI | |
| 11.00 – 11.20 | **Bertsch, V.; Harold, J.; Hyland, M.** *What drives people's opinions and preferences related to energy infrastructure developments? A multi-national analysis*. Economic and Social Research Institute and Trinity College Dublin, IE | |
| 11.20 – 11.40 | **Brison, V.; Pirlot, M.** *MCDA in environmental assessment contexts.* Université de Mons, Faculté Polytechnique, BE | |
| 11.40 – 12.00 | **Arvai, J.** *Decision support for sustainability: Research on the Why and the How*. Erb Institute for Global Sustainable Enterprise, School for Environment & Sustainability, and the Stephen M. Ross School of Business, University of Michigan, Ann Arbor, US | |
| **12.00 – 13.30** | **Lunch** | Main hall |
| 12.00 – 13.30 | EWG-BOR board meeting | Aqualino |

**13.30 – 14.50** **Session 5 talks: Environment & practice interventions** FC C20
4 talks à 20 mins (plenary); Session chair: Judit Lienert

13.30 – 13.50 **Spano, M.; Korzilius H.** *Strategic workforce planning: Implementing and operating System Dynamics models on an ongoing basis*. Radboud University, Nijmegen, NL

13.50 – 14.10 **White, L.; Kunc, M.; Malpass, J.; Burger, K.** *Introducing ORBIT: The Operational Research Behavioural Interventions Toolkit*, University of Warwick Business School, Coventry, UK

14.10 – 14.30 **Norese, M. F.** *How behavioural aspects can positively affect the actors of decision aid processes*. Department of Management and Production Engineering, Politecnico di Torino, IT

14.30 – 14.50 **Hujala, T.; Takala, T.; Hokajärvi, R.; Tikkanen, J.** *Facilitating collaborative problem scrutiny with varying working modes – building a decision-support model for multiobjective bioeconomy farms*. University of Eastern Finland, School of Forest Sciences, Joensuu, FI

14.50 – 15.20 **Coffee break** in front of FC C20

**15.20 – 16.00** **Plenary BOR business meeting**; FC C20
Perspectives & experiences on BOR;
General information upcoming events
Feedback on 1st meeting: what to keep / what to change?

# Abstracts

### Content

## Keynote

**Biases in judgment and decision making: History and relevance for prescriptive analysis.**

***Detlof von Winterfeldt***
*Tiberti Chair for Ethics and Decision Making; Viterbi School of Engineering; Univ. of South. California, US*

The first part of this presentation will introduce the history of research on biases in judgment and decision making (JDM) from the early 50s to the mid-seventies. The second part will describe the split between prescriptive and descriptive JDM research that started about 1970. The third part will address a core issue: Which of the numerous biases found in JDM are relevant to Decision and Risk Analysis (DRA) and Operations Research (OR) and which are not relevant? The presentation will conclude with an agenda for research to reduce biases in DRA and OR.

Prof. Dr. Detlof von Winterfeldt is renowned for his research and expertise in the foundation and practice of decision and risk analysis applied to the areas of technology development, environmental risks, natural hazards and terrorism. Detlof von Winterfeldt is the inaugural Tiberti Chair of Ethics and Decision Making and a Professor of Systems Engineering at the Daniel J. Epstein Department of Industrial and Systems Engineering in the Viterbi School of Engineering of the University of Southern California. He holds a joint appointment as Professor of Public Policy at the Price School of Public Policy at USC. In 2004 he co-founded the National Center for Risk and Economic Analysis of Terrorism Events (CREATE), the first universitybased center of excellence funded by the US Department of Homeland Security. Dr. von Winterfeldt received his Ph.D. in mathematical psychology from the University of Michigan.

# Session 3 Talks: BOR / Methods

### A new form of intransitivity of indifference: experimental evidence and formal analysis

***Vincent Mousseau*** *(presents paper)*
*Université Paris Saclay, CentraleSupélec, LGI, Gif sur Yvette, FR*

***Marc Pirlot***
*UMONS, MATHRO, Mons, BE*

Multicriteria conflict arises in pairwise comparisons, where each alternative outperforms the other one on some criterion, which imposes a trade-off. Comparing two alternatives can be difficult if their respective advantages are of high magnitude (the attribute spread is large). In this paper, we report experimental work aiming at investigating to which extent conflict in a comparison situation can lead decision makers to express incomplete preferences, that is, to refuse to compare the two alternatives, or to be unable to compare them with confidence.

We report on an experiment in which subjects expressed preferences on pairs of alternatives involving varying conflicts. Results show that depending on whether the participants are allowed to express incomplete preferences or not, attribute spread has a different effect: a large attribute spread increases the frequency of incomparability statements, when available, while it increases the use of indifference statements when only indifference and preference answers are permitted. These results lead us to derive some implications for preference elicitation methods involving comparison tasks.

