



**May 7/8, 2026**  
**Complexity Science Hub**  
**Metternichgasse 8, 1030 Vienna**

## **Workshop**

**RESILIENCE across socio-metabolic, network and supply chain systems:  
Integrating Social Science and Complexity Perspectives**

### **AGENDA**

**Thursday - May 7**

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**09:00-09:15 | Welcome Coffee**

**09:15-09:30 | Welcome and Introduction of REMASS** -Helmut Haberl

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**09:30-12:30 | Session 1: Social science-based resilience approaches**

Session lead and moderation: Anke Schaffartzik and Franziska Müller

Rapporteurs: Lilian, Sarah, Anke

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**09:30-09:45 | Kick-off - Impulse** by Anke and Franziska

**09:45-10:10 |** The social dynamics of social-ecological resilience

**Jamila Haider** (Stockholm Resilience Center)

Q and A session

**10:10-10:45 | Responsive Resilience**

**Axel Schaffer** (University of the Bundeswehr, Munich)

Q and A session

**10:45 – 11:00 | Coffee break**

**11:00-11:15 | Commentary** on the two presentations

**by Mahmoud Abouelnaga** (UNIDO, Vienna)

**11:15 – 12:00 | World café** - three parallel discussion groups hosted by the panelists

**12:00 – 12:30 | Wrap up**

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**12:30-13:30 | Lunch break - Rita brings**

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**13:30-18:00 | Session 2: Resilience from a Network Perspective**

Session Lead and moderation: Stefan Thurner

Rapporteurs: Teodoro, Juri and Leonardo

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**13:30-14:00 | Vulnerability of networks due to dependencies and methods of mitigations**

**Shlomo Havlin** (Bar-Ilan University, Israel)

**14:00-14:30 | Discussion**

**14:30-15:00 | Robustness of decentralized learning to nodes and data disruption**

**János Kertész** (CEU, Vienna)

**15:00-15:30 | Discussion**

**15:30-16:00 | Coffee break**

**16:00-16:30 | Structural and dynamic indicators of resilience and its loss** (*via Zoom*)

**Simon Levin** (Princeton University)

**16:30-17:00 | Discussion**

**17:00- 17:30 | Curtailing cascading failures in interdependent networks”** (*via Zoom*)

**Raissa D'Souza** (University of California, Davis)

**17:30-18:00 | Discussion**

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**18:30 | Working dinner**

Gasthaus Herlitschka, Traungasse 1, 1030 Vienna

**Friday - May 8**

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**09:15-09:30 | Recap Day 1 – Helmut Haberl**

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**09:30-12:00 | Session 3: Industrial ecology and supply chain resilience**

Session Lead: Stefan Giljum

Rapporteurs: Martin Cerny and Felix Maile

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**9:30-10:00 |** Risks distribution in the electric vehicle supply chain: company and big-data perspectives

**Xin Sun** (University of Groningen, NL)

**10:00-10:30 |** The role of industrial design for supply chain resilience of critical raw materials

**Benjamin Sprecher** (TU Delft, NL)

**10:30-10:45 |** Coffee Break

**10:45-11:45 |** Small **group discussions** (3 groups with one specific question each)  
40 min discussion; 20 min reporting back by session lead and rapporteurs

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**11:45-13:00 | Final session: Wrap up – key outcomes**

Session lead: Helmut Haberl

Rapporteurs: Jan and Caro/Shonali

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**11:45-12:15 | Individual reflection** – learnings and their relevance for ongoing REMASS research

**12:15-12:40 | Fish bowl - Pls:** which conclusions emerge from the workshop?

**12:40-13:00 | Feedback and closure**

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**13:00 | Fingerfood and refreshments – Rita brings**

**14:00-16:00** working group meetings

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## GUEST SPEAKERS

**Jamila Haider – Stockholm Resilience Center**  
**Researcher, Theme leader and principal researcher**

”The social dynamics of social-ecological resilience”

