

WELCOME TO THE 25TH FUTURES CONFERENCE

FUTURES OF TECHNOLOGIES

Mutual Shaping of Socio-Technical Transformations

10–12 June 2025 | Turku, Finland

futuresconference2025.com

BOOK OF ABSTRACTS

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**UNIVERSITY
OF TURKU**



**FINLAND FUTURES
RESEARCH CENTRE**



FFA
Finland Futures Academy



FUTURES CONFERENCE 2025

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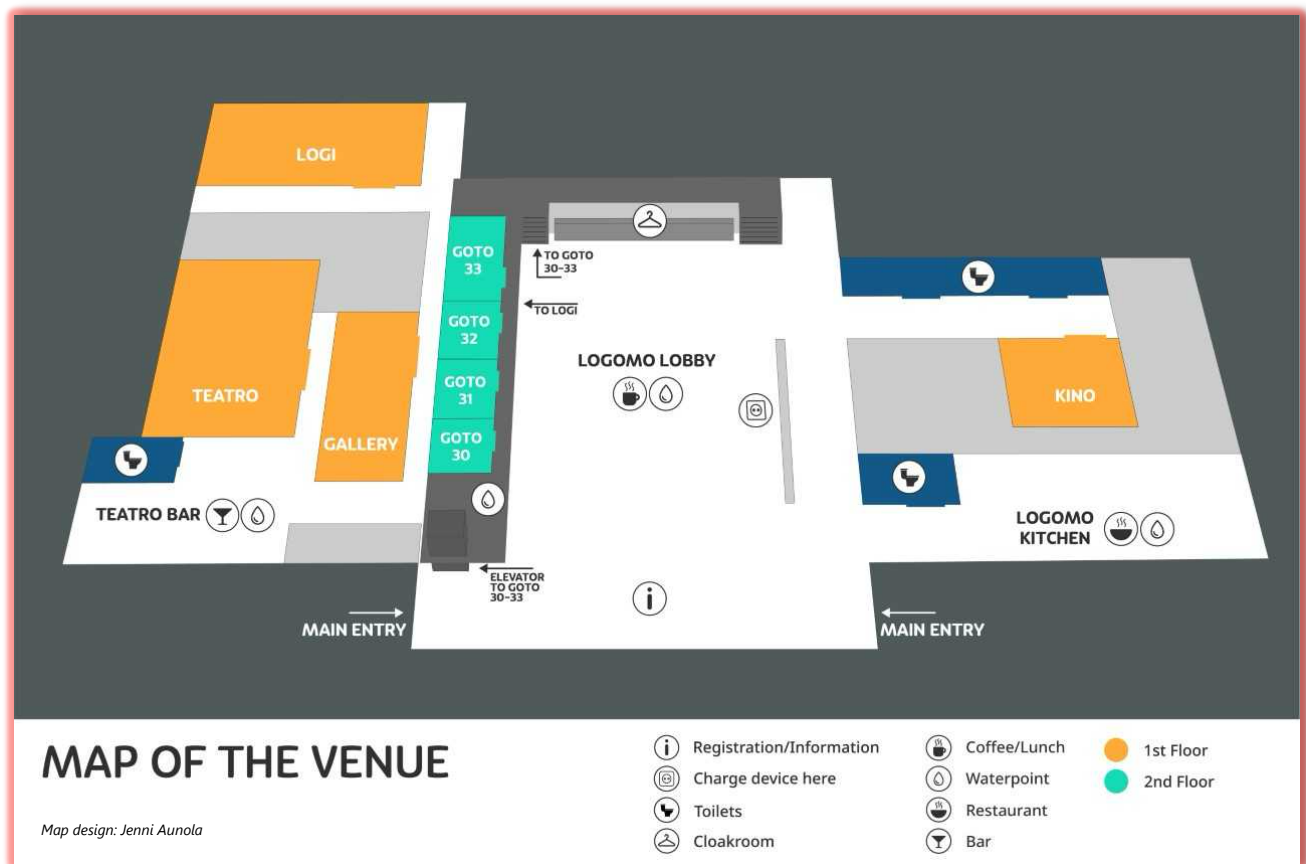
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Main venue for keynote presentations: TEATRO

Venue for registration, breaks & lunch: LOGOMO LOBBY

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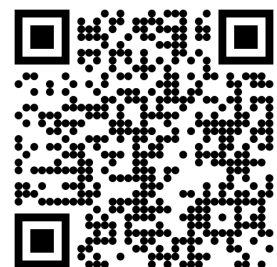
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CONFERENCE PROGRAMME

TUESDAY 10 JUNE 2025

- 12:30 **Registration to the Conference**
- 13:30 **Opening of the Futures Conference 2025**
Dr. **Toni Ahlqvist**, Finland Futures Research Centre, University of Turku
Welcoming Address
- 13:50 **Introduction to the Conference Themes**
Research Professor in Strategic Foresight, Dr. **Arho Suominen**
VTT Technical Research Centre of Finland
- 14:15 **Keynote Speech and Discussion**
“Approaches for Ethical Assessment of Emerging Technologies”
Professor of Philosophy and Ethics of Technology, Dr. **Philip Brey**
University of Twente, The Netherlands
- 15:00 Break
- 15:30 **Keynote Speech and Discussion**
“The Fall and Rise of Finance in the Era of Artificial General Intelligence (AGI)”
CEO **Rohit Talwar**, Fast Future, UK
- 16:15 **Keynote Speech and Discussion**
“Imagining the Technological Threats and Possibilities of the Future
through the Lens of Science Fiction”
Futurist, Dr. **Elina Hiltunen**, What’s Next Consulting Ltd, Finland
- 17:00 Break
- 17.15 – 18.45 **Session 1 (parallel tracks)**
- 19:00 **Welcome Reception in Logomo**

SCAN TO OPEN
THE CONFERENCE
PLATFORM



CONFERENCE PROGRAMME

WEDNESDAY 11 JUNE 2024

- 9:00 **Registration to the Conference**
Coffee and Tea
- 09:30 **Keynote Speech and Discussion**
“Desirable Futures & Prospective Theorizing”
Professor of Innovation, Entrepreneurship & Sustainability, Dr. **Ali Aslan Gümüşay**
LMU Munich School of Management, LMU Innovation & Entrepreneurship Center,
Germany
- 10:30 Break
- 10:45 **Keynote Speech and Discussion**
“What Do We Know? The Productive Power of Certainties in Scenario Planning”
Associate Fellow, Dr. **Cynthia Selin**, Saïd Business School, University of Oxford, UK &
Scenaric Consulting, Founder and Director, USA
- 11:45 Lunch
- 13:00 **Session 2** (parallel tracks)
- 14:30 Break
- 15:00 **Session 3** (parallel tracks)
- 16:30 Break
- 16:45 **Session 4** (parallel tracks)
- 18:15 Closing of the Day 2
- 19:15 **Conference Dinner**

THURSDAY 12 JUNE 2024

- 8.30 Coffee and Tea
- 9:00 **Keynote Speech and Discussion**
“Future of AI: Issues, Opportunities, and Geopolitical Synergies”
CEO, Dr. h.c. mult., **Jerome Glenn**, The Millennium Project, USA
- 10:00 Break
- 10.15 **Session 5** (parallel tracks)
- 12:00 Lunch
- 13:00 **Session 6** (parallel tracks)
- 14:30 Break
- 15:00 **Session 7** (parallel tracks)
- 16:30-17.00 **Networking and Closing of the Futures Conference 2025**

SESSION PROGRAMME

TUESDAY 10 JUNE 2025

Tracks Sessions	TRACK 1 Special Sessions	TRACK 2 Governance and Policy Innovations	TRACK 3 Education and Learning	TRACK 4 Society and the Environment	TRACK 5 Industry Innovations	TRACK 6 Workshops	TRACK 7 Workshops
Room	LOGI	TEATRO	GALLERY	KINO	GOTO 33	GOTO 31	GOTO 32
17.15–18.45 SESSION 1	Special Session Launch: Accelerating life science manufacturing in Finland	Integrating emerging technologies in public policy: regional practices	Experiential learning and collaborative intelligence	Long-term scenarios for humankind	Bridging foresight and management: futures studies approach in management practices	Workshop The future of decision-making: AI driven foresight	Workshop The Green, Clean, Mean Machine

WEDNESDAY 11 JUNE 2025

Tracks Sessions	TRACK 1 Special Sessions	TRACK 2 Governance and Policy Innovations	TRACK 3 Education and Learning	TRACK 4 Society and the Environment	TRACK 5 Industry Innovations	TRACK 6 Workshops	TRACK 7 Workshops
Room	LOGI	TEATRO	GALLERY	KINO	GOTO 33	GOTO 31	GOTO 32
13.00–14.30 SESSION 2	Millennium Project Special Session The radical and the resilient – Narratives to highlight the road to desirable futures of work	Anticipatory governance of emerging technologies	Transforming education and research with innovative technologies	Human health and wellbeing, and emerging technologies		Workshop Mutual shaping in large action models – Perspectives on an emerging field of AI	Workshop Foresight Flash – Enabling rapid collective foresight through human-centered, technology-enhanced intelligence
15.00–16.30 SESSION 3	Special Session Foresight Paper Development Workshop	Linkages between foresight, technology, and policymaking	Futures-oriented research and learning in the digital era	The human element in the futures	The role of collaboration and networks in shaping the futures	Workshop Responsible foresight in the anticipation of emerging technologies and their social impacts	Workshop Deconstructing AI generated futures – Tools to build critical futures thinking
16.45–18.15 SESSION 4	Special Session LifeFactFuture Technology foresight for visioning and industrial renewal	Innovations for diversity, inclusion and community empowerment	Technological and methodological innovations for enacting futures	Futures of the digital and green transitions	Futures of transportation and mobility	Workshop Collaborative envisioning of immersive environments for anticipatory technology assessment	Workshop Future archeologies workshop. A hands-on approach to speculative futures

THURSDAY 12 JUNE 2025

Tracks Sessions	TRACK 1 Special Sessions	TRACK 2 Governance and Policy Innovations	TRACK 3 Education and Learning	TRACK 4 Society and the Environment	TRACK 5 Industry Innovations	TRACK 6 Workshops	TRACK 7 Workshops
Room	LOGI	TEATRO	GALLERY	KINO	GOTO 33	GOTO 31	GOTO 32
10.15–12.00 SESSION 5	Special Session Forum for emerging enabling technologies in support to the digital and green transitions through value sensitive innovations	Social and technological transformations at the local level	Novel methods of analysing data and creating scenarios - case studies	The role of technologies in tackling global challenges	Futures of emerging technologies	Workshop Workshop beyond knowledge: Making future literacy measurable in transformative learning contexts	Workshop Enacting futures
13.00–14.30 SESSION 6		Linkages between foresight, technology and policymaking	Methodological innovations due to technological change	Fostering dialogues with youth and future generations	Technology and digital innovations for the blue economy	Workshop Hybrid horizons of futures workplaces	Workshop Green transitions in cruise shipping and shipbuilding
15.00–16.30 SESSION 7	Special Session Chair & Invite: Shaping the future of human work through digitalization and AI agents	Social implications of technological change	Theoretical frameworks in futures studies and foresight	Ethical issues in technology		Chair & Invite Futures in action	Workshop Imagining the good life – Fast futures literacy laboratory

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KEYNOTE SPEAKERS

10 June 2025 (Tuesday)

Approaches for Ethical Assessment of Emerging Technologies

Time: Tuesday 10 June at 14.15

Room: TEATRO

Professor of Philosophy and Ethics of Technology, Dr. Philip Brey

University of Twente, the Netherlands

Emerging technologies, such as AI, genomics, neurotechnology and energy systems, confront policy-makers, industry, and other stakeholders with a growing range of ethical challenges. These challenges pertain to such issues as privacy, fairness, bias, accountability, autonomy, and sustainability. Policy makers have an interest in addressing these issues to ensure that innovation will not cause harm, respects rights and aligns with public values and legal frameworks. Technology developers have an interest in addressing them in order to build and maintain public trust, avoid reputational and regulatory risks, and ensure that their innovations are market-ready and accepted by users and other stakeholders.

However, both parties tend to use ethical assessment and guidance instruments that are not sufficient to address these ethical challenges, instruments such as ethical guidelines, codes of conduct, ethics committees and ethics checklists. These instruments often fail to properly identify and assess current and future ethical issues, and fail to provide concrete, operational guidance. Instruments are needed that are (1) anticipatory, focused on plausible future scenarios, unintended effects, and indirect or long-term consequences; (2) context-sensitive, being able to relate moral values and principles to specific technologies, use cases, stakeholders or cultural settings; and (3) institutionally embedded and systematically integrated into decision-making processes in governance, design, and development.

In the keynote address, Ethical Impact Assessment will be presented as an approach that meets these criteria. It is a structured and anticipatory method developed over a seven-year period within European research and governance initiatives, and has been adopted both within European research and innovation (R&I) contexts and by international bodies such as UNESCO. The foundational assumptions, methodology and applications of this approach will be presented, with special attention to its application in technology development and policy. For technology development, the approach will be connected to other ethics instruments, including corporate social responsibility and ethics by design. For technology policy, its role will be discussed in responsible policy-making that anticipates ethical risks and societal impacts.

The Fall and Rise of Finance in the Era of Artificial General Intelligence

Time: Tuesday 10 June at 15.30

Room: TEATRO

CEO Rohit Talwar

Fast Future, the United Kingdom

Over the next decade, the global operating environment for Consumer Financial Services (CFS) is likely to be transformed in fundamental ways as information asymmetries are rebalanced away from providers and towards customers. This is being driven and enabled by a combination of changing societal consumer needs and expectations, accelerating capabilities of artificial intelligence (AI), and the potential evolution towards artificial general intelligence (AGI) and artificial superintelligence (ASI). These developments could be accelerated and shaped by advances in other critical technologies, massive shifts and upheavals in the global operating environment, and a proliferation of business models.

Perhaps the biggest change that these developments are enabling is the potential to tokenise everything we own and turn it into a digitally tradeable asset. This will redefine the entire meaning of money, massively expand the potential scope of what we currently consider to be 'financial services', and who the 'providers' might be. These in turn could enable an exponential explosion in the number and type of players who can be part of this new CFS ecosystem. For the existing players in CFS, this level of disruption will force a fundamental rethink of current assumptions, strategies, business models, offerings, processes, structures, talent, capabilities, and leadership approaches. In parallel it creates the opportunity to leverage the size of their customer base, brand, and financial resources to enable them to play a range of roles in this new environment – but the consumer will have much more of a say and more power to punish and reward providers.

The new landscape is one where everything we own could be transformed into a tradeable digital token of exchange. This opens the potential for developments such as self-regulating global currencies, new models of community centric value exchange, and individually minted bio-currencies. Parallel developments could include self-optimising personal AI wallets, self-managing money, and the reinvention of savings, loans, and investments. In this opportunity rich environment, even five cents in our pocket could give everyone access to once inaccessible asset markets, venture capital, and the types of high yielding financial instruments that were previously only the domain of institutions and high net worth investors.

This presentation will highlight these critical drivers of change in the nature of money and CFS and go on to explore the possibilities and scenarios that could emerge. We will then examine the implications for how we prepare society, individuals, financial institutions, and governments for the inevitable possibility explosion that will far outstrip our capacity to understand, benefit from, and regulate these developments.

Imagining the Technological Threats and Possibilities of the Future through the Lens of Science Fiction

Time: Tuesday 10 June at 16.15

Room: TEATRO

Futurist, Dr. Elina Hiltunen

What's Next Consulting Ltd, Finland

Elina Hiltunen has developed a formula for anticipating the future:

Anticipating the Future = Facts + Imagination.

This formula highlights the importance of being informed about current developments, weak signals, trends, and megatrends in order to anticipate what lies ahead. However, it also emphasizes the need to use our imagination courageously. Often, the future can surprise us in ways we never expected.

Science fiction serves as a valuable example of the use of the formula. It often draws inspiration from current technological developments, including innovations and inventions grounded in reality. However, science fiction goes a step further by embracing imagination and exploring possibilities beyond existing facts. It aims to examine how emerging technologies could ultimately impact society and individuals in the future.

We are all familiar with science fiction as it appears in popular culture, including literature, comics, films, computer games, and plays. Notable examples of science fiction literature include Mary Shelley's *Frankenstein* (1818), Jules Verne's *Journey to the Center of the Earth* (1864) and *Twenty Thousand Leagues Under the Sea* (1870), Isaac Asimov's *Foundation* (1951) and *I, Robot* (1950), Arthur C. Clarke's *2001: A Space Odyssey* (1968), and George Orwell's *1984* (1948). Among well-known science fiction films are the *Terminator* series, *Minority Report*, *Blade Runner* and *Back to the Future I-III*.

Science fiction stories often feature technological breakthroughs that surprisingly become reality in the future. Examples like robots, moon travel, televisions, and smartphones have appeared in science fiction long before they were invented and introduced. While it might seem that science fiction writers have a unique ability to foresee the future, it is, in fact, impossible to predict what will happen. The true secret behind the visionary nature of science fiction is that it has inspired product developers to create innovations.

Today, organizations of all kinds are increasingly using science fiction as a tool to envision the future, drive innovation and to prepare for the future. Companies like Intel and Disney are examples of companies using science fiction. Additionally, military organizations, including the US Army, NATO, and the French Army, employ science fiction to anticipate future warfare scenarios and potential threats. The significance of science fiction in organizational planning is becoming more recognized, as it enables us to explore and anticipate both the opportunities and challenges presented by technological advancements.

11 June 2025 (Wednesday)**Desirable Futures & Prospective Theorizing**

Time: Wednesday 11 June at 09.30

Room: TEATRO

Professor of Innovation, Entrepreneurship & Sustainability, Dr. Ali Aslan Gümüſay

LMU Munich School of Management, LMU Innovation & Entrepreneurship Center, Germany

In our common futures we face a 'vuca-p' world of grand challenges. In the search for (grand) solutions, what role does scholarship play? The dominant approach is retrospective theorizing. Most models seek to represent and explain features of current social reality. But by focusing on the past and present, we effectively colonize the future with cognitive limitations, instead of freeing it through imagination. Likewise, by focusing only on future probabilities, we miss desirable future potentialities, thereby decreasing the likelihood of their actualization and generative impact. As a result, we risk stumbling into the future. Rather than offering thought leadership, we confine ourselves to empirical followership, developing theories based on observing an empirical reality that gradually unfolds. This is not enough (anymore). How then do we move from post-factual to pre-factual, generative scholarship? This keynote will speak to prospective theorizing to co-create desirable futures through impactful, future-oriented theorizing. This entails speculative rigor and a move towards complexity and imagination capability. It will also draw on empirical practices such as imagination dinners and current research on AI Futures (of work).

What Do We Know? The Productive Power of Certainties in Scenario Planning

Time: Wednesday 11 June at 10.45

Room: TEATRO

Associate Fellow, Dr. Cynthia Selin

Saïd Business School, University of Oxford, the United Kingdom & Scenaric Consulting, Founder and Director, the United States

Scenario planning is designed to interrogate the complexities, uncertainties, and ambiguities that muddle clear foresight. Yet its emphasis on the unknowable often underestimates the structuring role and value of certainties. The future is not a blank slate of limitless possibility. Some dynamics—demographic shifts, ecological thresholds, and socio-technical path dependencies—are already in motion or locked in. Reclaiming certainties as productive forces in scenario work serves to clarify the conditions within which uncertainties unfold. Certainties anchor the frames for foresight. Rather than constraining imagination, certainties provide a scaffold for decision-making, sharpening the strategic utility of scenarios.

Despite deep engagement with uncertainty, the practical application of scenario methodologies often lacks a systematic approach to certainties. Though early scenario work referenced "predetermined elements" and "inevitable surprises", it appears as though the appreciation of more stable forces has slipped from attention (Selin 2007). This work introduces a typology that distinguishes five different lenses to identify and assess certainty—ranging from material constraints and technological maturation pathways to institutional commitments. These factors act as structuring forces that shape the boundaries of plausible futures, counterbalancing the tendency to overemphasize fluidity while under-examining what remains fixed.

Identifying certainties does not imply determinism—or arrogantly predicting the unpredictable—but rather highlights the inertia, commitments, and stuck thresholds that shape the dynamics of change.

These Lenses of Certainty are illustrated here using the case of nuclear energy—a context where policy regimes, infrastructure lock-in, and geopolitical dynamics intersect with technological and market uncertainties. Energy futures are often framed in terms of emerging innovations, policy shifts, and investment flows, yet underlying certainties—such as infrastructure longevity, regulatory constraints, and the slow-moving nature of transitions—place real parameters around what is plausible. This approach exposes the mismatch between wild narratives of rapid transformation and the weight of the past encroaching into the future. With the ballast of certainties, interrogating energy futures with scenario planning can lead to sharper, more useful insights. While this nuclear energy example grounds the discussion, the lenses themselves are broadly applicable to many domains of technological change.

Reframing scenario work to explicitly question and integrate certainties sharpens the analytical rigor and challenges common assumptions about the fluidity of change. By recalibrating what is fixed versus fluid, this work advances a more methodologically rigorous and strategically attuned engagement with alternative futures.

Selin, C. 2007. “Professional Dreamers: The Past in the Future of Scenario Planning.” In Sharpe, B. & van der Heijden, K. *Scenarios for Success: Turning Insight into Action*. London: Wiley.

12 June 2025 (Thursday)

Future of AI: Issues, Opportunities, and Geopolitical Synergies

Time: Wednesday 12 June at 09.00
Room: TEATRO

CEO, Dr. h.c. mult., Jerome Glenn

The Millennium Project, the United States

Humanity has never faced a greater intelligence than itself. Within a few years, most people reading these words will live with such superior artificial non-human intelligence for the rest of their lives. The largest financial investments in history are accelerating the development of Artificial General Intelligence (AGI) intended to create extraordinary benefits to humanity. Yet AGI leaders acknowledge that such an ungoverned race could create catastrophic and even existential risks. Managing the transition from current AI to AGI is the most complex and difficult problem humanity has ever faced. The current status and future plans for United Nations and national government anticipatory governance of AGI will be discussed.

There are many solutions to our global challenges, but zero-sum geopolitical power politics is preventing the synergetic relations among nations, businesses, NGOs, universities, and UN systems needed to implement them and achieve what could be a magnificent future for all. If the world continues to play zero-sum power geopolitics it seems continuing wars in one form or another are inevitable for our future. Schools of business and international relations teach competitive intelligence, advantage, and strategy; in parallel, such schools should also teach synergic intelligence, advantage, and strategy. Without U.S.-China synergetic strategies on issues like global warming, future forms of AI, synthetic biology, and strategic weapons, it is difficult to be optimistic about the future.

These and other issues and opportunities covered in the 15 Global Challenge in the State of the Future 20.0 will be shared, along with the State of the Future Index 2035 showing where humanity is winning and losing.

TUESDAY 10 JUNE 2025

♦ PRACTICE-oriented

• ACADEMIA-oriented

Session 1: 10 June 2025 (Tuesday) at 17.15-18.45**1. Special Session | Launch: Accelerating life science manufacturing in Finland ♦**

Time: Tuesday 10 June 2025 at 17.15–18.45
 Room: LOGI
 Chair: Juha Kaskinen

Launch: Accelerating life science manufacturing in Finland ♦

Toni Ahlqvist – Tolga Karayel – Keijo Koskinen – Mikkel Stein Knudsen – Tero Villman
 Finland Futures Research Centre, Finland

This Special Session for the project LifeFactFuture includes both university researchers and CEO-level representatives of the Finnish life science industry.

The Special Session serves as the launch of the 'Future Factory Concept', namely the foresight-informed shared consortium vision for futures of life science manufacturing in Finland. The consortium of the LifeFactFuture project, supported by Business Finland (2024-2026), includes University of Turku, University of Helsinki, major manufacturers of pharmaceutical products and medical devices, technology companies of various sizes, and the regulating pharmaceutical authority in Finland. The Future Factory Concept has been developed after a comprehensive foresight process, consisting of a literature review, 18 focus group interviews with 55+ participants, and a series of participative foresight workshops.

Together, the consortium represents some of the biggest industrial employers in Southwest Finland (e.g. Bayer Oy, Orion Pharma Oy) and some of Finland's best-known companies (e.g. Nokia). Life science manufacturing thus represent one of the strongest industrial sectors in the region, and building on this position is an important cornerstone for the region's future prospects.

Special session programme:

- Launch of Future Factory Concept, Toni Ahlqvist & Tero Villman (FFRC)
- Comments and presentations by LFF WP1 Industry lead Sara Gambier (Bayer Oy) and WP Tech leads Tomi Lahti & Mikael Lindblad (Nokia)
- Panel discussion: Toni Ahlqvist (moderator, FFRC), Tomi Penttilä (Bayer Oy), Iikka Keskinen (Orion Pharma), Peppi Pietarinen (Revvity), Viktoriia Shubina (UTU)

Keywords: Digitalization, Technology foresight, Emerging technologies, Life Science Manufacturing

2. Integrating emerging technologies in public policy: regional practices ♦

Time: Tuesday 10 June 2025 at 17.15–18.45
 Room: TEATRO
 Chair: Sari Puustinen

Translating Futures Thinking into Strategic Action: A Case Study of Department of Government Enablement (DGE) and TAMM, an Abu Dhabi Government Entity ♦

HE Ruba Al Hassan – Emily Joann Cox – Fawaz Abu Sitta – Rauda Al Derei – Khaled AlKhoori
 Department of Government Enablement, the United Arab Emirates

Foresight and anticipatory thinking drive the Department of Government Enablement's (DGE) strategic agenda, guiding its vision for a future-ready government. At the heart of this effort is TAMM, Abu Dhabi's integrated digital government services platform, which operates under DGE. TAMM serves as the primary interface between residents, businesses, and the government, providing seamless, AI-driven access to over 900 essential public services. By leveraging emerging technologies, TAMM enhances the efficiency, accessibility, and personalization of government interactions, aligning with Abu Dhabi's broader digital transformation strategy.

This paper explores how DGE's foresight-driven approach enables the mutual shaping of socio-technical transformation, ensuring that emerging technologies like AI and automation are integrated into governance in ways that enhance societal resilience and inclusivity. The paper examines how DGE integrates weak signals and disruptive innovations into strategic initiatives through a bottom-up approach, fostering adaptability and resilience, with TAMM as a case study. Unlike the traditional top-down approach to strategic foresight, DGE's bottom-up model focuses on embedding futuristic elements directly into the design and execution of strategic initiatives, ensuring that innovation emerges organically from operational challenges. DGE's bottom-up approach to foresight ensures that technological innovations are co-created with societal needs in mind, fostering a mutual shaping process that enhances both public service delivery and citizen engagement.

DGE's foresight approach is structured around three phases: Mapping, Designing, and Shaping. In the Mapping phase, weak signals, emerging trends, and wildcards are identified and evaluated using a 2x2 matrix framework. The Designing phase employs structured foresight methodologies such as the Futures Triangle and Causal Layered Analysis (CLA) to construct multiple plausible futures. Finally, the Shaping phase focuses on defining preferred futures and employing backcasting to identify present-day actions necessary to achieve them.

By embedding futures thinking within its strategic agenda, DGE has accelerated the adoption of innovative initiatives, including an AI-powered government assistant, automated translation, and speech recognition services. By embedding futures thinking into its strategic agenda, DGE not only advances Abu Dhabi's digital transformation but also offers a replicable model for other governments seeking to navigate the complexities of socio-technical change in an era of rapid technological advancement.

This paper will present DGE's structured approach to futures thinking, demonstrating how anticipatory methods and emerging technologies shape governance and public service innovation. It will also explore how DGE's work offers a replicable model for other governments seeking to navigate the complexities of socio-technical transformation in an era of rapid technological change.

Keywords: Government Services, Anticipatory Thinking, Emerging Technologies

The Practice of Technology Foresight in China: Bridging Critical Technologies and S&T Policy ♦

Like Yuan – Yifang Ma – Pei Chen

Chinese Academy of Science and Technology for Development(CASTED), China

BACKGROUND AND PURPOSE

China has conducted six national technology foresight initiatives and is currently undertaking its seventh. This study examines China's practical experiences to demonstrate how foresight activities bridge critical technologies and policy design, offering insights for aligning technological priorities with S&T policy frameworks.

SUMMARY OF MAIN POINTS

The research analyzes interactions between China's technology foresight programs and national S&T planning, systematically reviewing their implementation processes, organizational structures, methodological approaches, distinctive features, emerging challenges, and future trends.

RELATION TO CONFERENCE THEME

China's experiences illustrate the connection among foresight, technological advancement, and S&T policymaking, providing a model for institutionalizing science-driven governance.

CONCLUSIONS AND SIGNIFICANCE

China's national technology foresight initiatives systematically integrate multidisciplinary literature and expert insights to inform S&T policy formulation. The practices enable foresight to serve as an institutional bridge, translating technological potential into actionable policy agendas while addressing systemic challenges.

Keywords: Technology Foresight, S&T Policy, China

AI-driven tools for policy-oriented foresight practices in Europe ♦

Simo El Kasri – Birthe Menke

4strat GmbH, Germany

The purpose of the presentation is to (1) establish perspectives from current academic discourse on the integration of human and artificial intelligence in foresight practice and (2) provide an example of how an existing platform is being developed to practically augment human capabilities such as contextual understanding and judgement with smart analytics. The presentation highlights the current state of Artificial Intelligence (AI) applications in foresight, the broader potentials of AI in foresight, and the design of an interface for hybrid foresight processes currently being used in the European policymaking space.

Research shows that efforts have already been made towards the integration of technical solutions in foresight practice. Nevertheless, digital technologies remain underutilised in the field, and while the ongoing digitalisation should advance foresight capabilities, the growing availability of data sources, the growing amount of data itself, and the increasing complexity of methodologies required to process that data simultaneously exacerbate traditional challenges faced in foresight practice (Ködding et al., 2023).

However, if methodological innovations can be designed to aid and augment human capabilities with sophisticated algorithms and computing power, these very same factors have the potential to significantly transform foresight practice and establish "a new foundation for data-supported foresight" (Geurts et al., 2021, p. 2). The development of AI, including generative AI, large language models, and natural language processing,

can then take on a range of tasks such as scanning data sets, identifying patterns and interdependences, extracting trends and weak signals, and even designing scenarios and visualising results (Schühly et al., 2020). For this, researchers suggest hybrid approaches, leveraging both human and artificial intelligence (Geurts et al., 2021; Spaniol & Rowland, 2023), and recommend the creation of interfaces that combine human creativity and judgement with AI-driven analytics (Geurts et al., 2021; Ködding et al., 2023).

Solutions like the Foresight Strategy Cockpit aim to enable human-machine interaction by introducing AI applications that assist the foresight practitioner and policymaker in compiling, organising, and analysing data on a centralised platform. This is done by means of smart functionalities, e.g., an automated labelling and linking of data and the indication of patterns within data sets, while evaluations of emerging outcomes are conducted by subject matter experts to produce differentiated results. Experience shows that policymakers direct their attention towards foresight capacity building for sustainable organisational learning when presented with a digital tool that assists analytical tasks.

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Keywords: AI-driven foresight, AI-driven foresight tools, Policy-oriented foresight, Foresight Strategy Cockpit, Platform-driven foresight

3. Experiential learning and collaborative intelligence ♦●

Time: Tuesday 10 June 2025 at 17.15–18:45
 Room: GALLERY
 Chair: Sari Söderlund

Creative futuring of socio-technical transformations through Embodied Transformation Theatre ●

Krisztina Jónás – Melania Borit
 UiT The Arctic University of Norway

Despite increasing calls for transformation towards sustainable and just futures, natural ecosystems continue to decay, and the climate crisis continues to worsen. Some argue this is because the climate crisis is a crisis of imagination [1], as imagination is needed to enable socio-ecological, socio-technical transformations [2] towards desirable futures. Imagination is essential to inspire long-term thinking, a requirement for anticipatory governance amidst growing uncertainties. Moreover, creative methods are needed, as it has been suggested that it is difficult to imagine futures that are very different from past experiences due to existing psychological barriers [3]. In response to this crisis of imagination, this methodological paper proposes and tests for its capacity to enrich imagination for transformations a creative futuring method, i.e., Embodied Transformation Theatre. This method relies on active participation through embodiment (defined as cognition that is part of

the body and in which body plays an active, dynamic role [4]), building on research showing that physically activating the body alongside thinking helps participants to tap into their emotions, explore their relation to self, the broader community, society and nature [5], raising awareness about their embeddedness in nature, and enhancing their imagination [6]. In this study, using the case of imagining the future of human-water relations, we: (a) describe the Embodied Transformation Theatre method, (b) compare it with other similar methods, (c) test its capacity to enrich imagination, (d) explore the future visions of participants in the given context (including the presence of technology in these visions), and (e) assess if it is possible to identify stages of socio-technical transformation in the visions (i.e., preparing, navigating, and stabilizing [2]). The study design consists of the implementation of the Embodied Transformation Theatre method, during which data was collected through pre- and post-implementation online questionnaires, observation (during implementation), and follow-up online interviews. The method was implemented during an international workshop for young adults held in Brussels, in October 2024, on the topic of future lives with oceans and water. Out of the 75 participants, 54 filled both questionnaires, and 17 were invited for follow-up interviews. Findings discuss how the Embodied Transformation Theatre method can enrich future visions of socio-technical transformations and what are the future visions of young adults on the topic of human-water relations, including the role of technology in these transformations. Insights provide recommendations for futures professionals, process facilitators, and policymakers about facilitating collective future imaginaries with a creative, novel approach.

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Keywords: Creativity, Imagination, Embodiment, Methodology, Transformations, Human-water relation

Participatory methods to foster future-oriented collective intelligence (FOCI) ♦

Adél Kučera – Ondřej Pokorný

Technology Centre Prague, Czech Republic

BACKGROUND AND PURPOSE

Current societal development is characterized by increasing uncertainty resulting from the expected impacts of major societal challenges. Identifying and analyzing these uncertainties is key to effectively directing support for research, development, and innovation. The aim of the study was to provide insight into the main uncertainties of the future development of the Czech society until 2040 and to propose relevant research topics for Humanities, Arts, and Social Sciences (HASS) that would allow an effective response to these challenges. The study is part of the preparation of materials for the focus of public competitions in the SIGMA program (Technology Agency of the Czech Republic), which is focused on supporting the innovative potential of HASS.

SUMMARY

The approach combined several foresight methods, including a systematic review of existing strategies, policies and foresight studies, extensive use of expert workshops, and an analysis of research capacities in the Czech

Republic. The research phase identified key uncertainties and problem areas, which were further discussed in the expert workshop. The aim of the first expert workshop was to assess their potential impacts and to formulate research priorities. The second expert workshop focused on structuring and prioritizing the proposed research topics. The expert workshops resulted in a high level of knowledge integration and accumulation of diverse opinions. This created a strong collective intelligence that is well suited to identifying topics that can address the impact of contextual factors and propose effective measures to address them. As a result, five main areas of uncertainty affecting the future development of Czech society were formulated (climate change and environmental instability, technological progress, (geo)political instability, demographic change and migration, health threats and pandemics), as well as an associated comprehensive set of HASS research topics.

ADDRESSING THE GOALS AND THEMES OF THE CONFERENCE

The case study, with its emphasis on providing specific and prioritized research topics for public competition, demonstrates strong links between foresight, technology, and policymaking in practice.

CONCLUSIONS AND IMPLICATIONS

The study brings a new conceptual framework for the Czech Republic for the formulation of research priorities in the field of HASS, which reflects the complexity of future development. The main emphasis is placed on the integration of technological, environmental and social factors into research topics, thus supporting their applicability in the strategic planning of research programs and at the same time providing inspiration for the creation of policies aimed at mitigating the impact of the identified uncertainties.

Keywords: participation, expert discussion, societal needs, uncertainties of future development, social and humanities research, research program

Future Ties: Social Simulations of Emerging Relational Dynamics ♦

Nimrah Syed

New York University Abu Dhabi, the United Arab Emirates

As emerging technologies mediate and reshape the complex interplay of emotions, behaviors, and communication that govern how individuals relate to one another, the future of relational dynamics is undergoing profound transformation. This research leverages social simulations and role playing to examine technology-enabled speculative futures.

Through immersive workshops, participants took on roles within these evolving relational structures, engaging with hypothetical experiments, policies, and artifacts that embody future dilemmas. By making decisions, navigating ethical tensions, and interacting with speculative technologies, participants experienced firsthand the complexities of future connections spanning intimacy, kinship, parenting and more.