Moreover, in this experiment, the observed result can be described as a new form of intransitivity of indifference. [Luce 56] introduced a model for intransitive indifference relations which gives an account for negligible differences (just-noticeable differences) in which a sequence of non-noticeable differences results in a noticeable difference, i.e a preference. In our case, a sequence of indifference statements (for a pair of alternatives with limited multicriteria conflict), yields a comparison involving a strong multicriteria conflict, and therefore an incomparability statement.

Experimental data shows intransitivity of the indifference relation: a1 I a2 I a3 I … I an does not imply a1 I an; in contrast, a1 is incomparable to an. Such incomparability can be analyzed as a double veto phenomenon. We aim at proposing a formal analysis which gives an account of this new form of intransitivity of indifference observed in the behavior of decision makers.

**References:**
Luce, Duncan (1956). Semiorders and a theory of utility discrimination, Econometrica, 24(2), 178-191.

### What can you do to be more satisfied with your life? Answer: Be more proactive in your decision making!

***Johannes Siebert*** *(presents paper),* ***Reinhard Kunz***
*Management Center Innsbruck, 6020 Innsbruck, AT*
*University of Bayreuth, Faculty of Law, Economics and Management, 95440 Bayreuth, DE*

With Proactive Decision-Making (PDM) Siebert and Kunz (2016) introduced a relevant concept to behavioral OR and decision analysis. PDM is measured on a multidimensional scale. Two categories, proactive personality traits and proactive cognitive skills, comprise six dimensions. Personality traits are grounded on constructs such as proactive attitude and proactive behavior. Cognitive skills are theoretically grounded in value-focused thinking and decision quality. They can be used to explain decision satisfaction. Antecedents and other consequences are yet to be confirmed.

In this paper, we apply a structural equations model to analyze potential antecedents and consequences. We show in our first study that PDM can explain up to 36% of life satisfaction, i.e. proactive decision makers are more satisfied with their decisions and with their lives. Therefore, it is desirable to help individuals to enhance proactivity in their decision-making. We analyze the impact of a decision-making training on the PDM of its participants. In our second study 581 decision makers and/or decision analysts with different levels of professional experience participated. Data was collected before and after an online course.

In line with our hypotheses, the four proactive cognitive skills ‘systematic identification of objectives’, ‘systematic search for information’, ‘systematic identification of alternatives’, and ‘using a decision radar’ improved significantly, whereas the two proactive personality traits ‘showing initiative’ and ‘striving for improvement’ remained stable. In addition, after the training the participants were significantly more satisfied with their decisions. As an implication, we recommend schools, colleges, and universities to include decision-making courses in their curricula and individuals to participate in these courses to increase satisfaction with their decisions and lives.

**Keywords**: Proactive Decision-Making, Decision Satisfaction, Life Satisfaction, Learning Decision Analysis, Behavioral OR

**References:**
Siebert, Johannes; Kunz, Reinhard (2016). Developing and Validating the Multidimensional Proactive Decision-Making Scale. Special Issue „Behavioral Operations Research“ in European Journal of Operational Research, 249(3), 864-877. http://dx.doi.org/10.1016/j.ejor.2015.06.066

### Optimistic overconfidence in bidding behavior with differently represented cost feedback in electronic reverse auctions

***Ayşegül Engin*** *(presents paper),* ***Rudolf Vetschera***
*University of Vienna*

This paper concentrates on how individuals' bidding behaviors are influenced by feedback they receive from the auction platform under different forms of information representation. We assume that decision makers perceive the information they receive from an auction platform as stochastic, since they have only incomplete information about other bidders. Facing such uncertainties may lead to various decision biases, in this paper, we in particular consider optimistic overconfidence, which is defined as individuals' overestimation of the likelihood for occurrence of a favorable outcome. In an auction context, optimistic overconfidence may lead to overestimating the probability of winning an auction, and thus to more aggressive bidding behavior (i.e. more severe deviation form one's true costs) than what can be explained from other factors such as risk attitude and probability weighting effects.

We furthermore study how different forms of information presentation, and bidders' cognitive characteristics, influence the occurrence of such biases. We conduct an experiment in full factorial design with explicit stochastic information feedback with 2 different representation forms. We argue that if the individuals are presented with a fitting information representation format in accordance to their characteristics, processing the presented information will be easier, leading to less bias.

