ABSTRACTS

BMS RESEARCH CONFERENCE: NOVEMBER 6, 2025

For quick and easy full text searching of the entire program, this page contains the abstracts of all contributions to the 2025 BMS Research Conference
The contents of this page are also available as a pdf.
For less detail, please refer to the program overview.
NB: Alphanumeric codes indicate thematic clustering, whereby: E=Emerging Technologies; L=Learning; R=Resilience; M=Methods & reporting; S=Strategy & support; H=Health; I=Smart industry and organizations; (X)P=Sector plan

MORNING POSTERS

IDEATE: EMERGING TECHNOLOGIES

E1. Cocreating and Evaluating a Digital Inclusion Intervention for Parents in Poverty: Results from Qualitative Research

Lilian Boerkamp, Alexander van Deursen, Ester van Laar, Alex van der Zeeuw, Shenja van der Graaf, and Roel Lutkenhaus

As digital inclusion support is not one-size-fits-all, one should consider the implementation context and include stakeholder perspectives. Using cocreation, a digital inclusion intervention is designed for Dutch parents in poverty. An integral intervention approach is taken, considering barriers in all internet appropriation phases (attitude & motivation, material access, skills, and usage). A cocreation workshop and a focus group were conducted to design the intervention. The cocreation workshop resulted in prerequisites for a digital inclusion intervention, such as being able to ask for help easily, receiving a laptop, and promoting existing support initiatives. The focus group provided more specific feedback, such as reflections on the learning contents and the desired moments for scheduling classes. The combined insights resulted in the internet support program ‘Samen wegwijs op het internet’ (SWOI). As part of the research project, the SWOI intervention is also implemented and evaluated. SWOI took place from November 6, 2024 to January 29, 2025, in the southern region of Enschede, the Netherlands. During the program, 14 parents received a laptop, weekly training courses, and free and accessible support in internet and computer use. A qualitative approach is used to evaluate the feasibility and effectiveness of the program. Lessons were learned from observations, in-between feedback moments, and short interviews. Results highlight increased self-confidence in using the internet, greater independence, pride in one’s

learnings, and enhanced social contacts. Lessons learned for future digital inclusion interventions are shared, including a call for group learning and for appointing an intervention coordinator. This research informs the design of effective digital inclusion interventions using cocreation and may assist social workers, policymakers, and other professionals occupied with poverty relief, digital inclusion, or intervention design.

E2. Towards Ethical AI Applications: Understanding and Supporting Ethical Reflection of AI Software Developers in an Educational Design Research Project

Cecilia Schramm, Sebastian Dennerlein, Frank Leoné, and Maaike Endedijk

Artificial Intelligence (AI) can nowadays be found in virtually all domains, be it healthcare (Esteva et al., 2017; Bouton et al., 2016; Marr, 2017), marketing (Huang and Rust, 2021), public services (Haeck, 2024), social services (Patel, 2024) and others. AI, a system predominantly based on Machine Learning (ML), can generate output based on the input it receives to detect (Ambika, 2024), predict (Bera et al., 2022), recommend (Zhang et al., 2020), and more. With the contribution AI has made in these various domains, however, existing literature has also testified that this rise of AI implementation comes with new problems as well (Teo, 2024), especially from an ethical point of view (Petrozzino, 2021). The overarching goal of this research is to support the development of more ethical AI systems. Our focus is to understand and support the process of anticipating ethical issues before they occur or quickly resolve occurring ones. Moreover, the purpose of this research is to learn about the trajectory of ethical issues within AI software development teams. We want to understand the timeline of how the ethical issues were identified and eventually resolved, or when and why they were not resolved. Together with AI software developers, we will build a tool/package on this basis that supports the developers' ethical reflection, and associated action, throughout the software development process. This will be accomplished through in-depth interviews (group and individual), as well as active collaboration with the developers. There is no research yet on how AI software developers reflect on socio-technical interactions and potential ethical consequences of their work, nor about how they can be motivated to feel responsible for these issues and find ways of how to deal with them. This project will study how such reflection and learning processes happen in practice to build a model that can be employed in the development of a practical support tool. This tool will be in the form of an ethical reflection tool for the developers that assists them in implementing ethical principles into their working practices. This approach will integrate the "ethical by design" concept, which encourages practical ethics to be included into every phase of the software development process (Nurock et al., 2021).