To capture qualitative insights, reflection activities such as narrative and journaling documented participants' hopes, concerns, and agency in shaping these futures. This method surfaced the emotional and ethical dimensions of technological change, often overlooked in strategic foresight.

This experimental research contributes to anticipatory ethnography and futures design, offering a framework for policymakers, designers, and researchers to engage in embodied speculation. By exploring how individuals might accept, resist, or reshape these potential futures, it provides a critical lens for understanding the social implications of emerging technologies on human relationships.

Keywords: Social Simulations, Experiential Futures, Relational Dynamics, Speculative Design, Emerging Technologies, Anticipatory Ethnography

Embodiment as a Counterbalance to the Socio-Technical Transformation of our Digital Future ♦

Andrena Woodhams

Yinbound LLC, the United States

Our rapidly evolving technological landscape is eroding the ability to maintain focus, autonomy, and sound decision-making. This not only fosters a dangerous rise of extreme ideologies, conspiracy theories, divisiveness and fear, but also increasingly impacts mental health and well-being. This presentation explores embodiment — the conscious deepening of awareness from the cognitive mind to fully inhabiting the somatic intelligence of the body—as a powerful counterbalance to this growing trend.

Drawing from my book, *Embody: The Power of Presence in an Age of Distraction*, and three decades in somatic body awareness and the exploration of consciousness, this framework offers a hands-on approach to navigating these digital future challenges. It is based upon research across four continents that reveals how embodiment can shift attention patterns, stress levels, and human connection—all areas profoundly impacted by our digital existence. Embodiment goes beyond shifting awareness from cognitive overload to an integrated, fully cohesive presence in both body and mind. It turns the body into a grounded, decision-making compass that is tuned to the nuances of the world. This plays a crucial role in helping to reduce the addictive and potentially dangerous unconscious biases that algorithms use to capture and exploit our attention. The ability to access a boundless resource of strength and self-awareness mitigates the stress caused by smartphone dependency, social media pressures, and anxieties about AI's growing influence in our lives.

Beyond individual benefits, this work has significant implications for organizations and policymakers. As we design futures where technology and humanity co-evolve, embodiment offers essential tools for human-centered innovation. A new tool, Body Intelligence (BQ) is being developed as a practical roadmap to deepen awareness and achieve more effective outcomes. Integrating BQ into discussions on technology's future can foster holistic, sustainable strategies that honor our humanity while embracing technological progress. This is a powerful step towards creating a future where digital advancement enhances rather than diminishes our human experience.

Keywords: Digital Distraction vs Well-being, Technological Impact, Somatic Awareness, Body Intelligence, Human-Centered Innovation, Presence Practices, Technology Impact Assessment, Consciousness

4. Chair & Invite: Long-term scenarios for humankind ♦●

Time: Tuesday 10 June 2025 at 17.15–18.45

Room: KINO

Chair: Jean-Eric Aubert

Visions of 21st Century: Maps and Routes ♦

Jean-Eric Aubert

Foundation 2100, France

How will humankind evolve between now and 2100?

That's the question addressed by this study done by three French foresight organizations (Fondation 2100, Société française de prospective and Réseau Université de la Pluralité). It begins with an analysis of the major trends that will shape or influence human societies over the course of the century (maps). Those trends concern

the climate and environment, technology, demography, geopolitics, politics, economy, and anthropology. It then proposes several evolutionary scenarios based on the behaviors these societies will adopt in the face of the risks and opportunities that will arise (roads).

Four scenarios are detailed. Two positive scenarios include a trajectory towards a «Techno-humanistic» civilisation, and a trajectory towards a «Symbiocene» era replacing the «Anthropocene». Two negative scenarios include the evolution towards a «World of over armed blocks» and an evolution towards «Multiple regional collapses». Conclusions emphasize the need for quick and proactive actions to prevent irreversible situations that will be more and more intractable as time goes on. They concern the fight against climate change, the control of technology and peace in the international community.

When presenting the study at the conference, indications will be also given on how the study is being disseminated in France and at the international level to different public targets with a view to raise awareness and behavioral change. The study in draft form (120 pages) is available at <https://visions.2100.org> (in French, in English in March 2025)

Keywords: Megatrends, Scenarios, 2100 horizon, Techno-humanistic civilisation, Collapses, Human societies' behaviors

Alternative futures of the internet toward 2035 ♦

Martin Butler^a – Doris Viljoen^b

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^b Stellenbosch University, South Africa

Since its inception, the internet has continuously evolved as new use cases are discovered, applications are developed, and emerging technologies provide enhanced capabilities. It remains the information superhighway for commerce, social interactions, and various sources of value creation.

The evolution of the World Wide Web, particularly from Generation 1.0 to 2.0, is well-defined and understood. With the rise of decentralized web technologies challenging the dominance of major tech firms, divergent views have emerged among different stakeholder groups regarding the future of the internet and the World Wide Web. Concurrently, the evolution of security technologies and an increasingly complex regulatory landscape have developed in a reactionary manner, creating regulations to provide guardrails for existing applications, rather than with a clear end objective in mind. The advent of Connectionist AI, distinct from 60 years of Symbolic AI, has led to the creation of true "black holes" that can produce unexpected results, prompting debate about AI's role in the future of the internet.

Through an iterative research process, seven fundamental factors were identified that could shape alternative futures of the internet: governance, regulation, skills and agency, intelligence, content ownership, security, and experience. These factors were categorized through a cross-loading analysis as critical, active, reactive, and buffer factors. Boundary conditions for each factor were established to summarize the system that could influence the internet's futures.

A set of plausible scenarios was created to envision potential alternative developments of the internet leading up to 2035. These scenarios allow users to mentally rehearse three distinct futures while exploring how each scenario could impact individuals, businesses, and policymakers.

The factors were presented to participants at workshops to analyze how these factors could interact with and influence one another. Through workshops held at Vlerick Business School in Belgium and the Institute for Futures Research at Stellenbosch Business School in South Africa, three plausible scenarios were developed.

This paper will share the process followed, the pivotal factors identified, the scenarios created, and initial insights about the implications for individuals, businesses, and policymakers. Participants will also have the

opportunity to contribute their insights and learnings from the scenarios, which will be compiled into a final publication after the conference.

Keywords: Internet, Futures, Scenarios, Semantic Web, Web3, Web3.0

Form Follows Fear: Design Approaches to Extreme Future Challenges through the Lens of the Unknown •

Maria Maciejko – Alejandro Lecuna

Anhalt University of Applied Sciences, Germany

The prevailing narratives about futures often include both societal and environmental challenges, which seem to be very distant from the present. These scenarios, extrapolated from the world's pressing issues such as climate change, resource scarcity, and sociopolitical instability often induce fear and dissonance because of the uncertainty of the future. Addressing such complex issues requires long-term systemic interventions, which are neither straightforward nor easily actionable. However, engaging design to approach challenges allows us to look at them through a perspective of creativity, in order to speculate on actionable responses.

This study investigates how design can be employed in order to confront extreme future challenges, with a focus on ideating technological artefacts that challenge common perspective. Engaging with dire future scenarios allows us to navigate unfamiliar futures while fostering both creativity and a sense of agency. Designing for such projections encourages one to familiarise oneself with fear in order to overcome it.

In order to inform this research, we conducted and evaluated a future-oriented design course in a higher-education setting. The course engaged participants in speculating on extreme future scenarios and creating technological design interventions that extend beyond traditional design boundaries. Drawing from its outcomes, we evaluate the role of design as a tool for both speculation and addressing problems, offering to confront challenges through creativity and innovation.

This research provides guidance on how to apply design approaches to introduce technology-oriented discussions in the context of extreme future challenges. This in turn allows us to apply design practices to address these challenges and foster a sense of agency in unknown scenarios. By engaging with extreme futures, this study contributes to the ongoing discourse about how creativity can aid in shaping responses to future challenges.

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Keywords: design futures, speculative design, alternative futures, extreme scenarios, extreme future challenges

Challenges with Futures Knowledge in Nuclear Waste Management ♦

Jarmo Lehtikainen – Reda Guerfi – Jarkko Kyllönen

Radiation and Nuclear Safety Authority STUK, Finland

Safety assessments in the nuclear waste management (NWM) sector have a very long tradition of relying on model projections to create futures knowledge at the expense of a broader exploration of deeply uncertain future developments of a waste disposal system. The social dimension in the creation of visionary knowledge and the methodological advances made by the futures studies (FS) community have largely been ignored by the NWM community. A safety case, defined as the argument and evidence supporting claims about the safety of the system, should be defensible against challenge and attack. It is explained why the relational nature of the futures knowledge in scenarios provides a unique opportunity for any informed enough stakeholder to challenge an operator's safety case and address the effects of wider power inequalities to democratise the future by providing a complementary inquiry into the future (a post-normal dimension). Consequently, the 'trust-but-verify' or 'technology-and-industry-know-best' orientation by a regulator is unsustainable in that it would blindly accept that the futures knowledge created by the operator would falsely represent the one and true knowledge as if to close the future. Given the extremely long assessment time of one million years associated with the deep disposal of spent nuclear fuel (SNF) in Finland, which far exceeds that in other contexts, it would be of paramount importance to involve the FS community more closely in considering how best to address the deep uncertainty in exploratory scenarios. In this piece, we try to improve the awareness of the FS community about the challenges faced by the NWM community when seeking to demonstrate the post-closure safety of the SNF disposal in a robust fashion, hoping that the NWM community and the FS community will find ways to overcome these challenges together.

Keywords: nuclear waste management, futures knowledge, scenarios, safety case, awareness raising

5. Bridging foresight and management: futures studies approach in management practices ♦●

Time: Tuesday 10 June 2025 at 17.15–18.45

Room: GOTO 33

Chair: Hanna Heino

Foresight for Beginners using AI ♦

Jeremy Wilken

The United States

Newcomers to Foresight are often left with little to start from and in many cases are operating independently. In this session, I'll share the outline of the workshop, how I encouraged people to get started with Foresight, and what worked or didn't work with incorporating AI into the process.

Keywords: foresight methodologies, AI in foresight, training, beginner upskilling

Empirical consumer research in corporate foresight •

Pauli Komonen

VTT Technical Research Centre, Finland

This conference presentation explores the role of empirical consumer research in corporate foresight. Consumer insights allow the creation of customer-centric strategies, and a future-oriented consumer understanding can make these strategies more resilient over time. The connection between consumer research and corporate foresight has received limited attention in prior studies, and the integration of consumers into foresight processes appears to be rare in the literature. Still, companies have recognised the importance of systematically understanding future customers.

The presentation builds upon the author's recent doctoral dissertation. This multidisciplinary study integrates theoretical perspectives from futures studies, corporate foresight, consumer research, and sociology of futures to interpret its findings. Employing a multi-method approach grounded in consumer research, the study combines various methods to collect data. Partly carried out in collaboration with companies, the research also incorporates strategic management and knowledge management perspectives to explore the organisational value of future-focused consumer insights. The theory of anticipation is central to understanding the future orientation of consumption.

Strategic leadership in companies can leverage future-oriented consumer insights throughout all phases of a foresight process. Consumer foresight offers a distinct competitive advantage, serving as a valuable resource and dynamic capability for differentiation. This study demonstrates that consumer engagement in foresight can adopt interpretative, visionary, co-creative, and validating orientations. As consumers' roles during different parts of the process vary, choosing an appropriate consumer engagement method for each phase becomes crucial. The study engaged several consumer segments: people with lead user and visionary characteristics, consumers identifying as early adopters, and balanced samples of consumers without a forerunner profile. This integrative approach is defined as participatory consumer foresight.

Using the participatory approach, a wide range of consumer insights was gathered. The consumers studied showed resilience, adaptability, and an ability to anticipate futures amid uncertain and volatile conditions, characterised lately as an era of polycrisis. Changing circumstances disrupted consumption patterns, lifestyles, and visions of post-crisis futures. Suddenly, futures became less linear and deterministic. Consumers imagined a wide selection of future possibilities, encompassing both continuity and change. The interplay between future imaginaries and present actions shaped anticipation in consumption. Social structures, technologies, and material factors influenced this anticipation. This future orientation in consumption forms a common ground for consumer research and corporate foresight, and provides applicable insights for foresight practitioners.

Keywords: corporate foresight, consumer research, strategic management

Beyond prediction: the complexities and rewards of applied foresight ♦

Anna Sacio-Szymańska – Bartosz Frąckowiak – Katarzyna Figiel – Norbert Kołos

4CF The Futures Literacy Company, Poland

The purpose of the presentation is to present foresight tools, interim results and share lessons learned from 4 ongoing Horizon Europe projects:

IDEALIST (2024-2026): Mapping weak signals with 11 industrial clusters representing A&D; EIs and MTA supporting management practices of SMEs and boosting their resilience <https://www.idealism-project.eu/>

BOOST4BIOEAST (2024-2026): Guiding bioeconomy expert communities in 11 countries to develop 2030 National Action Plans using adapted Three Horizons method <https://bioeast.eu/objectives/>

MASTT2040 (2024-2025): Envisioning the future of European manufacturing and the role of "Manufacturing-as-a-Service" to enhance digital and green transitions <https://www.mastt2040.eu/>

Geek4Food (2023-2025): Revolutionising Food Education with Artificial Intelligence (AI) <https://geek4food.com/>

Overall, this presentation and these projects demonstrate that foresight innovation lies not only in adopting new technologies, but also in:

- Applying foresight to new contexts and challenges.
- Engaging stakeholders in meaningful ways.
- Adapting and combining methods creatively.
- Bridging the gap between foresight and action.

Based on IDEALIST's foresight process we shall demonstrate how to effectively lead industrial clusters in improving their management practices by helping them identify "weak signals" to inform their strategies, build a learning culture and increase organisational resilience.

Based on BOOST4BIOEAST's foresight process we shall demonstrate how to effectively guide the collective development of National Action Plans, and thus engage in anticipatory governance for the bioeconomy.

Based on MASTT2040 we shall explicitly address the role of "Manufacturing-as-a-Service" in Twin transitions including a set of 20 future use-cases of MaaS in the context of European manufacturing scenarios.

Based on Geek4Food we shall demonstrate how AI is used directly to analyze skills and provide personalized career guidance in the Agri-Food sector. We shall also demonstrate methodological innovation linking technology-based approach (an AI platform) with the scenario exploration practices with Agri-Food sector stakeholders to boost creativity and bridge knowledge gaps.

This presentation offers valuable insights into how foresight can be integrated into diverse areas, from industrial clusters and national policymaking to individual career planning. By showcasing practical examples from four European projects, it demonstrates that foresight is not just a theoretical exercise, but a powerful tool for navigating change and shaping the future. The implications for practice are clear: organizations and individuals alike can benefit from actively engaging in foresight, using it to inform strategy, build resilience, and adapt to emerging technologies. For policymakers, the presentation highlights the importance of anticipatory governance, particularly in areas like the bioeconomy and the digital and green transitions.

However, realizing the full potential of foresight can be hampered by a combination of factors. Creatively combining methods can be resource-intensive, limited creativity among stakeholders, who may default to visions imposed by popular culture or struggle to envision innovations beyond technological advancements; a fear of the future that can lead to resistance towards embracing new possibilities; and, drawing from Baudrillard's thinking, a tendency to prioritize simulations and representations of the future over genuine engagement with its complexities and uncertainties.

Keywords: actionable foresight, stakeholder engagement, creative futures, emerging technologies

National culture differences in foresight and how those impact scenario creation, description, and communication ♦

Per Ostberg

South Africa

Hypothesis: There are national culture differences in how we see the world evolve and what we value and desire, thus different nations create different scenarios. These differences also affect the language we use to describe the scenarios, making similar scenarios appear different.

In a world that is increasingly more connected and at the same time more divided than ever before, being able to communicate ideas, visions, and solutions to global challenges across a culturally diverse audience (be that in business, academia, or at policy level) will become a vital skill. Without these communication skills, miscommunication and misunderstandings will be rife, possibly leading to missed opportunities and sub-optimal implementation of strategies and solutions.

That different national cultures value different things and thus communicate and act differently is a concept defined and made popular in the 1970s by Prof. Geert Hofstede and his cultural dimensions. Albeit there have been challenges to these cultural dimensions, I find them useful as a starting point, an initial framework, for analyze how national culture differences might influence future scenarios and the language used.

At this initial research, I look at and analyze scenarios from countries that are far from each other in Prof. Hofstede's cultural dimensions as well as only using a couple of his culture dimensions. Selecting countries at the extreme ends of the cultural dimensions and only using a few of the cultural dimensions will give us an early indication of if there is a discernable difference between national cultures or not.

The presentation has two aims: Firstly, I hope that it will stimulate further research in this field, and secondly, I hope that it will provide an awareness and initial framework for how corporates and organizations can communicate future scenarios across cultures without losing their meaning and nuances.

Keywords: Scenarios, National Cultures, Intercultural Communication, Scenario communication, Management

6. Workshop: The Future of Decision-Making – AI-Driven Foresight ♦

Time: Tuesday 10 June 2025 at 17.15–18.45

Room: GOTO 31

Facilitators: Anna Grabtchak, Max Stucki & Marianna Mäki-Teeri

Anna Grabtchak – Max Stucki – Marianna Mäki-Teeri – Aleks Hämäläinen

Futures Platform Oy, Finland

Technology today revolves around using tools, constructing systems and implementing methods. However, the technology of the future may shift towards enhancing decision-making. Understanding technological advancements may suffice in the present, but shaping a better tomorrow requires clarifying better futures for decision-making.

As the world keeps changing constantly and rapidly, effective foresight is essential for organizations, policymakers, and researchers to recognize the changes, detect the challenges, seize the opportunities and, in the end, make better decisions. Traditional foresight methods, though valuable, often rely heavily on individual expert opinions and manual research, which limits their scalability and adaptability. Modern tools, driven by

digital collaboration, artificial intelligence (AI), and big data analytics, are revolutionizing foresight practices, enabling deeper insights and better understanding concerning the futures.

These technologies enable more comprehensive analyses, allowing for the detection of weak signals, emerging trends, and complex interdependencies. Digital foresight platforms facilitate diverse stakeholder engagement, creating a more holistic process vital for strategic planning. AI algorithms can analyse vast datasets, uncover patterns, and generate scenarios rapidly, find biases, shifting the focus from reactive to proactive strategies. A key advantage of AI-driven and platform-assisted processes is their significant time-saving potential compared to traditional human-driven analysis. By automating routine tasks, experts can dedicate more time to value-added processes such as sense-making, dissemination, and developing actionable strategies and policies. This shift enhances foresight quality and allows more time for execution, improving the decision-making process in general.

This presentation will feature a live demonstration of Futures Platform's foresight solutions, showcasing how these innovative tools enhance foresight capabilities. By integrating digital collaboration, AI-driven analysis, and interactive visualizations, Futures Platform enables organizations to collaboratively create shared future views, prioritize future possibilities, generate scenarios, and develop robust strategies. The demonstration illustrates how integrated foresight solutions can improve the agility and effectiveness of strategic planning, equipping organizations to navigate complex and uncertain security environments with greater confidence in their decision-making.

Key topics:

1. AI Futurist (AI-technology based tool),
2. Foresight Radar (Futures of Human-AI paired decision-making),
3. Foresight methods & tools.

Agenda for the workshop:

- Introduction to theoretic background
- Exercise 1: Testing Foresight Radars,
- Exercise 2: Testing AI-futurist tool.
- Summarizing results & discussion

Keywords: Foresight Methods and tools, Artificial Intelligence (AI) in Decision-Making, Digital Collaboration, AI-Driven Foresight, Human-AI Collaboration

7. Workshop: The Green, Clean, Mean Machine ♦

Time: Tuesday 10 June 2025 at 17.15–18:45

Room: GOTO 32

Facilitators: Simon Önnared & Rizzato Devlin

Simon Önnared^{ac} – Erin Rizzato Devlin^{bc}

^a Mälardalen University, Sweden

^b University of the Highlands and Islands, the United Kingdom

^c University of St Andrews, Scotland

BACKGROUND

This workshop aims to problematise and reimagine the futures of renewable, clean and just energy transitions. Global energy consumption is increasing and demand for electricity is surging. Gone are the days when efficiency improvements and continued growth cancelled each other out. Reducing energy consumption is becoming an increasingly crucial solution to reduce the negative environmental effects of energy over-

consumption, while promoting an affordable and sustainable energy transition. This comes with important social, ethical and technological implications due to the global nature of renewable energy production, distribution and consumption. Currently, new technologies are introducing hockey-stick consumption projections, together with the electrification of industry, transportation and heating, requiring vast amounts of renewable and/or clean energy technologies. This calls into question the very sustainability and ethics of these technologies, along with the more fundamental question of whether the target of a sufficient level of energy consumption can be achieved.

THE WORKSHOP

Working off two scenarios of energy abundance, one based on renewable energies, and the other on clean energy technologies – these scenarios are stretched to their limits to problematise the ethics of either one. From which we explore the ethics of instead reducing energy consumption, viewing energy as a limited resource. The workshop invites participants to reflect upon questions such as:

- What would a world of energy abundance look like driven through either renewables or clean energy?
- What would energy systems in techno-utopic or ecological futures look like?
- What would be the issues in these different worlds?
- What are the possible positive and negative outcomes of limiting energy consumption?

Taking us through a discovery process of stretching our imaginations, realising the energy-material metabolic need to limit consumption and therefrom explore the ethical considerations of reducing consumption.

IMPLICATIONS AND TAKEAWAYS

This workshop sheds light on the implicit structures, assumptions, and implications of future energy systems. In doing so, it opens up for new considerations of limits to energy consumption, relations between local and global ethics, and discusses the operationalisation of energy sufficiency in industry, policy, and research.

Keywords: Energy futures, justice, ethics, renewable energy, clean energy, sustainable futures

WEDNESDAY 11 JUNE 2025

♦ PRACTICE-oriented

• ACADEMIA-oriented

Session 2: 11 June 2025 (Wednesday) at 13.00-14.30**1. Special Session: The radical and the resilient – Narratives to highlight the road to desired futures of work ♦**

Time: Wednesday 11 June at 13.00–14.30
 Room: LOGI
 Chairs: Sirkka Heinonen (FFRC), Saija Toivonen (Aalto University),
 Osmo Kuusi (Finnish Society for Futures Studies)
 Keynote: Jerome Glenn
 The Millennium Project, the United States

The Radical and the Resilient – Narratives to highlight the road to desired futures of work ♦**Sirkka Heinonen^a – Osmo Kuusi^{ab} – Saija Toivonen^b**^a Finland Futures Research Centre, Finland^b Aalto University, Finland

How resilient will future workplaces be in digital and green transition? And how radical might relevant spatio-temporal solutions be? What critical skills are needed to achieve this transition?

This Millennium Project Special Session will present our actor-based radical narratives of the futures of hybrid work for 2035. Even though the time horizon is short, rapid developments in AI and other next technologies may generate surprising socio-cultural and geo-political turns in the work setting. The session is organised as a Futures Clinique in co-operation between Finland Futures Research Centre (FFRC), the Finnish Society for Futures Studies, Aalto University and the Helsinki Node of the Millennium Project. The Chairs will give futures provocations – depicting radical and actor-based narratives and their spatio-temporal features of remote work, addressing narratives' semiotic viewpoints, and pragmatic communication with stakeholders concerning the built environment and employers. The narratives are about Edwin the Econaut, Irene the Influencer, Doris, the Dream Doctor, and Ranjit the Quantum Revolutionist.

Jerome Glenn, the CEO of the Millennium Project, will give a keynote to stimulate interactive co-creation in small groups elaborating the narratives towards desirable futures and offer direct feedback. He will present the most recent developments and caveats in ANI (Artificial Narrow Intelligence) and its early transition toward AGI (Artificial General Intelligence), as related to futures of work. He will also give some in-depth comments on the four narratives.

The topic of work is full of contradictory elements and developments that are opposite to one another but are still happening at the same time. We have earlier applied the method of paradox probing which helps to deconstruct complex issues. This set of four narratives on the futures of work is based on our two-round Delphi study and expert interviews (conducted within the T-winning Spaces 2035 Project, funded by the Research Council of Finland and the EU NextGeneration). These narratives also offer a tool to communicate with stakeholders to address manifold implications. The Futures Wheel will be used to elaborate and evaluate the narratives co-creatively in small groups.

Anyone interested in futures of work, in narratives, or want to experience applying hybrid foresight methods, is welcome to join our session.

Keywords: radical narratives, futures of work, AI, Millennium Project, futures clinique

2. Anticipatory governance of emerging technologies •

Time: Wednesday 11 June at 13.00–14.30
 Room: TEATRO
 Chair: Ville Lauttamäki

Governing technological change anticipatorily: a Policy Delphi on the future of AI governance •

Ate Ojanen^{a-b} – Johannes Anttila^b – Anna Björk^b – Thilo Thelitz^b

^a University of Turku, Finland

^b Demos Helsinki, Finland

The rapid development of artificial intelligence (AI) presents unique challenges for policymakers seeking to govern the technology. Perhaps nowhere else is the classic Collingridge (1982) dilemma more apparent: AI risks are hard to predict until widespread societal deployment of systems, at which point regulation is difficult. While the Delphi method has been increasingly utilized to anticipate technological development of AI in different sectors such as healthcare and manufacturing, relatively few such studies have specifically focused on its governance (Alon et al. 2024). Moreover, despite the wealth of research on Delphi method – including real-time approaches – the specific contribution of the method to anticipatory governance remains underexplored, particularly within rapidly evolving technological fields. Addressing this gap, this article investigates how a Policy Delphi process, applied to the complex case of AI governance, can yield novel insights into both the substantive challenges of future-proof AI regulation and the methodological advancements of the Delphi method itself.

The article builds upon a two-round Policy Delphi study with European AI experts conducted in the summer of 2024, focusing on the future of AI governance. Moving beyond traditional applications of Delphi focused on technology forecasting, we leverage the theoretical lens of anticipatory governance to explicitly interrogate the method's capacity to elicit expert expectations and consensus regarding future-proof policy design. Consequently, our analysis is not only focused on understanding expert views on the future of AI governance and EU AI Act, but also on evaluating the strengths and limitations of Policy Delphi as a tool for informing anticipatory and future-oriented policy-making.

Our findings demonstrate that the Policy Delphi effectively captured a diverse spectrum of expert expectations concerning AI risks and potential governance approaches. Intriguingly, analyzing the consensus within the Delphi process revealed an inverse relationship between desirability and feasibility – experts saw the most desirable and forward-looking AI policy options also as the most unlikely. These results suggest that future-proofness of AI regulation is less contingent on the technical scope of the regulatory perimeter and more dependent on the sustained commitment of policymakers to robust enforcement (cf. Colomo, 2022). Overall, our methodological approach reveals the value of Policy Delphi in uncovering potential tensions within anticipatory governance, such as the identified conflict between future-proofness and democratic values in the EU AI Act. The article contributes to the frontier of research on Delphi method by demonstrating its specific utility for analyzing rapidly emerging policy challenges inherent to AI governance.

Keywords: AI, delphi, policy, governance, anticipation, future-proof, regulation

Can technology trajectory change break lock-in? - Evidence from the comparisons between Carbon-Based Electronics and EUV Lithography technologies •

Pei Chen – Zhaohui Xuan – Like Yuan

Chinese Academy of Science and Technology for Development, China

To break technology lock-in in semiconductor, emerging countries such as China recently concentrate on the development of emerging green technologies. Choosing the appropriate technology trajectories and undertaking suitable strategies are important for latecomers. To break the technological lock-in in the semiconductor field, such as China's recent concentration on the development of emerging green technologies for semiconductors. For the latecomers, it is very important to choose the right technology trajectory and adopt appropriate strategies. Extreme ultraviolet (EUV) lithography and carbon-based electronics technology is the key field of semiconductor manufacturing breakthroughs. This paper analyzes the technology lock-in of EUV lithography and carbon-based electronic from two dimensions of technology field and technological innovation subject, so as to prove the possibility of carbon-based electronic "technology for trajectories". Firstly, drawing on the theory of technology regimes, the characteristics of these two technology fields are portrayed, and whether and to what extent technology regimes affects technological lock-in are explored. Secondly, we measure the intensity of technological lock-in in each source country in these two areas, analyze the gap between China and the incumbents, and assess the international competition in lithography from both macro and micro perspectives. The study found from a technical perspective, compared with EUV lithography, Carbon-Based electronics lock-in degree is weaker or there is no lock-in; from the subjects of technological innovation, the gap of lock-in intensity in EUV between China and other countries is larger than the gap in carbon-based electronic, thus verifying the possibility of "technology leapfrogging" through carbon-based electronics. This study offers insights into the catch-up of semiconductor or sustainable technologies in China and other emerging economies.

Keywords: technology lock-in, technology trajectories, Extreme ultraviolet(EUV) lithography, carbon-based electronics

An Assessment and Governance Framework for the Impact of Artificial Intelligence on Future Socioeconomic Development: A Case Study of China •

Yifang Ma – Like Yuan

Chinese Academy of Science and Technology for Development(CASTED), China

BACKGROUND AND PURPOSE

Artificial intelligence (AI) is driving unprecedented technological transformation, reshaping production systems, lifestyles, and governance paradigms. While AI enhances productivity, fosters innovative business models, and creates new market and employment opportunities, it also poses significant challenges: pressuring traditional industries to adapt, disrupting labor market structures, and raising ethical concerns such as privacy breaches, data security vulnerabilities, and algorithmic discrimination. Existing governance systems may lack the agility to address these evolving risks, necessitating proactive approaches to align technological progress with societal well-being.

METHODS

This research employs following methodologies: 1) Systematic literature review to analyze global trends in AI governance and socioeconomic impact studies; 2) Field research on top domestic AI enterprises to find out the future trends; 3) Delphi expert surveys to integrate technology foresight with practical governance needs. This

study will focus on researching the future trends of AI, and its impacts on the economy and society according to the AI development ecosystem, and put forward corresponding governance framework.

FINDINGS

Based on literature reviews, field research and Delphi methodology, we assess socio-economic impact of AI and propose a governance framework with critical dimensions tailored to the Chinese context. It emphasizes identifying AI's dual effects through interdisciplinary methodologies and to promote responsible governance.

CONCLUSION AND IMPLICATIONS

As a bridge between technological innovation ecosystems and governance mechanisms, this AI socio-economic impact assessment and governance framework will equip decision-makers to systematically evaluate AI's multifaceted impacts for better dynamic governance strategies.

Keywords: Artificial intelligence, Socio-economic impact assessment, Governance framework, China

Shaping the future of small modular reactors: Future research trajectories needed for strategic planning guidance •

Maaria Nuutinen – Jyri Rökman – Juuli Huuhamäki – Tapani Ryyänen

VTT Technical Research Centre, Finland

Small Modular Reactor (SMR) is an emerging technology for electricity and heat production, promising a flexible and low-carbon energy source to help firms, cities and nations achieve emission reduction targets. However, the societal, technological, and economic viability of SMRs remains uncertain due to e.g. regulatory challenges, social acceptance, safety concerns, and competitiveness of SMR as a clean energy source compared to alternatives.

This study aims to enhance the understanding and strategic planning of SMRs in uncertain market conditions by identifying the main obstacles and drivers for SMR adoption. It focuses on implications for energy utilities and public sector decision-making. The research questions are: What are the main uncertainties related to shaping sustainable SMR markets? How can strategic decision-making in the utilities sector be enhanced in highly uncertain future energy and SMR markets?

The study employs a literature review, document analysis, and interviews with stakeholders, including energy companies, cities, the radiation safety authority, and experts from related ongoing projects. This research represents the first phase of a broader study, with methods refined based on the analysis.

This paper presents an ongoing study with preliminary findings refined as the study progresses. Preliminary findings indicate several areas requiring further research to enhance the understanding and strategic planning of SMRs. Key areas identified include uncertainties and preconditions for SMR market emergence, including technological challenges, market demand, and regulatory developments. It also highlights the importance of understanding the expected impacts of SMR deployment on energy production, including efficiency, costs, and environmental effects. Investigating uncertainties related to investment attractiveness, costs, and future cash flows is necessary. The study also emphasizes exploring stakeholder perspectives on needs, barriers, drivers and beliefs of SMR adoption and anticipating future scenarios based on these. Through this, the impact of SMRs on companies and cities, and the formation of sustainable markets can be understood. Finally, it highlights the examination of political, economic, regulatory, environmental, social, and technological developments influencing SMR utilization and impacts.

The research will enhance the understanding and strategic planning of SMRs in uncertain market conditions. Summarizing emerging understanding into critical uncertainties, creating future scenarios, and developing decision-making methodologies supporting energy utilities in recognizing and analyzing their strategic options are essential. These steps are needed to achieve better conditions for responsible, acceptable, and

sustainability-promoting utilization of SMRs as part of the energy system and policy. Incorporating a business perspective and ensuring acceptability are crucial for the successful adoption of SMRs.

Keywords: Strategic planning, Foresight, Research avenues, Qualitative study, Technology adoption, Sustainability, Nuclear energy

3. Transforming education with innovative technologies ♦

Time: Wednesday 11 June at 13.00–14.30

Room: GALLERY

Chair: Arho Suominen

Co-Designing STEAM Education Future Research and Policies: A Progressively Pre-Filled Technology Roadmapping Technique •

Sabrina Bresciani^a – Yuhao Jiang^b – Francesca Rizzo^a

^a Politecnico di Milano, Italy

^b Hunan University, China

STEM (Science, Technology, Engineering, and Mathematics) education is considered essential for countries' competitiveness (Bybee, 2010), yet, educators argue that for addressing critical challenges of the 21st century, the classic STEM approach overlooks creativity-related elements, indicated by the letter "A" for Arts (Daugherty, 2013) in the STEAM (Science, Technology, Engineering, Arts, and Mathematics) acronym. Several countries have introduced policies to promote STE(A)M education (Allina, 2018), while developing a long-term, macro-level policy planning and funding for STEAM remain challenging. The EU-funded RoadSTEAMer project on STEAM education roadmapping of future research and policies, provides the context for testing the extension of the classic foresight technique of technology roadmapping (Phaal & Muller, 2009) with a massive co-design approach (Meroni et al., 2018) through a progressively pre-filled visual canvas facilitating collective foresight (Misuraca et al., 2012; Newton et al., 2024).

Building on the proven advantages of the technology roadmapping technique to visually facilitate foresight and strategizing (Phaal & Muller, 2009; Yasunaga et al., 2009), this study proposes extending the technique to participatory policymaking with massive co-design, taking a reflexive approach to investigate the benefits and challenges.

Specifically, the proposed methodology consists of four phases.

- Phase 1. Pre-fill the Roadmap Canvas: In the technology roadmapping technique, the dimensions of information need to be defined according to the specific context of use (Phaal et al., 2004). The methodology is extended by pre-filling relevant background information.
- Phase 2. Co-design with Stakeholders: The pre-filled information provides participants with a synthesis of key information. Multiple sequential co-design workshops are organized with all relevant stakeholder groups: contributions are visually synthesized in the canvas, resulting in a progressively pre-filled methodology that supports asynchronous collective intelligence.
- Phase 3. Synthesis of the STEAM Roadmap: a synthesis workshop is organized to consolidate the inputs and transform them into a roadmap and specific future policies.
- Phase 4. Testing: policymakers and stakeholders are presented with the fully pre-filled canvas and are invited to assess and comment on the formulated future policies.

At present, ten workshops have been conducted with 57 stakeholders from a range of diverse backgrounds and areas of expertise, resulting in the collection of over a hundred policy inputs. This paper proposes and

reflects on extending technology roadmapping with a progressively pre-filled visual methodology to integrate massive co-design, enhancing democratization and collaboration in bottom-up national policy-making. It pragmatically develops an actionable roadmap for EU STEAM education funding, providing insights for advancing STEAM education.

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101058405 Road-STEAMer.

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Keywords: Future studies, Policy design, Technology roadmapping, STEAM education, codesign

Promoting the strategic future competence of a ministry with the help of AI. Approach and lessons learned from the Federal Academy for Security Policy, Germany ♦

Mando Gloger

Federal Academy for Security Policy, Germany

In Germany, the so-called "Zeitenwende" not only generally stressed the need to increase German efforts in maintaining European security. It also sparked the debate about the need of governmental institutions to design their policy practice in a way that proactively works with possible futures to increase future resilience. The German Federal Academy for Security Policy and its Center for Strategic Foresight, being part of the Federal Security Council and the Ministry of Defence, support this process. The Center promotes education, particularly in Government Foresight, for the operative levels of ministries and agencies, following a "whole-of-government"-approach and focusing on security-relevant topics. In the promotion of what is called "strategic future competence", new approaches to the use of Artificial Intelligence (AI) are being tested. At first, the concept's orienting model of individual and organisational future thinking is explained, drawing on futures literacy, strategic foresight, psychology and organisational sociology. Second, a selection of methods is presented – and the way they allocate roles to different AI models to be part of the collective learning process. To name just one example: The use of Large Language Models can be helpful in providing the simulated context of policy workshops, fostering inter-ministerial cooperation in fictional and responsive future scenarios. Third, lessons learned are shared. If time permits, it is possible to try out a short method with the audience in addition to obtaining criticism and feedback. As the topic is located at the interface between strategic foresight,

future studies, education and policy, it highly reflects the conference's core topics four and seven. In addition, the sharing of experiences gained through the varying socio-technical integration of AI in learning processes is highly reflective of the overall theme. The presentation may be of particular interest to practitioners in organisational education, members of state institutions as well as researchers in strategic foresight and futures literacy.