**Keywords:** Behavioral Operations Research, Overconfidence, Information Representation, Experiment, Auctions

### Behavioral effects in two procedures for creating a strategy portfolio for climate change mitigation

***Tuomas J. Lahtinen*** *(presents paper),* ***Raimo P. Hämäläinen***
*Systems Analysis Laboratory, Aalto University, FI*

In environmental problems we often need to find a set of actions, i.e. a portfolio, in order to meet the diverse goals of the stakeholders in an acceptable way. In practice, it is common that the portfolios are generated in a step-by-step manner without using modeling support. Such processes can lead to sub-optimal results and path dependence can easily emerge (Lahtinen et al. 2017). The outcome of the process can depend on the order in which different actions are considered and added into the portfolio. The drivers of this phenomenon can be, e.g. biases and cognitive limitations (Fasolo et al. 2011). It can be very challenging for the experts to evaluate how each action contributes to the overall effect when there already is a set of other actions whose effects can be interdependent. This can lead, e.g. to double counting of the benefits, or to not seeing that different actions can complement each other. Behavioral research on environmental portfolio problems is important as there can be unanticipated risks related to the systemic nature of the problems.

In the workshop, we use an interactive decision tool to study behavioral effects in a portfolio generation task related to climate change mitigation. The case is based on the Climate wedges game originally

developed in the Princeton University (Hotinski 2015). In our experiment, the subjects follow two procedures in creating their preferred portfolio of emission reduction strategies. In one procedure, the subjects initially have an empty basket and they need to add strategies into it. In another procedure, the subjects initially have all candidate strategies in their basket and they need to remove strategies from it. We analyze the subjects' behavior along the procedures followed.

**Keywords**: Behavioural OR, Environment, Portfolio Decision Making, Climate Change Mitigation, Biases

**References:**

Lahtinen, T.J.; Hämäläinen, R.P.; Liesiö, J. (2017). Portfolio Decision Analysis Methods in Environmental Decision Making. Environmental Modelling and Software, 94, 73-86.

Hotinski, R. (2015). Stabilization Wedges: A Concept & Game. Carbon Mitigation Initiative, Princeton University. https://cmi.princeton.edu/wedges/pdfs/teachers_guide.pdf

Fasolo, B.; Morton, A.; von Winterfeldt, D. (2011). Behavioural issues in portfolio decision analysis. In: Salo, A., Keisler, J.M., Morton, A. (Eds.), Portfolio Decision Analysis. Springer, 149-165.

# Session 4 Talks: BOR / Methods

### Debiasing belief perseverance in the context of fake news

***Jana Krejčí*** *(presents paper)*
*Department of Industrial Engineering, University of Trento, IT*

***Johannes Siebert***
*Business & Management, MCI Management Center Innsbruck, AT*

The fundamental objective of this project is to reduce the negative impact of fake news (false news stories packaged and published as if they were genuine) on the real world. During the 2016 US presidential election campaign, fake news became a global phenomenon, in particular due to the growing use of social media as a source for news. The proliferation of fake news online has been of increased concern to the European Parliament since. Yet, no agreement on how to tackle this issue has been reached. The tremendous impact of fake news on individuals' decision making is due to the belief-perseverance bias that is responsible for sustainable perseverance of fake news in individuals' minds. Thus, the central research question is: How to debias the belief-perseverance bias in the context of fake news? The belief-perseverance bias belongs to the group of motivational biases, which are difficult to correct. Although it was suggested already in early publications that effective debiasing methods should include a combination of various debiasing techniques, scholars have rather focused on isolated debiasing techniques. Moreover, the already limited experimental empirical research on debiasing motivational biases has focused primarily on investigating efficacy of single debiasing methods, without comparing efficacy of different debiasing methods and without studying their efficiency. Due to missing experimentally-driven comparisons of debiasing methods within one experiment, there are only limited implications for practical applications in terms of which debiasing method to use in order to achieve the best debiasing effect. We will fill in this research gap and contribute to the advancement in the research field by: (i) improving the existing debiasing methods and developing new ones; (ii) combining various debiasing methods; (iii) comparing efficacy of various debiasing methods and their combinations; and (iv) measuring and comparing efficiency of various debiasing methods and their combinations. Efficacy and efficiency of the debiasing methods will be tested in two questionnaire-based experiments in order to derive recommendations.

**Keywords**: Belief Perseverance Bias, Debiasing Methods, Fake News, Questionnaire-based Experiments

### Risk attitudes and behavioral biases in operative regulation of water courses

***Jyri Mustajoki*** *(presents paper)****, Mika Marttunen, Anne-Mari Rytkönen***
*Freshwater Centre, Finnish Environment Institute, P.O.Box 140, 00251 Helsinki, FI*

We interviewed 19 water course operators with an aim to study how the risk attitudes and behavioral biases can affect the operative decision making in water course regulation. Another aim was to increase the awareness of the biases and consequently to create conditions to improve the quality of decision making. More than half of the interviewees thought that personal risk attitudes have an effect on the decisions, as there are various ways to interpret the instructions and as the interests of various user groups in the river basin can be emphasised differently. The majority of the interviewees considered themselves to be rather risk neutral than risk averse in their decision making. However, it is not always clear what actually is the risk in water course regulation, as strict avoidance of a certain risk, e.g. flood risk, can lead to other kinds of risks, e.g. degradation of living conditions of fish. We also presented a list of 11 common behavioral biases for the interviewees, and asked them to identify which of these can be possible in their decision making. The most commonly identified biases were the availability heuristics, technology bias and group thinking. All the listed biases were considered possible by at least some of the interviewees. We also analysed possible means to avoid various biases; the identification of the potential biases itself is a leap towards avoiding them.