### Abstract:

In this presentation a review of how the study of social-ecological resilience – defined as the capacity to persist, adapt and transform with change – has evolved with and encountered the social sciences will be presented. Through a scoping review, a review of reviews, and a problematizing review, understandings of resilience are presented not as pre-given but rather as emergent through ‘encounters,’ a space in which ideas and doings interact and entwine. The review identifies five encounters: 1) linked social-ecological dynamics encounter relational resilience; 2) co-production for resilience encounters knowing ‘with’ resilience; 3) power of resilience encounters reclaiming resilience from below; 4) transformation for the future encounters resilience in the unfolding present; and 5) a focus on scaling encounters patterning for resilience, situated in unique histories, cultures and ecologies. These encounters highlight profound shifts in how the concept of resilience itself is changing, becoming more relational, political and entangled with the world of which it is a part.

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**Axel Schaffer – University of the Bundeswehr Munich**  
**Professor of Change and Sustainability**

“Responsive Resilience”

### Abstract:

Social ecological resilience can be defined as a system’s capacity to cope and adapt to exogenous shocks while maintaining its core functions. It can be considered a value-neutral system property, which may strengthen or hinder sustainable development (think of intact ecosystems vs. a fossil-based energy system). The concept of *responsive resilience* further adds the intention to protect a system’s desired functions. Interventions could take place in the aftermath of an external shock, but they might also occur in the form of proactive measures. Thus, the idea is to carefully reshape a system (or a network of systems), where failure can occur without jeopardizing core functionality. Thus, responsive resilience is not about avoiding shocks or crises altogether, but about interventions that take the form of a relational-dialogical response within actors of the same or neighboring actors.

At best, the concept of responsive resilience could help to transfer the concept of resilience to normative systems. However, as it moves away from a merely descriptive understanding of resilience, it may also add to the ongoing expansion of resilience carrying the risk of increasing vagueness and arbitrariness.

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**Mahmoud Abouelnaga – United Nations Industrial Development Organization  
(UNIDO), Vienna  
Industrial Decarbonization Hubs Lead**

Mahmoud Abouelnaga is the Industrial Decarbonization Hubs Lead at the United Nations Industrial Development Organization (UNIDO). He leads UNIDO's global portfolio on developing a pipeline of investment-ready clean energy and industrial decarbonization projects across emerging markets and developing economies. He is also a Nonresident Senior Fellow at the Atlantic Council where he focuses on innovation ecosystems and commercialization of disruptive climate mitigation technologies.

Prior to that, Mahmoud worked for the U.S. Department of Energy where he was responsible for the rulemaking and electrification programs within the Federal Energy Management Program. Earlier in his career, he led the carbon management portfolio at the Center for Climate and Energy Solutions (C2ES) in Washington, D.C. and worked as an energy engineer in France and Egypt. He holds three master's degrees: M.Sc. in Sustainable Energy Engineering from KTH Royal Institute of Technology, M.Sc. in Environmental Management from Universidad Politécnica de Madrid, and M.A. in International Development and Policy from the University of Chicago, where he was an inaugural Obama Scholar.

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**Shlomo Havlin - Bar-Ilan University, Israel  
Professor in the Physics Department**

“Vulnerability of networks due to dependencies and methods of mitigations”

**Abstract**

Interdependent networks appear in all aspects of nature and technology. A theoretical framework for percolation theory of interdependent networks will be presented. In interdependent networks, such as infrastructures, when nodes in one network fail, they cause dependent nodes in other networks to also fail. This may happen recursively and can lead to a **cascade of failures** and to a sudden collapse of the system. Same phenomena occurs when dependencies or overloads appear within a given single network. I will present analytical solutions based on percolation theory, for the functional network and the cascading failures as well as developing an efficient method

for mitigating this vulnerability. I will finally show that the abstract interdependent percolation theory and its novel behavior in networks of networks can be realized and proven in controlled experiments on interdependent superconducting networks.