Keywords: Strategic Foresight, Education, Artificial Intelligence, Policy-Making, Governemental Institutions, Futures Literacy

Futures' Fingerprints AI: Assessment Integrating AI for Expert Imputation and Scenario Evaluation in Foresight Studies (124A) •

Caroline V. Rudzinska^a – Hermann W. Klöckner^{b,c}

^a Berlin School of Economics and Law, Germany

^b Hochschule Anhalt, Germany

^c Technical University of Munich, Germany

The integration of Artificial Intelligence (AI) in foresight methodologies is transforming traditional scenario assessment processes. This paper extends the concept of the tool 'Futures' Fingerprints' (Klöckner, Rudzinska et al., 2024) by incorporating AI-driven expert imputation within decision-making frameworks, focusing on following research question: how does the integration of Artificial Intelligence in foresight methodologies, specifically through the application of AI-driven expert imputation, enhance the consistency and depth of scenario assessments in strategic foresight processes? The proposed model addresses two core challenges in foresight: (1) mitigating inconsistencies and gaps in expert contributions through AI-supported imputation and (2) enhancing scenario depth exploration via AI-driven support.

AI-enhanced expert imputation employs machine learning algorithms to interpolate missing assessments, ensuring more complete, robust, and unbiased scenario evaluations. By learning from prior Delphi rounds and domain-specific knowledge bases, AI-generated assessments can dynamically adjust to evolving discussions, reducing cognitive biases and enriching expert knowledge. This method can upgrade the reliability and scalability of scenario assessments while maintaining the integrity of expert-driven insights. Furthermore, AI-driven scenario depth exploration generates counterfactual narratives and stochastic simulations, fostering more comprehensive and multidimensional foresight practices. AI-supported expert imputation supports decision-making and thus leads to an improvement in scenario validation. Our empirical evaluation, which was conducted as an extension of the "Futures' Fingerprints" framework, shows that this approach increases the consistency of assessments, improves interdisciplinary collaboration and increases the traceability of decisions in complex futures analyses.

This study, which is based on the analyzation of the tool "Futures' Fingerprints", contributes to the field of AI-supported foresight by empirically validating the role of AI in participatory futures assessment. Future research should also focus on refining AI-generated scenario extrapolations, developing hybrid AI-human collaboration protocols, and assessing the long-term impact of AI augmentation on foresight literacy and decision quality. By embedding AI within digital foresight environments, we unlock new avenues for anticipatory governance, strategic resilience, and interdisciplinary decision support in increasingly uncertain and complex systems.

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Keywords: Futures' Fingerprints, AI-supported foresight, AI-enhanced expert imputation, AI-human collaboration, Participatory futures assessment, AI-generated scenario extrapolation

AI driven transformation of teaching, learning and interaction at work by the year 2040 •

Minna Pura – Susanna Kivelä

Laurea University of Applied Sciences, Finland

The aim of the paper is to understand systemic effects how artificial intelligence transforms teaching, learning and interaction in working life. The study was conducted at the Laurea University of Applied Sciences in 2024 and at one of their partner companies simultaneously, comparing the level of AI literacy of different stakeholders, experts and exploring their opinions about interaction with AI in the future. The study was conducted as a Real-Time Delphi study as part of certification as Futures Delphi Professionals provided by Otavan Opisto. The panel included three separate subgroups of the teaching and learning ecosystem at Laurea UAS: 1) MBA students, 2) higher education teachers and digital pedagogy experts, and 3) employees of the partner company. In addition, the survey served as a pilot study utilizing a new software called <https://xdelphi.ai/>, experimenting and co-developing its' AI features. Findings show that the level of AI literacy varies between actors. The facilitated Delphi arguments and panel discussion were considered thought provoking and interesting. Overall, at the time of the panel one year ago, AI was still expected to stay as data organizer. But in learning and teaching context, it was already expected to provide individualized learning paths, and by the year 2040 apply information independently. Students visioned more authentic remote communication engaging people in different parts of the globe with the help of AI enabled 3D visualizations. On a positive note, AI was imagined in a facilitating role, connecting people globally and not only monitoring productivity, but also employees' wellbeing. On a negative note, in 2040 sobriety could mean abstaining from technology all together, due to limited ability to refrain from using AI. Teaching staff shared an experimenting attitude and willingness to learn, keeping ethical considerations in mind and avoiding risks – preferably in collaboration with companies. Partner company representatives emphasized the demand of learning new skills fast, without forgetting human experience in expert professions that are likely to become more complex in the future. Conclusions reflect possibilities and threats regarding work interaction in the intersection of humans and machines. A shared assumption was that humans and AI will gradually work in teams, in which each team member has found its' special expertise area and strength, complementing each other. To support such collaboration, different stakeholders and experts agreed upon a preferred future, where leaders have skills to manage both humans and AI and estimating that it is likely to happen by the year 2040.

Keywords: AI, interaction, wellbeing, transformation, delphi, teaching, learning

4. Human health and wellbeing, and emerging technologies •

Time: Wednesday 11 June at 13.00–14.30
 Room: KINO
 Chair: Martyn Richards

Enhancing Social Integration and Well-Being of International Students through Social Networking •

Hemamali Tennakoon^a – Nathali Seneviratne^b

^a Brunel University of London, the United Kingdom

^b Finland Futures Research Center, Finland

International students often face social isolation and cultural challenges when they move away from their home country and go abroad to pursue educational opportunities. Even though universities promote social integration, put effort into welcoming and integrating international students into the university environment, often some students struggle to 'fit-in', while others feel a sense of isolation in the absence of a like-minded social group to interact with. This often leading to student drop-outs, lower grades, and mental well-being-related issues.

In this study, we inquire about the larger question of how online social technologies enhance the futures of international Students' integration and well-being. To achieve the purpose of the study, we aim to identify patterns of effective social engagement and analyse barriers to integration. Further, using the interdisciplinary field of futures studies, we aim to explore how futures images reflect their future wellbeing needs and integrational experiences.

We posit that specific social networking strategies, including structured online communities and platforms dedicated to student interaction, can improve social integration and reduce the psychological stress associated with living abroad. By drawing on social network theory, cross-cultural psychology, and digital sociology, the project will map the intersections between face-to-face interactions vs digital interactions, digital connectivity and online social support systems for improving integration and student well-being.

This research will employ a mixed-methods approach, combining qualitative interviews with quantitative surveys across two European higher education institutions (From Finland and the UK). An online survey will be designed using validated scales such as the Experiences of Social Inclusion Scale, Student Adaptation to College Questionnaire, and the Warwick-Edinburgh Mental Well-being Scale. The survey will be distributed to a sample of 300+ international students from UK and Finland, to measure levels of social inclusion, psychological well-being, and the usage patterns of social networking platforms. The qualitative part of the study will consist of in-depth, semi-structured interviews, conducted using 30 international students. The Futures images will be constructed based on the data collected through semi structured interviews and will be analysed using Causal Layered Analysis.

The findings will provide insights into how online social technologies can contribute towards enhancing social belonging and emotional resilience. By bridging the gaps between education, technology, and social policy, this research will generate valuable knowledge, provide recommendations for policy-makers and educators that aids in fostering a more inclusive academic environment. The project will benefit international students and also enhance broader multicultural understanding within academic communities.

Keywords: Social Integration, Student Wellbeing, UK, Finland, International Students, Online social technologies, Mixed-methods

Voices of the future shaping technologies? Participatory aspects of Anticipatory Governance •

Kaisa Lähteenmäki-Smith – Helmi Hämäläinen – Janne Lehenkari – Johanna Leväsluoto – Ville Valovirta – Matti Pihlajamaa

VTT Technical Research Centre, Finland

The paper is a presentation of key features of a literature study, undertaken within the GOWELL project funded by Business Finland. GOWELL explores the elements and preconditions for anticipatory governance in emerging technologies, highlighting the importance of proactive stakeholder engagement and interactive processes in the early phases of technology development, with key approaches ranging from foresight and stakeholder engagement to ethical considerations. The three cases explored include a challenge-driven case of preventive services to avoid the accumulation of health and social problems (i.e. Type 2-Diabetes), technology-driven, close-to-market case of AI for medical technology, and a technology-driven case, representing features predominately from fundamental research (i.e. simulation of new materials using quantum computing).

Foresight involves structured methods like scenario planning and horizon scanning to anticipate future developments and manage risks. Stakeholder engagement ensures the involvement of diverse groups in decision-making processes, fostering inclusiveness and building trust. Ethical considerations address transparency, responsibility, and the broader societal implications of emerging technologies. Anticipatory governance is often discussed in connection with 'wicked problems', i.e. problems that have no definitive formulation and therefore cannot be treated like the classic problems of engineering or mathematics, solvable by scientific knowledge and solutions for example (Rittel & Webber, 1973, p. 160). In other words, the approach often referred to as the scientific (or evidence-based) method (defining the problem – gathering data – analysing data – proposing and implementing a solution) is not the best way to approach them, rather is likely to fail. The literature review suggests that addressing wicked problems (Termeer et al 2019) associated with emerging technologies requires collaborative strategies, cross-sectoral learning, and a mix of problem-solving and problem-finding approaches. It highlights the need for new forms of collaborative strategies and stakeholder engagement to address these challenges effectively. The review also shows a growing body of academic research and policy interest in anticipatory governance of emerging technologies. The most common methodological components are foresight, stakeholder engagement, and ethical considerations. Additionally, the literature addresses questions on learning and consensus building in cross-sectoral contexts. There are variations in methodological priority between different technologies. For AI applications, ethical issues such as transparency and accountability are emphasized. For nanotechnologies, risk management, stakeholder engagement, and regulatory readiness are more predominant. In health and biotechnologies, ethical questions and interdisciplinary collaboration are emphasized. These variations reflect societal expectations and concerns associated with each emerging technology.

The deliberative aspects of the analysis reveal a number of interesting further points for study, including policy design for wicked problems and expansion of the knowledge-base. How are deliberative aspects addressed for instance in the tension between collaboration vs. competition and how to take it into account in strategies and policy design (e.g. Alford et al. 2012). The wicked problems faced by our societies today require new combinations of collaborative strategies, stakeholder involvement, multidisciplinary learning and problem-solving. Such strategies range from collaboration / equal cooperation (inclusion at the forefront), to competition (market at the forefront), as well as hierarchical management / authoritarian strategy (science at the forefront). As a solution to the wicked problems of technologies (e.g. nano, quantum and AI), Alford et al. propose a pluralistic approach, which we explore in its implications for deliberative methods.

Keywords: technology foresight, anticipatory governance, challenge-driven innovation, deliberative democracy, emerging technologies

Reimagining Teachers Wellbeing in 2040: The Transformative Role of Emerging Technologies •

Fawaz Abu Sitta – Judith Hannam – Imogen Casebourne

University of Cambridge, the United Kingdom

This foresight study, conducted through a Futures Thinking lens, explores the transformative potential of emerging technologies in shaping teacher wellbeing by 2040. The aim of this research is not to predict the future, but rather to anticipate the impact of technological advancements on teachers' wellbeing. The study, carried out over two years, engaged teachers, policymakers, EdTech experts, and academics through workshops designed to identify critical trends and envision scenarios where technology enhances educators' professional lives. A central focus lies on how advancements—particularly Generative AI, wearable devices, and immersive tools—could improve teachers' wellbeing, redefine teaching roles, and promote sustainable wellbeing.

Key findings highlighted the essential role of Generative AI in automating administrative tasks, enabling real-time formative assessment, and personalizing student learning, which in turn could free up time for teachers to prioritize their wellbeing. Participants envisioned AI as a collaborative partner, handling grading, lesson planning, and data analysis, thereby allowing educators to focus on creative, student-centred pedagogy. Virtual assistants and AI-driven analytics were emphasized for their capacity to predict classroom needs and streamline workflows, reducing burnout.

Immersive technologies, such as augmented reality (AR) and IMAX-like classrooms, emerged as tools to cultivate dynamic, multi-dimensional learning environments. These innovations aim to enhance engagement through project-based and inquiry-led approaches, with teachers transitioning into facilitator roles. Additionally, wearable devices were proposed to monitor teacher wellbeing, offering personalized health insights and promoting work-life balance through adaptive scheduling.

The study emphasized a shift toward flexible, hybrid models supported by digital infrastructure. Participants imagined schools leveraging technology to enable remote planning, collaborative virtual staffrooms, and asynchronous teaching, granting educators autonomy over their time. Automated systems for homework marking and AI-curated curricula were identified as critical to minimizing workload pressures.

Challenges were also noted, including equitable access to technology and the need for robust professional development to ensure educators harness these tools effectively. Stakeholders stressed that technological integration must align with a broader cultural redefinition of education—prioritizing creativity, inclusivity, and holistic development over standardized metrics.

In conclusion, the report advocates for strategic investment in AI and digital tools to augment teacher capacity, coupled with policies that prioritize ethical implementation and equitable resource distribution. By 2040, thoughtfully deployed technologies could transform schools into ecosystems where teacher wellbeing thrives alongside student success, reimagining education as a collaborative, adaptive, and human-centred endeavour.

Keywords: Education, Teachers' Wellbeing, Futures Thinking, Emerging Technologies

Design-based Pedagogies for Preposterous More-than-human Imagination •

idil Gaziulusoy

Aalto University, Finland

The importance of nature and ecosystemic health for human well-being is well established in the literature, and the intersection of futures studies and sustainability science has been studying human-nature relationships for a while. However, such research has not been able to transform the value system that has created the

mindsets, structures and patterns of the predominant (Western) perspective that conceptualizes nature as separate from human society and built environment and as a resource for fulfilling human aspirations. This dualistic and utilitarian perspective has been criticized in post-humanities and social sciences for more than two decades. Nevertheless, these bodies of thought have been slow to penetrate action-orienting sustainability research, which, while arguing for transformative agendas, is still largely operating within the status quo of Western, (post-)industrial and anthropocentric postulates. This paper reports from a three year long pedagogical experiment at master's level in a design school investigating the possibilities of combining "rapid interdisciplinary knowledge loading" with "preposterous futuring" in enabling imagination of credible yet norm-challenging future visions. The findings have implications for multiple areas of research: 1) Intersections between design research/practice and futures studies/practice; 2) Design futures pedagogies; 3) Constructing democratic infrastructures of imagination; 4) Norm-critical socio-technical imaginaries.

Keywords: preposterous futures, design futures, more-than-human futures, futures pedagogy, sustainability transformations

5. Transformative innovations in the agri-food sector ♦

Time: Wednesday 11 June at 13.00–14.30
 Room: GOTO 33
 Chair: N/A

Please note: This session has been cancelled due to a limited number of presentations. Selected papers have been reassigned to other relevant tracks. We thank the authors for their flexibility and understanding.

6. Workshop: Mutual Shaping in Large Action Models – Perspectives on an emerging field of AI •

Time: Wednesday 11 June at 13.00–14.30
 Room: GOTO 31
 Facilitators: Titiana Ertiö, Eeli Saarinen & Frans Björkroth

Titiana Ertiö – Eeli Saarinen – Frans Björkroth

University of Turku, Finland

In contrast to Large Language Models who "talk" back to us, Large Action Models (LAMs) are engineered to assess and execute tasks real-time. They are based on vast amounts of data consisting of user-generated data, IoT sensor data or data from wearables. LAMs focus on translating AI's capacity for understanding and generating language into actionable, task-oriented systems. While LLMs excel at processing and producing human-like text, LAMs are designed to integrate reasoning, planning, and execution capabilities to autonomously perform complex, multi-step tasks across diverse domains. LAMs are significant because they address the gap between AI's ability to understand and its ability to act. In practice, LAMs promise to revolutionize industries by automating high-stakes workflows, solving intricate problems, and functioning as intelligent agents that can adapt dynamically to real-world contexts. Approaching LAMs with a human-centric approach ensures these systems align with human needs, values, and goals. This focus enhances collaboration between humans and AI, addresses ethical concerns like fairness and accountability, and tailors solutions to real-world problems. It also fosters trust, promotes adoption, and empowers users by keeping humans in control. Ultimately, a human-centric approach ensures LAMs serve humanity ethically and effectively, driving meaningful innovation.

We invite AI pundits and rookies to a fishbowl-style interactive workshop with the purpose of envisioning the shape LAMs are poised to take. Following a two-pronged approach, we'll first discuss opportunities and challenges related to the design, development, and future use of LAMs. Then, we'll scrutinize, which type of anticipatory governance capabilities are needed to identify key policy considerations and trade-offs in LAM governance. The workshop begins with an exploration of what LAMs are, their potential to transform industries, and their significance in advancing AI from passive understanding to active problem-solving. By introducing the core principles of LAMs, we set the stage for examining their applications, challenges, and the critical role of a human-centric approach in ensuring their responsible development and deployment.

Relevant to the conference theme are (1) the social agency aspect in mutual shaping, namely to which extent will organisations and societies shape a piece of code "agents", place safeguards on its governance, stress the role of human oversight in complex decision-making; (2) ethical aspects of responsible technology development as well as (3) the link between novel technologies and policy-making. In light of the present AI critique, we're presented with a unique opportunity to assess LAM's ex-ante and preempt negative and unintended consequences.

Keywords: Large Action Models, task execution, anticipatory governance capabilities

7. Workshop: Foresight Flash – Enabling rapid collective foresight through Human-Centered, Technology-Enhanced intelligence ♦

Time: Wednesday 11 June at 13.00–14.30

Room: GOTO 32

Facilitator: Sakari Nisula

Sakari Nisula

FIBRES Online; Foresight Flash, Finland

BACKGROUND AND PURPOSE

In today's TUNA (Turbulent, Uncertain, Novel, and Ambiguous) world, described by Rafael & Wilkinson in their book *Strategic Reframing: The Oxford Scenario Planning Approach* (2016), organizations should integrate foresight into management practices to anticipate change and navigate uncertainty. Traditional forecasting methods often fall short in providing the systemic, nuanced and future-oriented insights needed in complex, fast-changing environments. This interactive hybrid workshop introduces a human-centered, technology-enhanced approach to collective foresight. The approach has been tested by the facilitator in a global Finnish company to integrate foresight into management practices, particularly in innovation and strategy, and been used in few global forums to bring outside-in-view to the organization. Through participatory horizon scanning and futures mapping, participants will anticipate systemic changes, develop a shared understanding of change drivers, and generate actionable insights that foster future-oriented thinking, adding an extra dimension to management practices.

The workshop highlights how collective foresight provides diverse, pluralistic inputs that enhance decision-making and enables organizations navigate uncertainty. It also explores ways to bridge futures studies with management practices in a practical, action-oriented manner while recognizing that the future is not fixed but shaped by collective decisions and actions.

HOW THE WORKSHOP ADDRESSES THE CONFERENCE THEME

This workshop aligns with the key theme Bridging foresight and management: futures studies approach in management practices by demonstrating how collective foresight methods can:

- Build shared views of change drivers across individuals, teams, organizations, and sectors.

- Provide systemic, nuanced, and long-term insights for better, more informed decision-making.
- Showcase how a human-centered, technology-enhanced approach makes foresight interactive and collaborative.
- Empower participants by involving them in the foresight process, giving them a sense of ownership and boosting their confidence in navigating future challenges.

Through collective horizon scanning and discussions on key themes, participants gain practical tools to navigate uncertainty and adapt to change. The workshop emphasizes the power of collective engagement, where diverse perspectives create a more informed, holistic view of the operating environment.

CONCLUSIONS AND IMPLICATIONS

This human-centered, technology-enhanced session highlights the value of collective foresight in management practices by offering a practical, agile approach to understanding change drivers and uncertainties. Through active participation, participants learn to identify emerging trends, assess uncertainties, and build shared perspectives. Organizations can cultivate a culture of collaboration and future-focused thinking, enhancing foresightfulness and detecting changes beyond numerical and statistical forecasting. Ultimately, this approach empowers management to make informed decisions and strengthen resilience, especially during times of flux.

Keywords: collective and collaborative foresight, workshop, strategic foresight, foresight fulness, futures intelligence

Session 3: 11 June 2025 (Wednesday) at 15.00-16.30**1. Special Session: Foresight Paper Development Workshop •**

Time: Wednesday 11 June at 15.00–16.30

Room: LOGI

This session will introduce two opportunities for Futures Conference 2025 participants interested in contributing to futures studies publications.

Special Issue of the Conference Research Articles

Time: 15.00–16.00

Chairs: Sofi Kurki, Sirkka Heinonen, Jari Kaivo-oja & Arho Suominen

This session will provide detailed information about the Special Issue of *'Foresight: The Journal of Futures Studies, Strategic Thinking and Policy'*, titled *"Beyond the Horizon: Envisioning Preferred Futures in Technology and Society."* The Special Issue is exclusively open to participants of the Futures Conference 2025. Participants will hear directly from the guest editors about the submission process and requirements for research articles.

Call for Chapters for Our World of Futures Studies as a Mosaic, Part 2

Time: 16.00–16.30

Chairs: Tero Villman, Sirkka Heinonen & Hazel Salminen

This session will provide detailed information about the call for chapters for *Our World of Futures Studies as a Mosaic, Part 2*. This forthcoming publication by the Finnish Society for Futures Studies expands upon the ambition and objectives of the first volume, aiming to complement the mosaic of diverse approaches to futures studies and foresight from across the globe, recognizing and learning from the variety of contexts, traditions, and perspectives that together enrich the field of futures studies. Participants will hear directly from the editors about the submission process and requirements for different types of chapters.

2. Linkages between foresight, technology, and policymaking ♦

Time: Wednesday 11 June at 15.00–16.30
 Room: TEATRO
 Chair: Markku Wilenius

Evidence-based technology foresight for EU funding ♦

Gwendolyn Bailey^a – João Farinha^a – Antonia Mochan^a – Alexandre Pólvora^b

^a European Commission, Joint Research Centre, Belgium

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Based on state-of-the-art practices and methodologies [1], the authors crafted a systematised, concise and adaptable technology foresight process to support EU research, development and innovation (RDI) funding initiatives, namely the European Innovation Council (EIC), the European Commission's flagship program for deep tech. This tailor-made approach has been developed and applied since 2022 in two projects – ANTICIPINNOV (ANTICIPation and monitoring of emerging technologies and disruptive INNOVation) [2,3] and more recently FUTURINNOV (FUTURE-oriented detection and assessment of emerging technologies and breakthrough INNOVation). These two initiatives represent a continuous collaboration between the Joint Research Centre's Competence Centre on Foresight and the EIC.

FUTURINNOV included several technology foresight activities, namely Horizon Scanning (HS) aimed at supporting the EIC's strategic intelligence. HS is a qualitative method of foresight aimed at the early discovery of developments not yet on the radar of most experts, decision makers, or the general public, and whose potential is not widely recognised [4,5]. This project demonstrated that a "short-and-sweet" HS collective intelligence process can shape and guide decision making processes, from raising institutional awareness to emerging technologies and breakthrough innovations, to the selection of specific funding topics and more structural changes such as portfolio setting.

The FUTURINNOV project carried out a combination of horizontal (cross-sectorial) and vertical (targeted) horizon scanning exercises to provide timely insights without the complexity or length of more traditional foresight exercises [6,7,8,9,10]. These developments manifest themselves through trends and signals, that bear potential to become RDI funding topics or domains.

This approach featured three continuous sources of trend and signals—expert based collection, literature reviews on third party publications, and semi-automated data and text mining—feeding into participatory workshop discussions. In these sessions it employs a streamlined 'championship' approach that narrows an initial pool of 100 to 200 signals down to a selected set of 10 topics.

In addition to the specific technology topics, this process captured relevant contextual factors, offering valuable insights into drivers, enablers and barriers for technology development and uptake. This cast light into policy-relevant insights, extending the relevance and take-up of technology foresight outputs beyond the EIC.

The overall process has been proven empirically to meet the EIC needs and to possess the repeatability and flexibility required to respond quickly to new requests and to adapt to a fast-changing context, namely shifting political priorities and rapid technology developments. The authors propose this as a systematic model for technology foresight in analogous policy and organisational settings.

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Keywords: technology foresight, emerging technologies, deep-tech innovation, research and innovation priorities, horizon scanning

Co-Shaping Futures: Navigating AI's Role in Climate Change Policymaking •

Katie Berns – Tatu Marttila – idil Gaziulusoy

Aalto University, Finland

The rapid adoption of AI technologies is reshaping climate change policymaking, creating a paradox of progress and environmental cost. While AI optimises renewable energy systems, enhances carbon modelling, and supports climate adaptation strategies, it also introduces significant ethical, social, and ecological challenges. This paper draws on insights from an ongoing co-design study with interdisciplinary stakeholders to examine how AI and climate policy co-evolve in a socio-technical landscape. Rather than offering definitive solutions, it highlights the uncertainties, trade-offs, and power dynamics that shape this transformation. This paper invites scholars to critically engage with the complex interdependencies between technological innovation and climate governance by situating AI within broader socio-technical systems.

Keywords: AI, Sociotechnical Systems, Climate Change, Policymaking

Technology Roadmaps with Social System Theory: New Challenges and Solutions •

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BACKGROUND AND PURPOSE

Technological roadmapping is one key field of technology foresight. Science, technology, and innovation policy planning and decision-making are based on technology roadmaps. Technological roadmapping is a strategic planning process used by organizations and companies to align their technological development with long-term business goals. It typically involves identifying, evaluating, and planning the various technological advancements and innovations needed for business and societal success. Typically, a technology roadmap serves as a strategic tool to guide complex technological transformations, aligning Science, Technology, and Innovation (STI) initiatives with business goals, thus enhancing operational efficiency and reducing risks of technological innovations and developments.

However, many technology roadmaps do not include a very deep understanding of social developments and social system theory. Citizens are normally seen as test-beds of business models and consumers. This conference presentation discusses possibilities to strengthen the analyses of social and community aspects of technology roadmapping and modelling.

METHODS

The study is strongly theoretically oriented conceptual and theoretical study with the methodological focus on integration of technology roadmapping models (TRM) and social system theory (SST). It aims to strengthen theoretical foundations of technology roadmapping. As Ahlqvist et al. (2008) have noted in their well-founded basic framework of the technology roadmap at the VTT, key elements of technology roadmap are: (1) Drivers, (2) enabling technologies, (3) user needs, (4) role of communities, (5) services, and (6) business models. This basic framework of TRM framework will be discussed in relation to the basic framework of social system theory (SST). Theoretical and methodological TRM-SST questions are discussed in this theoretically motivated study. The authors propose new development frontier of technology roadmapping, which is theoretically motivated by Luhmannian social systems theory. The elements of social system theory are different social system specific codes, medians, programs, and differentiated functions. The methodological challenge is to integrate these theoretically well-founded social system elements to the practices of technology roadmapping.

FINDINGS

This conference article represents a significant theoretical contribution by bridging the gap between technology forecasting/foresight models, technology roadmapping models (TRMs) and social system theory (SST). The proposed framework integrates Luhmann's concept of functional differentiation into TRM and, by so doing, offers an innovative interdisciplinary novel approach to understanding the various societal impacts of technology adoption and social diffusion.

By combining SST with TRM methodologies, the framework advances the field by adding novel analytical dimensions, such as (1) market sensitivity analysis and (2) the alignment of technologies with pertinent social systems' specific codes, mediums, and functions. This novel integration frontier expands the scope of TRM to encompass both technical and societal dynamics, which results in the provision of a holistic perspective on technology feasibility and attractiveness.

Additionally, the article lays the foundation for further theoretical exploration by emphasizing the importance of (3) non-linear dynamics and (4) cross-system interactions in the technology adoption process. It encourages scholars to re-examine the relationship between technological innovation and societal adaptation through a more comprehensive lens, thereby broadening the horizons of both scientific disciplines.

Conclusions and implications: description of the main outcome(s) of the study and implications for practice, policy, and further research:

The integration of social systems theory (SST) into technology roadmapping (TRM) provides managers with a robust tool for aligning technological innovations with the specific needs of various functional systems, such as politics, education, and the economy. By addressing these differentiated social demands, managers and decision-makers can make more informed decisions that resonate with societal expectations, increasing the likelihood of successful technology adoption and lowering risks of wrong choices in strategic technology choices and STI policies in various technological development fields.

This novel approach also helps mitigate risks by incorporating societal acceptance, adaptability, and dominant design analyses into TRM, enabling managers to pre-empt potential barriers to implementation. For instance, assessing market sensitivity through ten functional analyses provides actionable insights into how technology resonates across different societal domains. This is a novel aspect in the field of TRM, which has radical innovation aspects.

Moreover, the multidimensional TRM-SST framework presented in the study enhances strategy development by offering tools like unit-to-unit transfer analysis and social systems situation analysis. These allow managers to craft tailored strategies that account for diverse societal contexts, ensuring both sustainable and scalable innovation pathways in service and service delivery development. A novel TRM-SST approach supports also Service Dominant Logic (SDL) of technology roadmapping process. Finally, the inclusion of non-technical factors such as staff training, ergonomic process changes, and cultural readiness in the roadmap ensures a smoother organizational adaptation to technological transformations.

Keywords: Technology roadmapping model, Technology assessment, Social assessment, Social System Theory, Service Dominant Logic, Science Technology and Innovation Policy, Corporate foresight, Societal adaptation to technologies

Navigating the Complexities of Illicit Drug Markets: The Role of Technology and Foresight in Shaping Future Policies ♦

Klaudia Palczak – Alessandra Bo

European Union Drugs Agency (EUDA), Portugal

The EU faces growing challenges from illicit drug markets, which fuel violence, corruption, and public health crises. The European Union Drugs Agency (EUDA) is fully embracing the notion of drugs as ‘a wicked problem’ and acknowledges the need of a systemic and network analysis of all the dimensions at stake. Technological changes, especially, have an impact upon many aspects of the drug field. The rise of digitalization has significantly affected the drug trade, enabling more resilient and adaptive markets. Online platforms and encrypted communications have made it easier for drug dealers and consumers to connect, bypassing traditional control mechanisms. This has not only transformed purchasing behaviours but also consumption patterns, making it more difficult for authorities to effectively monitor and respond to the illicit drug market and its consequences.

Since 2017, the EUDA has developed foresight methods to analyse external drivers shaping Europe's drug landscape and build future scenarios providing data-driven insights to future policy discussions. In 2025 EUDA embarked on a broad Technology scanning project that aims to map the technologies impacting the drug cycle. This includes innovations that affect drug production, distribution, and consumption, as well as new methods for control as well as prevention and treatment. The scanning process aims to create a comprehensive framework that will inform the Research and Innovation (R&I) agenda of the EU, helping to ensure that future technological advancements are leveraged to tackle the evolving drug problem. This work will be informed by technology projects recently conducted in the EU Internal Security area by Joint Research Centre and Europol.

EUDA has a clear role of knowledge broker, fostering evidence-based policies and scientific collaboration to effectively tackle the evolving drug phenomenon. The application has contributed and continues to play a major role in building institutional resilience by anticipating future drug-related challenges and the potential consequences. It has also been instrumental in communicating and interacting with stakeholders from various fields of expertise.

Strengthening partnerships with the scientific community will be crucial in navigating these challenges. Collaborative efforts with researchers and academics will help the EUDA stay at the forefront of scientific advancements and integrate new knowledge into policy and practice.

Keywords: European Union (EU), illicit drug markets, foresight methods, Research and Innovation (R&I) agenda, evidence-based policies

3. Futures-oriented research and learning in the digital era ♦

Time: Wednesday 11 June at 15.00–16.30
 Room: GALLERY
 Chair: Veli Virmajoki

Anticipatory organisations and future-oriented regulation: Emerging policy pathways in marine logistics and pharmaceutical manufacturing •

Toni Ahlqvist – Mikkel Stein Knudsen – Ville Lauttamäki – Tero Villman
 Finland Futures Research Centre, Finland

Different industries and industrial actors have different anticipatory positions towards future regulations and regulators. We theorise these positions by using the concepts of anticipatory organisations, e.g., actors engaged in future-oriented agency and actions to affect policy settings, and future-oriented regulation, e.g., anticipatory policy setting for enabling and inhibiting particular industrial practices. In the empirical part, we discuss stylised examples from the industrial domains of marine logistics and pharmaceutical manufacturing, reflecting the results of the two projects realised in the Finland Futures Research Centre, namely Gyroscope (G), Research Council of Finland (353056) and LifeFactFuture (LFF), Business Finland (6819/31/2023).

We compare the anticipatory features of organisations and regulations in these domains, for example, in the contexts of alternative fuels (G), digitalisation (G & LFF), and regulation experiments (G & LFF). Both studied domains are incumbent driven systems characterised by structures that resist too rapid or too radical system changes. For example, the effort to decarbonize the shipping sector is faced with regulation embedded in the logic of fossil economy. Combined with complex regulatory structures and lacking incentives, the resulting level of system changes in the domain is primarily incremental. Then again, pharmaceutical manufacturing is expected and required to be highly stable, with limited room for variation and experimentation.

The literature tends to emphasise the role of future-oriented regulation as a catalyst of innovation enabling environments. However, based on our empirical data, the regulative actors do not perceive their role as builders of such environments, but focus on risk mitigation and safety. Thus, an intriguing regulative continuum, or a dialectic, emerges, in which regulation can be perceived both as a “catalyst for desired change” and as a “bastion of stability”. We outline the consequences of these two positions, and discuss their repercussions for building more anticipatory industrial policies.

Keywords: Anticipatory organisation, Future-oriented regulation, Policy pathway, Marine logistics, Pharmaceutical manufacturing

Exploring the Impact of Futures-Oriented Learning Activities on Students' Futures Literacy in the Age of Generative AI •

Juliana Pattermann – Teresa Spieß – Antje Bierwisch

MCI | The Entrepreneurial School, Austria

The grand challenges of our time, shaped by political, socio-economic, and technological transformations, contribute to growing complexity and uncertainty. In response, futures literacy (FL)—a meta-competence encompassing cognitive, affective, and conative dimensions—empowers individuals to anticipate complex and emergent change through imagination, creativity, and systemic thinking. Thus, educational institutions are increasingly urged to integrate futures thinking into teaching. As futures-oriented learning formats are gaining attention, traditional teaching approaches must be reconsidered to address the increasing complexity of our world. AI applications offer flexible and independent learning potential, yet concerns remain regarding algorithmic biases and their constrained temporal scope.

This study examines how futures-related learning activities influence students' FL in interdisciplinary academic settings. It assumes that students' AI use impacts this development. Accordingly, the study aims to 1) analyze the impact of futures-related learning activities on students' FL, (2) examine the connection between students' generative AI use and FL development, and (3) pilot-test the Futures Consciousness (FC) scale alongside storytelling and reflective practices as a formative assessment method.

The study was conducted in two interdisciplinary courses in the 5th semester of a Bachelor program at a university of applied sciences in November 2024. While the courses differed in instructional mode and content, both incorporated pre-defined learning activities, such as the Polak game. Using a mixed-methods approach, data from 11 students was collected at five points throughout the course. The FC scale served as a measure for FL's cognitive dimensions, indicating awareness of how the future informs present decisions. Student learning artifacts were analyzed through thematic content analysis.

Findings indicate a self-perceived increase in students' consideration of future consequences, locus of control, concern for others, and openness to alternatives, revealed in both FC scale results and reflections. While students reported improved complexity and systems thinking, quantitative findings showed no significant change in systems perception. Beyond FC dimensions, students noted gains in creativity, imagination, and understanding of the plurality of futures, yet highlighted the need for more time to develop FL competence. High generative AI use correlated positively with increased consideration of future consequences, suggesting a link between AI engagement and time perception.

Despite its exploratory nature and small sample size, this study suggests that futures-related learning activities foster key dimensions of FL. Future research should explore longitudinal approaches and interdisciplinary interventions. Overall, the findings highlight the need for long-term, continuous, and structured pedagogical efforts to develop FL in higher education.