**Keywords**: Behavioral Biases, Risk Attitudes, Watershed Regulation, Environmental Decision Making

**What drives people's opinions and preferences related to energy infrastructure developments? A multi-national analysis**

***Valentin Bertsch*** *(presents paper)****, Jason Harold, Marie Hyland***
*Economic and Social Research Institute and Trinity College Dublin, IE*

Greenhouse gas emissions need to be reduced globally to combat climate change. The decarbonisation of the energy system is an important prerequisite in this context, which the EU plans to achieve by increasing energy efficiency and expanding renewable energy sources (RES). This involves significant investments in energy infrastructure. However, while citizens generally express acceptance of these investments on an abstract level, policy makers and planners are frequently met with resistance from local communities to specific energy infrastructure development proposals. Some authors argue that this local resistance can be explained by "NIMBYism" suggesting that people support such developments in general but object to these for selfish reasons when the planned developments affect their vicinity. However, the NIMBY ("not in my backyard") explanation is widely acknowledged as too simplistic. It is therefore crucial to understand what really drives people's preferences to effectively communicate with those who will be affected by infrastructure developments.

This study presents and analyses data from an unprecedented survey based on nationally representative samples of the population in Germany, Ireland and the US involving more than 4000 participants in total. The survey aims at understanding the drivers that shape people's preferences in relation to different energy infrastructure technologies, particularly focussing on the spatial proximity between infrastructure developments and people's homes. Researchers have been studying people's behaviour and attitudes in relation to energy technologies and the use of natural resources and the environment, and what influences these, for many years. Building on environmental psychological theory, we distinguish between external (demographic, economic, structural) and internal (attitudes, beliefs) factors driving people's attitudes. To elicit the required information, this multi-method study combines survey design with methods from multi-criteria decision analysis. Subsequently, the results are evaluated using econometrics. We find that, in general, German and Irish citizens are willing to accept energy infrastructure at smaller distances to their homes than their US counterparts. Moreover, attitudinal factors shape people's preferences more consistently than any socio-demographic aspects. The study summarises literature from environmental psychology before presenting the data and selected results of the survey. Subsequently, policy implications as well as implications for future research are discussed.

**Keywords**: Energy Infrastructure, Land Use Planning, Multi-criteria Decision Analysis, Environmental Psychology, Empirical Analysis

**MCDA in environmental assessment contexts**

***Valérie Brison*** *(presents paper)****, Marc Pirlot***
*Université de Mons, Faculté Polytechnique, BE*

Multi-criteria decision aiding can be useful in environmental studies aiming to support decision making on environmental policies. For example, the ESNET (Ecosystemic Services NETworks) project aims at analyzing different scenarios of land-use in the horizon 2040 and their impacts on ecosystemic services (i.e., services provided by Nature). In this project, we have maps that represent the evaluation of the pixels on the considered services. Several types of multidimensional and spatial information need to be aggregated. First, the pixels evaluations have to be aggregated to produce assessments at the commune level. Then, services need to be combined into packages in a way that depends on the type of area considered (rural, forest or peri-urban area). This is done using several rules given by experts to assign the communes of the region under study to a category representing the quality of the package of ecosystemic services. Finally, maps representing the state of the region under different scenarios have to be compared. We shall present various multi-criteria models that were developed for helping to structure and solve such problems. The conditions of applicability of such models have been studied in a formal way (including axiomatics).

**Keywords**: Spatial Decision Aiding, Comparison of Maps, Preferences

**Decision support for sustainability: Research on the Why and the How**

***Joe Arvai*** *(presents paper)*
*Erb Institute for Global Sustainable Enterprise, School for Environment & Sustainability, and the Stephen M. Ross School of Business, University of Michigan, Ann Arbor, US*

We have witnessed, over the last decade, an explosion of interest in the science of judgment and decision-making. For example, bestsellers like *Predictably Irrational* and *Thinking, Fast and Slow* have provided engaging summaries of research focused on how people make choices. But, by and large, insights from this research about how to improve the quality of important personal and policy choices have struggled to keep pace with society's needs. This is especially the case when we think about complex sustainability challenges – and opportunities – that cry out for active (vs. passive) decision support. The good news is, emerging research on applied decision-making points to some promising paths forward. In this presentation, I will discuss experimental work from my group – focusing on both familiar and unfamiliar choices – that focuses on *why* active decision support is necessary. This will be followed by a discussion of follow-on experimental and applied work aimed at the *how*: operationalizing active and accessible decision support for pressing sustainability challenges.