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**János Kertész - CEU Vienna**  
**Professor and Head of Department of Network and Data Science**

“Robustness of decentralized learning to nodes and data disruption”

Abstract:

Coordination-free decentralized federated learning, based on peer-to-peer communication, is increasingly proposed for on-device training of machine learning models, promising privacy-preserving, communication-efficient training processes with no risk of single-point-failure. We focus on robustness issues, specifically, we study the effect of nodes' disruption on the collective learning process. The following cases are considered: (i) different distributions of data across nodes and (ii) different times when disruption occurs with respect to the start of the collaborative learning task. Through these configurations, we are able to show the non-trivial interplay between the properties of the network nodes, the persistence of knowledge acquired collectively before disruption or lack thereof, and the effect of data availability pre- and post-disruption. Our results show that decentralised learning processes are remarkably robust to network disruption. As long as even minimum amounts of data remain available somewhere in the network, the learning process is able to recover from disruptions and achieve significant classification accuracy. This clearly varies depending on the remaining connectivity after disruption, but we show that even nodes that remain completely isolated can retain significant knowledge acquired before the disruption.

Luigi Palmieri, Chiara Boldrini, Lorenzo Valerio, Andrea Passarella, Marco Conti, János Kertész, *Computer Communications*, 241, 108250 (2025)

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**Simon Levin – Princeton University**  
**Professor in Ecology and Evolutionary Biology**

“Structural and dynamic indicators of Resilience and its loss”

Abstract:

The concepts of resilience and critical transitions, whereby resilience is lost, are

obviously intimately connected, though the literatures on the two topics have developed somewhat independently. Classically, of course, the topic has been central in statistical physics and related disciplines but also finding expression in Turing's work on pattern formation, Rene Thom's explorations in bifurcations and catastrophe theory, as well as Herman Haken's theories of synergetics. Holling's 1973 paper led to great interest in early warning indicators of sudden change, especially those signals associated with second-order phase transitions. These fit in a broader framework of structural and dynamic indicators of resilience and its loss which hold great potential for dealing with complex systems

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**Raissa D'Souza – University of California, Davis**  
**Professor of Computer Science and Mechanical Engineering**

“Curtailling cascading failures in interdependent networks”

**Abstract:**

We live in a system of interdependent networks, spanning social, biological, and engineered systems. Many of these systems exhibit phase transitions and failures that cascade within and across systems. This talk will discuss resilience in classic models of self-organized-criticality, showing that optimizing tradeoffs can encourage extreme events from Black Swans to Dragon Kings. Then resilience and vulnerability in multi-layered social systems inspired by macaque monkeys will be presented. Finally, resilience in coupled bi-stable systems that model abrupt changes in social and ecological systems will be discussed.

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**Xin Sun – University of Groningen**  
**Assistant Professor at the Integrated Research on Energy, Environment and Society group, Energy and Sustainability Research Institute Groningen**

“Risks distribution in the electric vehicle supply chain: company and big-data perspectives”

**Abstract:**

This study investigates how risks are distributed across the electric vehicle (EV) supply chain by combining high-resolution market data with company-level analyses of critical material supply. Building on detailed EV datasets for China and the EU, it captures spatial and technological heterogeneity in battery demand, revealing uneven pressures on critical materials such as lithium, cobalt, and nickel. At the supply side, a company-oriented perspective highlights how foreign direct investment reshapes control over

material production, redistributing risks beyond geographic boundaries and concentrating influence among multinational actors. By linking demand-side granularity with ownership-based supply networks, the talk uncovers how disruptions and dependencies propagate across regions and firms. The results provide new insights into systemic vulnerabilities and support strategies for more resilient and transparent EV supply chains.

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**Benjamin Sprecher – TU Delft**  
**Assistant Professor Faculty of Industrial Design Engineering**

“The role of industrial design for supply chain resilience of critical raw materials”

**Abstract:**

In this presentation, we will discuss research on resilience in the context of critical raw materials and explain how it links to product design. Despite its potential, the role of industrial design in this context is largely overlooked, both in research and in practice. Our research findings strongly suggest that deliberate design choices can reduce reliance on critical raw materials. We discuss what a more resilience-aware design practice could look like and show some examples of good and bad product design and how product design can impact resilience on the system level.

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