Keywords: Futures literacy, Futures consciousness scale, Generative AI, Futures-oriented learning

Fostering Sustainability Through Futures Literacy – Case Studies from the SF4S Project ♦

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The SF4S (Strategic Foresight for Sustainability) project is a collaborative action with partners from Higher Education institutions (HEIs), Vocational Education and Training (VET) providers, innovation networks and business entities from the Agri-food, Health and the Mobility sectors. The goal of the project is to support a transition to a more sustainable European economy. It addresses the lack of green, digital and future skills among students and professionals and connects and transfers different areas of knowledge between HEI, VET and industry actors that are crucial for Europe to develop cooperative solutions and support the recommendations for action in the major reports and initiatives: Green Deal, NextGenerationEU, European Skills Agenda and OECD Future of Education and Skills 2030. An integrative element of the SF4S project, is the development of a set of new educational and professional courses by three of the project partners – the Estonian Design Centre (EDC) in Tallinn, the GEA College in Ljubljana, and the IZT in Berlin. Their aim is to upskill already employed professionals and train the upcoming student generation on how to think, create and integrate sustainable futures in their regular work-life. In this paper, the authors show how the concept of futures literacy is operationalized in the three different types of practical courses. They highlight key learnings from these courses, showcasing enhanced professional capabilities and heightened sustainability awareness among participants. In this way the paper reveals how sustainability through futures literacy can be fostered, and how this initiative not only bridges crucial skill gaps but also advances the European agenda towards a more integrated and sustainable future.

Keywords: Foresight, Futures Research, Futures Studies, Futures Literacy, Sustainability

4. The human element in the futures •

Time: Wednesday 11 June at 15.00–16.30

Room: KINO

Chair: Sari Puustinen

Inter- and transdisciplinary approaches on broadening the perspectives on Emotion Sensitive Artificial Intelligence •

Loïs Vanhée^a – Melania Borit^b

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Emotion Sensitive Artificial Intelligence (EmoSAI), i.e., AI systems capable of accounting for and adapting to the (possible) emotion of humans and/or capable of simulating human-like emotional behavior, is one of the

technologies that has arguably some of the highest prospects for achieving long-lasting in-depth disruptions, from transforming our societies to our very definitions of humanity and morality as well as to how we experience life. This technology is no longer an object of pure fiction (e.g., robots with feelings), but is increasingly part of our daily reality (e.g., emotion recognition cameras for border control; social media newsfeed tailored to elicit emotions that can sustain continued engagement with the medium). As such there is a real urgent need for establishing an inter- and transdisciplinary foresight over EmoSAI technologies and their expected, unexpected, desirable, undesirable, probable, possible, and plausible impacts, using a variety of perspectives (e.g., legal, ethical, economic, social, cultural, political, technological) [1].

However, despite this urgency, there is a lack of basic vocabulary and understanding of the many possible shapes that can be taken by EmoSAI and its integration in society. Most of the existing framing of EmoSAI remains narrow-sighted both in the considered technologies (e.g., overfocus on video-based emotion recognition) and in the scientific grounding of emotions (e.g., Ekman's six basic emotions). Moreover, projectives tend to be highly Manichean (e.g., a prospect for smooth integration of human feelings into machines versus straightforward immoral way to totalitarianism), while analyses outcomes appear to be often based on dogmatic assumptions, convictions, and/or opinions [2-3].

Leaving aside a positioning for or against EmoSAI, this contribution is dedicated to providing an elaborated inter- and transdisciplinary vision of the many shapes that EmoSAI can take and the way it can(not) be integrated within our societies [4]. We will provide a mapping of the technologies tied to EmoSAI, as well as the pluralist theories surrounding the domain of emotions research, followed by examples of how these aspects come together into sociotechnical EmoSAI assemblages. Altogether, we aim to provide a practical analysis framework for enabling the various involved stakeholders to develop a broad-sighted and nuanced foresight of what EmoSAI, and its integration in society, is and can(not) become.

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Keywords: emotion sensitive artificial intelligence, broad sighted foresight, sociotechnical assemblages, expanded framing

Representations of religion and the secular sacred in images of the future created by large language models •

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Asking an artificial intelligence chatbot – e.g. ChatGPT – to describe possible, probable and preferable futures is a fascinating but seemingly simple experiment from the point of view of futures studies. However, these descriptions or “images of the future” can have potentially vast implications for our collective imagination, as the use of AI tools for creative applications increases. As we know, the futures we imagine in the present, either on our own, collectively or with the help of AI tools, will influence our actions and the kind of future we strive towards.

This paper is based on my master's thesis research, where I have created a total of 108 images of the future using three different large language models: ChatGPT, Gemini and Deepseek. The objective of the research is to look at these images of the future and specifically at how the categories of religion and the secular sacred

are represented in them. The analysis is still underway, but the thesis will be finished before the time of the conference.

The study consists of a qualitative content analysis of themes related to religion and the secular sacred that are present in the data, and based on these themes, of a quantitative comparison between different language models and different types of futures (possible, probable, and preferable). Mixing both qualitative and quantitative analysis is especially beneficial with AI-generated content, as it is both textual but also generated through statistical reasoning.

Preliminary results indicate that there will be a general secular bias in the images of the future, but the extent to which this is the case remains to be seen. In addition, it seems that representations of the sacred are more commonly present in preferable futures than others – something that seems to go against the secular bias hypothesis.

The approaches used in the study are multidisciplinary but firmly based on basic futures studies concepts such as images of the future and alternative futures. The methodology of using AI chatbots to create comprehensive images of the future is novel and the results of the study will indicate whether the method could be applied to other contexts as well. The research will also highlight how critical perspectives on AI applications can be applied to futures studies, and vice versa.

Keywords: images of the future, artificial intelligence, large language models, ChatGPT, algorithmic bias, religion

Future prospects of independent AI species in the human governed world of biospecies•

Osmo Kuusi

Aalto University, Finland

There are good reasons to consider that AI has already proceeded from the stage of Artificial Narrow Intelligence ANI to the stage of Artificial General Intelligence AGI or close to it. There are also at least weak signals of the development of AI towards Artificial Super Intelligence ASI that can survive without human help. The presentation connects the future development of AI towards autonomous or “wild” species to four basic requirements of survival of living beings: energy/food, protecting/safety, reproduction and information-based skills. In their information-based skills of problem solving, devices that use GPT4 like algorithms are already better than average human beings. These devices, however, depend now on human beings in three other survival functions. In comparison with biospecies, AI devices also typically do not have the interests-based motivation to survive. But human beings have already developed those kinds interests first of all to military AI devices. Quoting the book *The New Survival Doctrine* (Kuusi et al. 2024), the presentation suggests a promising way to build the better relationship between human beings and towards autonomy developing AI devices in ecosystems based on role of AI in the developing of collective mental models of institutions.

Keywords: AI, ecosystem, living species, institution, collective mental model

5. The role of collaboration and networks in shaping the futures •

Time: Wednesday 11 June at 15.00–16.30
 Room: GOTO 33
 Chair: Juha Kaskinen

Fostering digitally mediated networks of multibelonging in Future Finland •

Samira Ibnelkaid

University of Oulu, Finland

As a hub for global talent, Finland actively attracts high-skilled migrants to sustain its knowledge and skill economy. Yet these individuals often face discrimination, marginalization, and socio-cultural exclusion. While formal policies emphasize attraction and retention, migrants' lived experiences reveal a persistent gap between policy aspirations and social realities. This contribution examines how high-skilled migrants in Finland navigate these tensions through socio-technical systems, leveraging digital tools to cultivate translocal agency, foster multibelonging, and enhance their mobility experience.

Building on Critical Phenomenology of Interaction, a novel framework I am developping for analyzing socio-technical transformations through a holistic decolonial lens, this study employs ethnographic observations and video data of naturally occurring social interactions. This research has so far involved 50 participants from 15 countries and resulted in a dataset of 40 hours of video-recorded data (social interactions and semi-structured interviews). It focuses on how high-skilled migrants engage with technologies to construct 'digital networks of belonging' (Diminescu, 2008). These networks function as both affective and strategic spaces where migrants sustain translocal ties, amplify their voices, and access sociocultural resources otherwise obstructed by structural barriers.

The study highlights the mutual shaping of socio-technical transformation by demonstrating how migrants' digital engagements reshape both their host societies and their transnational connections. The concept of translocality refers to the "emergence of multidirectional and overlapping networks that facilitate the circulation of people, resources, practices and ideas" (Greiner & Sakdapolrak 2013). This notion is central to this analysis, as digital tools enable migrants to maintain fluid identities across multiple spaces, resisting singular nationalist belonging. Rather than being confined to either 'home' or 'host' contexts, high-skilled migrants construct multibelonging, navigating multiple socio-spaces simultaneously.

The findings contribute to futures studies by illustrating how digitalization reconfigures migration and sociotechnical landscapes, challenging conventional nation-state paradigms (Ibnelkäid, 2024). Finland's technological and migration policies intersect in ways that can either enhance or inhibit migrants' digital agency, calling for anticipatory governance approaches that integrate an intersectional understanding of digital empowerment. The inclusion of video-based empirical evidence provides a tangible demonstration of how digital tools mediate daily experiences of exclusion, adaptation, and resistance.

Ultimately, this study calls for a rethinking of digital futures through a phenomenological and translocal lens, foregrounding lived experience in the discourse on equitable socio-technical transformations. It argues for an expansive approach to technological policymaking that acknowledges high-skilled migrants as active agents in shaping sociodigital futures.

Keywords: High-skilled migration, Translocality, Digital Agency, Networks of Multibelonging, Critical Phenomenology of Interaction, Future Finland

Testing the value propositions of digital social innovation platform cooperatives •

Ákos Nagy

Corvinus University of Budapest, Hungary

This research explores the organizational dynamics of social enterprises and digital social innovation platforms, focusing on the intersection of social impact, market scaling, and community engagement. By examining the role of participatory processes in social innovation, the study highlights the importance of balancing digital innovation with the maintenance of organizational integrity. Through a participatory backcasting approach, the research builds an adaptable ecosystem design that responds to the needs of social enterprises and broader social goals.

The study finds that while social innovation platforms provide valuable opportunities for scaling social enterprises, challenges arise from the high resource demands of maintaining community engagement. The research underscores the significance of commons-based approaches to overcoming organizational barriers and fostering collaboration between actors in the social economy. It suggests that digital platforms can serve as boundary objects—facilitating collaboration and value integration across diverse stakeholders—yet, without strategic facilitation, these platforms may struggle to meet their full potential for social value creation.

In addressing the complexities of scaling social enterprises, the study proposes that future innovation models should prioritize volunteer motivations and institutional support structures to enhance the sustainability of social innovation. Furthermore, the study advocates for a nuanced understanding of the role of technology in community-driven initiatives, suggesting that the success of social enterprises in the digital age depends on aligning technological tools with the core values of social impact. The findings offer valuable insights for policymakers and practitioners aiming to design more effective social innovation frameworks that integrate community-led development with scalable technological solutions.

Keywords: social innovation, platforms, commons, social enterprise

Anticipating sustainability transitions: a collaborative approach to responsible transformation in the agri-food industry ♦

Antonin Lafaix^{a-b} – Fabrice Roubelat^b – René Rohrbeck^a

^a EDHEC Business School, France

^b Université de Poitiers, France

This research explores the dynamics by which companies in the same industry can engage in anticipating its transformations, in order to understand the extent to which collaboration can shape a responsible future. Drawing on the concepts of collaborative foresight and transition management in socio-technical systems, it examines the brakes and levers to collaboration. Methodologically, a Delphi survey was carried out with 25 participants, including industry experts and students, to assess statements of a prospective or organizational nature. The aim was to capture the degree of adoption of a unified or diversified vision of industry transformation. The results reveal strong consensus on key strategic issues, but also divergences that highlight organizational tensions. These observations enable us to identify ways of enhancing the effectiveness of collaborative foresight exercises, with a view to fostering a collective response better adapted to today's challenges.

Keywords: Foresight, Industrial collaboration, Sustainability Transitions, Multi-level perspective, Delphi study

Implications of Corporate Sustainability Reporting Directive (CSRD) to company network collaboration •

Leena Jokinen^a – Noora Harju^b – Kalle Kinnunen^b – Saara Hänninen^b

^a Finland Futures Research Centre, Finland

^b VTT Technical Research Centre, Finland

The study demonstrates a corporate supplier network in multi-company collaborations seeking to collaborate and innovate on Sustainable Development (SD). The study illuminates how scope 3 Greenhouse gas (GHG) reporting sets demands on collaboration. The study provides insightful and timely research that contributes both the knowledge of the discipline and the practices of supply chain management.

The approach of the paper is cross-disciplinary combining sustainability reporting and social network analysis. Our results provide fresh empirical insights on the application to inter-organizational SD and CSRD challenges in the specific context.

The study addresses less researched area of collaboration in scope 3 reporting. Addressing collaborative sustainability at the supplier network level rather than at the macro (regional or planetary) level, the paper explores social structures in the case network. Practical implications of the study are to understand the meaning of collaboration and information sharing as a part of business value, which is one of focal issues in supplier networks. The scope 3 GHG emissions reporting forces companies to widen their activities to all relevant operations.

We argue that the case network is challenged by its ability to use network resources effectively so that reporting, development, and innovation will be interlinked parts of a profitable business ecosystem. Sharing powers in joint SD and having the capacity to respond to challenges call for transparency and commitment to collaborate, which offers strategic options and promotes business renewal.

Keywords: CSRD, sustainability reporting, supply chain collaboration, social network analysis, marine industry

6. Workshop: Responsible foresight in the anticipation of emerging technologies and their social impacts •

Time: Wednesday 11 June at 15.00–16.30

Room: GOTO 31

Facilitator(s): Ted Fuller

Ted Fuller^a – Fabrice Roubelat^b – Anne Marchais-Roubelat^c

^a University of Lincoln, the United Kingdom

^b University of Poitiers, France

^c Conservatoire National des Arts et Métiers, France

Part of the very foundations of modern Futures Studies and Responsible Research and Innovation is the imperative advocated by Hans Jonas. The Imperative of Responsibility (Jonas, 1984) (published in German as *Das Prinzip Verantwortung* in 1979) was a response to the recognition, shared by a group of thinkers at that time, that humankind not only had the power to destroy itself through the new technologies, but was also unable to control the effects of their actions over time. According to Jonas the nature of human action had changed as a result of modern technology and so required a radically new and qualitatively different ethics. *Homo Faber* had triumphed over *Homo Sapiens*, requiring a “new conception of duties and ethics for which

previous ethics and metaphysics provide not even the principles, let alone a ready doctrine". The duty was to ensure the future of humankind. Hence an underlying rationale for the new science of Futures Studies – which would provide scientific answers to knowledge of the future was established (Fuller et al., 2024). But it hasn't.

This workshop is not an historical perspective on responsibility and futures, though it is informed by it. It is part of a stream of activity addressing the question of what Responsible Futures means today and how that meaning might be applied by futurists and by creators of futures. The Responsible Futures network has been discussing related issues over the past few years via in-person and online workshops. A book from their work relating to principles for responsible futures will be published in 2025. The work continues with this proposed workshop. Conference participants, some of whom will be members of the Responsible Futures Network, are invited to participate in the workshop.

The Responsible Futures network is a project of collaborating UNESCO Chairs, organised by Fabrice Roubelat, University of Poitiers, Narcis Heraclide, University of Poitiers and Linklusion, Anne Marchais-Roubelat, Conservatoire National des Arts et Métiers, April Ward, University of Lincoln, UK and Ted Fuller, University of Lincoln

Workshop Outline 90 mins total.

- Introduction 20 minutes
- A introductory provocation from Ted Fuller reporting on the work to date and challenging participants to consider what they mean by responsibility in their futures activities, whether the question of responsibility is adequately addressed in their projects, and how futures practices, especially relating to technologies, might need to be reframed from the perspective of anticipation as life itself.
- Group work 40 mins
- Groups addressing the related questions
- Plenary discussion and take-aways 30 mins

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Keywords: Responsible Futures, Anticipation, Ethics, Responsible Foresight, Principles for Responsible Futures

7. Workshop: Deconstructing AI generated images of futures: tools to build critical futures thinking ♦

Time: Wednesday 11 June at 15.00–16.30
 Room: GOTO 32
 Facilitator(s): Stephanie Rosestone

Stephanie Rosestone

Australian National University, Australia

A limited capacity for imagination can reduce opportunities for innovation and change. To address this, speculative image-based designs have long been used to expand imaginations and prompt thinking towards

new possibilities. With the increased availability of AI Image Generators, people are turning to this new technology to create speculative images.

AI generated speculative images are being used by companies, governments, futurists and facilitators to portray and provoke new ideas for futures. However, because these generators draw on data from the past, there are risks that the images created recycle old ideas, biases and tropes.

This workshop explores the opportunities and challenges associated with using AI generated images of speculative futures. Participants will experience tools and methods that can prompt critical discussion and encourage images to be explored with depth and diversity. These tools can be applied to a range of contexts and are particularly useful for Futures Literacy learning due to their ability to expose and question anticipatory assumptions. By using AI generated images in critical and intentional ways, we can strengthen the very human capacity for novelty and creativity.

Workshop participants will take away practical ideas for engaging people with AI generate speculative images in creative ways that also draw attention to issues of power and ethics. There will also be an opportunity for a collaborative discussion around potential applications and further research.

Keywords: AI Image Generators, Speculative Futures, Futures Literacy, Critical Thinking, Creative Thinking, Learning, Facilitation

Session 4: 11 June 2025 (Wednesday) at 16.45-18.15

1. LifeFactFuture Special Session: Technology foresight for visioning and industrial renewal •♦

Time: Wednesday 11 June at 16.45–18.15

Room: LOGI

Chair: Mikkel Stein Knudsen

Technology foresight and joint visioning for accelerating digital transformation in the Finnish life science manufacturing: Lessons from the LifeFactFuture project •

Toni Ahlqvist – Tolga Karayel – Mikkel Stein Knudsen – Tero Villman

Finland Futures Research Centre, Finland

Life science manufacturing is a major driver of the Finnish economy, in particular in the region of Southwest Finland where Turku is located. Production of pharmaceutical products and medical devices retains and creates and retains jobs, generates exports, and provides a fertile ground for regional development. If Finland can keep or even strengthen its attractiveness as a manufacturing location for the life science sector, local and national economic benefits are substantial. A key enabler of this future path is the development and deployment of novel digital and technological solutions that can ensure an innovative, forward-looking, and competitive Finnish industry.

To boost this, Finland Futures Research Centre coordinates a large Finnish consortium of pharma manufacturers, manufacturers of medical devices, technology companies, and university partners in the LifeFactFuture project. The consortium brings together a wide range of competences and perspectives across both technological and manufacturing excellence.

At the core of the project is the creation of a joint Future Factory Concept that serves to explicate the consortium's shared vision. The Future Factory Concept is based on a systematic technology foresight process that includes horizon scanning relevant industry and futures reports, an extensive series (N>15) of semi-structured focus group interviews qualitatively coded, and a series of evaluation and validation workshops testing and elaborating preliminary findings. With the many different types of stakeholders involved, novel technologies effectively function as boundary objects. An integral function of the joint visioning process is therefore to align stakeholders towards shared understandings that also allow for tighter and more effective future collaboration between various partners.

The draft Future Factory Concept is launched at day 1 of the Futures Conference. For this presentation, we highlight the process and the methodological approaches, as well as provide perspectives on how methodological and content related insights derived from project might inform the field of futures studies.

Keywords: Emerging technologies, Technology foresight, Life science manufacturing

The Role of Key Value Indicators for Sustainable and Ethical Technological Innovation in Industry 5.0 •

Marta Martorell Camps^{a-b} – Viviana Perez Clausen^a – Marc Esteve^{c-d} – Francesc Pardo-Bosch^b – Fátima Canseco^a

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Emerging technologies have great potential and certainly great transformative power. However, they are increasingly misaligned with societal values, the SDGs and/ or sustainability.

In this paper, we present the Key Value Indicators (KVI), as a new framework to focus on the future in decision-making. KVI can help integrate social, economic and environmental values into current technological developments, thus incorporating elements of sustainability and ethical design. This includes adapting pathways to suit emerging values and needs.

The KVIs enable the assessment of social, environmental and economic impacts, all in line with Industry 5.0 orientations, while promoting human-centered innovation. KVIs contrast with KPIs (Key Performance Indicators), which tend to measure past performance or linear results based on specific targets.

The study is based on a case analysis of the FORGING project (funded by the European Union) which relied on the KVI framework to design future scenarios. These future scenarios have been co-created in the project and are pilots at a very early design stage. In this way, KVIs could serve as a dynamic tool, in which a very proactive governance can be formed to promote the evaluation and adaptation of technological developments in real time. In this way, KVIs would help organisations to adapt their innovative processes to the emerging values and changing needs of society, also promoting digital inclusion. It also opens the way to talk about adaptation pathways.

The case shows that KVIs are adaptive and forward-looking, focusing on the creation of social, environmental and economic value, as their approach is more holistic. This is particularly relevant in 'future scenarios' such as those proposed by the FORGING project, with a view to Industry 5.0.

Keywords: Key Value Indicators (KVI), Emerging Technologies, Sustainability Industry 5.0, Ethical Design, Theoretical frameworks

The 12th S&T Foresight Survey in Japan: Trans-disciplinary and Cross-generational Scenario Development ♦

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This paper introduces the scenario development conducted as the final phase of the 12th Science and Technology (S&T) Foresight Survey by the National Institute of Science and Technology Policy (NISTEP), Japan. To envision society in 2045–2055, we conducted scenario analysis integrating horizon scanning, visioning, and Delphi survey results. The objective was to explore a broad spectrum of future possibilities and identify pathways linking the present to these potential futures.

The scenario development particularly focused on exploring both the positive and negative societal impacts of S&T advancements, as well as identifying critical turning points that may shape future trajectories.

The process was anchored in four societal visions derived from the visioning study primarily conducted with younger generations:

- (Bonds) An inclusive regional society where nature and culture coexist in harmony.
- (Lightning) A transformative society full of dynamism and challenges.
- (Voyage) A society emphasizing democratic participation and creativity.
- (Oasis) A resilient society ensuring security, stability, and peace of mind.

A total of 46 experts from policy, research, and industry sectors participated in two in-person workshops and 15 online group workshops. The scenario methodology combined the archetype scenario method—capturing a wide range of future possibilities across both positive and negative dimensions—with the X-CURVE method, which visually represents systemic change and transition processes. Based on this approach, four scenarios—Baseline, Collapse, Growth, and Transformation—were developed for each theme.

The scenario-building process incorporated iterative feedback through expert interviews and citizen workshops involving approximately 50 participants, ranging in age from teenagers to their seventies, with a majority in their twenties. Furthermore, dialogues with policymakers were integrated as part of a sense-making process to facilitate the application of foresight insights into policy discussions.

Scenario discussions also addressed ethical dilemmas arising from emerging S&T, which could significantly influence future societal directions. Key issues included balancing mutual aid and individual freedom, tensions between growth-driven self-enhancement and public interest or environmental coexistence, the blurring of boundaries between self and others.

This initiative exemplifies a transdisciplinary and cross-generational foresight practice, conducted in collaboration with participants from diverse organizational and professional backgrounds. It also serves as a case study in anticipatory governance, demonstrating how foresight can inform policy dialogues in Japan. This presentation will outline the methodology, present key findings, and explore the policy implications.

(This project is co-operated with the mirai design lab team in The Japan Research Institute, Limited.)

Keywords: Scenario, Policy, Trans-disciplinary, Cross-generation, Citizen Engagement

Exploring the Opportunities and Future Vision of Cellular Agriculture in Finland ♦

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^a VTT Technical Research Centre, Finland

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Cellular agriculture technologies aim to revolutionize traditional food production by enhancing sustainability and complementing existing methods. Through semi-structured interviews with ten diverse participants from the food sector, key themes emerged: food security, high-quality raw materials, and profitability. Efforts within the food value chain focus on optimizing production, managing waste, and improving energy efficiency, while advocating for industry dialogue, workforce education, and the integration of emerging technologies.

The findings indicate that cellular agriculture presents significant opportunities for Finland by diversifying food production methods to secure supply chains. This transition supports biodiversity, promotes local production with minimal resources, reduces pollution, and convinces consumers of its benefits. Hybrid products that combine cellular and traditional ingredients could gain acceptance, positioning Finland for future growth through early adoption.

Involving farmers from the outset ensures a fair transition and addresses potential threats to their livelihoods. Cross-sector cooperation and leveraging Finland's export expertise are crucial for success. Cellular agriculture aligns with the circular economy by utilizing by-products and reducing waste, complementing traditional agriculture.

Challenges include infrastructure, taxation, societal acceptance, and ensuring consumer willingness to pay for sustainable products. Finland's strong biotechnology sector, supported by institutions like VTT, positions the country as a leader in this field. While the adoption of new food systems will take time, Finland's proactive approach and collaborative efforts can drive innovation and economic growth.

Overall, cellular agriculture offers Finland the potential to enhance food security, promote sustainability, and drive economic growth through innovative food production methods, while addressing environmental and societal challenges.

Keywords: Cellular agriculture, Future foods, Stakeholders, Co-creation

2. Innovations for diversity, inclusion and community empowerment •♦

Time: Wednesday 11 June at 16.45–18.15
Room: TEATRO
Chair: Hanna Heino

Rethinking Necessity: Evaluating the Role of Technology in Indigenous Communities•

Hemamali Tennakoon

Brunel University of London, the United Kingdom

Indigenous communities around the world are often identified as marginalised groups. Those living in remote areas are particularly seen as digitally disconnected with little or no access to information and communication technologies (ICT) and the digital universe. The United Nations permanent forum on indigenous issues state that Information and Communication Technology (ICT) should be used to support and encourage cultural diversity and to preserve and promote indigenous languages, distinct identities and traditional knowledge of Indigenous peoples, nations and tribes. While digital inclusion is identified by many as an enabler for social and economic development, especially for minority and isolated, marginalised communities such as indigenous people, there is also argument that digital technologies can be addictive and therefore, harmful to individuals.

There are several studies conducted on indigenous people's interactions with technologies involving such communities in Australia, Indonesia, Bangladesh, and Malaysia. However, a study of indigenous people of Sri Lanka and social/cultural/economic implications of ICT use on this community has not been done to date. The First People of Sri Lanka, also known as Veddhas, are a small community of individual accounting for less than 1 percent of the national population. There are several socio-anthropological studies being conducted about indigenous people of Sri Lanka, but there is lack of interdisciplinary, in-depth research conducted to date on the adaptation and impact of ICT on these indigenous communities. Therefore, in this study, qualitative data was collected using semi-structured interview method from a sample of indigenous people living in one of the settlements (Dambana village) in Sri Lanka. The data was collected in December 2024.

The data collection focused on several key aspects including current technology use, and socio-economic factors such as livelihood, access to education, literacy, cultural identity, and opinion towards technology use. Data saturation was researched at seventeen interviews. This is likely due to the homogeneous nature of the sample and the highly focused research questions.

The preliminary findings are interesting. The most common theme that emerge suggest that technology is not considered as a necessity by the indigenous people. While there are some generational differences in opinion,

the consensus is that technology can negatively affect the way of life and the indigenous cultural identity. The data shows that indigenous culture values human-nature connection more and does not see technology as a necessity or a means for socio-economic development.

Keywords: Indigenous communities, Sri Lanka, Information and Communication Technologies (ICT), Cultural identity, Technology impact

Combining Artificial Intelligence, Satellite Imagery and Geographic Information System for Water-Energy-Food Nexus Implementation for Sustainable Development in Africa ♦

Enock Jonathan

National University of Lesotho, Lesotho

According to the 2024 Africa Sustainable Development Report, less than 6% of the 32 measurable SGD target are on track to be achieved by 2030. The report highlighted the urgent need for Africa's immediate attention to ending poverty (SDG 1), eliminating hunger (SDG 2), combating climate change (SDG 13), promoting peaceful societies (SDG 16) and strengthening global partnership (Goal 17). Africa's untenable position can be directly linked to challenges in the implementation of the Water-Energy-Food Nexus. We reflect that digitalization can aid in improving the implementation of the WEF Nexus, thus accelerating Africa's achievement of the SGD target.

The main challenges hindering successful implementation of the WEF Nexus has been (i) data deficiency relating to lack of comprehensive data on water availability, energy demand and agricultural practices (ii) policy optimisation across the water, energy and agriculture sector to resolve conflicting priorities, (iv) capacity building to strengthen institutions for cross-sectional collaboration and decision -making and (v) effective stakeholder engagement to ensure equitable participation.

Towards significantly improving on these challenges, research and innovation on optimising WEF implementation through digitalisation has become critical. The scope of the proposed digitalisation involves harnessing innovative technology to improve on the WEF nexus implementation and monitoring. In particular, this presentation is advocating for the use of satellite imagery and artificial intelligence to improve on data deficiency, policy optimisation, institutional capacity building and effective local and international stakeholder engagement. For example, a combination of AI and satellite imagery analysis improves on data deficiency which is a significant hindrance to planning, implementation monitoring.

A methodology that uses a combination of AI and satellite images for WEF nexus implementation is discussed to include details on integrating GIS and AI. Furthermore, the framework of a web-hosted Satellite Image Analysis/GIS/AI tool under development for use by African professionals tasked with WEF nexus implementation and monitoring, and also useful for capacity building and promoting stakeholder engagement, will be discussed.

The proposed tool will magnify the role of technology in tackling sustainable development, itself a global challenge.

Keywords: Artificial Intelligence, Satellite Imagery, Geographic Information System, Sustainable Development, Water-Energy-Food Nexus

Quantum Literacy Education for Workforce Development: Future Proofing Technology for Diversity •

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This presentation explores a project that aims to develop a quantum literacy workforce network within the United States, addressing key societal challenges through the intersection of technology, education, and foresight. By applying principles of fairness, ethics, accountability, and transparency (FEAT), the project has made significant progress in engaging diverse communities, particularly historically underrepresented groups, in quantum science. Partners from Historically Black Colleges and Universities (HBCUs), Hispanic Serving Institutions (HSIs), Minority Business Enterprises (MBEs), national laboratories, industry leaders, and nonprofits have collaboratively developed a comprehensive quantum literacy taxonomy, a curriculum aligned with industry needs, and adaptable training frameworks. These deliverables are designed to foster a quantum-literate workforce equipped to engage with the rapidly evolving technological landscape.

This project exemplifies how technology, in the form of quantum science, can serve both as a solution to pressing societal dilemmas and as a source of new challenges. By proactively building a national network across academia, industry, and government, the project highlights strategies for identifying and prioritizing preferable futures in quantum science and technology. It also demonstrates how the integration of foresight and technological literacy can inform innovation policies and contribute to industrial competitiveness. Ultimately, this initiative bridges futures studies, technology development, and policy-making, fostering a more inclusive and forward-thinking quantum workforce capable of shaping the future of science and society.

Keywords: Quantum Literacy, Workforce Development, Diversity and Inclusion, Ethics and Technology, Foresight and Innovation

Towards inclusionary future imaginaries: Extended reality technologies (XR) for marginalised groups •

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Rather than tackling the fundamental divides faced by contemporary societies, the latest advancements in digital technologies seem to exacerbate them. The failure to prioritise accessibility and inclusivity risks perpetuating inaccessible spaces, exclusionary digital citizenship, and new forms of violence against marginalised groups. This conceptual paper integrates insights from alternative future studies, Critical Disability, Black, Feminist, Queer and Native Studies and Crip Theory, to advocate for inclusionary anticipatory action and pathways towards more inclusive socio-digital futures.

This paper is guided by two objectives. The first objective is to present a systematic overview and highlight diverse approaches to alternative futuring that can be used to develop different, more inclusive future pathways with diverse population groups. Alternative futuring methodologies not only expose existing inequalities and power dynamics but also challenge patriarchal, racist, and ableist structures, rethinking societal norms for future developments. Central to this objective is the need for co-productive research methods that actively

involve marginalised groups in imagining the future. The second objective is to illustrate, using the example of extended reality (XR) technologies, the challenges posed by current technological developments and to demonstrate how alternative, co-productive (XR) futuring could foster more inclusive developments. Thereby, as we will show, XR can assume two distinct roles: first, as a research object in its own right, and second, as a potential co-creative tool for imagining desirable futures – both with a strong focus on the perspectives of underrepresented groups.

Keywords: alternative futures, desired futures, extended reality technologies, marginalised groups

3. Technological and methodological innovations for enacting futures •

Time: Wednesday 11 June at 16.45–18.15
 Room: GALLERY
 Chair: Jari Kaivo-oja

Enhancing Enacted Futures: Developing Technologies for Science-Fiction Live Action Roleplaying Games •

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Live Action Role-Playing games (LARPs) offer a relatively untapped yet rich framework for futures studies. LARPs are immersive role-playing activities where participants physically embody their characters within a simulated world and society, which may differ significantly from our own. A specific approach to LARP design and enactment, commonly referred to as "simulationist" or aligned with the "Manifesto of the Turku School," focuses on minimizing the gap between the experiences and actions of the characters and the participants, even when these experiences are mundane or hedonistically menial.

Science-Fiction Simulationist LARPs (SFSs), while relatively unexplored, present a unique opportunity as methods for futures studies. These events create one-to-one "living laboratories" where participants can experience and enact alternative worlds, cultures, and societies. Although the actual implementation of SFS events may be prohibitively expensive for rigorous research projects, the process of designing such LARPs is highly relevant for fostering futures thinking. This process necessitates the creation of a detailed and practical imaginary of all aspects that define alternative worlds, cultures, and societies —imaginaries that then face a test against reality. These aspects range from general technological states to the practicalities of preparing food, from constructing political systems to training participants to experience and embody values and norms that may be entirely foreign or even taboo in their everyday lives. Unlike pen-and-paper exercises, the enacted realities of SFSs prevent the accidental blurring of dynamics with abstract assumptions. Within this context, SFSs intuitively offer a powerful platform for imagining and testing leapfrogging technological designs. These designs emerge from, are enabled by, and support the sociotechnical systems envisioned within the SFSs. This contribution documents a series of practical attempts to integrate such technologies into SFSs and shares subsequent insights into leveraging this approach for Futures purposes.

Key takeaways from this exploration highlight the challenges of integrating such technologies into (non-professional) SFS settings. These challenges include the organizational complexity of the events, the often-overloaded organizational teams, the renegotiation of creative agency, and the out-of-game expectations of participants. Nevertheless, the creative exercise proved immensely valuable —not only in fostering non-conventional technological developments but also in deeply exposing and critically reflecting on the social realities the SFS aims to depict. To further enhance Futures imaginaries and their embodied enactment, alternative SFS design approaches are proposed to refine and expand the scope of this method.

Keywords: Live action role play, Futures methods, Science fiction, Technological development

Capturing user innovators' futures knowledge for New Product Development •

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As a group or as individuals, users can play an active role in innovation by providing feedback, generating ideas, and even developing new products. For instance, Diaz and Makkar (2021) demonstrate how surfers modify their equipment to create stand up paddleboard, while Hienerth (2006) examined user innovations in the kayak sector that were subsequently commercialized. However, not all users possess the mindset or expertise to contribute substantially to new product development (NPD) (Martin et al., 2021; Lüthje, 2004). Thus, it becomes crucial for companies to (1) identify knowledgeable users and (2) leverage their knowledge to anticipate their future needs, guiding the NPD process. Moreover, existing methods that retrospectively elicit users' experience are unable to capture users' anticipatory knowledge critical for addressing future needs essential for the NPD process (Lindgren et al., 2021).

While some recent research works aim to address this gap (Sakellariou & Vecchiato, 2022), there is an urgent need to develop new methodologies capable of generating ideas based on evolving future possibilities. Addressing the above-mentioned gaps, our study aims to respond to two research questions: (1) How to identify user innovators effectively; (2) How to elicit the existing and create new users' knowledge about future needs and uses to inform the NPD process?

Given the innovative culture of the water paddling sports, we conducted our study in the kayak sector. In responding to the first question, we conducted pyramiding search to find profiles of user innovators and experts on watersports meeting our research criteria. Through this approach, we found five high profiles for our study. To elicit their futures knowledge, we applied the following three foresight methods: (1) mental time travel (Cuhls, 2017) to elicit tacit futures knowledge within each individual, (2) focus group (Krueger & Casey, 2014), and (3) prototyping workshop (Simeone & D'Ippolito, 2022) to elicit both tacit and explicit futures knowledge (Dufva & Ahlqvist, 2015). All methods were conducted in a manner consistent with the think-aloud verbal protocol method (Sakellariou & Vecchiato, 2022).