# Session 5 Talks: Environment & practice interventions

### Strategic workforce planning: Implementing and operating System Dynamics models on an ongoing basis

***Miriam Spano*** *(presents paper)****, Hubert Korzilius***
*Radboud University, Nijmegen, NL*

*Introduction*: Demographic change is a megatrend that affects businesses in terms of workforce aging and talent scarcity. Strategic workforce planning (SWP) is hailed as the necessary process to assess and address workforce-related risks. Such planning requires a dynamic approach due to the lagging nature of human resource management in contrast to the fast-paced business environment. Given its suitability to address complex issues System dynamics (SD) is appropriate to facilitate such complex planning. However, it is unknown what the impact is of using SD models on ongoing operations in companies and on relating activities.

*Purpose*: This study explored how three German companies implemented and operate SD models on an ongoing basis as integrated SWP tools and whether there are any impacting factors that need to be considered when doing so. While previous papers have highlighted the usefulness of SD for strategic management, researchers have voiced doubt whether sustainable implementation of such methodology is attainable.

*Design & methodology & approach*: Partnering with a consultancy firm in the field, a qualitative multi-case study was conducted to explore the experience of three German companies of implementing and operating SD models on an ongoing basis in the context of SWP. The main data collection method was qualitative interviews.

*Findings*: The main finding is that SD models are indeed successfully implemented in organisations for ongoing use. However, there are many factors that influence the success of such an undertaking. Neither the knowledge of the methodology nor participation in the modelling workshops appeared to be crucial elements but rather the importance of the context in which modelling projects take place.

*Practical Implications*: Practitioners need to consider their choices of language, software and consulting approach and are likely to engage in a long-term relationship rather than single project based to enable a sustainable model use.

*Originality/value*: To the authors' knowledge, this study is the first to document the use of simulation models in routine operation in the context of strategic workforce planning. A preliminary process map is introduced and forms the basis for future research and practical recommendations.

**Keywords**: Implementation, Ongoing Use, System Dynamics, Strategic Workforce Planning, Demographic Change

### Introducing ORBIT: The Operational Research Behavioural Interventions Toolkit

***Leroy White*** *(presents paper)*
*University of Warwick Business School, Coventry, UK*

***Martin Kunc***

***Jonathan Malpass***

***Katharina Burger*** *(presents paper)*
*University of Portsmouth, UK*

The OR field has a long-standing interest in interventions in organisations. However, only recently, has the field focused on the processes related to changes in human behaviour as an intervention progresses. The need for guidance in the application of insights from behavioural sciences in the design, implementation and evaluation of OR interventions is particularly pressing in the context of organisational transformation projects. As a contribution to addressing some of the challenges, we are developing the Operational Research Behavioural Interventions Toolkit (ORBIT), that supports practitioners in understanding the links between different behavioural OR insights, and what and when particular insights are best suited to improve the implementation of a transformation project. As a first step, we are collecting stories,

experiences and insights from OR practitioners and those doing OR by a different name, to surface the ways in which behavioural aspects of transformation project interventions are competently addressed. Second, we seek to understand attitudes, beliefs and knowledge of practitioners who are designing behavioural interventions, so that the conditions of possibility for impact in organisations are identified. Finally, we aim to provide a digital hub, serving as a collaboration space for the exchange of evidence-based enhancements to behavioural OR interventions. Our presentation will focus on the findings thus far. In particular, we will present an outline of the ORBIT toolkit. The focus will be on its design to provide a shared way of thinking about the behavioural interventions during transformation challenges in organisations. In sum, the toolkit is intended to serve as a starting point for collaborative empirical research towards an open-source platform for OR interventions, that practitioners can draw on to identify the improvements they need to make to better implement changes arising in their transformation projects.

**How behavioural aspects can positively affect the actors of decision aid processes**

***Maria Franca Norese*** *(presents paper)*
*Department of Management and Production Engineering, Politecnico di Torino, IT*

Problem situations require different approaches, in relation to the complexity of both decision problem and system. Information acquisition and processing, and revisions in problem structuring, operational context definition and model development generally cause delays and a difficult course of action, mainly in terms of recurring cycles and duration.