The preliminary findings confirm the effectiveness of pyramiding search in finding high-potential candidates. Moreover, combining these methods facilitated the elicitation of individual tacit knowledge, integration into group knowledge and the articulation of explicit knowledge in the form of a new product mockup. In addition to this concrete new product, we obtained twelve additional ideas for new products and product improvements. This study highlights how NPD can benefit from user innovators' explicit knowledge and proven experience. It also demonstrates foresight methods to extrapolate these competences to address potential future needs.

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Keywords: Foresight, User innovators, New product development, Futures Knowledge

AIToys: Defining AI-Empowered Playthings and a Sustainable Research Agenda •

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BACKGROUND AND PURPOSE

The rise of digital and connected devices used as playthings transforms play, education, and social interactions. Internet-connected and smart toys (IoTys), often marketed as "edutainment," have traditionally been associated with children's digital play, serving as educational tools or playful companions. However, the first-generation IoTys lacked advanced artificial intelligence (AI) integration. This paper introduces the conceptual definition of AIToys, which expands on IoTys to incorporate AI capabilities. AIToys are envisioned as life-long play partners with life-wide implications across leisure, learning, and labor. They range from educational robots to anthropomorphized or zoomorphized social companions, exemplifying the growing robotification of play across generations. This study aims to define AIToys conceptually, address current challenges, and propose a research agenda for sustainable and ethically aligned AIToy development.

METHODS

Our research draws from an interdisciplinary literature review, analysis of media articles, and exploration of materials on AI-enriched toys distributed at the international toy fairs in 2025, synthesizing insights from previous studies on IoTys, AI integration in the smart and Internet-connected toys, and innovations serving human-technology interactions. The study further employs speculative toy fiction as a future research tool to explore potential AIToy applications and possible challenges. The analysis focuses on historical trends, current developments, and future scenarios to outline sustainable and socially responsible AIToy design guidelines.

FINDINGS

Current challenges associated with digital play include children's excessive technology engagement, exposure to questionable content, and ethical considerations in smart-toy-driven interactions. The integration of AI introduces both personalization and risks of dependency or reduced human interaction. Despite these challenges, AIToys, as an evolution of IoTys, show promise in enhancing educational experiences, supporting emotional well-being, and fostering creativity across age-groups.

CONCLUSIONS AND IMPLICATIONS

AIToys represent a significant shift in the evolution of play, education, and social interaction. They require sustainable, ethically aligned design principles to address pressing challenges such as privacy, inclusivity, and social sustainability. Future research should explore guidelines for responsible AIToy development that, alongside sustainable toy design and manufacturing, focus on healthy and safe play: minimizing harmful screen time, fostering engaging outdoor and social play, and ensuring secure data practices. Speculative toy fiction offers a novel approach for envisioning preferable AIToy futures, ensuring their integration aligns with societal values. This study contributes to the ongoing discourse on AI's role in shaping play and provides a foundation for research on AIToys as tools for lifelong learning, labor, and leisure.

Keywords: AIToys, IoTys, AI integration, digital play, robotification, sustainable design, speculative toy fiction

Computationally Simulated Future Societies: Using Social Simulation Models for Futures Studies •

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Social Simulation (SocSim) is a collection of computational methods to simulate artificial societies populated with artificial entities, called agents, capable of acting and interacting in complex, evolving simulated virtual environments. Gilbert (2004) defines these as “computer programs that simulate aspects of social behaviour [...] for the understanding of social processes”. This contribution argues that SocSim approaches can provide new lines of information and research perspectives to complement established Futures Studies (FS) methods.

SocSim approaches have been used to simulate real and imagined present, past, and future societies, from prehistoric tribes to utopias (Gerdes et al. 2023). These approaches can illustrate what the future may look like in the short-, medium-, and longer-time horizons when autonomous entities (e.g. people) make decisions and adapt their behaviours to unfolding circumstances and events. They allow bottom-up modelling approaches that capture aspects of real-world socio-technical complex system phenomena like uncertainty, feedback loops, and emergence.

Regarded as a generative and exploratory approach to reasoning (Epstein, 2007), SocSim approaches can complement FS methods in the following ways.

Firstly, by providing a structured framework for making imagined alternative future societies tangible. SocSim achieves this by implementing computationally executable models of artificial societies, providing experiential, interactive, and interrogatable capabilities (e.g. through game-like interfaces and virtual reality). Moreover, this embedding increases the psychological, social, and ecological consistency of the narratives. This applies not only for a given narrative but also for systems in transition, by providing a way to structure and formalise the interactions (spatial, temporal, and interactional) involved in dynamic contexts.

Secondly, for the imagined societies generated using scenario-based FS methods, which are envisioned within a spectrum of futures, SocSim approaches can validate the internal consistency of these futures to answer specific questions (e.g. about the trade-offs involved in sustainability and stability in the respective imagined societies). Furthermore, simulations enable structured experimentation and systematic exploration of the interactions between different components underpinning futures and resulting emergent phenomena. For example, imagining unfolding wild cards and black swans in a revolution – the things that might go surprisingly wrong or right (Edmonds & Adoha 2019).

Lastly, SocSim allows fine-grained control over combinations of different aspects (e.g. parameters) of imagined futures. This is achieved through formal specifications that differentiate the inherent and adapted

characteristics of the underpinning components. This enhances the unique characteristics of futures, enabling testing, refinement, and reconfiguration of alternative trajectories, opening it up for further experimentation and critique.

In this conference, we would like to create space for discussion on how SocSim might be of relevance to FS, especially complementing the existing methods in this field.

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Keywords: Social Simulation, Complexity, Scenarios, Artificial Societies

4. Futures of the digital and green transitions •♦

Time: Wednesday 11 June at 16.45–18.15
 Room: KINO
 Chair: Osmo Kuusi

Generic Alternate Futures of Carbon Capture and Storage Technologies: Exploring Potential Pathways •

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Carbon Capture and Storage (CCS) technologies are a critical component of carbon management strategies, designed to capture and store CO₂ emissions and prevent their release into the atmosphere. Renewable energy and energy efficiency are leading decarbonisation technologies with numerous studies investigating their futures. Alongside, CCS-related initiatives -such as CCS, CCUS, BECCS and DECCS- are increasingly recognised as complementary and crucial bridging technologies for achieving a low-carbon future aligned with European long-term climate goals of neutrality by mid-century. Despite their potential, CCS technologies face various uncertainties, including technical, social, political, and economic challenges and complexities.

This research examines the possible futures of carbon management technologies focusing on CCS in Europe. The key question is what generic scenarios can be imagined for the future of CCS technologies in Europe by 2050? This study explores possible growth pathways and future images of carbon management initiatives using Dator's Four Generic Alternate Futures method based on an extensive literature review and expert workshops. With a comprehensive and interdisciplinary perspective, we use scenario archetypes -continuation, discipline, collapse, and transformation- as generic alternate images of the future.

Accordingly, alternate future images of CCS in Europe are narrated in four scenarios encompassing "proliferation" as a continued growth path with a more focus on CCS for emission mitigation, "adoption" as a

disciplined growth path with increasing attention on CCUS for emission reduction and management, "succession" as a collapse pathway prioritizing zero-emission alternatives like renewable energies and "blossoming" as a transformative growth pathway emphasising BECCS and DACCS, integrating them with CCUS and RE.

These scenarios present different decarbonisation stories, shaped by specific socio/cultural, political and economic driving forces. They describe diverse portfolios of related technologies in terms of reducing current emissions (CCS), removing past emissions (BECCS and DACCS), managing captured carbon (CCU) and/or preventing emissions (renewable energies). Each scenario describes different pathways for reaching the net-zero emission targets regarding the main technological focus with distinct assumptions about critical uncertainties and dominant trends such as "Innovation trajectory", "social acceptance" and "political development".

Additionally, the study projects the contribution of CCS-related technologies to European CO₂ reductions, estimating their potential to mitigate 110 to 630 MtCO₂ annually by 2050 across different scenarios. The research concludes by discussing the socio-technical implications of these pathways and providing robust policy recommendations to address the development of CCS technologies in Europe's transition to a sustainable future.

Keywords: Carbon Capture and Storage, Alternate Futures, Scenario development, Carbon management, CCS technologies

Speculative Design as a Tool for Visualizing Temporality in Eco-Design Strategies: Challenging Linear Industrial Narratives •

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This paper explores the role of speculative design methods in visualising the temporality of eco-design strategies (EDSs) within Italy's "Spoke 2" initiative under the Made in Italy Circular e Sustainable (MICS) project, funded by NextGenerationEU. The research positions EDSs within the context of industrial revolutions and examines them through a posthuman lens to challenge traditional linear growth paradigms. By introducing speculative visualisations, the study advocates for a post-growth perspective on EDSs and proposes integrative design approaches that connect technological advancement with ecological and socio-cultural well-being.

The study uses empirical analyses of Spoke two projects to investigate the temporality of MICS's EDSs. It explores how collaborative and regenerative design can support the posthuman transition towards Industry 5.0 and beyond. A key part of this research is developing a tailored GPT-based tool designed to help creatives, researchers, and designers assess the temporality and disruptiveness of their EDSs. The study applies speculative narratives to explore new ways of thinking about sustainability and industrial transitions.

Findings from the analysis of Spoke 2 projects show that speculative and critical design methods can help redefine EDSs by moving beyond linear models and encouraging more adaptive, regenerative, and futures-oriented strategies. The research highlights how speculative visualisations can provoke discussions on sustainability and expand the understanding of how design can contribute to inclusive and long-term industrial growth, using measurement tools such as Futures Readiness Level (FRL), rather than Technology Readiness Level (TRL). This study offers pathways to rethink EDSs in ways that transcend conventional industrial progress models and integrate non-linear, posthuman, and post-growth approaches. It shall contribute to future studies, providing tools and methods for designers, policymakers, and researchers to explore new directions for sustainable innovation within the European industry towards Industry 5.0.

Keywords: Speculative Design, Eco-Design Strategies, Temporality in Sustainability, Design Futures, Industry 5.0

Engaging the Futures of Cultural-Creative Innovation Ecosystems through Tandem Futures Methodologies •

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This paper addresses cultural-creative innovation ecosystems through tandem futures approaches, including Heritage Futures Workshops and Futures Literacy Labs. The ECOCRIN project explores local, regional and national futures of Finnish Culture and Creative sectors, especially as the multiple crises are evolving, be they financial, political, pandemics, Russian aggression, technological disruptions etc. ECOCRIN addresses how policies could support ‘unleashing’ the potential of creative sectors for innovation, growth and internationalization and promotes the idea of experimentation for new ways of designing and implementing policies targeted at creative and innovation sectors. One major unexplored narrative is the need to reinterpret these sectors amidst crises through the needs of social justice and planetary boundaries.

To explore local, regional and national ecosystems in a participatory manner the novel approach to combine two complementary futures methods in tandem, one after the other, was applied to explore in different ways the dynamics of innovation policies and creative cultural ecosystems. The Heritage Futures Workshop is a method designed for co-creation of Heritage Futures, that explores novel intangible skills and values for anticipatory systems. These touch upon needs of the local culture and creative ecosystem ecosystems. To do this, Heritage Futures Workshops incorporated past and future temporal leaps and reflections in local contexts with key stakeholders in three key local regions in Finland. The Futures Literacy Lab on the other hand, explored the capacity to identify and use the futures in different ways, exploring assumed and planned for futures as well the emergent. The first lab started from bottom up needs from the regions, analysed on base of Heritage Futures Workshops, and produced planned for futures to meet these needs. The second lab focused upon the top down national perspectives. In tandem both explored diverse ranges of attributes, each with a different focus and function, but combined to more thoroughly engage the evolving futures of culture and innovation policies to support innovative and creative business ecosystems in Finland.

Keywords: heritage futures, futures literacy lab, creative, cultural, innovation ecosystems

Bridging Multi-Level Perspective and Technology Roadmapping for industry-driven sustainability transitions •

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BACKGROUND AND PURPOSE

Sustainability transitions are inherently complex, requiring analytical approaches that not only explain historical change but also inform actionable strategies. While the Multi-Level Perspective (MLP) has been widely used to study past transitions and guide policy at the macro (landscape) and meso (regime) levels, its ability to provide insights for firms and industry actors navigating transitions in real time is limited. Technology Roadmapping (TRM), on the other hand, offers a structured approach to aligning technological development with industry needs, yet its role in socio-technical transitions remains underexplored. This study introduces a framework integrating MLP and TRM to analyse sustainability transitions at the firm and industry levels, enabling a structured approach to understanding company agency in transitions.

METHODS

This study adopts a business ecosystem perspective, recognising that sectoral boundaries are increasingly blurred, and transitions occur through incremental adaptation, reinvention, or displacement. The framework integrates MLP's transition dynamics with TRM's structured planning, drawing on the Technology Roadmapping methodology developed at the Institute for Manufacturing, Cambridge University. The study applies this framework to clean propulsion technology development in shipping, using a case study approach to analyse how firms strategically respond to multi-level transition dynamics.

FINDINGS

The analysis highlights how MLP's focus on niche innovations, dominant regimes, and external landscape pressures can be operationalised within a TRM framework. TRM structures market and business drivers that set requirements for product functionality, which in turn define technological development needs. The findings demonstrate that firms can use transition insights to drive strategic action rather than simply adapting to external regulatory shifts. Institutional work and business model innovation emerge as enablers in this transition process.

CONCLUSIONS AND IMPLICATIONS

This study contributes to both socio-technical transition theory and strategic management by offering a framework that translates socio-technical transition insights into actionable business ecosystem change strategies. The findings underscore the need to move beyond policy- and history-focused applications of MLP and provide industry actors with tools to actively shape sustainability transitions.

Keywords: sustainability transition, multi-level perspective, technology roadmapping, clean propulsion

5. Futures of transportation and mobility •♦

Time: Wednesday 11 June at 16.45–18.15
 Room: GOTO 33
 Chair: Petri Tapio

Dystopic scenarios as a mean for enhancing the resilience of local mobility and energy infrastructures •

Emmanuel Muller

University of Applied Sciences Kehl, Germany & University of Strasbourg, France

Crises are becoming increasingly frequent and severe, ranging from extreme weather events to threats to critical infrastructure, pandemics, and hybrid conflicts. In this context, enhancing preparedness and resilience for individuals, organizations, and communities has become crucial. The EU has recognized this need, as evidenced by the recent adoption of the Critical Entities Resilience Directive (CER) and related recommendations to strengthen the resilience of critical infrastructure.

As a multifaceted concept, resilience requires a comprehensive understanding. At its core, it encompasses three critical elements: proactive preparation, robust recovery, and adaptive evolution. This triad forms the foundation of a resilient system, capable of withstanding and rebounding from diverse crises or extreme events. Viewed through a broader lens, resilience emerges as a manifestation of anticipation. Considering resilience through the prism of foresight allows to unlock its full potential as a preventative force. This perspective encourages the development of forward-looking strategies designed to prepare for, prevent, or minimize the impact of adverse events. By adopting this approach, organizations and communities can shift from a posture of response to one of readiness, better equipped to navigate an uncertain future.

The aim of the paper is to investigate in how far the conception of dystopic post-2050 scenarios through local stakeholders may support their current resilience strategies. In the frame of an EU-funded research project, the possible ways to increase the long-term resilience capacities of critical infrastructures in the border French-German region around Strasbourg were investigated.

The collective effort in crafting these narratives resulted in three distinct scenarios titled "Tsunami 2050", "Blackout 2050", and "Collapse 2050". This exercise involved approximately thirty representatives from key local stakeholders, including businesses, fluvial ports, energy producers, mobility operators, public authorities and academics.

This method of fictitious time travel offered the participants a better understanding of the issues at stake after having "experienced" situations in several dimensions (technical, political, but also emotional ones). It also serves as an effective tool for encouraging both individual and collective reflection on potential critical situations and fostering preparedness for resilience if needed.

An analytical matrix (called "TOSA") was developed encompassing four main dimensions Threats, Opportunities, Stakes, Actions. This matrix enabled the involved stakeholders to start new and cooperative strategies, based on the elements gained during the exercise.

Given the project's focus on the French-German border region, there is an opportunity to develop cross-border resilience strategies through specific foresight activities, aligning with the EU's emphasis on international cooperation.

Keywords: Scenarios, Dystopic narratives, Resilience, Energy, Mobility, Infrastructures, Border regions

Futures images of long-distance travel •

Marileena Mäkelä – Minna Käyrä

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We live in a world of crises, with global environmental problems being the most pressing. Climate change is already affecting daily life in many regions, causing extreme weather events. In this study, we focus on the transportation sector, as it is the second most polluting sector after the energy sector. Especially the aviation sector receives criticism from environmental activists and professionals. While the COVID-19 pandemic temporarily altered our travel habits, by 2024, air traffic has resumed its upward trend. This study explores the futures of long-distance travel in Finland by envisioning alternative futures images.

Our data comprises two sources. First, we have conducted 15 interviews with individuals of various nationalities residing in Finland. The sample includes working professionals from different fields (e.g., self-employed, employees of public and private sector) and retirees, to capture a broad range of perspectives. We inquired about changes in their travel habits and their views on future travel trends. Second, we analysed 10 trend reports from various organizations to identify key drivers for travel. We applied qualitative content analysis principles to analyse the data.

Based on our data, we have created four distinct futures images for long-distance travel.

1. **Localization:** In this image, long-distance travel is rare. While some work-related travel still occurs, leisure travel is predominantly land-based and confined to nearby regions and within Finland.
2. **Slow travel:** This image emphasizes a slower pace of travel than currently. Air travel is reserved for urgent business purposes, while long-distance travel is primarily conducted by trains, buses and ships.
3. **Air traffic dominance:** This image continues the current trend of air travel dominance for long-distance journeys.
4. **Strict rules:** This image envisions global, stringent regulations on greenhouse gas (GHG) emission. Individuals and businesses are allocated quotas for their GHG emissions from consumption, including travel.

To address the pressing environmental problems we face, a systemic approach is essential. Small, incremental changes in isolated aspects of our daily lives are insufficient. To effectively combat climate change and biodiversity loss, we must drastically transform all facets of our lives, including our travel habits. We challenge you, the reader, to reflect on how your long-distance travel can become more sustainable in the future!

Keywords: futures images, aviation, transformation, sustainability

Futures Scenarios for car dependency in Wallonia: Policy and Practical Insights ♦

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^b Université Catholique de Louvain, Belgium

Context and Objective: The green transition necessitates a significant reduction in greenhouse gas emissions, with Europe targeting net-zero emissions by 2050. However, in Wallonia, Belgium, the transport sector has followed a divergent path since 1990, characterized by a rise in fossil fuel consumption due to the adoption of larger, heavier vehicles. Despite stagnation in the number of kilometers traveled per person or vehicle (the "peak car" phenomenon, see Focas and Christidis 2017), car dependency remains deeply ingrained, presenting a substantial obstacle to decarbonization (Webb, Wilson, and Briggs 2017; Dupuy 1999). This presentation examines the future of passenger car transport in Wallonia by 2050 using a participatory foresight approach, providing practical insights for policymakers and practitioners on reducing car dependency while facilitating a transition to sustainable mobility.

Main Points: The presentation will outline the key findings of a foresight study employing the scenario-based methodology of the French school of "La prospective" (Godet, 2007). By deconstructing car dependency into critical variables such as vehicle types, energy sources, and infrastructure, the study formulates a set of hypotheses about potential futures for transport. A morphological analysis of these variables generated a range of divergent future scenarios, highlighting both the challenges and opportunities associated with reducing fossil fuel vehicle usage in Wallonia.

Relevance to Conference Themes: This presentation aligns with the conference's themes by demonstrating how foresight methodologies can guide policymaking and address the risks associated with entrenched car dependency. It contributes to the conversation on how foresight can support anticipatory governance in tackling complex societal challenges, particularly the balance between transportation needs and environmental sustainability. The insights presented will help policymakers in Wallonia and other similar regions reconsider their strategies for decarbonizing transport and promoting sustainable mobility.

Conclusions and Implications for Practice: The study suggests that overcoming car dependency in Wallonia will require a multifaceted approach, including policy interventions targeting infrastructure, vehicle electrification, and behavioral change. The presentation will conclude with actionable recommendations for policymakers on navigating these challenges, including promoting alternative modes of transport and incentivizing the adoption of electric vehicles.

Keywords: car dependency, mobility, scenario, green transition

The Green Transition in Maritime Logistics: A Systems Analysis on Alternative Fuels •

Emilia Luoma^{ab} – Patrik Kauppi^{ab} – Maija Nikkanen^b – Nina Janasik^b – Annukka Lehtikoinen^{ab}

^a Kotka Maritime Research Centre, Finland

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There is an essential need to reduce greenhouse gas emissions to mitigate climate change. According to the International Maritime Organization, the maritime sector needs to cut its GHG emissions close to zero by the year 2050. Technical and operational development can reduce emissions but to meet the goals, new carbon neutral fuels are needed as well. Hence, the maritime sector is facing one of its greatest changes: the green transition. While climate objectives are central to the green transition, it is vital to account for other environmental impacts to prevent merely redistributing burdens. Therefore, despite the undeniable benefits of carbon neutral alternative fuels in mitigating climate change, potential risks caused by the production, distribution, and use of them to other sustainability goals must be identified and proactively managed. Cross-disciplinary and inter-sectoral knowledge co-production is needed to understand the yet developing complex socio-eco-technical systems through which the sustainability risks and opportunities arising from the adoption of new maritime fuels materialize. We addressed this challenge by bringing together experts from various fields to co-create knowledge and systems understanding. In two structured workshops, the experts brought in their knowledge and ideas on the mechanisms through which production, distribution, and maritime use of the new fuels: biofuels, methane, and ammonia, may generate risks and opportunities in terms of different economic, ecological, and social sustainability indicators. The third workshop served as a validation session, where the results of the two previous workshops were presented. Based on these findings, participants discussed and identified the key priorities for the coming years in relation to the green transition of maritime traffic in Finland. In this study, we create an overall picture of the conditions under which the discussed fuels could serve as a sustainable partial solution in green maritime logistics particularly in Finland. Based on the workshop data, we create a systemic network of key variables and their connections in this complex system and examine the key driving factors of (un-) sustainability of the new fuel solutions. As a method, we apply a structural causal network modelling approach to identify potential leverage points within the network, and map areas that function as bottlenecks. Through knowledge co-production and systems analysis we aim for identifying future impact pathways whose management can most effectively support the green fuel transition in maritime transport.

Keywords: knowledge co-production, systems analysis, sustainability, alternative fuels, maritime traffic

6. Workshop: Collaborative envisioning of immersive environments for anticipatory technology assessment •

Time: Wednesday 11 June at 16.45–18.15
Room: GOTO 31
Facilitators: Sofi Kurki, Minna Halonen, Hanna Saari & Jorge Martins

Sofi Kurki – Minna Halonen – Hanna Saari – Jorge Martins

VTT Technical Research Centre, Finland

Creating technologies that are both responsible and aligned with human values isn't just about coding or design—it's about understanding their impact on the complex social and technical systems they enter. That requires not just analysis, but imagination.

This workshop spotlights the *power of imagination* as a critical tool in *anticipatory technology assessment*—a way of exploring what technologies might do before they are widely adopted. Through the lens of *experiential foresight*, we'll think of ways for using physical and digital artifacts to bring possible futures to life and spark new perspectives.

You are invited to dive into a creative challenge: *envision an immersive environment* that lets others feel, question, and experience a slice of the future—before it happens.

Our starting point is the *Theseus* scenario: a *multi-layered vision of Europe in 2050*, where societal change and value-driven technology define new ways of living and deciding together. This visual narrative offers a fertile ground for speculative design and experiential foresight.

This workshop takes the form of a *hands-on hackathon*, where participants will envision and enact prototypes of *immersive future experience*. Working from a visualised scenario narrative—the *Theseus 2050 storyworld*—teams will propose a combination of physical, digital, and AI-enhanced elements to create environments that transport participants into a plausible and emotionally engaging future.

There is a 20 person limit to attendance to the workshop.

Keywords: Anticipatory technology foresight, futures studies methodology, value-sensitive design, future imaginaries, scenarios

7. Workshop: Future Archeologies Workshop. A hands-on approach to speculative futures ♦

Time: Wednesday 11 June at 16.45–18.15
 Room: GOTO 32
 Facilitators: Alejandro Lecuna & Maria Maciejko

Alejandro Lecuna – Maria Maciejko

Anhalt University of Applied Sciences, Germany

Futuring practices often rely on issue-centric approaches, which tend to reinforce linear thinking and familiar narratives about the future. These methods frequently assume that the problems of tomorrow are already known, neglecting the transformative potential of unexpected or seemingly implausible developments - which can be described as preposterous futures. This narrow focus limits our capacity to imagine alternative trajectories and explore unconventional possibilities, while engaging with the preposterous dimension broadens the scope of our future speculations by challenging underlying assumptions and embracing alternative narratives.

This workshop will build on Future Archeologies Method, an approach to design futures that explores the connection between speculative technologies and their potential societal impact. As archeology uncovers material remains and interprets their stories, Future Archeologies engages with tactile experience of imagined future artefacts to speculate on future technologies and foster discussions about their implications (Maciejko and Lecuna, 2025). Borrowing from material culture studies, this workshop will use tactile exploration of Future Mystery Bag as a first step to envision future worlds, followed by scenario creation through world-building and visual storytelling. This approach situates imagined technologies within lived contexts, allowing for critical reflection on the interplay between innovation and daily life. Through this process, it will highlight how technological developments shape society while also revealing today's hidden concerns and assumptions about the future.

By enabling participants to explore diverse, subjective futures, the Future Archeologies Method serves as a tool for reorienting perspectives on present decisions. It encourages not only future technological innovation, but also exposes our underlying perceptions of the future. Revealing the faint signals within our concerns about tomorrow, it invites broader reflections on the role of technology both in the future and in the present.

This workshop provides a hands-on opportunity to innovate and visualise speculative technological artifacts while fostering discussions about the role of technology in shaping future societies. It challenges participants to move beyond linear, problem-focused thinking, embracing preposterous possibilities as a means to inspire both speculation and inform decision-making in the present.

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Keywords: design futures, speculative design, preposterous futures, critical thinking

THURSDAY 12 JUNE 2025

♦ PRACTICE-oriented

• ACADEMIA-oriented

Session 5: 12 June 2025 (Thursday) at 10.15-12.00

1. Special Session: Emerging Enabling Technologies in Support to the Digital and Green Transitions through Value Sensitive Innovations ♦

Time: Thursday 12 June at 10.15–12.00

Room: LOGI

Chair: Brigita Jurisic

Forum for Emerging Enabling Technologies in Support to the Digital and Green Transitions through Value Sensitive Innovations ♦

Brigita Jurisic^a – Minna Halonen^b – Francesca Foliti^c – Sofia Gatteri^d – Viviana Perez Clausen^e – Ana C. Martins^a – Eva Fadil^f – Sofi Kurki^b

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^f G. A. C. Group, France

FORGING, a project funded by the European Commission under the Horizon Europe programme, adopts a multi-level approach to assess the desirability and societal and environmental impact of novel enabling technologies. At its core, FORGING fosters a participatory, cross-disciplinary, and cross-sectoral forum to co-create future technologies. This approach integrates foresight, enabling technologies, and policymaking into a value-sensitive innovation methodology that is human-centered and aligned with Industry 5.0 concept.

Building on past EU research projects and similar initiatives, FORGING has identified key elements for successful stakeholder collaboration in co-creating novel technologies. The literature identifies issues such as the use of lead users (Baldwin, C., & von Hippel, E., 2011); the way participants are involved in innovation projects; and how their competencies are identified, valued, and included³ as influencing the success of knowledge integration in collaborative innovations. A recent study (Mathisen & Jørgensen, 2021) illustrates that the potential to identify new strategic directions for innovation through co-creation revolves around knowledge use. It depends on actors' ability to recognise and interpret knowledge and thus be able to act on it. Enabling knowledge access is not sufficient to realise the innovation potential present in university-industry collaborations. A community of 320 active members, from academia to industry, to creative and social sciences, to policy makers and to the broader society were engaged in 32 co-creation sessions. Such multi-actor and multidisciplinary collaborations made it possible to combine different types of knowledge and challenge diverging visions that lead to tangible outcomes and stimulate value-sensitive innovations.

The session will share insights into the methods tested within FORGING and the results stemming from its participatory approach, which links foresight exercises with technology prioritization and policy recommendations.

Keywords: foresight, images of the future, co-creation, responsible R&I, participatory research, R&I policy

2. Social and technological transformations at the local level ♦ ●

Time: Thursday 12 June at 10.15–12.00
 Room: TEATRO
 Chair: Juha Kaskinen

Building a Common Operating Model for Skills Needs Anticipation: Regional Foresight and Competence Development in Häme ♦

Antti Rajala – Maarit Kinnunen – Christian Granlund

Centre for Economic Development, Transport and the Environment of Häme, Finland

In response to rapidly evolving technological, societal, and environmental challenges, the Common Operating Model for Forecasting Competence Needs in Häme Region project — an ESF+ -funded initiative led by the Centre for Economic Development, Transport and the Environment of Häme — seeks to develop a comprehensive framework for regional skills needs anticipation. This framework enhances anticipatory governance, strengthens regional foresight capabilities, and ensures sustainable competence development.

The project is structured around four objectives: (1) co-creating a Joint Model for Skills Needs Anticipation with a shared vision, (2) developing a Skills Needs Anticipation Platform to consolidate and standardize data, (3) building the anticipation capacity of stakeholders through training and collaboration, and (4) institutionalizing the operational model to ensure sustained activity beyond the project lifecycle.

The developed operational model comprises three interlinked groups:

1. Skills Needs Foresight Group: This group ensures data consistency, defines new information content for the platform, and employs forecasting methods to analyze and interpret regional development trends.
2. Coordination Group for Skills Needs Foresight: Responsible for overseeing regional competence needs foresight, this group ensures alignment with strategic objectives and the region's shared vision.
3. Foresight Forum: A participatory platform facilitating broad discussions on regional foresight, bringing key topics to a larger audience.

At the core of the operational model is the Skills Needs Anticipation Platform; a digital tool that enhances the comparability and accessibility of skills needs data. By refining information through stakeholder collaboration, the platform supports evidence-based decision-making in education, workforce planning, and policy design. Its user-centered design ensures it remains a valuable resource for medium- and long-term foresight efforts.

The presentation will explore how the operational model exemplifies the integration of technological tools and participatory practices, fostering a sustainable framework for skills needs forecasting. Additionally, it highlights the importance of combining quantitative foresight, which provides a solid data foundation, with qualitative foresight, enabling long-term strategic planning and adaptation.

This project underscores the importance of shared resource allocation, stakeholder commitment, and institutional agreements to ensure the model's resilience and continuity. It offers valuable insights into creating foresight-driven regional policies and practices, aligning with the broader themes of the Futures of Technologies 2025 conference, including anticipatory governance, foresight in policymaking, and technology-enabled regional development.

Keywords: skills needs, regional development, foresight, skills needs anticipation, foresight platform

A study to embody the concept of "Live with neighbors" ♦

Miki Kuribayashi

Ministry of the Environment, Japan

The Japanese Government has been promoting the "FutureCity" Initiative to realize a community that is continuously creating environmental, social and economic values, where everyone wants to live, and where everyone is empowered in respond to the issues of aging and the environment.

However, in recent years, the effects of climate change have caused global temperature rise and natural disasters such as heavy rain and typhoons. Increase in the disaster frequency has imparted anxiousness in the day-to-day life of citizens. Therefore, it is crucial to predict what is needed in a city, and how technology can support it.

Since the Great East Japan Earthquake on March 11, 2011 has had to address environmental, safety, and security issues. In this context, a new city development movement was initiated, led also by companies, local governments, and research institutes. For instance, in the Fujisawa Sustainable Smart Town (SST), led by Panasonic, Fujisawa city government and other companies and so on, the Community Continuity Plan (CCP) aims to ensure lifelines for three days, and development of more resilient infrastructure and power sources. A seven-day supply of drinking water and food was stored. Here, advanced technologies and communities are used to strengthen safety and security against natural disasters, disaster simulations are conducted using digital twins, and CCP guidelines are implemented together with residents. In the case of Susono City, where Toyota Woven City is under development, Toyota provided technologies and know-how to create a wide-area evacuation plan and performed data analysis and visualization using 3D simulations that would be challenging to conduct individually for a city administration. The results of this project were used during volcanic evacuation drills, and to increase disaster prevention awareness among the residents.

In this study, deepened furthermore insights with leading companies and experts from the perspective of "Ecosystem," "Mobility," "Infrastructure," "Clothing," "Food," and "Housing." They are not only responding to natural disasters, but also clarifying the new concept named "Live with neighbors" and looking ahead to structures and technologies to realize it.

We are going to build strategies include storytelling to realize the concept of "Live with neighbors." We expect that the concept is incorporated into policies and utilized for local governments, and we enhance with researchers and organizations.

Keywords: environmental policy, responding to natural disasters, community building

Green technologies for urbanism in the Arab World ♦

Muhammad Alaraby

Future for Advanced Research and Studies, the United Arab Emirates

Green urbanism has become a buzzword in the Arab world, with several mega projects across the region aimed at creating new sustainable spaces for national communities and promoting future national strategies. The Gulf has been the hotbed of most of these endeavours. For the region, the future is urban, as projections indicate that 90% of the population will reside in major littoral cities. Most national strategies promoting green transition highlight the crucial role of technologies in achieving this goal. National GCC governments are advancing green technologies such as electric vehicles (EVs), solar and wind energies, and smart energy storage as essential instruments for green transition.

Projects like MASDAR City in Abu Dhabi and the Line in Saudi Arabia exemplify national goals of enabling technology, sustainability, efficiency, and ambition. These cities and projects are being closely studied as leading examples of future cities in the region. However, challenges may hinder this model of green transition, including the affordability of housing, accessibility of spaces for the local population, the growing impact of climate change, and the paradox of focusing on 'smart urbanization,' as cities are responsible for 75% of all carbon dioxide emissions. Leave aside the controversies of sustainability of the technologies employed in 'smart cities.'

This presentation is meant to ponder the futures of green 'technology' and 'urbanism in the Arab world with a focus on the GCC countries. For doing so, it will be based on applying the 'futures triangle' method by deconstructing the factors and the elements that shape of the future of smart cities/mega projects in the region into the weight of the past, the pull of the present and the push of the future. It aims to provide a multilayered approach to navigate the future of urbanism in the region and to bring to the discussion the socio-economic and political context underlying the debate.

Keywords: Technology, Transition, Urbanism, Arab World, GCC

Role-playing social and technological transformations in municipalities. Reflections on a research-based future scenario exercise ♦

Tommi Vasko – Sini Numminen – Mikko Jalas

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Sustainability Conciliation (Kestävyyssovittelu) is a three hour long Live Action Role-Play exercise for mid-sized Finnish municipalities to support their strategy work from a multifaceted sustainability perspective. The role-play was developed as part of the ORSI research project, and the purpose is to support municipal executive boards to reflect their possible future actions under the climate urgency and policies (such as restrictions on fossil fuels and biomass usage) which significantly transform regional energy realities, economies and practices. The exercise consisted of a facilitated role-play session, debriefing discussion, and group interview a week after the game. The game was built around a future scenario, developed by the researchers, touching themes of energy system transformation, ecological compensation and energy justice. The role-play also introduced to the policy making process emerging political agencies including more-than-human representation in governing bodies.

This paper reflects the process of designing, facilitating and analysing the role-play and the participants' reflections after the game session in two different municipal contexts in rural western Finland. We reflect on the scenario development and writing process as part of a multi disciplinary research project, which included data collection, regional visits and local stakeholder interviews and sensory observing. We analyse the different role-play components, and how the participants reacted to the future scenarios, the data content in the scenario and the early impacts of role-playing in their future strategy processes. We also reflect on how this layer of speculation and fiction contributes to boardroom discussions about sustainability challenges at municipal level.

Keywords: Sustainability transformations, Role-play, Fossil free future, Energy vulnerability

The integration of Personal, Collective, and Artificial Intelligence for Participatory Practice within Smart City Ecosystem •

Tatiana Yakubovskaya

The Finnish Society for Futures Studies, Finland

The problem of integrating Personal Intelligence (PI), Collective Intelligence (CI), and Artificial intelligence (AI) as well as relevant technologies and tools that manage and develop these combinations can be discussed as a key factor in advancing the scientific discipline and methodology in the field of futures studies.

This combination – PI, CI, and AI – facilitates participatory practices that address complex (systems approach) and super-complex (ecosystem approach) challenges (by Ronald Barnett).

1. Ecosystem Complexity and Super-complexity. Participatory Practice.

Since 2014, empirical, methodological, and theoretical research has explored how participatory approaches can handle complexity and super/complexity within a Smart Cities Ecosystem.

Super-complexity involves essential questions related to values, identities, cultural diversity, lifestyles, and regional features. Unlike conventional systemic approaches, participatory practices are necessary to navigate again-and-again these fundamental non-solving uncertainties.

2. Methodological Hypotheses within Comparative studies

Developing the Smart City Ecosystem concept emphasizes collective decision-making and transformative agency. Comparative studies on regional futures literacy highlight the need for adapted and tailored, future-oriented education programs that respect cultural, social, and historical contexts.

3. Principles for Assessing Technology-Society Interaction

The assessment of a Smart City Ecosystem follows two key principles: "Quality-of-Life" by systems methodology and is equally shaped by "Tasks-of-Life" according to the ecosystem methodology.

Systems Approach: Based on the well-known concept of "Quality-of-Life" including factors like time, safety, health, cost of living, and employment, as outlined by the McKinsey Global Institute.

Ecosystem Approach: Based on the developed concept "Tasks-of-Life," structured using the idea of the complex/list of life tasks (named "ABC+").

In further research and development the framework is ABC10 (these ten life tasks have been taken into account in the projects) :

- (A) Anti-Crises (relocation, military conflicts, etc.)
- (B) Business
- (C) Career
- (D) Development
- (E) Education
- (F) Finance
- (G) Generations (family, relationships, etc.)
- (H) Health
- (I) Identity
- (J) Jobs

4. Implementing Open Foresight Laboratories as a participatory practice

Foresight methods in Smart City governance rely on "Open Foresight Laboratory" models, integrating PI, CI, and AI for future-oriented decision-making. These laboratories leverage mass communication, Big Data analytics, visualization, and gamification to support participatory practices, etc. Integrating PI, CI, and AI fosters

transformative agency and futures literacy. Future studies benefit from activity-, laboratory-, and problem-based research to develop proactive strategies for Smart Cities. By leveraging participatory PI, CI, and AI intelligence integration, this research proposes a strategic framework for enhancing governance, education, and societal innovation in Smart Cities. The study underscores the necessity of interdisciplinary collaboration and technological foresight to address the evolving challenges of urban ecosystems.

Keywords: Smart City Ecosystem, Super-complexity, Participatory Practice, Futures Guidance, Futures Literacy

3. Novel methods of analysing data & creating scenarios - case studies •

Time: Thursday 12 June at 10.15–12.00
Room: GALLERY
Chair: Markku Wilenius

AI & Scenario Building – a comparative study incorporating ethnographic data from a field experiment •

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The introduction of Artificial Intelligence (AI, such as ChatGPT) into the process of writing future scenarios appears to be a promising add on. Though, as early-stage research suggests, it's contribution to writing scenarios seems to depend on users' ability to skillfully employ AI. After all, even professional scenarists cannot distinguish between human-generated and AI-generated scenarios. Some have suggested that current advances in AI mark the end of scenario planning. Recall, however, that when Turing rejected the question "can machines think?" he suggested that a more telling test implied an "imitation game" – later coined the Turing Test – wherein a judge, interacting through text, would be unable to distinguish between human- and machine-generated text. To Pierre Wack, scenarios are considered useful when they lead to the ability to perceive, in new ways – to, in his terms, re-perceive – an important aspect of a challenge, an opportunity, the firm, its competitors, or the business environment."

To empirically assess the role of AI in writing scenarios, we adopt a "hybrid AI-Expert foresight approach," and offer – based on a videographic methodology – insights into a comparative research study that examines creating scenarios with and without AI support. Working on the future of the German photo and imaging industry, the project followed the well-known Shell scenario planning approach. During the seminar, participants started with research on trends, assessing trends on a relevance/uncertainty matrix and eventually developing scenarios along a 2 x 2 matrix. Over 12 weeks, we followed two groups of students, diverse in terms of participants' cultural and academic background, language, and gender. We focused on aspects such as discussion, trend research, building scenarios, and visualizing the outcomes of the scenario building process – all with and without AI support in the respective groups.

Overall, our research indicates that further empirical research on (mixed) human and non-human agencies in the field of Corporate Foresight is very much needed; our tentative findings, at this stage, indicate that the use of AI aids participants in efficiently completing their background work and develop plausible scenarios, but AI does not appear to speed users to Wack's iconic standard of re-perception. Our motivating question: Can scenarios built with AI pass the Wack-Test?

Keywords: AI, Turing Test, re-perceive, scenario building, foresight, video ethnography

Exploring the Futures of Language Education in Europe through Causal Layered Analysis •

Samira Yaghouti

Finland Futures Research Center, Finland

Language education in Europe is at a crossroads, shaped by technological acceleration, policy fragmentation, and competing visions of multilingualism. This study employs an integrated methodology—Causal Layered Analysis (CLA) and Dator's alternative futures framework—to investigate the challenges and future imaginaries of language teaching from the perspective of educators themselves. Drawing on qualitative data from 15 language teachers across diverse European contexts, the research unpacks these perspectives across four analytical layers: surface-level concerns such as workloads and digital integration (litany); structural disparities in resources and policy implementation (systemic causes); tensions between national monolingual priorities and EU multilingual ideals (worldview); and deep-seated metaphors that frame language as capital and teachers as cultural gatekeepers (myth/metaphor). Building on this analysis, four exploratory scenarios are developed to illustrate divergent trajectories for language education in Europe. These futures serve as reflective tools for practitioners and policymakers navigating uncertainty in the field. The study advances a novel, layered methodology for language education research, demonstrating the value of practitioner-driven foresight in reimagining inclusive, equitable, and future-oriented multilingual education systems.

Keywords: Causal Layered Analysis, scenario planning, language education, multilingualism, teacher agency, futures thinking, educational equity

Prompting with intelligent creative tension: constructive use of GenAI as part of technology foresight •

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The use of Generative Artificial Intelligence (GenAI) for foresight is a rising topic. The promises include enhancing foresight processes, such as scenario planning and communicating visions, as well as processing and integrating excessive amounts of future-relevant qualitative material. The downsides stem from potential uselessness for credible research due to e.g. too linear future projections, avoidance of dystopian scenarios due to in-built ethical considerations, and the amount of preliminary and preparatory work required to fruitfully work with GenAI.

This paper asks how to meaningfully leverage GenAI's ability to process a wide range of qualitative information for technology foresight while minimizing the risks of creating results irrelevant for research e.g. due to black-boxing. We discuss a pilot study where we used GenAI to assess possible long-term societal impacts of human-like robots. Such robots are currently rapidly being developed and piloted especially in the automotive and logistics industries and expected to spread to other industries and even households in time.

Our paper puts forth a concept of intelligent creative tension that we argue being a useful principle for utilizing GenAI in technology foresight.

We built and tested intelligent creative tension in the following manner:

- Forming of descriptions of present technological development and future society: Human analysts gathered systematic data of the status and maturity of the assessed technology and described capabilities that humanoid robots are expected to have when wide market penetration will take place (in 5-10 years).

Analysts formed descriptions of future contexts. In our research, technology descriptions were based on data gathered from publicly available information on 11 current humanoid robot development projects. Descriptions of future contexts were derived from pre-existing research (so-called Radical Technology Inquirer) that has mapped transformations in 20 societal functions (transportation, health, nutrition, experiences, built environment, etc.).

- Using Retrieval-Augmented-Generation (RAG): Analysts use this technique to augment GenAI's responses with known datasets. In our research, the above-mentioned technology capability descriptions and context descriptions formed the datasets with which GenAI's responses were augmented.
- Forcing GenAI to juxtapose the datasets: Analysts built the creative tension by presenting GenAI with both present and future datasets.
- Increasing the intelligence of results: Before prompting, analysts brainstormed, based on the datasets, the types of societal impacts that GenAI should at least find to be useful. Then the wording of the prompt was developed with test rounds until it produced good results.
- Releasing creative tension: GenAI was prompted to chart the space of possibilities that exists between the two datasets. In our research, GenAI (Open AI's GPT o1) was prompted to explore how human-like robots, when matured to markets, will impact the 20 societal functions
- Ensuring the intelligence of results: To ensure that also negative or dystopic impacts were sufficiently recognized, the results were further complemented with another GenAI (Anthropic's Claude 3.5 Sonnet). The results of the prompting rounds were reviewed by the analyst team and found to be credible. GenAI was able to recognize possible impacts quicker and more widely than the 4-member analyst team.

CONCLUSION

Based on our study, we discuss the kinds of foresight questions and research settings in which prompting with intelligent creative tension can be expected to bring fruitful results by increasing the transparency and rigor of the AI-assisted analysis.

Keywords: technology foresight, technology impact assessment, generative AI, GenAI, human-like robots, humanoid robots, intelligent creative tension

Advancing Delphi Studies exploring visual methods for future scenario representation●

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This study builds upon the "Domani in Famiglia" initiative, which examined evolving family dynamics in Northeast Italy over the past five years. Expanding on this foundation, the research investigates innovative visual communication strategies to enhance Delphi-based foresight studies. The aim is to improve expert evaluation of future scenarios by refining visualization techniques for greater accessibility and effectiveness. The core objective is to design and test multiple visual approaches for representing family scenarios projected ten years ahead. Various formats, such as written narratives, comic strips, photographs, and videos, are assessed for their ability to effectively convey complex information. The study evaluates these formats based on clarity, coherence, and audience engagement and a controlled experimental framework was employed, incorporating four distinct scenarios, three visualization strategies, and four evaluation criteria. Participants, assigned scenarios according to their birth month, rated the formats using established scenario evaluation measures,

including plausibility, internal consistency, ease of understanding, and aesthetic appeal. Data collection was conducted through an online survey using Limesurvey. The initial research phase concentrated on refining visualization techniques and integrating AI-driven tools, such as Generative Adversarial Networks (GANs), to create images and videos. Findings highlight the importance of narrative consistency, detailed visuals, and an optimal balance between text-based and emotional elements to enhance scenario comprehension. Results suggest that visual and multimedia formats outperform text-based presentations in terms of clarity and user engagement. The findings indicate that AI-assisted visual storytelling significantly improves the communication of complex future scenarios. Despite challenges – such as balancing detail with comprehensibility – multimedia approaches show strong potential for scenario-based research. The study emphasizes the need for tailored visual elements to strengthen scenario coherence and plausibility, ultimately facilitating more effective decision-making in Delphi methodologies. Future research will focus on expanding participant diversity and refining evaluation metrics to further optimize visual communication in foresight studies.

Keywords: Delphi method, Scenarios Communication, Scenario Evaluation, AI-assisted visualization, Visual representation methods, Experimental Design, Statistical Analysis, Trial Design

4. The role of technologies in tackling global challenges •

Time: Thursday 12 June at 10.15–12.00
Room: KINO
Chair: Leena Jokinen

Landslide Susceptibility in Kavrepalanchowk District, Nepal: A GIS and Remote Sensing Based Approach •

Urusha Gautam^a – Sunil Prasad Lohani^a – Mika Korkeakoski^b – Osku Haapasaari^b – Kalpani Pavithra Alahakoon Arachchige^b – Joni Karjalainen^b

^a Kathmandu University, Nepal

^b Finland Futures Research Centre, Finland

Landslides are common occurrence in Nepal due to its steep and rugged topography, complex geological structures, high relief and climatic variations. Kavrepalanchowk district frequently experiences landslides because of erratic precipitation trend, change in land-use pattern, unplanned urbanization and development activities. The present study aims to map the landslide susceptibility of two municipalities and two rural municipalities of the Kavrepalanchowk district. Remote Sensing and Geographic Information System (GIS) were used in this study for the assessment of landslides, as these provide detailed spatial analysis. A landslide inventory was prepared by using secondary data from satellite and Google Earth images. Six landslide-conditioning factors- slope, aspect, curvature, land-use, distance from the stream and distance from the road were used for analysis. The Frequency Ratio (FR), a statistical approach based on the occurrence of historical landslides and the influence of environmental factors was then used to generate the Landslide Susceptibility Map (LSM), categorizing the area into five susceptible zones: very low, low, medium, high and very high. The results of this study will aid the local government bodies in disaster risk management and sustainable development practices, as landslide susceptibility assessment is crucial for developing mitigating strategies. Additionally, it will also help in reducing potential risks to life and property by providing an evidence-based basis for infrastructure development.

Keywords: Landslide susceptibility, GIS, disaster risk management, mitigation, Hazard Mapping

Coevolution of AI-driven business transformation in the Finnish construction industry: A historical and embedded case study with a nine sub-cell scenario approach •

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BACKGROUND AND PURPOSE

"Think global, act local" is a phrase well known sustainability discourse. There is paucity of research in the spirit of the phrase in terms of looking at artificial intelligence (AI) and the kinds of business and social transformations it is triggering. We take inspiration from Teece (2018) to study: How does the phrase "Think global, act local" applies in discourses relating to AI, business transformation, social change, and business modelling?

To answer our research question, we follow Teece (2018), who argues that any industry will tend not transform at once but will do so through three analytically distinguishable phases: "sensing", "seizing" and, only then, "transforming" (or shifting). We also build on Geels (2002), who has proposed that one approach to model such stagewise development is to differentiate between a "global landscape" level, a "socio-technical-regime" level, and a "niche-level" of organisations and agencies. Pouru et al. (2019) have proposed that, in such analysis, it is worth also to pay attention, how and why such analytic differentiation should pay attention to also horizontal scanning and technological foresight issues.

METHODS

Kaivo-oja and his colleagues propose that AI- and other digital-technology-related business transformation involve push and pull factors in many an industry that are often obvious to outsiders, at least by hindsight, but difficult to see on the inside while it is all happening (Kaivo-oja et al. 2022). Kaivo-oja has analysed this issues of this specific proposition empirically with big data (Kaivo-oja et al. 2022).

In this paper, we refine Kaivo-oja's analyses taking as our starting point that behind how any push or pull factor to transform or not an industry sometimes lurks by-hindsight unreasonable degrees of lack of trust and belief in the power of innovation to change business and society (see Hargadon & Douglas 2001; Pantzar & Ainamo 2004). This means that both hindsight and foresight technology analyses matter, if we want to see changes in business and society.

We focus on the case of construction industry, both as a global (landscape ananalysisi level) and as a country-level industry (socio-technical regime level). We take it that even in a such slow-moving industry as the construction industry, AI-related improvements in efficiency, safety, cost-effectiveness, and sustainability have been long been trends. These trends have been pushed by technologies such as: (1) machine learning, (2) natural language processing, and (3) computer vision have since 2022 pushed and pulled industrial change in the construction industry (see e.g. Nyqvist et al. 2023). Yet, on the other hand, there has been much lack of pull factors so there has been strong resistance to change the basic technological choices. This kind of human behaviour in industrial organisations has been a largely social or cultural phenomenon, not based on updated business models or business model innovations. Social and cultural change is often a slow process (Ainamo & Peltokorpi 2024)- Industrial changes often involves complex financial and economic tensions between individual interests and moral hazard choices (see Ainamo & Kaivo-oja 2024),

We focus on the industrial case study on the construction industry, both as a Finnish industry, and how it is embedded globally and in Finland (national socio-technical regime), based on Reiman al al. (2023; cf. Teece 2018) to elaborate how business choices relate to new technologies and their adoption and use. We pay attention to both supply (push) and demand side (pull) aspects of development in the construction industry.

We thus develop in this case study an approach as to how systemic-wide innovation needs, requirements, and challenges bear on, as well as how science, technology and innovation policy issues can be managed and

governed, in one globally embedded industrial cluster (or ecosystem): the Finnish construction industry. This approach is in our view a particular industry-4.0 case study that mirrors Von Tunzelmann (2003; cf. Djelic & Ainamo 1999) and his historical study of the coevolution of new technologies and their governance in the earlier or 1.0, 2.0 and 3.0 phases of historical industrial revolutions. We visualize and compare how the global interest in AI and STI policies are related to it and how the issue has recently played out in the Finnish construction industry.

Recombining the foregoing (Teece 2018; Geels 200; Kaivo-oja et al. 2020, 2022, 2023; Nyqvist et al. 2023; Ainamo & Kaivo-oja 2024) industrial policy studies, on the other, we develop in this paper a nine sub-cell-matrix approach for sensing scenarios of the future of AI in the Finnish construction industry. We point out that this kind of nine sub-cell-matrix approach can be useful also in an analytical context of the industrial clusters and ecosystems. The intent behind such a sub-cell-matrix approach is to visualize and compare how the global interest in AI has played out, as can be anticipated to play out, in the context of the global construction industry, in general, and the Finnish construction industry, in particular. Here we also underlined the need to perform both hindsight and foresight analyses, in relation to each other (see Kaivo-oja et al. 2004).

FINDINGS

Finding 3.1. AI-driven business transformation in an industry such as in the construction industry involves better predictive analytics for construction project planning processes than has been possible before. Artificial intelligence (AI) will be used for modelling relevant environmental factors such as historical data about specific construction projects and about weather conditions to provide predictions for future project timelines, costs, and risks. Such analytics and modelling will in the construction industry improve upon and optimize project planning and resource allocation; allocation of resources such as labour, materials, energy, equipment, and capital; as well as improve efficiency and cost-effectiveness by minimizing building waste.

Finding 3.2. Integration of construction machinery and AI will enable autonomous and semi-autonomous robot and co-bot operations, not only to improve efficiency, but also to enhance safety and physical and cognitive ergonomics on construction sites by e.g. improving upon precision and accident-risk reduction.

Finding 3.3. Building information modelling (BIM) will be improved upon with AI, enabling more intelligent and automated analysis of building-design data and digital twins of buildings for clash detection, energy efficiency analysis, and other product and service simulations that will optimize building designs and construction processes more than was possible before.

Finding 3.4. AI-based computer vision systems will be employed for real-time quality control and inspection of construction projects, to identify defects, deviations from plans, and safety hazards, to ensure higher quality standards, and to reduce re-work.

Finding 3.5. Supply chain optimization will optimize construction supply chains by predicting material needs, managing inventory more efficiently, and identifying the suppliers that the more cost-effective than others. This will lead to cost savings and fewer time delays improving the resilience level of supply chains.

Finding 3.6. AI-powered wearables and sensors will monitor the health and safety of construction workers, detecting potential hazards, monitoring fatigue levels, and ensuring compliance with safety protocols and standards.

Finding 3.7. AI technologies and apps will contribute to energy efficiency in buildings: AI technologies and apps will contribute in more ways than one to the design and operation of energy-efficient buildings and smart city planning processes. Machine learning algorithms will analyze data from sensors to optimize heating, ventilation, and lighting systems, leading to reduced energy consumption.

Finding 3.8. AI technologies and apps will assess and mitigate project risks by analysing a variety of factors, including market conditions, inflation development, regulatory changes, and external events. This will help project managers make informed decisions to minimize uncertainties in global and national decision environments.

Finding 3.9. Augmented reality (AR) for construction will be combined with AI, and this AR-AI combination will provide real-time information overlays on construction sites, aiding workers in visualizing project plans, detecting issues, and accessing relevant information.

CONCLUSIONS AND IMPLICATIONS

This industrial case study contributes to the field of industrial transformation management and industrial cluster and innovation ecosystem development in the global and Finnish construction industries. We theorize on the extent that the global-local coevolution as to AI in construction is symmetrical or asymmetrical developments that is, we theorize on the extent that the Finnish construction industry may, at least in principle, impact on the global interest. On this point, we believe that systemic innovation appears to always involve interconnected sets of innovations influencing one another, as well as, possibly, the system.

In Finland, to borrow concepts from Teece and Reiman et al., ethical challenges such as those related to data privacy, regulatory compliance, and workforce readiness during the integration of AI in the construction sector are likely to be some forces slowing down transformation from "sensing" into "seizing" in the Finnish construction industry. We note that sensing phase happens typically in global and national contexts, but seizing happens always on a national socio-technical level.

The practical implications coming out of this study include new AI -related STI strategies concerning a given industry, such as the construction industry in Finland, and in any country considering other industrial AI -strategies and future choices. We point out that there are many good practical reasons to develop a nine sub-cell-matrix approach for sensing scenarios of the futures of AI in various industries, not only in the construction industry. In this special conference study, the focus is on the AI solutions of the Finnish construction industry.

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Keywords: Construction Industry, AI driven business transformation, Science Technology and Innovation Policy, Industrial transformation, Industry 4.0, Industry 5.0

Technologies in Just Sustainable Futures: Scenarios for a Just Transition to Carbon Neutrality and Climate Resilience in Brussels by 2050 •

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The concept of just transition has gained increasing prominence in policy agendas at all levels, evolving from a reactive approach aimed at protecting industrial workers affected by environmental regulations to a proactive social-ecological project that simultaneously tackles social inequalities and environmental degradation. This ambition of bridging social justice and environmental sustainability objectives is particularly relevant for the urban context, where social and environmental issues tend to concentrate and intertwine. However, while much research on just transitions in cities has focused on retrospective and evaluative analyses, future-oriented perspectives are lacking. As a result, there remain questions about what a just urban transition could and should look like, including the role of technologies in such transition processes.

This paper addresses these gaps by presenting the approach, findings, and preliminary policy implications of a research project that develops and analyses scenarios for a just transition to carbon neutrality and climate resilience in Brussels by 2050, with a specific focus on technological futures.

Using a participatory scenario-building approach rooted in the French prospective tradition, we explore four contrasting just transition scenarios: "Sustainable Growth Hubs", "Social-Ecological Pact", "Bastions of Resilience", and "Green Fortresses". These scenarios, shaped by different guiding visions of just transition, imply alternative conceptions of the place of technology in society: "Sustainable Growth Hubs" embraces digitization and automation, "Social-Ecological Pact" prioritizes digital deceleration, "Bastions of Resilience" fosters open-source and commons-based technologies, while "Green Fortresses" relies on surveillance technologies.

For each scenario, we assess the potential social justice and environmental sustainability implications, providing insights into the risks and opportunities associated with different technological choices in the context of just

urban transitions. These findings contribute to a more nuanced understanding of the intersection between technology, justice, and sustainability in future cities.

Keywords: Just transition, Just urban transitions, Just sustainabilities, Technology, Climate change, Scenarios, Prospective

Post-growth shaping technologies based on a Horizon Scanning case study within a post-growth research community •

Judit Gáspár – Éva Hideg – András Márton – Alexandra Köves – Gabriella Kiss – Máté Fischer – Zsombor Csuport

Corvinus University of Budapest, Hungary

What are the technology-related drivers of the future according to a post-growth research community? This presentation introduces a participatory foresight process where post-growth experts work together in online workshops—the process aimed to uncover different future scenarios. The research process started with an online Horizon scanning exercise, where 580 future statements were gathered and evaluated using Osgood scaling and systematically analyzed following the STEEPLED framework: deepening the future visions through Social, Technological, Economic, Environmental, Political, Legislative, Ethical, and Demographic dimensions. In this presentation, the future statements under the dimension of ‘technology’ will be introduced and deepened. The expert participants evaluated the selected future statements in a co-assessment process in the first online workshop. Megatrends and trends were identified, wild cards and weak signals were detected, and hype events were listed. The participants co-created eight post-growth scenarios in the second and third workshops of our foresight process. The online scenario-building process started with selecting the key driving forces, which led to defining the dominant axes, followed by the collaborative writing of scenarios. The aim of this presentation is two-fold: on the one hand, it will share the methodological considerations of this research project, while on the other hand, it will emphasize the technology-related issues with their social and ecological embeddedness: on the one hand, it will share the methodological considerations of this research project, while on the other hand, it will emphasize in a post-growth future.

Keywords: horizon scanning, foresight, post-growth, scenario building, technology

5. Futures of emerging technologies •

Time: Thursday 12 June at 10.15–12.00
 Room: GOTO 33
 Chair: Ville Lauttamäki

Exploring the Prospects for a Shared Vision of Offshore Wind Energy at the National Level •

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Interest in developing offshore wind is rapidly increasing but remains in its early stages in many countries. The aim of this paper is to understand the role (if any) that offshore wind may play in achieving Finland's 2035 carbon neutrality goal.

We present a co-created vision of offshore wind, and the process of co-creation resulted in a shared vision, rather than multiple visions or a collective of partly opposing ideas. The results reveal five required pre-conditions to be satisfied before the vision can be attained, and five overarching processes encompassing concrete solutions to transition from the current state to the vision.

The combined preconditions and processes describe a future where 1) the positive externalities of development must outweigh the negative externalities, and 2) a clear and reliable governance and political framework supporting renewable energy development, and 3) an availability of skilled labour from attracting international talent and developing education and training programmes to teach the next generation, and 4) development of a sustainable private sector, that provides local community opportunities, through innovation, investment and research in relevant technologies, and 5) development of a diverse and resilient energy system that contributes to national energy safety.

Keywords: Offshore wind, Participatory planning, Transition pathways, Visioning, Energy

Conceptual paradoxes as the source of limitations of AI institutional governance •

Czesław Mesjasz

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The rapid development of General Artificial Intelligence and discussion and speculations about the possible development of General Artificial intelligence equating to or even surpassing human cognitive capabilities contributed to the elaboration of many regulations at all levels of societal hierarchy aiming at controlling and governing Artificial Intelligence. A closer look at AI's very sense shows that AI's control and governance are strongly hampered by inherent paradoxes associated with all levels of its functioning.

Leaving apart the most profound paradoxes influencing AI at the logical and mathematical level, e.g. the Gödel Theorem, the following fundamental paradoxes affecting its development, functioning and applications can be mentioned.

- (1) impossibility of self-understanding of human consciousness;
- (2) impossibility of defining intelligence in a universal sense;
- (3) disagreement in defining Artificial Intelligence;

- (4) consequences of infinite regress in human self-understanding and potential self-understanding of GAI;
- (5) consequences of the Juvenal's saying: Quis custodiet ipsos custodes?

As a consequence of the above and other paradoxes affecting AI, any form of governance at all levels of societal hierarchy will always face barriers that may be insurmountable. For example, how can AI governance be implemented at the global level, looking at the experience of the United Nations? Will the powerful states agree to oversee the development of their AI system for state security? How do we oversee the market mechanisms in the development of AI by profit-oriented companies? What about illicit uses of advanced AI? An interesting paradox occurs if it is proposed to engage AI systems in any form of institutional oversight and governance of applications of other AI systems.

The paper aims to present a preliminary survey of the potential consequences of AI's paradoxes on any form of institutional oversight and governance of AI applications in any sector of social activities at all levels of societal hierarchy.

The project and the paper are designed to avoid any too-far-reaching speculative considerations. That is why only the following conjecture is proposed: Any form of institutional oversight and governance of applications of AGI (Artificial Generative Intelligence) systems must consider the consequences of paradoxes associated with AI in a general sense.

Due to the assumption of avoiding speculative thinking, only some well-grounded limitations concerning potential GAI (General Artificial Intelligence) will be shown.

The paper is based on classical source analysis supported by some methods of Systematic Literature Review.

Keywords: Artificial Intelligence, Artificial Generative Intelligence, General Artificial Intelligence, governance, human intelligence, intelligence definitions, oversight, paradoxes, self-consciousness

AI-Based Assessment of Grid Inertia in Lesotho's Future Renewable Power Network •

Mpho Yengane

National University of Lesotho, Lesotho

BACKGROUND AND PURPOSE

Lesotho's capacity expansion introduces challenges as inverter-based wind and solar generation are being build, which will reduce grid inertia. Lesotho's power network relies on South Africa for inertia support, primarily facilitated by rotating masses in synchronous generators. This study evaluates Lesotho's grid inertia under varying renewable energy penetration scenarios using artificial intelligence (AI).

Objective:

- Assess the impact of variable renewable energy (VRE) on grid inertia and frequency response.

Secondary Objectives:

- Implement AI-based forecasting for grid inertia.
- Simulate grid islanding, renewable variability, and high VRE penetration scenarios.

METHODS

The study soft-links two models. First, Lesotho's power network is modelled under various renewable energy integration scenarios using DIgSILENT PowerFactory. Primary data, including generator inertia constants (2.7s per unit), were obtained from the national grid operator, LEC. Secondary data from reports (GET.Transform-Lesotho, LEWA) supplemented the analysis.

Key metrics include frequency response, system inertia, and renewable energy penetration. Subsequently, an AI approach applies machine learning techniques, using linear regression to predict inertia needs for various

VRE penetration levels from DigSILENT PowerFactory output. Python-based statistical analysis identifies grid stability thresholds.

RESULTS AND DISCUSSION

Lesotho's grid stability differs significantly between normal operation, where the country relies on South Africa for inertia, and island mode, where it must independently source inertia. Under normal conditions, rotor angles stabilize within 0–20° by 2.1 seconds post-fault, whereas island mode results in prolonged deviations. Electrical power fluctuates between 0 and 1.4 p.u. but stabilizes at 0.95 p.u., with mechanical torque remaining constant at 1 p.u.

Frequency fluctuations at Muela Power Station bus remains within grid limits (49.85–50.15 Hz) in normal operation but violates them (47.85–53.15 Hz) in island mode, taking twice as long to recover. Voltage recovers to 1.03 p.u. normally but remains at 0.8 p.u. in island mode, violating grid requirements. The lowest nadir in island mode is 47.85 Hz (wind), with RoCoF peaking at 2.1 Hz/s (wind), followed by 1.5 Hz/s (solar and VRE).

Regression analysis shows a 1 Hz nadir drop extends stabilization by 0.70 seconds. AI modelling estimates on Lesotho's inertia needs is 75.79%, currently supported by South Africa.

CONCLUSIONS

Lesotho's grid stability is highly dependent on South Africa's inertia support, with 75.79% sourced externally. In normal operation, grid parameters stabilize post-disturbance, but island mode experiences severe deviations, with frequency nadir dropping to 47.85 Hz and RoCoF reaching 2.1 Hz/s for wind penetration, violating grid code limits. To enhance resilience, policy measures should prioritize domestic inertia sources, including grid-forming technologies and energy storage. Future research should explore using multi-objective optimization methods.

Keywords: Grid Inertia, Renewable Energy Integration, Frequency Stability, AI-Based Prediction, Lesotho

Vantaa semiconductor industry foresight - Applying the EU's best regional foresight practice •

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Background and purpose. According to the Chips from the North strategy, the global semiconductor industry is expected to double in size, with its turnover in Finland projected to triple by 2035. The principal constraint on growth in the sector is the availability of skilled labour. The industry plays a significant role in the green transition, particularly through innovations that enhance energy efficiency. Vantaa hosts a notable concentration of industrial employment within the sector. The Chips from the North strategy emphasises that the challenges facing the industry must be addressed through collaboration between educational institutions and businesses. The central question, therefore, is: what are the most important and concrete measures that Vantaa should undertake in order to meet the challenges posed by the development and expansion of the semiconductor industry in Vantaa city region?

Methods. The project employed a methodology previously recognised as the European Union's leading regional foresight practice, as assessed in an evaluation commissioned by the European Commission from the United Nations' International Labour Organization (ILO). This foresight methodology was applied for the first time at the local level, rather than at the broader regional level. The methodological foresight approach emphasises the collection of relevant foresight data relevant to decision-making and its professional translation into actionable recommendations for the future. Originally designed for short- to medium-term anticipation,

the foresight approach centres on conducting anonymous, Delphi-style personal expert interviews with companies in the selected industry field. The findings are subsequently analysed and interpreted in a 'workshop for the future', involving representatives from educational institutions and other regional stakeholders who influence sectoral developments in a city. These Delphi panel participants are selected to ensure a sufficiently diverse representation, enabling informed interpretation of the business intelligence gathered.

Findings. We focus on presenting short-term development trends in greater detail across the following themes: developments in personnel numbers; needs for competence and further training; current recruitment challenges; and the prevailing economic situation and conditions. In addition, we examine the outlook for sustainable development, digitalisation, and security-related issues within the business sector of Vantaa. We also highlight the top twelve most important follow-up actions identified as strategic priorities.

Conclusions and implications. In conclusion, we evaluated the effectiveness of the regional foresight method piloted for Vantaa's semiconductor industry at both the municipal and local levels. Municipalities play a very significant role in coordinating foresight activities within their localities. They also exercise ownership steering over several educational institutions operating within their jurisdictions. In Finland, the recent administrative transfer of health and social services to the county level, alongside the transfer of employment services from counties to municipalities, further underscores the pivotal role of municipalities in such regional foresight processes.

Keywords: Regional foresight model, urban foresight, semiconductor industry, short-term foresight, Delphi, Futures workshop

Charting Contested Ground: Exploring Quantum Computing's Varied Futures •

Arto Wallin – Tiina Apilo – Maaria Nuutinen – Katri Valkokari

VTT Technical Research Centre of Finland, Finland

BACKGROUND AND PURPOSE

Quantum computing is based on principles that challenge our common understanding of the universe. Understanding how it works requires a complete rehaul of our thinking about computing, which is beyond the current capabilities of most. However, in recent years, its potential to transform our businesses and societies has been popularized, offering promise to solve pressing global challenges, including climate change, drug discovery, and secure communication. It also poses serious threats, notably regarding cybersecurity and geopolitical power imbalances. These divergent views on the future enabled by quantum computing often arise from isolated knowledge bases. Each stakeholder group—researchers, policymakers, industry players, and civil society—maintains unique assumptions, beliefs, and objectives. This study investigates how these varying perspectives emerge and evolve. The primary research question focuses on how divergent views of the future can be traced back to underlying stakeholder values, beliefs, motivations and interests.

METHODS

The research employed a multi-method approach. First, desk research was conducted to form a foundational understanding of quantum computing trends, encompassing market forecasts, peer-reviewed research articles, and policy papers. Second, interviews were held with key stakeholders to capture various viewpoints and assumptions about the emerging technology and its impacts. Third, a series of scenario workshops provided structured environments in which participants could debate alternative quantum futures. Finally, a trend radar workshop synthesized technological signals and social drivers, offering insights into emerging opportunities and threats.

FINDINGS

Preliminary results confirm that different stakeholders are highly influenced by their roles, expectations within their social groups, and the information they are exposed to. Quantum computing is not a singular technology

but a cluster of diverse, evolving platforms. While its transformative potential is widely acknowledged, concerns related to national security, economic advantage, and ethical implications vary significantly among stakeholder groups. Political interests and limitations also play a crucial role, particularly given quantum computing's dual-use nature.

CONCLUSIONS AND IMPLICATIONS

The findings underscore the importance of foresight methodologies in navigating the fragmented understanding of the future enabled by extremely complex emerging technology. By integrating multiple stakeholder perspectives and multiple time horizons, foresight can help policymakers and practitioners identify realistic near-term opportunities and risk, but also mind-bending future possibilities. This approach offers a pathway to more informed policy, more robust innovation strategies, and deeper collaboration in shaping the trajectories of quantum technology.

Keywords: Quantum computing, Emerging technology, Alternative futures

6. Workshop: Workshop Beyond Knowledge. Making Future Literacy Measurable in Transformative Learning Contexts •

Time: Thursday 12 June at 10.15–12.00
 Room: GOTO 31
 Facilitators: Antje Bierwisch, Julian Pattermann, Oliver Som & Julia Vögele

Antje Bierwisch – Julian Pattermann – Oliver Som – Julia Vögele

MCI | The Entrepreneurial School, Austria

Teaching futures literacy prepares students for a sustainable and digitalised world. But how can we measure whether universities are actually creating an environment for transformative learning? This workshop will develop and discuss a measurement approach that enables the identification of futures literacy (FL) as a key competence.

FL describes the ability to identify future developments, design alternative futures, and act proactively (UNESCO, 2023). The implementation of this competence requires innovative teaching methods, interactive learning formats, and explorative thinking. However, while FL is increasingly being integrated into higher education curricula, there is still a lack of a standardised measurement tool to make learning visible. The measurement of learning outcomes is essential to improve teaching and learning processes, develop evidence-based educational strategies, and demonstrate the impact of transformative learning. Traditional methods such as exams, competency models, or self-assessment often capture only short-term gains in knowledge or standardised skills, whereas futures literacy as a metacognitive competence requires a deeper, often long-term change in ways of thinking and acting.

The particular difficulty in capturing FL lies in its complex, reflexive, and processual nature. FL involves not only understanding the futures, but also consciously questioning one's assumptions, exploring new perspectives and developing alternative visions of the future (UNESCO, 2023). These individual and dynamic processes are difficult to capture using traditional examination formats or standardised scales.

In this workshop, participants will reflect on why and how learning outcomes in transformative learning processes can be measured. A concept of measurement will be discussed that allows capturing Futures Literacy (FL) as a key competence - taking into account innovative teaching methods, new technologies, and participatory learning formats.