Some interventions of multi-criteria decision aid have been studied some years ago and some contexts of action, activities and factors, which have an important impact on the processes, have been identified and analysed. They can be seen as paths of the facilitator in interaction with the decision system and process. Then several direct experiences of decision aiding were analysed in relation to the relationships between decisional and operational ambits and produced skills and methodological results.

When they were proposed in laboratories to students of degree and master courses, it was evident that the transfer of this kind of knowledge is difficult. The large number of students (more than 3500 over the sixteen years) and the learning processes that were developed in always more structured laboratories (the first oriented only to the use of some multi-criteria and problem structuring methods, later on also to activities of problem formulation, model structuring and result analysis, to improve problem and model structuring) allowed me to better understand which are the main difficulties for an inexpert practitioner. A model-based process (MBP) approach was used in these laboratories and in some master theses, in relation to actual problems, and now the students arrive at a good understanding of some methods and their use, develop models for not so clear decision situations, criticize their models when they produce strange or unacceptable results and (at least the doctoral students in their laboratories and the students in their theses) learn how to consistently improve models and results.

The identified elements that characterize an intervention of decision aid in practice will be described, together with the actions that implement an MBP approach and underline how only a consistent logical approach in all the phases of the decision aid process can guarantee robustness of the conclusions of an intervention.

**Keywords**: The Practice of OR, OR Intervention, Decision Aid Process, Decision Aid Typologies

**Facilitating collaborative problem scrutiny with varying working modes – building a decision-support model for multiobjective bioeconomy farms**

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Low-carbon, resource-efficient, and biodiversity-friendly are characterizing features of bio-based economy, which is actively pursued in various European countries by means of national bioeconomy strategies, regional and rural development programmes, and business incubation efforts. As a part of this stream, a project was conducted in the Oulu region of northern Finland, aiming at an all-inclusive decision-support and planning model for multiobjective bioeconomy farms. The principles, main components, and activities of the model were collaboratively constructed together with main stakeholders representing economic agricultural research and accounting, entrepreneurship, forest and farm-business planning and consultancy. The process included a literature review by scientists, current situation analysis by practical agriculture and forestry advising organizations, and two facilitated workshops, in which the background information was first used for problem structuring, followed by a systematic generation of ideas and their refinement. The workshops pursued collaborative atmosphere and participants' sense of ownership via a sequence of action-oriented phases that utilized varying learning and communication styles and employed carefully chosen soft-OR methods. The core of the first workshop employed 635-brainwriting, which allowed the participants to generate many action ideas in a short time. Those ideas were, based on the preceding problem structuring phase, located under three main themes, namely customer benefit, multiobjectivity of the bioeconomy, and orchestration of the whole. Furthermore, the participants indicated associative links between the ideas and clustered them in the subsequent discussion phase. This type of data allowed drawing and analysing a concept map (with Decision Explorer) containing relationship information from the participants. The second workshop, in turn, continued from the earlier intermediate results with a thematic gallery walk and approached the practical implementation of the model via approval voting of action candidates, followed by "a framed open space" exercise, i.e. participants' joint contemplation guided with action-oriented specific questions. Final structure to the workshop outputs was achieved through participatory assessment i.e. assigning points for the most promising actions. Participants' feedback indicated success in offering varying working modes, thus maintaining interest and activeness. The interplay between individual and collective thinking as well as strict and open instructions appears as a plausible intervention strategy for collaborative modelling.

**Keywords**: 635-brainwriting, Bioeconomy, Concept Map, Facilitated Modelling, Open Space

# Review pitch presentations & poster

### Experimental use of Strategic Choice Approach (SCA) by individuals as an architectural design tool.

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The paper proposes the use of the Strategic Choice Approach as a way of structuring the architectural design process, done by individuals and partly supported by meetings and interviews with DMs, experts, and stakeholders. The aim is to stimulate a debate around the use of SCA and its possible merging with architectural design, also analysing how the micro-processes involved in this merging can work in practice. We reflect on the possible use of SCA to determine prescriptive conditions on physical form at a scale that is still intermediate between the single building and the urban tissue: the method is employed as a design tool to provide alternative transformation scenarios. It represents a way of approaching the challenge of planning in an uncertain world, eliciting guidelines and strategies, and furthermore it produces an architectural project or transformation in a physical sense. Moreover, by investigating what occurs during the different micro-processes with the interviewees, we focus on some behavioural issues and effects, in relation to the context, the models of the application and the different entities involved in the interventions. This proposal shows an application to a real-world problem, currently under debate by the City of Turin (Italy), the re-use of abandoned barracks located in a prestigious residential area.