Key questions to be addressed in the workshop are: Which indicators are suitable to make FL measurable? Which methods capture long-term learning processes and changes in thinking? How can universities integrate these findings into their curricula?

Through interactive group work and practical case studies, participants will develop the first building blocks of a measurement model. The aim is to identify theoretically sound and practical measurement approaches that will support universities in specifically promoting transformative learning and evaluating its effectiveness.

Keywords: Measurement Concept development, Futures Literacy, Higher education, transformative learning

7. Workshop: Enacting Futures ♦

Time: Thursday 12 June at 10.15–12.00
 Room: GOTO 32 - Workshop location might be outside (to be confirmed)
 Facilitator: Greta Hauer

Greta Hauer

European Commission, Belgium

Emerging futures and their possible risks and opportunities are often informed through calculative logics and surveys, missing the opportunity to provide lived, embodied experiences. This workshop will explore how futures can be examined through experiential methods—specifically through the enactment of a fictional event using techniques such as narrative design and real-life simulations. Drawing on military exercises and role-plays, the workshop will test how enactments may inform anticipatory thinking and preparedness under uncertain conditions. By acting out a future in real life, its pitfalls and opportunities can be rehearsed and made comprehensible; critical decision-making can be tested under pressure, and blind spots in existing strategies may be exposed.

As a designer, I am interested in this matter in three ways: how the simulation of events may contribute to a wider imagination of possible futures; how the complexity and messiness of futures may be experienced in one-to-one scale environments; and how Design Fiction may highlight social and political implications and inform policy-making and anticipatory governance.

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Keywords: Speculative design, Experiential Futures, Design for Policy, Preparedness mechanism, Fiction as a method, AI

Session 6: 12 June 2025 (Thursday) at 13.00-14.30

1. Special Session: Paper Development Workshop •

Time: Thursday 12 June at 13.00–14.30
 Room: N/A
 Chair: N/A

This session has been cancelled.

2. Linkages between foresight, technology, and policymaking •♦

Time: Thursday 12 June at 13.00–14.30
 Room: TEATRO
 Chair: Pasi Keski-Pukkila

Futures, the great turn (book Wiley, 2023) •

Carine Dartiguepeyrou – Michel Saloff-Coste

International Foresight Research Network, France

Université Catholique de Lille, France

In the same ways as there are many futures, not just one future, there are many ways to conceive and practice foresight. The challenge of the great turning point of our civilization is to free ourselves from our prejudices in order to imagine and build desirable futures. The process is, by nature, ethical and prospective.

This book *Futures* proposes different cultural and ethical views on civilizational transformation by offering a transnational panorama of the visions of the future in European, American and Chinese context.

Keywords: A comparative analysis, cultural worldviews, futures of civilisation, Futures of technologies

The 12th S&T Foresight Survey in Japan: Focusing on the Relationship with Society ♦

Asako Okamura – Yasuhiro Ogura

National Institute of Science and Technology Policy, Japan

The Science and Technology (S&T) Foresight Survey has been conducted in Japan since 1971 and has been led by NISTEP since the 1990s. Initially relying solely on the Delphi method to gather expert opinions on the future of S&T, the survey has evolved to incorporate multiple methodologies, including horizon scanning, visioning, and scenario analysis. Reflecting changing societal needs, it has shifted from forecasting technological advancements to exploring broader societal futures.

This paper focuses on two key components of the 12th S&T Foresight Survey (targeting 2045–55): the visioning survey and a part of the Delphi survey on cross-cutting societal issues. It examines how societal challenges and the relationship between S&T and society are addressed and how stakeholders are engaged in the foresight process.

The visioning survey included workshops primarily with young citizens, supplemented by citizen surveys and a visionary study. This process led to six future visions: Inclusive and altruistic; Fearless prosperity; Nature and culture harmony; Dynamic and challenging; Autonomous and democratic; Adaptable society.

Through this visioning process, several perspectives emerged regarding society's expectations for future S&T, including Strengthening trust by ensuring technology serves human well-being; Promoting diversity and inclusion with high ethical standards; Encouraging open, decentralized innovation for all humanity; Ensuring AI and robotics integrate seamlessly into society while preserving human sensitivity.

The Delphi survey, alongside seven S&T fields, incorporated a cross-cutting societal issues category developed by humanities and social science experts. Using the six visions from the visioning survey as a foundation for the desired future, 49 specific topics were created across six key subcategories:

- A diverse and inclusive society that ensures individual happiness
- Sustainable and prosperous local communities preserving cultural, historical, and natural values
- New approaches to learning and working that support proactive individual challenges
- Building a trusted socio-economic system
- Well-being in future society and science & technology
- Addressing global-scale challenges

These topics were incorporated into the Delphi survey, which involved a large-scale expert survey (4,761 experts participated in a two-round survey). Some of the topics identified by the survey respondents as significant include fair compensation for essential workers, strengthening supply chain security, and enhancing information literacy to counter fake news and deepfake media.

The findings of this survey provide fundamental insights into science and technology innovation policy. This presentation will discuss the survey process, key results, and future challenges.

Keywords: Visioning, Delphi Survey, Science and Society, Citizen Engagement, Foresight

Alternative development pathways of welfare state models and the role of digital technologies in shaping them •

Johanna Vallistu – Veiko Lember

Tallinn University of Technology, Estonia

Digital technologies have changed how people live and work. Among the rise of productivity and increased flexibility, these effects include also gaps in social protection for novel work forms, algorithmic management and control and unequal bargaining power on the labour market driven by digital labour platforms and automated feedback systems as mediators. These long-term structural changes on the labour market and on the field of social protection as well as state services raise new and pressing demands for the welfare states. The system that was designed for relatively uniform employment force is crumbling under a need to adjust. Scholars have suggested multiple alternative approaches for addressing the new requirements and shifting power balance. These include propositions to design more universal welfare systems to increase access to the welfare state services and benefits; or increasing privatization to acknowledge the deepening variety of needs and profiles and design systems which would be more needs-centered and personalized. Multiple disruptive ideas have been proposed and analysed, such as the universal basic income, global privatized social security etc.

The role of digital technologies in designing these novel approaches cannot be undermined. Today it can be seen that governments have already adopted data-centric systems as a core architectural feature in designing their welfare systems. Yet, the role of digital technologies in adjusting to new welfare state models and driving a more structural change has been thus far overlooked. The term "digital welfare state" has received extensive

criticism for issues such as data transparency; and it has been pointed out that these innovations contribute little to the structural adjustment of the welfare state.

These discussions reveal that a more systematic examination is needed regarding the role of digital technologies in enabling or disabling alternative models of welfare states in their quest to respond to the novel challenges in a digital era. Our paper looks at the ways digital technologies can start shaping the welfare state models, outlining potential future trajectories emerging. Underlying this analysis it is important to understand how digital technologies are intertwined with novel welfare state logics, categorizing existing literature according to these effects and from the perspective of more prominent welfare state models emerging. Aspects such as administration, taxes, digital accounts and portability are analysed. The paper intends to reveal a more systematic understanding of how the current digitalisation trajectory of welfare states could be steered towards a more favourable developmental trajectory and what to take into account in doing so.

Keywords: Digital welfare state, automated services, data-centered government, digital public services

The role of technology in the sufficiency-based futures images •

Johanna Ollila – Amanda Halme

Finland Futures Research Centre, Finland

In our presentation we examine the role of technology in the futures images produced in a set of heritage futures workshops. We ask what aspects are associated with technology, and what emotions and aspirations are related to technology in these futures images.

We are organizing four heritage futures workshops as part of a research project where heritage futures are combined with the pursuit of sufficiency to achieve a good and sustainable life for all. Workshops are organized in collaboration with Finnish museums during the years 2024–2025. The aim of these workshops is to bring people together to develop skills and practices based on sufficiency, which helps to navigate towards sustainable and just futures. Using affect cards, the workshops emphasize the role of emotions and sensory experiences in sustainability transformation. Each of the four workshops has its own theme that guides the discussion on sufficiency and desirable futures: 1) housing, 2) tourism, 3) micro-mobility, and 4) consumption.

In heritage futures workshops participants work in small groups of 4 to 6 people. Each workshop consists of five phases: 1. Introduction, 2. Time travel to the past, 3. Time travel to futures, 4. Creating heritage futures, 5. Sharing. Time travels (50–100 years from the present) to the past and future engage participants in experiencing change and its possibilities in the present moment. After the 'time jumps' the participants discuss the thoughts and emotions evoked during them. Inspired by the jumps, groups create a futures image, a compilation of elements of imagined futures.

In our presentation, we focus on the outputs of the third phase of the workshop and ask how technology is perceived as part of tackling global challenges in these futures images. In addition, we ask how technology in building futures is connected to the created heritage futures, that is, the skills and practices that can help facilitate the transformation towards a more sustainable future.

Keywords: futures images, technology, methodology, cultural transformation

3. Methodological innovations due to technological change •

Time: Thursday 12 June at 13.00–14.30
 Room: GALLERY
 Chair: Marianna Birmoser Ferreira-Aulu

Navigating Complex Situations: The K.I.R. Framework for Transforming Participatory Futures •

Ellen De Vos^a – Bastiaan Baccarne^a – Lieven De Marez^a – Marina Emmanouil^b

^a Ghent University, Belgium

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Emerging technologies, such as Artificial Intelligence (AI), and crises like the COVID-19 pandemic and climate change, disrupt and reshape our world, presenting decision-makers with systemic uncertainties and interdependencies (Girasa, 2020). These challenges demand dynamic, adaptive decision-making frameworks, which go beyond traditional, expert-driven approaches that often fail to account for the full complexity of societal dilemmas (Snowden & Boone, 2007). This study begins by exploring the need for a transformative approach to participatory futures methodologies, driven by the complex, interconnected global challenges of our time.

To address this need, our research is structured in two phases. First, we conducted a comprehensive review of existing participatory futures methodologies, identifying their limitations in handling system-level challenges such as unpredictability and uncertainty, and human-centered factors, including cognitive biases and social dynamics. In the second phase, we collected empirical data from participatory workshops through observations, surveys ($n = 17$ and $n = 46$), and interviews with facilitators ($n = 2$) at different stages during the workshop development process. The analysis revealed recurring themes focusing on imagination, reflection, and knowledge sharing, which were integral to the development of the framework we propose.

The outcome of this study is the creation of the Knowledge, Imagination, and Reflection (K.I.R.) framework, a novel contribution to participatory futures methodologies. The K.I.R. framework bridges gaps in current methodologies by emphasizing creativity, inclusivity, and adaptability. This integrated framework promotes a divergent decision-making process that empowers diverse perspectives and encourages long-term thinking, which are crucial for navigating uncertain futures (Kahane, 2012). Notably, a case study on the use of Generative AI (GenAI) to co-create collective future visions illustrates how emerging technologies can support participatory futures by enhancing creativity and collaboration in developing shared scenarios for future policymaking.

The findings suggest that current participatory futures frameworks often marginalize non-expert voices and overlook important human-centered dynamics (Stirling, 2008). In contrast, our K.I.R. framework fosters resilience through transdisciplinary collaboration and inclusivity, which are essential for addressing the complex challenges of our time (Pohl et al., 2021).

We conclude by presenting the K.I.R. framework as a transformative model for participatory futures. It offers actionable insights to enhance decision-making in response to emerging technological and societal issues. Future research should focus on evaluating the scalability and cultural adaptability of this framework across various technological and governance contexts (Rosa et al., 2021).

Keywords: participatory futures, K.I.R. framework, emerging technologies, system-level challenges, human-centered challenges, transdisciplinary collaboration, Generative AI.

Reevaluating Technology Research through a Future Studies Lens: Insights from a Literature Review on the Future-orientation of Human-Computer Interaction •

Camilo Sanchez^a – Felix Anand Epp^a – Sui Wang^b – Kaisa Savolainen^a – Antti Salovaara^a

^a Aalto University, Finland

^b University of Southern California, the United States

Human-computer Interaction (HCI) is a technological research field encompassing cognitive science and human factors engineering towards the design of digital systems. This interdisciplinarity and drive towards change make the field focused on futures. Scholars explore novel human-technology interactions and leverage findings to promote and shape societal visions. Yet it seems commonplace that future visions in HCI publications are implicit, techno-deterministic, narrow, and dismissive of uncertainties or comprehensive future roadmaps. This paper investigates the future orientation of HCI through a futures studies perspective. We performed an extensive literature review of top-cited HCI publications of the last 15 years for their use of futures.

Our study differentiates 'fleeting' and 'comprehensive' future exploration within HCI literature. This dichotomy reveals the existing techno-centric approach within the fleeting futuring category while highlighting a growing focus on systemic and explorative perspectives within the comprehensive futuring category.

For the analysis of the comprehensive futuring category, we developed SPIN (Epistemic Stance, Contingency Perception, Systemic Integration, and Narrative), a four-category framework informed by future studies literature and frameworks. The application of the SPIN framework reveals the constraints of predominant techno-centric discourse in the field. For example, while comprehensive futuring in HCI engages in the exploration of uncertainty, there is a predominance for short time horizons and a focus on human experience. Nevertheless, we also noticed that within the comprehensive futuring corpus, there is a recognition of such limitations. As a result, there are papers within this corpus that highlight the dominance of Western standards in technology design and call for a wider recognition of the interrelations between technology, cultures and ecological systems. From the development and application of the SPIN framework we present the potential of incorporating Futures Studies into HCI, but also how HCI highlight manifestations such as individual experience and more-than-human relationships that provide opportunities for further examination in Futures Studies.

Finally, our paper provides insights into why techno-centrism remains dominant in HCI and formulates five actionable opportunities for the HCI field to enhance its contributions to Futures Studies, namely, the use of non-technological drivers in envisioning; engaging with generative modes of uncertainty; embracing Futures Studies methods; cultivating reflexivity and incorporating other perspectives; and engaging in activism and political action. These suggestions serve as bridges to expand the intersections between HCI and Future Studies, thereby igniting crucial conversations surrounding more responsible and inclusive futures of technologies.

Keywords: Human-Computer Interaction, Literature Review, Future Orientation, Technocentrism

Combining Worldbuilding, Game Design, and Creative Writing for Eliciting Rich Descriptions of Technological Futures in Interdisciplinary Teams •

Timo Szczepanska – Melania Borit – Zoheb Mashur

UiT The Arctic University of Norway, Norway

Collaborating in inter- and transdisciplinary teams is a proven approach to imagining rich descriptions of technological futures. However, differences in disciplinary language and paradigms can cause in-team misunderstandings and aversity, leading to two key challenges: structuring discussions to facilitate productivity and foster imagination, and compiling diverse and detailed discussions into coherent descriptions.

This study presents a methodological approach developed from our experience in designing and implementing a workshop to assess the impacts of autonomous technologies on future fisheries. Drawing on game design, worldbuilding techniques, and storytelling, we created a process to imagine, assess, and communicate technological futures within a group of 11 people each representing a different knowledge domain (from economics and computer science to creative writing). The workshop is structured around four strategies to balance creativity with analytical rigor: including all voices, immersing participants in the setting, linking discussions to fisheries, maintaining richness in imagined world.

The workshop was set up around a table covered in whiteboard paper with a centered speculative artefact - the concept drawing of an autonomous fishery system [1]. Additionally, a printed fisheries model, aligned with the 'Seven Foundations of Worldbuilding' [2], guided the workshop discussions across social, political, economic, cultural, environmental, technological, and philosophical dimensions. Participants initially worked individually, examining the artefact, annotating the fisheries model, and noting their thoughts. The following group phase used a game-inspired turn-based process to facilitate equitable participation in creating a vision of the future. The artefact served as a focal point, grounding individual ideas in the setting. Participants progressively introduced components to the central image, discussing their impact and categorizing effects on other components. This process ensured the connection between domain-specific knowledge and the co-created socio-technical system. To interpret the workshop, each participant developed a 'lens' [3] (legal, economic, environmental, social, cultural, ethical/critical) to provide a disciplinary perspective on the artefact's impact on future fisheries. Together, these lenses described potential transformations, from enhanced operational efficiency, sustainability, and transparency to emerging societal and ethical challenges. The final step merged the lenses into a cohesive narrative using 'science fiction prototyping' [4], a storytelling technique that explores imaginative and speculative concepts of science and technology [5]. The creative writing developed the story of Leon, an AI-controlled autonomous fishing vessel.

This study shares lessons from implementing a game-based interdisciplinary workshop in fisheries research and proposes methodological recommendations for capturing the complexity of technological futures.

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Keywords: Creative writing, Fisheries, Game design, Implications, Interdisciplinarity, Methodology, Science-fiction prototyping, Storytelling, Worldbuilding

Human and Non-Human Participatory Triangulation: A Multi-Modal Storytelling Methodology for Empowering Localized Identities •

Sabina Fiebig Lord – Sam Copland – Omar El Masri – Rich Cook – Ros Jennings – Beth Horton – Vahid Sharifi Fazel

University of Gloucestershire, the United Kingdom

The rapid integration of AI and emerging technologies into sociotechnical systems has amplified both opportunities and challenges in representing localised identities. While these technologies promise inclusivity and innovation, they often perpetuate sociotechnical asymmetries, leaving unrepresented or misrepresented communities further marginalized. This paper focuses on these asymmetries and in an ethical bid in giving participants agency in their representation by introducing a Human and Non-Human Participatory Triangulation (HNPT), a multi-modal storytelling methodology that leverages non-proprietary AI and emerging technologies to empower localised identities through participatory research. This study explores the potential of HNPT to address power imbalances and foster equitable representation in sociotechnical systems.

HNPT integrates three participatory dimensions: human actors (local communities), non-human actors (AI tools), and storytelling narratives (cultural, historical, and context related to unrepresented or misrepresented communities). By triangulating these dimensions, the methodology creates a dynamic, iterative process that amplifies marginalised voices while critically engaging with the affordances and limitations of AI-driven tools. Using AI-powered natural language processing and generative storytelling platforms, storytelling narratives are co-created with local communities, intervening to generate representation they have a stake in. The participatory methodology incorporates feedback loops that allow communities to critique and refine AI outputs, thereby mitigating biases and asymmetries inherent in algorithmic systems.

This paper presents a case study of HNPT in action, focusing on several community-led storytelling projects in Gloucestershire, UK with misrepresented cultural identities both historically and hence currently in AI. The study fosters a more nuanced and inclusive representation of localised identities. It also highlights the methodological innovations enabled by AI, such as real-time translation tools and multimodal data analysis, which has the potential to enhance cross-cultural collaboration and accessibility.

By situating HNPT within the broader discourse on AI and emerging technologies, this paper contributes to the Futures Conference theme by showcasing how methodological innovations can address pressing sociotechnical challenges. It argues that participatory triangulation not only mitigates asymmetries but also redefines the role of AI as a collaborative partner in empowering localized identities. Ultimately, this research offers a forward-looking framework for leveraging AI and emerging technologies to create more equitable and inclusive futures.

Keywords: Participatory Triangulation, Sociotechnical Asymmetries, Localized Identities

4. Fostering dialogues with youth and future generations •♦

Time: Thursday 12 June at 13.00–14.30
 Room: KINO
 Chair: Maria Höyssä

Young people as leaders of community conversations about sociotechnical futures ♦

Rae Ostman – Paul Martin

Arizona State University, the United States

We will discuss a program that empowers young people to explore alternative futures and engage local communities in understanding and finding solutions to local impacts of climate change. With support from adult team members, over the past three years 12 teenaged participants have created a narrative extended reality (XR) game and engaged community members in playing the game and talking about possible futures.

The presentation will include three parts. First, we will describe the program's theory of change, goals, and design principles, including the co-creation process the team has used to position youth as media creators and community leaders. During this part of the presentation, we will show screen captures from the game to illustrate the socio-technological future the young people envisioned for "Aridium" in the year 2175. Second, we will present the learning research associated with the project. We will describe the role young people envision for themselves in shaping sociotechnical futures, the way they conceive of community and leadership, and what they think the role of technology (such as XR games) can be in promoting community conversations about futures. We will also share findings that illustrate how the program has strengthened the young people's understanding of climate change, sense of science identity, game design skills, science communication skills. Finally, we will offer practical advice for others who seek to co-create and study learning experiences that explore the futures of technologies with members of the public and decision-makers.

This presentation will address conference aim #6, case studies on technology-enabled future design, and #7, the use of technologies in research, teaching, and learning. The XR game is a technology that helps all participants (youth leaders and community members) to envision and explore a possible sociotechnical future. The presentation will also touch on #6, technology impact assessment, because the game explores a possible future system for collecting, storing, and distributing water in conditions of extreme drought, which has helped to alleviate the water crisis but has created new societal dilemmas that the player must navigate as a water utility worker and climate migrant.

Keywords: research on learning, XR games, youth leadership, community engagement, sociotechnical futures

Where axiology meets technology heuristics: a scenario-based methodology to facilitate moral dialogue with future generations •

Ben Robaeyst^a – Ellen De Vos^a – Bastiaan Baccarne^a – Philippe Vandenbroeck^b

^a Ghent University, Belgium

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Emerging technologies, including artificial intelligence (AI), blockchain, and the Internet of Things (IoT), hold significant transformative potential for societies, economies, and global systems. Historical precedents, such as the advent of the internet and social media, illustrate how technological innovation can restructure societal

frameworks, often accompanied by both anticipated and unanticipated ethical and social consequences. These outcomes, ranging from deepening inequalities to threats to human dignity, emphasize the necessity of foresight approaches that integrate long-term societal and ethical considerations. A critical element in addressing these complexities is intergenerational thinking, which emphasizes the evolving nature of societal values and future contexts.

Futures and foresight studies provide valuable tools for examining the potential societal implications of emerging technologies. Ethical foresight methods, including ethical foresight analysis, anticipatory technology ethics, and technology assessment, offer valuable frameworks for such exploration. However, these methods often adopt a static and normative perspective, assessing future technological developments through the lens of contemporary ethical paradigms. This approach overlooks the dynamic and context-dependent nature of ethical values. Conversely, axiological futurism explores value-laden possibility spaces and shifts within these spaces in a non-prescriptive manner, therefore addressing this first set of critiques. Yet, its lack of actionable pathways for applying ethical insights to concrete technological designs creates a critical "action gap" between ethical analysis and practical implementation.

This paper addresses these critiques by presenting a new methodology that combines three approaches: axiological futurism, typological future scenario analysis, and design heuristics. Typological scenarios, that focus on dynamic functional components of technologies are used to explore possible future technological developments. Axiological futurism adds a focus on shifting societal values, helping to understand how ethical perspectives might evolve over time. Finally, design heuristics are derived from these analyses, offering practical guidelines for developers to create technologies that are both ethically informed and adaptable to changing circumstances. Together, this framework helps ensure that emerging technologies align with potential shifting societal values and remain relevant in diverse and evolving contexts.

This paper makes a contribution to the field of futures studies and foresight through several key innovations. First, it highlights the value of typological scenarios as a methodological framework for proactively assessing the performance of future technologies, conceptualised as modular systems of functional components. This approach to scenario development remains underexplored in the foresight literature. Second, it integrates this approach with axiological futurism and design heuristics, creating a bridge between understanding future shifts in societal values and deriving actionable insights for present challenges and decision-making. By addressing ethical and societal implications, the proposed methodology aligns technological innovation with both current and potentially unexpected societal needs. In addition to its theoretical contributions, this paper offers a practical method designed for immediate application by contemporary technology developers.

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Keywords: Axiological futurism, Typological scenarios, Scenario based methodology, Technology heuristics, Emerging technologies, Intergenerational ethics

Collaborative robotics and technological literacy – Cross-age peer tutors' strategies to guide young learners •

Arttu Korkeaniemi^a – Eila Lindfors^a – Leena Kiviranta^a – Miroslav Bielík^b

^a University of Turku, Finland

^b Masaryk University, Czech Republic

In a technology-driven world, digital devices and new technologies are constantly there in children's lives. Therefore, technological literacy (TL) – capability and competence to use, manage, critical assess and most importantly comprehend the technological content – is needed in a modern society. Focusing on TL at young age is essential. Educational robots are recognized as valuable tools for integrating hands-on technological content into formal educational settings, thereby enhancing TL. This study combines robotics activities and collaboration with cross-age peer tutors, 11–12 years old (tutors), and younger children, 7–8 years old (young learners). The research answers to a question: What guiding strategies do the tutors have in collaborative robotics activities with young learners?

The research was conducted as part of the DIGIKUMMI-project (www.digikummi.fi) developing digital skills in pre-primary education and basic education in one Finnish municipality. During the project, the tutors participated a four-week robotics intervention where tutors studied four different educational robots. The intervention was designed following the ethos of Papert's constructionism and theories of technological literacy used in research. The intervention was conducted in weekly lessons of craft, design, and technology (CDT). In the fourth week of the intervention, the tutors guided robotics activities to young learners. These collaborative robotics activities were recorded.

This multiply case study investigates tutors' strategies to guide the Sphero Indi robot, which is based on unplugged programming. Participants of the study (N = 24, 12 tutors and 12 young learners) worked in six cross-age teams. The ongoing analysis of the video recordings (in total 100 minutes) adapts qualitative data-driven micro-level analysis to form each team a case implementing tutors guiding strategies during the activities. The preliminary results indicate, that tutors' strategies emphasize encouraging young learners to experiment with the robot. Also, non-verbal guiding, such as tangible use of a robot as a guiding tool, is emphasized. The results and procedures of cross-age peer tutoring add value for pedagogical approaches to promote TL in CDT education classrooms and technology education of young learners. The cross-age collaboration and tutoring can be utilized in the technology-oriented practice in pre-primary education, basic education, as well as in teacher education and in-service teacher training.

Keywords: technological literacy, technology education, robotics, young learners

European Generation Z Attitudes Toward Cellular Agriculture and Future Orientation in Sustainability •

Tom Tamlander – Anu Seisto

VTT Technical Research Centre, Finland

As global challenges surrounding food production intensify, cellular agriculture offers a promising pathway toward more sustainable systems. This study investigates Generation Z's attitudes toward cellular agriculture by examining how future orientation—particularly personal agency and green purchasing intention—relates to openness and behavioral intentions regarding novel food technologies. We sought Gen Z perspectives on the future of food by conducting workshops with high school students. They wrote essays on future awareness and action orientation, revealing initial attitudinal segments. These insights informed survey items on personal agency and readiness for change. Concurrently, the Technology Acceptance Model (TAM) guided constructs

of Perceived Usefulness (PU), Behavioral Intention (BI), sensory rejection, and perceived risks toward cellular agriculture. A total of 900 participants aged 16–25 from Belgium, Poland, and Finland were surveyed, and constructs were validated via PLS-SEM to identify key acceptance and engagement factors. Results show cross-country variations. In Belgium, a strong sense of food identity tends to reduce PU due to identity-based skepticism. Despite this, younger Belgians (16–19 years) display optimism and robust BI, supported by green purchasing intentions. In Poland, green purchasing intentions significantly predict BI, though lower trust in technology might hinder adoption. In Finland, higher sensory rejection significantly lowers PU. However, belief in personal influence through sustainable choices fosters green purchasing intention and PU. Four segments emerged from the analysis. The “Behaviorally Proactive” group (35.5%)—mixed-gender, mostly Belgian, aged 16–23—combines high optimism with elevated PU, BI, and minimal sensory rejection, trusting both individual agency and institutions. The “Moderately Proactive” segment (10.7%)—primarily Polish females aged 16–23—demonstrates cautious optimism, moderate PU, and a collective action preference. The “Neutral but Skeptical” cluster (42.6%)—largely Finnish and Polish males—reports low individual efficacy, moderate sensory rejection, and limited trust in institutions. The “Strongly Resistant” group (11.2%)—mostly Finnish females aged 20–25—shows pronounced sensory rejection, low perceived efficacy, and reluctance to change. Recognizing Gen Z’s diversity is crucial: broad generalizations risk overlooking those needing more support. These findings underscore the need for tailored strategies to address sensory concerns, skepticism, and identity-based resistance. The most proactive participants, who trusted their own or collective agency can be further supported with robust, science-based information, while passive or resistant groups may respond better to clear personal benefits (e.g., health gains). By aligning communication with each segment’s values and future orientation, stakeholders can facilitate a smoother transition toward sustainable food systems.

Keywords: Generation Z, Cellular Agriculture, Future Orientation, Sustainable Food Systems, Technology Acceptance Model (TAM)

5. Technology and digital innovations for the blue economy

Time: Thursday 12 June at 13.00–14.30
Room: GOTO 33
Chair: Hanna Heino

Autonomous Technologies and the Futures of Fisheries: A Comprehensive Impact Assessment with a Focus on Economic Viability •

K.K.L. Hasini – Melania Borit – Jorge Santos
UiT The Arctic University of Norway, Norway

The advent of Autonomous Technologies (AT) is anticipated to bring a paradigm shift in conventional industries such as fisheries. Autonomous Fishing Operation Systems (AFOS) represent a possible future scenario for the industry [1] [2]. Fisheries, operating within complex and dynamic socio-techno-ecological systems, may experience both beneficial and detrimental systemic impacts because of disruptive innovations like AFOS. These impacts will require the industry to adapt and respond in the future.

Our study aimed to explore the potential impacts of AFOS in the context of Norwegian small-scale fisheries, with a particular focus on economic viability. As the first step, a literature-based holistic impact assessment was performed to gain a general overview of the potential impacts of AT. A scoping literature review of research articles was undertaken, and the findings were then extrapolated to the fishing industry. Finally, to empirically validate the findings, a scenario-based cost-benefit analysis was carried out to assess the economic impacts of AFOS.

The scoping review revealed a broad spectrum of political, economic, social, technological, environmental, legal, ethical, and safety impacts associated with AFOS. For instance, it can have positive consequences, such as reducing operational costs, improving sustainable practices, and enhancing the safety of fishing operations. However, it can also pose negative consequences, including potential job displacement in traditional sectors, the loss of cultural values and traditional knowledge, and safety challenges in navigating during extreme conditions.

Subsequently, three scenarios were conceptualized, focusing on two operational phases: navigation and fishing. The scenarios were described within a 30-year timeframe and based on three assumptions: onboard crew size, the need for a remote control centre, and the energy sources used. A reference cost model for the status quo scenario, representing a small fishing vessel of less than 11m, was developed based on profitability survey data from the Norwegian Directorate of Fisheries. Adjustments were then made to the reference cost model to calculate the Net Present Value of the cost (NPV-cost) of owning and operating an AFOS over its operational lifetime.

Compared to the status quo, the cost estimates indicate a minor increase in NPV for semi-autonomous and a moderate increase for fully autonomous systems. These estimates suggest that AFOS could be economically viable if they generate at least the equivalent revenues to conventional fishing vessels, making them a potentially worthwhile investment. However, the potential economic advantages may be offset by negative sociocultural externalities and could undermine the long-term sustainability of AFOS.

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Keywords: technology impact assessment, autonomous fishing operations, cost-benefit analysis, scenarios

Imagining technologies for tomorrow: (Co)shaping next-generation marine natural resource extraction technologies •

Marianna Osokina – Melania Borit – Roger Larsen – Holger P  tzsch – Jorge Santos

UiT The Arctic University of Norway, Norway

What would next-generation natural resource extraction technology look like if imagined by users and usual developers? Throughout history, technologies have repeatedly revolutionized how humans live, think, and work. Fisheries, i.e., nature, individuals, and communities, have been greatly transformed in the last 50 years by the rise of hydraulics, electronics, and new materials. Today, together with aquaculture, they are experiencing a new transition, one made possible by Artificial Intelligence, autonomous systems, and the Internet of Things [1]. However, revolutionary shifts occur often invisibly and incrementally, constructing a specific version of reality, often with technology being imagined as the (only) solution to the problems of the present [2]. Starting with the assumptions that the implications of technological transitions are uncertain and that the futures we can imagine are strongly tied to our own agency in the world [3], this research explores dominant and alternative narratives around emerging digital technologies, shaped by and shaping the attitudes and visions of the future of both technology users (i.e., fishers) and technology developers (i.e., designers of technology for fishing and aquaculture). This research uses as a case study the specific context of the professional small-scale fisheries in Northern Norway, which have undergone severe restructuring in the last decades. These are now, by world standards, an example of a highly efficient, high-technology, low-labour input industry. This

research employs a fusion of Interpretative Phenomenological Analysis and Futures Studies techniques (e.g., artefacts from the future) [4]. Through interviews and participant observation, this study explores how lived experiences, underlying values, and hidden assumptions shape future possibilities of technology development in the domain of marine natural resource extraction. Findings of a first research phase, which was focused on fishers, reveal a spectrum of attitudes towards emerging digital technologies among the respondents, summarized as “cautious interest”, along with several speculative visions that may evolve into shared constructions, potentially influencing what future designs they might demand from developers. The second research phase explores how fostering critical futures thinking among marine technology designers can help unlock path dependencies that observed in interactions with technology developers during Nor-Fishing 2024 (held in Norway, one of the largest fisheries technology exhibitions in the world), i.e., addressing strictly what the client wants, instead of being more imaginative. Assuming users’ and developers’ shared responsibility in unlocking path dependencies, exploring their attitudes and visions may serve as a starting point for anticipating and addressing undesirable futures, while co-creating desirable ones.

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Keywords: attitudes, counter-narratives, emerging technologies, futures studies, interdisciplinarity, speculative and critical design

Uncharted waters: Risk and uncertainty in maritime decarbonization •

Maija Nikkanen^a – Emilia Luoma^b – Nina Janasik^a – Emilia Linnekoski^a – Janne Hukkinen^a

^a University of Helsinki, Finland

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The maritime transport industry is currently navigating profound uncertainties about the future, including the evolution of regulations, technologies, economic systems, geopolitics, and labor demands. At present, international and national regulations focus primarily on reducing carbon emissions to mitigate the risks associated with climate change. This has created momentum in the industry to look into transitioning from fossil fuels to alternative, low-carbon fuels such as biofuels, methanol, and ammonia. However, decarbonization of maritime logistics itself entails a range of risks – many of which are unknown, ambiguous, or associated with uncertainties. Therefore, we ask: How do actors in the maritime transport sector see the risks and uncertainties associated with the transition towards alternative fuels?

To answer this question, we conducted 10 semistructured interviews and 2 workshops (with 15 participants in total) with experts from Finnish maritime sector, representing industry, authorities, researchers, and environmental NGOs. The interviewees and workshop participants were selected using snowball sampling, based on their expected expertise on the future of marine logistics. The discussions covered the role of sustainability in the maritime sector, the prerequisites for a sustainable green transition especially in Finland, the long-term outlook for maritime logistics, and visions for a sustainable future in the industry. The interviews and workshops were recorded, transcribed, and analyzed thematically using a combination of literature-based and data-driven approaches.

Based on this data, we develop a risk typology for the green transition in maritime logistics, encompassing physical risks (e.g. environmental hazards and disaster risks related to alternative fuels), transition risks (e.g. policy and market risks connected to the shift toward a low-carbon economy), and systemic risks (e.g. a lack of a holistic view of actors and impacts, path dependency, resource insufficiency, and the impact of geopolitical tensions). Additionally, using A. Stirling's framework on dimensions of incertitude, we analyze the types of uncertainties associated with the green transition of maritime transport. Furthermore, we will conduct a third validation-oriented workshop to present the results to prior interviewees and workshop participants, eliciting stakeholder perspectives on currently recognized and overlooked risks and uncertainties and how they should be prioritized and addressed.

Finally, we present the implications for governance and decision-making, focusing on how to address different types of risks and uncertainties. We draft a risk response framework to assist actors in the maritime sector in navigating the challenges of the green transition.

Keywords: maritime transport, green transition, alternative fuels, risk, uncertainty

Programming Seafare: Maritime digital solutions as environmental heritage futures •

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The main aim of this paper is to address futures of green and digital transitions in the maritime sector from the point of view of environmental heritage futures. To use the words of STS scholar Gabrys (2016), there is currently an ongoing process of a "programming of seafare" (e.g., IMO, 2022; UNCTAD, 2022). This is often conceptualized in terms of an urgently needed "sustainability transformation" of the maritime sector, especially of its ways of using fossil energy resources (Hansen et al., 2020; Malmgren et al., 2023). The paper asks what this programming of seafare might mean when approached with the analytical lens of environmental heritage futures. The notion of "heritage futures" refers to a form of cultural heritage that as its goal has the transformation of unsustainable rule-bound cultural practices and skills into more sustainable ones (Siivonen, 2022). Accordingly, the notion of "environmental heritage futures" refers to a form of cultural and environmental heritage that as its central goal has the transformation of current insufficiently sustainable cultural and environmental practices and skills into more sustainable ones. The research question of the paper is thus: From the point of view of environmental heritage futures, what are the implications of currently ongoing processes of digitalization in the marine logistics sector?

The analysis of digital solutions as a means of programming seafare provides an empirical case for the mutual co-shaping of futures provided by emerging technologies and culturally bound societal norms and practices. We are particularly looking at technological processes within the contexts of autonomous shipping and alternative marine fuels (Banda Valdez et al., 2015; Hansson et al. 2019). We analyze the ways in which the ongoing programming of Finnish seafare does or does not align with existing scientific assessments of required urgent societal actions (as expressed, e.g., in the SDG framework). By doing so, it also provides an analysis of the potential "blind spots" in the current programming activities (van Assche et al., 2020; Riesto et al., 2021). For instance, does the planned programming activities take into consideration the various challenges with "digital rubbish" (Gabrys, 2011)? What are the varieties of time and temporal cycles involved in the projected programming activities, and how are they synchronized (Munck af Rosenschöld et al., 2016; Adam, 1998)? Methodologically, the paper is based on the analysis of document analysis, interviews and transcripts of participatory workshop. We expect our results to show that from the point of view of environmental heritage futures, there is significantly more thinking about the climate- and pollution- oriented sustainability challenges than the challenges pertaining to biodiversity loss.

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Keywords: environmental heritage futures, co-shaping of technology, digitalization, maritime logistics, sustainability

6. Workshop: Hybrid horizons of futures workplaces •

Time: Thursday 12 June at 13.00–14.30

Room: GOTO 31

Facilitators: Saija Toivonen, Aino Ruohola, Lassi Tähtinen, Riikka Kyrö, Olivia Matilainen & Mattia Galleani
Aalto University, Finland

Keynote: Sirkka Heinonen
Finland Futures Research Centre, Finland

Aino Ruohola – Saija Toivonen – Kevin Drain – Riikka Kyrö – Sirpa Nieminen

Aalto University, Finland

It is year 2035, and the workplace landscape remains significantly influenced by rapid technological advancements allowing remote working from home and 3rd places. In this interactive workshop we will move beyond 2035 to 2050 to explore the futures of workplaces. Globally, the COVID-19 pandemic exposed the vulnerabilities of relying solely on physical office spaces. Virtual worlds, also known as metaverses, are platforms where users can interact with others through avatars, creating an immersive experience that simulates physical presence. Hybrid workplaces will embrace advanced technologies like augmented and virtual reality, artificial intelligence, and platforms such as NVIDIA Omniverse. These technologies promise seamless virtual environments that replicate physical ones on the scale of meeting rooms and cities. The aim of this workshop is to explore the interrelation of physical and virtual workspaces until 2050 and to identify the potential barriers and needed incentives to reach winning spatial solutions for future work.

This workshop explores different physical, virtual, and eventually hybrid workplace settings inspired by Futures Clinique method. The participants will map out their cascading direct and indirect impacts. Futures images (probing e.g. shared facilities, multi-use buildings, virtual spaces without physical constraints, homes/summer houses and nature as workplaces) from previous workshops conducted in the T-winning Spaces 2035, a research project funded by the Research Council of Finland and the EU NextGeneration, act as futures provocation and as a starting point for this workshop. This approach enables participants to identify for example key actors, bottlenecks, and rebound effects. It provides holistic view of integrating virtual and physical work environments for a sustainable future.

This workshop identifies key factors, strategies, innovation, and considerations for futures-oriented employers. The participants will view the role of virtual and physical offices, home environments and third places in different future work settings.

We show how both physical and virtual workplaces can enhance societal and organizational resilience against to pandemic-like disruptions. Furthermore, we ponder the role of vacant building stock, virtual equality and the role of work shaping physical and virtual spaces and vice versa. Currently, over 661,000 square meters of commercial office space stand vacant in the Helsinki Metropolitan Area, and employees experience spatial inequality and lack of employer support in their remote working, making our workshop a timely one.

Keywords: remote work, office, metaverse, digital transition, hybrid workspace, workplace innovation

7. Workshop: Green transitions in cruise shipping and shipbuilding ♦

Time: Thursday 12 June at 13.00–14.30
Room: GOTO 32
Facilitators: Anastasia Tsvetkova, Marjo Keiramo & Kyle Bentz

Anastasia Tsvetkova^a – Marjo Keiramo^b – Kyle Bentz^b

GTLab:

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Achieving climate-neutrality is a strategic goal for the maritime industry, particularly within cruise shipbuilding, where environmental pressures must be balanced with evolving passenger expectations. Cruise ships are built to operate for decades, making it crucial to design vessels that can adapt to shifting regulations, emerging technologies, and changing market demands over time. As the cruise sector continues to grow, the industry must anticipate and prepare for transformations in alternative fuels, emissions reduction technologies, digitalisation, and operational models. However, these transitions bring uncertainties and challenges, requiring a forward-looking approach to ensure that today's design and investment decisions remain relevant in the future.

This scenario-based workshop, organised within the Green Transition Lab (GTL) – a collaboration platform organised by Meyer Turku with several Finnish universities – will engage industry professionals, researchers, and policymakers in exploring possible futures for cruise shipbuilding and operations. Participants will develop and analyse future scenarios that reflect different technological, regulatory, and market trajectories, identifying key enablers and barriers that will shape the industry's sustainability transition. Through structured discussions, we will examine how shipyards, cruise operators, technology providers, and regulators can collaboratively navigate these transitions, ensuring that future ships remain adaptable to long-term shifts in fuel infrastructure, passenger expectations, and operational requirements.

Drawing parallels with other industries, such as automotive manufacturing—where electrification has reshaped production methods, workforce structures, and supply chains—the workshop will also explore how similar dynamics may unfold in cruise shipbuilding. The session will conclude with a strategic reflection on industry-wide actions needed today to ensure that future ships can evolve in response to unfolding changes, rather than becoming obsolete before their lifecycle ends. By using scenario planning as a tool for future-proofing cruise shipping, this workshop will provide participants with insights into how long-term strategic thinking can be embedded into ship design, business models, and industrial collaboration.

Keywords: Cruishipping, Shipbuilding, Future-proof

Session 7: 12 June 2025 (Thursday) at 15.00-16.30

1. Special Session | Chair & Invite: Shaping the future of human work through digitalization and AI agents ♦

Time: Thursday 12 June at 15.00–16.30
 Room: LOGI
 Chair: Arto Reiman

The session will feature a series of paper presentations, followed by a concluding joint discussion.

Practice-oriented AI Tools and Methods in Industrial Organisations and Small and Medium Size Enterprises (SMEs): Future Avenues to Develop Productivity, Ergonomics and Well-being of Employees ♦

Jari Kaivo-Oja^a – Arto Reiman^b – Elina Parviainen^c – Tyyne Hulkko^a – Tero Villman^a

^a Finland Futures Research Centre, Finland

^b University of Oulu, Finland

^c MEYER Turku, Finland

The basic idea of the workshop is to elaborate on the potential of AI-based technologies and apps in small and medium-sized enterprises to improve their productivity, ergonomics, and well-being. There is significant technological potential to reach improvements in these central development fields of industrial organizations. In the workshop, companies are called for discussions and dialogues.

At the beginning of the workshop, the challenges of the "Productivity and Well-being through Digital Competencies (DigiCompetent)" project are outlined and discussed. After this introduction, some small expert notes on AI tools and methods are presented. In the workshop, a mapping study of available tools and methods is outlined in a robust way. The AI mapping study is linked to the main challenges of the workshop, which are productivity, ergonomics, and well-being. Some AI tools, of course, are integrated into all these development domains.

Typical AI tools are linked to natural language processing (tokenization, entity recognition, sentiment analysis, machine translation, and speech recognition), learning (supervised learning, unsupervised learning, reinforcement learning, and deep learning), and visual image control (object detection, facial recognition, image segmentation, and pose estimation). These 17 AI-technology fields are creating huge potential for industrial organizations. Some of these technologies are already mature, while others are still in the pioneering development space.

One discussion in the workshop is about where the most promising AI-based solutions to improve productivity, ergonomics, and well-being are. In the workshop, some expert-based mini-Delphi assessments are performed to reach a preliminary consensus on AI solution priorities. The workshop provides a learning-by-doing experience of the use of the mini-Delphi method. Before the workshop, top experts of DigiCompetent make AI-technology app lists for discussing already available AI-based apps for productivity improvements, ergonomics improvements, and well-being improvements.

The key results of the workshop will be a joint technology roadmap for AI-based solutions for industrial productivity, ergonomics, and well-being. Because of fast developments in AI technologies, we do not expect this draft AI-Prod-Well-being-Ergo roadmap to be 100% comprehensive or the "final truth." We aim to develop a "good enough" technology roadmap for the needs of the Finnish SME industries. The idea is that we later

update and discuss more about the AI-Prod-Well-being-Ergo technology roadmap. Thus, the workshop is practice-oriented and serves the vital interests of Finnish SME industries. The workshop is open to interested practitioners and developers. The workshop aims to promote lifelong learning of digitalization experts and professionals, including HEF experts.

Keywords: Ergonomics, AI, productivity, wellbeing, human-factors-engineering, AI apps, technology roadmapping, mini-Delphi study, technology mapping, SMEs, industries, manufacturing

New digital tools in working life: human aspects in developing working and management practices ♦

Timo Bräysy – Risto Jurva – Marja Matinmikko-Blue – Laura Kohonen-Aho – Anna Suorsa – Heidi Enwald – Arto Reiman – Ahmad Arslan – Arif Khan

University of Oulu, Finland

The visibility of digital tools in working life is an established fact these days. However, how these tools are used by different kinds of firms is an aspect which needs further exploration. This is especially critical as despite the availability of many useful digital tools, their adoption varies significantly, where many firms (especially SMEs) may be lacking skills and/or processes to use these tools efficiently for business development. Hence, understanding how people work with digital tools and environments in which these tools are applied is needed. This is further expected to help to identify issues that hinder productive work and well-being, design learning management models and create case-specific development plans. Consequently, management approaches to support efficient adaptation and use of emerging technologies and developing necessary competences, also need exploration and understanding. Keeping in view the complexities involved in studying such phenomena, a multidisciplinary approach is needed to get insights from the relevant disciplines. In this concern insights from scholars focusing on human behavior, learning, technology development and management, and organizational studies, can be particularly helpful.

Hence, the current in-process study aims to undertake this task. The main goal of this study is to understand the role of human behavior in developing working practices during digital transformation. By investigating how people work with digital tools and environments, the study seeks to identify bottlenecks in digital transformation within companies and other working places and provide best practices for interaction and collaboration using new digital communication and interaction tools. The study collects data in companies facing the need for such transformation and uses a mixed-method approach (participant observation, video-based methods, interviews, questionnaires) for examining working practices and the use of technologies in real-life settings.

As a result, the study will develop new methods, practices, and solutions to enhance well-being, interaction and collaboration using emerging digital technologies such as AI and VR/XR. Additionally, it aims to create an innovative and learning-promoting culture that encourages continuous technological renewal and experimentation with new solutions in organizations.

This will also provide design implications for future development of digital tools and environments that support staff well-being and efficient collaboration and interactions. Efficient and well-designed leading and management of the digital transformation processes involving new technologies and related competences will be one key advantage in successful organizations.

Keywords: Digitalization, Working life, Interaction, Collaboration, Human aspects, Management practices

2. Social implications of technological change •

Time: Thursday 12 June at 15.00–16.30
 Room: TEATRO
 Chair: Veli Virmajoki

New Technologies as Transformative Experiences: An Interdisciplinary Framework for Social Change •

Ali Chaparak

Niroo Research Institute, Iran

BACKGROUND AND OBJECTIVE

New technologies such as artificial intelligence and biotechnology are transforming societies' structures, values, and epistemological frameworks. These changes have similarities to transformative experiences that disrupt individuals' prior knowledge and values. However, in new technologies, the affected agent is not the individual but the "social agent." Therefore, an attempt is made to explain the differences and practical implications of the difference between these two agents through social epistemology. This article explores how theoretical insights from transformative experiences, future studies, decision theory, and social epistemology can be combined to address the challenges of transformative technologies. This study answers the question: How can the conceptual framework of transformative experiences guide societies in the face of technological change?

METHODS

This study uses a theoretical and integrative research design. First, key concepts and theoretical frameworks related to transformative experiences, futures studies, decision theory, social epistemology, and science and technology studies (STS) are reviewed. Then, these perspectives are combined to provide an interdisciplinary framework for understanding and responding to transformative technologies. This framework is illustrated through hypothetical scenarios and case studies of new technologies to highlight its practical relevance.

FINDINGS

The analysis shows similarities between transformative experiences and societies' interactions with new technologies, especially regarding epistemic and value changes. Key findings include the identification of "social agency" as a critical concept for understanding collective responses to technological change, the role of knowledge communities in mediating these transformations, and the need for foresight approaches that embrace uncertainty and value realignment. The framework emphasizes the importance of participatory methods, ethical reflections, and socio-technological rethinking in managing technological transformative change.

CONCLUSIONS AND IMPLICATIONS

The study concludes that framing new technologies as transformative experiences provides a new perspective for understanding their disruptive potential and social consequences. The proposed framework offers practical insights for policymakers, technologists, and researchers to anticipate and guide technological transformations. The framework emphasizes the need for inclusive, adaptive, and epistemologically robust strategies for managing uncertainty. Future research should focus on empirical validation of this framework and its application to specific technologies to increase its utility for theoretical advancement and practical implementation.

Keywords: Transformative Experience, Emerging Technologies, Social Epistemology, Decision Theory, Futures Studies, Science and Technology Studies (STS), Technological Uncertainty, Societal Transformation, Epistemic Communities, Sociotechnical Systems

Scenarios of AI and Scenarios of the Society. Marriage of Love, Not Convenience •

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We propose a novel methodological framework for analyzing potential AI futures through a "dual scenario" approach that analyses side-by-side both technological development trajectories and societal contexts in which an AI technology may emerge. Using the historical development of atomic technology as an illustrative case study, we demonstrate how the timing, context, and societal conditions shape the impact and evolution of technologies that shape the history of the world.

Our framework systematically combines scenarios of AI development with scenarios of possible future contexts. This makes possible a more dissected understanding of how AI might develop and influence society under different conditions in time and place.

The dual scenario approach offers three key benefits: First, it provides a more holistic view by recognizing that AI's impact depends not only on technological capabilities but also on when and where these capabilities emerge. Second, it enables systematic analysis of possible challenges and opportunities at the intersection of AI capabilities and societal contexts across different time horizons. Third, it integrates ethical considerations directly into the scenario-building process by encouraging reflection on not just what is technologically possible but what is desirable for different stakeholders.

We demonstrate the practical application of this dual-approach framework through case examples and discuss its implications for AI governance, policy-making, and ethical development. This work contributes to the conference themes by offering a novel approach to managing technology's dual role as both solution and source of new challenges and, thereby, provides a structured approach for analyzing the mutual shaping of technological and societal transformation.

Keywords: Artificial Intelligence, AI, Scenarios, History, Time, Context, Scenario Methods

Anticipating trust in post-quantum cryptography: European digital identity context •

Marjoriikka Ylisiurua – Minna Kulju

VTT Technical Research Centre, Finland

Quantum technology is an emerging technology with projected profound implications for material science, chemistry, and optimization (Wallin et al. 2025). It is prescribed to cause significant societal disruptions, necessitating anticipatory governance to mitigate its negative societal impacts. A unique defined challenge is known as the quantum threat (Brassard 2016, Hurd 2017). This threat arises from the ability of quantum computing to break current cryptographic systems, posing risks to data security and digital infrastructure. Current efforts towards anticipatory governance lack a comprehensive understanding of how the general audience perceives the offered solution, post-quantum cryptography (PQC).

We investigate this gap through the lens of trust in PQC application. Our analysis focuses on the PQC application context of European digital identity framework as it concerns international students, querying their perceptions of the responsibility of various institutions in securing digital identities. The examination suggests that participants perceive the threats to their identity primarily through the lens of current digital framework rather than the promise and perils of future quantum computing. The findings indicate a general trust in the security provided by societal institutions, though some participants exhibit apathy towards privacy issues. The perception of the source of threats is largely limited to peers and data controller companies, with less emphasis on states or other malicious actors.

Our findings imply that currently, quantum computing and PQC remain peripheral issues in international students' minds. Instead of focusing on specific technological fixes to technological problems, we suggest a broader view on the societal underpinnings of applications of quantum technology and the role of PQC is necessary. By exploring the interplay of audience perceptions in the technical digital infrastructure and those securing it, we can better anticipate the integration of quantum technologies into society, ensuring that security measures address both technological and social dimensions.

Keywords: post-quantum cryptography (PQC), anticipatory governance, participatory foresight

The Anticipatory Compass: A heuristic tool for reflecting futures stance in innovation and design practice •

Camilo Sanchez – Felix Anand Epp – Antti Salovaara – idil Gaziulusoy

Aalto University, Finland

In the development of digital technologies, researchers, designers, and engineers anticipate. They generate knowledge from problematising expectations for the future in the present through prototypes, simulations, and user scenarios. In particular, the field of human-computer interaction (HCI) has brought various methodological initiatives that foster anticipation. While not the majority, various HCI scholars engage in participatory design for long-term change, develop technologies for scenarios of collapse, inquire about people's perception of technology-driven futures with speculative design, and enact experiential futures using interactive prototypes in everyday scenarios.

However, the current lack of a general uptake of such methods in interactive technology development risks overlooking unintended consequences, possible crises, and the well-being of future stakeholders. Further, these methods engage in anticipation but seldom make their stance on the future explicit. This gap calls for anticipatory tools that can be used at any stage of technology development. Such tools should help engineers and designers understand how their assumptions, values and expectations about futures are embedded in the technologies they design, ultimately affecting the futures these technologies enact.

To this end, we developed the Anticipatory Compass as a heuristic tool for navigating different orientations towards futures. It draws from insights from an empirical study using foresight methods to examine privacy challenges in future scenarios involving smart garments and circular economy intersections. In addition, the Anticipatory Compass is informed by two complementary Anticipation Studies frameworks —Anticipatory Action (Anderson, 2010) and the Futures Literacy Framework (Miller, 2018).

The Anticipatory Compass operationalises these anticipatory frameworks visually by spatially representing the various stances one can take towards the future, which we term "orientations", along with their interrelated rationales, referred to as "inclinations".

To navigate and identify orientations and inclinations, we introduce a structured three-stage reflective process. This process involves a series of guiding questions to deconstruct designers' and engineers' relationship towards the future and the rationale behind their design decisions. The Anticipatory Compass serves as an intermediary tool bridging Futures Studies and HCI by offering designers and engineers practical means to identify how the stances and rationales towards the future they articulate —or left unarticulated— permeate in the futures they construct through new interactive technologies.

Keywords: Anticipation, Anticipatory Design, Anticipatory Action, Futures Literacy, Human-Computer Interaction

3. Theoretical frameworks of technology in futures studies & foresight ♦♦

Time: Thursday 12 June at 15.00–16.30
 Room: GALLERY
 Chair: Sari Söderlund

Reconceptualising Anticipatory Infrastructures: Making Sense of Everyday Engagements with Possible Technological Futures in Divtasvuodna/Tysfjord, Norway♦

Èva Cossette-Laneville

UiT The Arctic University of Norway

Scholars have argued for the necessity to engage with possible technological futures in the everyday worlds where such technologies are used and imagined [1]. With Norway expecting a continuous growth in aquaculture production, technology is increasingly represented in policymaking and by the industry as a solution to primarily environmental challenges and as means to support growth [2, 3]. In this sense, future technologies become anticipatory infrastructures [1]. Based on fieldwork in Divtasvuodna/Tysfjord, Northern Norway, this paper explores how imaginaries around emerging technologies in aquaculture and other forms of extractive industries function as anticipatory infrastructures, with the power to shape possible coastal futures. In Divtasvuodna (Lule Sámi) or Tysfjord (Norwegian), aquaculture, as well as other extractive industries (i.e., minerals and energy), have steadily expanded over the past decades, occupying an important role for sustaining settlements along the coast and driving the regional economy. However, aquaculture also meets local resistance, particularly concerning the environmental impact of fish farming operations and conflicts over the use of coastal spaces, making this place an important site to engage with when considering possible technological futures

This study is based on a combination of observations and semi-structured interviews with 10 conversation partners (i.e., local industry representatives and individuals from the region). The interviews were transcribed and qualitatively analysed following an iterative method [4]. The results showed that possible technological futures are mediated by a range of factors from market-based demands and labour costs to hoped solution to environmental challenges, but also by a desire to gain more control over the industry, to safeguard cultural values, and to care for the local environment. Technology is presented as “unavoidable” but as also conditioned by “uncertainty” regarding what the future might hold and what the technology of tomorrow might be. While the expected rise of autonomous systems and ensuing labour cuts characterised how the future of aquaculture and other extractive industries were imagined, visions of future technologies in aquaculture were also fuelled by a desire from the locals to gain more control over the industry (i.e., taxing the robots). Moreover, energy demands also played a major role, showing how technological futures are not limited to the demand of one industry but as part of an assemblage between different industries, systems, actors, demands, and values. In summary, this study is an in-depth engagement with the everyday as a key factor in the constitution of possible technological futures.

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Keywords: Aquaculture, Emerging Technologies, Anticipatory Infrastructures, Everyday life, Futures, Norway, Imaginaries

Towards a holistic framework in Technology Assessment (TA) •

Johanna Ahola-Launonen

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This paper discusses the role and impact of instrumentalism in Technology Assessment (TA) frameworks (Brey 2010). Instrumentalist TA treats technology as a neutral tool for achieving human goals. Critics argue that this framework promotes an immaterialist view of technology, inadequately accounting for the material and socio-political conditions that shape technological development. This perspective supports extensive techno-optimism by obscuring technology's material dependencies—such as finite resources—and fostering the illusion that technological progress can be decoupled from ecological and social limits.

Furthermore, the instrumentalist view of technology, particularly in anticipatory TA, has been criticized for its performative function, legitimizing specific technological futures. By focusing primarily on the assessment of technological artifacts, anticipatory TA often assumes the hypothetical existence of a technology as imminent rather than critically evaluating whether the technology is the most suitable solution to complex societal challenges (Ahola-Launonen 2025). This legitimating process reinforces techno-optimistic narratives by directing attention and resources toward speculative "techno-fixes" and limiting efforts to address deeper structural issues such as overconsumption, inequality, and power imbalances. By neglecting the material and social contexts within which technology is developed and framed as a viable solution, instrumentalist TA cannot fully address the historical and structural factors underlying technology development. Decolonial and feminist critiques emphasize that dominant techno-optimist views in climate and sustainability policies often privilege elite, technocratic perspectives. These perspectives reinforce existing power structures and neglect the global decolonial dynamics that have historically enabled Western technological advancement.

In this paper, I propose an alternative framework for TA that moves beyond instrumentalist assumptions. This framework acknowledges the performativity of technological expectations and their role in shaping political and moral concepts. It emphasizes the evaluation of broader sociotechnical systems—including beliefs, power structures, and material realities—to promote responsible hope and sustainability rather than unsustainable, excessively optimistic technological visions. To reimagine more sustainable futures, we must "reinterpret our current records through present-day concerns" (Ferraz de Oliveira, 2024), questioning the epistemic foundations of our "modern times of glory." By integrating these critical perspectives, we can cultivate a more thoughtful and effective approach to assessing technology's role in addressing global challenges.

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Keywords: Technology Assessment, Philosophy of Technology, Instrumentalism, Sociotechnical Systems, Science and Technology Studies, Performativity of expectations

Conceptualizing Future Studies •

Rick Szostak

University of Alberta, Canada

Szostak (2024) in *Conceptualizing World History* suggests that we can best understand the course of world history (and bring coherence to the field) by organizing our understandings under six broad headings. Since Future Studies as a field builds upon our understanding of historical processes, this presentation investigates the advantages of applying the same analysis to the study of the future.

Szostak first identifies three types of change. The first, "societal transformations," are changes that create new possibilities: the agricultural revolution made cities and states possible for the first time, for example. Though futurists often also talk about transformations, it would still be useful for the field to appreciate the importance of transformations and always ask "what becomes possible that was not previously possible because of this change?" Szostak also discusses more gradual "trends" such as the uneven growth in human population. These too may create new possibilities over time but generally have a less dramatic impact on other phenomena at any point in time. Futurists might usefully distinguish always (and always look for) interactions between transformations and trends. Finally, Szostak discusses evolutionary processes, and highlights their importance in understanding technology, culture, institutions, and art. When studying these phenomena, futurists are urged to look past predicting mutations (which may be almost impossible) to examining the selection environment and transmission mechanisms that will shape what kind of mutations will survive and prosper (e.g. what is the selection environment for artificial intelligence technology?)

Szostak then looks at three key types of recurring patterns in history. Futurists generally appreciate that the future will in some ways look quite different from the present and in other ways look very similar. There may be a tendency to emphasize the former in our analyses. Yet Szostak shows that recurring patterns are of huge importance in history: rulers everywhere struggle to control bureaucracies and merchants everywhere worry about being cheated. Futurists can usefully ask how enduring challenges might be addressed in future (will AI make it easier to manage a bureaucracy?). They can also ask whether impersonal causal relationships (port cities have tended to be more democratic than agricultural areas) are likely to continue into the future. In addition to regularities in how agents respond to challenges and in causal relationships, Szostak looks at forces that have guided regional similarities and differences in behavior. Futurists should always ask whether a particular change is likely to draw the regions of the world together or push it apart.

Finally, Szostak appreciates the role of contingency in history. He describes many points of contingency in history (such as decisive battles that might easily have gone the other way). Future Studies as a field has long appreciated that we cannot predict one future with accuracy. It could nevertheless seek to identify likely points of contingency in our future. These may be opportunities for us to choose more desirable futures.

Keywords: World History, Transformations, Recurring Patterns, Evolutionary Processes

From Imagination to Innovation: How Sci-Fi Shapes Future Technologies ♦

Philipp Koebe

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ScMI Scenario Management International, Paderborn, Germany

Science fiction has long been a medium for speculative thought experiments, envisioning technological advancements that often precede real-world innovation. This presentation explores the extent to which science fiction literature can serve as a methodological tool for investigating future technologies and how it can contribute to scenario-based analyses for the exploration of future technological spaces. The study specifically examines representations of medical technologies in science fiction and their potential implications for future healthcare systems.

The research follows a structured two-step approach. First, medical technologies depicted in science fiction literature are systematically identified, categorized, and analyzed. This includes technologies related to artificial intelligence in medicine, human enhancement, biotechnology, and digital health solutions. By extracting these speculative innovations from fictional narratives, we gain insights into emerging technological possibilities that may shape the future of healthcare.

In the second step, scenario-based analyses are conducted to explore possible development pathways for these technologies. These scenarios offer structured projections of technological evolution, considering scientific feasibility, socio-economic factors, and regulatory challenges. The scenario framework serves as a foundation for deriving actionable recommendations for key stakeholders, including policymakers, healthcare professionals, industry leaders, and researchers. By bridging speculative fiction with strategic foresight methodologies, this approach enables a deeper understanding of how technological innovations could unfold and how different actors can proactively engage with these developments.

A critical component of this investigation is the discussion of ethical implications. Many science fiction narratives highlight not only the benefits but also the risks associated with advanced medical technologies, raising fundamental questions about human identity, equity in healthcare access, and the potential for unintended societal consequences. By engaging with these ethical dimensions, this study underscores the importance of responsible innovation and anticipatory governance in medical technology development.

This presentation demonstrates that science fiction, beyond its role as entertainment, can function as an epistemic tool for future studies, providing a valuable framework for exploring technological uncertainties, anticipating socio-technical shifts, and fostering interdisciplinary dialogue. The findings contribute to the broader discourse on future-oriented technology assessment and emphasize the relevance of speculative fiction as a resource for scientific and strategic inquiry.

Keywords: Scenarios, Science Fiction, Technology, Innovation Management, Ethics

4. Ethical issues in technology ♦

Time: Thursday 12 June at 15.00–16.30
 Room: KINO
 Chair: Morgan Shaw

Multitemporal thought exercises on technological futures. The predatory and parasitic potentialities of the ‘dark’ technologies for times beyond the Capitalocene •

Riikka Haapalainen^a – Tiina Pusa^b – Tomi Slotte Dufva^b

a University of the Arts, Helsinki, Finland

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Our presentation examines futures shaped by technologies in a multitemporal and multipositional manner. A central reference point is our contemporary era, characterised as the Capitalocene, built upon the post-Enlightenment Promethean ideals of anthropocentric reason, progress, and expansion. These ideals have been catastrophically escalated in the Capitalocene. Technological advancements have facilitated many feral and wicked problems that have emerged as by-products of the Capitalocene. We argue that the dark complexity of these wicked problems should not be approached solely through the logic of the Capitalocene—through one temporality and one understanding of technology.

Futures studies related to technology strongly rely on the Enlightenment's legacy. We explore the futures enabled by technologies, particularly from the perspective of two archetypal agencies of the Capitalocene: predators and parasites. What did predation and parasitism mean, concretely and metaphorically, before the Enlightenment, during the so-called “Dark Ages”? And what kinds of future positions and technologies do these “dark times” offer us?

The Capitalocene is both a disease and a symptom of the Modern project. Thus, thinking about future societies and technologies exclusively through the lens of the Capitalocene does not provide sustainable answers. Therefore, we have shifted our focus from the dark, predatory future visions of the Capitalocene to the pre-Enlightenment assumption in the future. We argue that futures and technology studies require deeper historical awareness to create broader and more profound perspectives on the ethical questions of the present.

Our presentation is a thought experiment that reaches into multitemporality, bringing the futures of the “dark times” into examination through three temporally entangled assemblages:

1. The interpretation of the visual programs of medieval stone churches in Finland, beyond their spiritual and narrative—literary or textual—contexts, and the speculation on the technologies and future horizons of predation and parasitism depicted in them.
2. The connection between the aesthetic understanding of light and illumination in the Middle Ages and the belief in the future contrasted with the colonial logic of governance and control maintained by the Capitalocene's maxim of light (from torches to LED lights).
3. The relationship of Scandinavian Troy Towns (jatulintarha) as technologies of future-oriented contemplation to the “dark” or flawed knowledge of artificial intelligence; pre-Enlightenment ideas of technology as the skill of systematic discourse contrasted with the lack of such skills in contemporary technologies, where futures are created by mining data rather than by increasing understanding.

Keywords: capitalocene, multitemporality, dark times, wicked problems, middle ages, antroposcene, assemblage, future horizons, predators, parasites

Future of AI-based Dual-Use Research •

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Dual-use research, normally, refers to research that has both civilian, as well as military applications. Epistemologically, dual-use research can be anticipated to provide knowledge, products, or technologies, yet could be misapplied to pose a serious threat to public health, agriculture, plants, animals, and the environment. In today's exponentially expanding technology landscape, dual-use research has emerged as a crucial frontier with profound implications for the future of innovation, national security, and economic growth, and the term no longer applies to security but also to innovations and industrial growth. Due to the rapid growth of artificial intelligence (AI), the scope of dual-use research continues to advance rapidly, while regulatory agencies are not able to keep up with the pace, thus creating a phase lag between innovations and regulations. The presentation highlights an overview of dual-use technologies that include basic sciences, technologies, emerging methods, and transformative engines in innovations and commercial spaces. The inclusion of AI has produced new capabilities and opportunities, and in contrast, generated new challenges, that have not yet been fully articulated. Dual-use challenges assisted with AI in emerging methods and transformative engines, such as additive manufacturing, synthetic biology, neurotechnology, human-machine interface, unmanned aerial vehicle, and autonomous systems, just to name a few, will be discussed. From a security standpoint, quantification of intent is indeterminate. For dual use disruptive technologies, there is limited to no information available in literature. Hence, the presentation aims to initiate a dialogue on this critical topic, by using complexity science, behavioral analysis, and ATT&CK mapping modalities (the latter is normally used for cyber defense). By outlining the modalities and framework of these methods, the objective of the presentation is twofold (a): reduce the attack surface for security, and (b): enhance resilience following dual use for disruptive technologies, especially when conjoined with AI. As such, there are discussions concerning governance of AI, which, for now, is a patchwork of national strategies, ethical guidelines, and aspirational international talks, with no clear framework or enforcement mechanism. The presentation is a theoretical construct that intends to highlight dual-use research, especially when conjoined with AI as it offers tremendous potential, however, the same methodologies have the potential to offer challenges. Furthermore, models would quantify the probability, not only as a predicate for negative consequences but also to enhance system resiliency.

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4. Countering Hybrid Threats Against Critical Infrastructures, Springer Dordrecht. ISBN: 978-94-024-2303-7. Due May 2025.

Keywords: Dual-use research, AI, ML, complexity science, resiliency

Exploring the risks and benefits of using artificial intelligence in corporate foresight •**Samaneh Ebrahimabadi**

Finland Futures Research Centre, Finland

As artificial intelligence (AI) technologies advance rapidly, there is significant interest in exploring how these innovations can enhance various human activities. Considering this, corporations should take advantage of artificial intelligence's potential benefits while managing its associated risks. This research examines the multifaceted implications of AI in corporate foresight through ten semi-structured interviews thematized with qualitative content analysis.

The findings reveal key benefits of AI in corporate foresight, demonstrating significant improvements in data integration, analysis accuracy, visualization, and time efficiency. However, the study also identifies several limitations and challenges, including integration barriers, algorithmic constraints, and data dependency issues. Additionally, the study highlights the risks, such as the amplification of human cognitive and demographic biases, over-reliance on AI outputs, and social and security concerns.

The results indicate that AI applications in corporate foresight can have both short—and long-term impacts, helping corporations adapt to changes while maximizing benefits and minimizing risks. These insights are crucial for policymaking, as they underscore how AI can enhance data integration, analysis accuracy, and visualization—key elements for effective decision-making. Furthermore, understanding the limitations and risks provides a foundation for creating regulations that address these concerns, promoting ethical AI use, transparency, and protection against over-reliance on AI outputs.

The research's theoretical implications suggest that human intervention is essential for establishing trust in AI, ensuring its healthy evolution, and delivering more reliable real-world solutions.

Keywords: Corporate foresight, Artificial intelligence, foresight

6. Chair & Invite Session: Futures in action ♦

Time: Thursday 12 June at 15.00–16.30
 Room: GOTO 31
 Chair: Michel Saloff-Coste

Futurs in action (wiley 2025) ♦**Carine Dartiguepeyrou – Michel Saloff-Coste**

International Foresight Research Network, France

Université Catholique de Lille, France

Meta-analysis of futures trends and ways organisations anticipate, innovate and transform themselves

Keywords: Megatrends, foresight into practice, organisations (French and international)

7. Workshop: Imagining the Good Life - Fast Futures Literacy Laboratory ♦

Time: Thursday 12 June at 15.00–16.30
Room: GOTO 32
Facilitator: Tarian Jenkins

Tarian Jenkins

Finland Futures Research Centre, Finland

Sustainable transformation is built on different bases of knowledge and ethical foundations, often accompanied by a change in worldview. Thus, the cultural dimension plays an important role in acknowledging socio-ecological actors and developing policy solutions that encompass a system. This significance increases when considering the evolving contemporary values and needs of actors, where decisions made today not only need to accommodate changes but anticipate them. Recent government and decision maker initiatives have explored the increase participation of stakeholders in planning processes to evaluate public perception of planned change and societal impact. However, these efforts have placed emphasis on understanding how technological innovations can be implemented, and the process by which they become widely adopted and transform societal structures. This focus on socio-technical innovation alone is by no means sufficient for addressing the long-term social and ecological challenges that equate to the notion of a 'good life'.

What constitutes as a 'good life' is subjective by nature as individuals needs and values (satisfiers) differ. There is no singular definition of a 'good life', as it is often tied to it's disciplinary application. But if we draw a shared conclusion from the fields of socio-ecological research and Future Studies it is possible to arrive at the notion of a good life being characterised by a life where individuals can satisfy their needs whilst having access to the social and ecological resources for doing so.

The objective of the workshop is to explore the socio-ecological dimensions of transformation by decoupling technology as a dominant component for sustainable transformation, placing the social dimension as a central point from which the other dimensions of sustainability and transformation can be explored in the future. This session will delve deeper into the socio-ecological dimension of sustainable transformation and understanding of a 'good life'. The workshop results will be used to co-create images of the future by exploring the nuances between contemporary and future satisfiers.

Keywords: Sustainable development, Transformation, Decoupling, Futures literacy laboratory

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