**Keywords**: Strategic Choice Approach, Architectural Design, Decision Processes

### Asymmetry bias in Multi-Criteria Decision Analysis

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A meta-analysis of 61 environmental and energy applications showed that prior laboratory research findings regarding procedural and behavioural biases in MCDA are also applicable in real-world applications. In this presentation, we present the results of the analyses investigating how the hierarchy structure affects the weights of the lowest level objectives. We found that the mean global weight in the smallest hierarchy branch was higher than in the largest hierarchy branch. We also found that the lowest-level objective having the highest weight located most often in the smallest hierarchy branch. These findings may suggest that hierarchical weighting is prone to a bias which we call the asymmetry bias. It has similarities with the splitting bias but has an opposite effect on the weights. The asymmetry bias occurs only in hierarchical weighting, whereas the splitting bias can occur both in hierarchical and non-hierarchical weighting. This phenomenon has received little attention in the MCDA literature. We also report our experiences from a recent MCDA case carried out by a decision analyst not being aware of the meta-analysis; its findings also support the existence of the asymmetry bias.

**Keywords**. Behavioral Biases, Objectives Hierarchy, Meta-Analysis, Environmental Decision Making

**The lead time syndrome: The coordination behavior of human planners in multi-period production planning**

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Production planning and control (PPC) systems are designed to efficiently manage the flow of materials and goods and the utilization of people, equipment and capacity. In order to handle the complexity of manufacturing firms, it is advantageous to decompose the management task into partial parts (top- and base planning level) coordinated by a hierarchical structure. Planning levels are interrelated by instructions (e.g., order release decision of upper/centralized planning level) and feedback. This basic structure is fundamental for PPC systems and without the management of lead times (determining an appropriate planning value for lead times hereinafter denoted as planned lead time) the hierarchical coordination is undermined.

In most lead time management approaches planned lead time is assumed to be an exogenous variable and thus approach the problem of setting planned lead times as a forecast problem that - under certain circumstances - may cause the lead time syndrome. The lead time syndrome is a positive feedback loop where the flow times increase the lead times (via lead time updating) and the lead times in turn increase the actual flow times (via the order releases and the resulting inventory levels at the work centers). The majority of previous research on the lead time syndrome has been focusing on descriptive or quantitative analysis, without explicitly considering the human behavior influencing the occurrence of the lead time syndrome. In contrast, we isolate the cause-and-effect relationship between the coordination behavior of human planners and the lead time syndrome. Therefore, we conduct a laboratory experiment to simulate a within-firm coordination of a hierarchical production planning situation. In this multi-period planning environment, participants place production orders in isolated groups of three. There exists no information exchange within or between groups. Periodically, the participants receive lead time information as feedback from a one-staged production system with limited capacity. Our major goal is to analyze whether human planners coordination behavior, induced by limited production capacity, causes the lead time syndrome.

**Keywords**: Lead Time Syndrome, Hierarchical Production Planning and Control, Coordination Behavior, Feedback Information

**The many (inter)faces of preference elicitation: building adaptable interactive applications**

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Eliciting preferences as inputs to decision models has been a permanent concern of decision analysts. The elicitation problem has three dimensions: which type of information to ask for, how to ask for it, and which questions to ask. Especially the second dimension on how to elicit this information from decision-makers remains elusive, despite numerous elicitation approaches which have been proposed. This process is necessarily interactive and has been shown to be subject to different biases, as it is about translating or reconstructing elements of a decision-makers' mental model to a decision model. Numerous elements can be varied by the analyst in this elicitation process. We may vary what information is provided and in which form (visual, numbers, text, physical objects), in what form the elicitation takes place (with a facilitator or

unaided), what type of feedback is provided and how, what the type of task is (choosing, ordering, matching, rating), and others more. A reductionist, experimental approach to elucidate these factors in order to design better elicitation processes requires a setup where we can control these variables. We present a software framework development for building adaptable and interactive preference elicitation tools. It is itself based on the web-application framework shiny for the statistical programming language R, which allows building graphical user interfaces while leveraging the statistical capabilities of R. With this framework we can design various interfaces for preference elicitation, varying the aforementioned factors. This makes it an ideal base for experimental investigation. As we have the possibility for inferring decision models in the background during the elicitation, the framework is also of interest for adaptive elicitation, where the questions which are asked depend on previous answers. We have implemented an interactive tool for the elicitation of trade-off preferences in which we can vary the type of task (choice and matching), the information provided to the user, and the visualization and feedback to the user. We illustrate this approach by applications in computer aided personal interviews for quantifying preference models for an assessment of the ecological state of rivers and wastewater infrastructure planning.

**Recommender systems in which preferences are explicitly modeled**

***Souhir Bensouissi, Marc Pirlot*** *(presents paper)*
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We address situations in which the decision maker has to select alternatives that fulfil a need and are well-adapted to a given subject. In such a context, an alternative is not good or bad in itself; it may be good for some subjects and bad for others. Aiding physicians to select an appropriate antibiotic for a patient is an example of such a decision process in a medical context.

In the absence of sufficient case bases, an explicit model for assessing the suitability of a solution for a subject has to be designed. It cannot be learned as it is in classical recommender systems (e.g. for personalizing replies to queries in search engines or recommending products to customers on a website). This implies that field knowledge has to be structured and mobilized to feed the model.

We have developed a general architecture of a system that aims to provide recommendations tailored to the characteristics of the subject. The heart of the system combines a multiple criteria assessment model (to be chosen adequately) and ontologies encoding the knowledge relative to the subject characteristics, the alternatives properties and the subject's needs.

This system has been instantiated in the case of antibiotics prescription. The need is to kill the germs that cause the patient's infection. This has to be done taking into account the patient's allergies and other characteristics as well as the medical policies aiming to avoid developing germs resistance to antibiotics. This work has been performed in close cooperation with the infectiologists of the EpiCURA hospital center (BE).

It will be advocated that such an approach is useful also in environmental decision problems, in which solutions have to be implemented in specific contexts. Some solutions may be suitable in some cases and not in others depending on the physical, societal and environmental context.

**Modelling the planning of sustainable urban stormwater infrastructure – influencing greenfield outcomes through stakeholder preferences**

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Water Sensitive Urban Design (WSUD) stormwater systems have gained increased attention in recent decades. Yet, their planning and design remains opportunistic despite the multiple benefits they can contribute to water quality improvement, ecological health and urban amenity if they are considered, strategically, as part of the master planning process. Existing modelling tools for WSUD are limited in their capability to simultaneously consider the planning and engineering design aspects of these decentralised systems.

We developed the Urban Biophysical Environments and Technologies Simulator (UrbanBEATS), an integrated model to support the development of WSUD solutions for urban catchments. This spatial tool considers the biophysical constraints, statutory requirements and stakeholder preferences for different WSUD stormwater technologies in generating feasible infrastructure layouts for a range of water management objectives. Starting with input maps of land use, population, local soil and elevation, the model uses urban planning parameters and user-defined water management scenarios to generate a range of WSUD layouts. These various solutions are location-specific and comprise combinations of lot-, street- and large-scale infrastructures and six possible technologies including bioretention systems, wetlands, ponds, swales, infiltration and storage tanks. To select suitable solutions, the model scores and ranks each WSUD layout, a process, which is guided not only by water management objectives defined strictly by targets and a serviceable area of the catchment but also by stakeholder preferences for the available technology types, which are elicited in a workshop setting.

In this study, we set up and calibrate the UrbanBEATS model for a 24km2 greenfield development in Melbourne's western growth corridor. Using data from the development's master plan and outcomes of a stakeholder workshop, we train the model to develop infrastructure layouts similar to the proposed solution for the development, which was designed by a reputable WSUD engineering company. Results demonstrate how stakeholder preferences influence the model's infrastructure options and how the variation of these enables users to explore how differences in stakeholder opinions may affect resulting infrastructure outcomes. The modelling approach and environment enables a collaborative approach to WSUD planning and allows stakeholders to rigorously test new ideas and explore robust solutions to sustainable stormwater management.

**Keywords**: Integrated Modelling, Water Sensitive Urban Design (WSUD), Model Sensitivity, Urban Planning, Planning-support System

**Gamified preference elicitation surveys: learning to construct preferences**

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Recently, there is a strong call for public participation in environmental modelling to support decision-making. We transfer this call to environmental Multi-Criteria Decision Analysis (MCDA), applying it to urban wastewater management (UWM) decision-making. UWM relies on public investments; thus decision-making requires transparency. Moreover, alternative UWM options induce changes in the daily life of end-users. To facilitate a smooth transition from the centralized to alternative UWM systems, we need to know the preferences of stakeholders and ideally of end-users.

Environmental MCDA is so far mostly applied in a deliberative democracy framework (with selected stakeholders). We suggest using it in a participatory democracy framework (involving citizens as well). Our research question focuses on how to elicit reliable preferences from citizens in large numbers? Gamification and serious games are nowadays pervasive. They allow communicating about and with a (simplified) model of the decision issue. They are said to enhance participation, motivation and learning, by triggering the same psychological factors as those needed for mindful decision-making. However, scientifically rigorous evaluations of their actual benefits and possible drawbacks are scarce.

To collect preferences from citizens, we propose a gamified MCDA online survey for preference elicitation. It includes game elements (win-fail situations and related feedbacks, a narrative with non-player characters) to compensate for the absence of the decision analyst. A control version of the survey (without game elements) allows for rigorous evaluation.

The preliminary results of the prototype testing with students are encouraging. Participants learn about UWM thanks to the survey, and the survey facilitates preference construction. The qualitative feedbacks on the gamified version are also positive.