E3. Governing the design of emerging energy technologies towards responsible and just futures

Efi Nakopoulou and Kornelia Konrad

As the EU accelerates the transition to renewable energy sources (RES) and their technologies, as part of the broader energy strategy, specific goals and targets have been set for each RES. The member-states have committed to this energy strategy

targets and have designed their own national plans as to how to achieve these targets. In the context of this energy strategy, solar photovoltaic (PV) technologies have come to the forefront and are foreseen to lead in the global electricity supply. In addition, other energy technologies like green hydrogen, building on solar technologies, have come to the forefront in recent years as a means of reaching these targets.
Our research examines the socio-technical embedding of emerging energy technologies that can play a supportive role for this transition to renewables, and thereby is deeply rooted to the energy transition. Emerging (energy) technologies are shrouded with uncertainty. At the same time, this implies that their design is still in-the-making and thus at times more malleable, allowing for the active shaping of their design and required materials. Responsible research and innovation (RRI) has become established as an important strand of literature and methods to facilitate responsible design, especially for emerging technologies. However, this literature has given limited attention to critical dimensions surrounding these emerging technologies, such as the geopolitics of raw materials, nor have they developed a clear methodology as to how to consider them for designing such technologies 'responsibly'. We aim to inform RRI by placing emphasis on the geopolitics of raw materials for the emerging technologies under examination and propose a methodological tool, drawing from the long tradition of Constructive Technology Assessment. Our research is informed by various primary and secondary sources and a series of semi-structured interviews with diverse stakeholders all the way from users to raw material producers.

E4. The Interplay Between Professional Identity and Digital Health Technology: An Integrative Review

Mila Grozdanovska, Marlon Nieuwenhuis, Maaike Endedijk, and Matthijs Noordzij

Background: Digital technology adoption among healthcare professionals remains low, as technology can threaten professional identity – the intersection of ""who we are"" and ""what we do"". To address adoption challenges, prior research has predominantly employed Technology Acceptance Models, which view users and technology as static entities operating independently. However, emerging research suggests that professional identity and technology dynamically interact and shape each other, yet this interplay remains underexplored among (mental) healthcare students and professionals. We aim to explore how professional identity is shaped by, and shapes, interactions with digital technologies, how this interplay varies across different healthcare professions and technologies, and which theoretical frameworks are used to characterize the relationship between professional identity and technology.
Method: The integrative review followed Whittemore and Knafl's (2005) methodological framework. Keywords were grouped into four categories: digital health technologies, professional identity, healthcare students and professionals, and user-technology interactions. Title-and-abstract screening was performed in ASReview and full-text screening in Covidence. Data analysis will involve thematic analysis and narrative synthesis.
(Preliminary) Findings: Thirty-three articles were included in the analysis. A range of theoretical frameworks were used, most commonly the Theoretical Domains Framework (TDF), Sensemaking, and Technological Affordances. Several studies, however, lacked explicit theoretical grounding. Professional identity was both reshaped by digital technologies through changes in autonomy, role boundaries, and perceived competence, and actively shaped how these technologies were interpreted and used.

Professionals engaged selectively with technologies based on role values, adapted their use to maintain professional norms, and resisted features seen as threatening expertise or autonomy. Research focused primarily on nurses, but also on mental health professionals, social workers, and allied health professionals. Few studies were conducted among students. Electronic medical records and telehealth were the most studied technologies, typically in pre- or early-adoption phases.
Discussion: The interaction between professional identity and digital technologies is a dynamic, mutually shaping process. Understanding how this interplay affects (future) professionals across various fields can provide insights into addressing technology adoption and aligning education with the evolving needs of the healthcare workforce.

E5. Autonomous boats are possible? incorporating good seamanship by a spatiotemporal Multi-graph Network for Trajectory Prediction
Shunqiang Xu, Ville Lehtola, Simone Borsci, and Stephanie van den Berg

Teaching autopilot systems good seamanship (GS) is a major challenge, especially when autonomous ships face complex situations involving multiple nearby vessels. Existing maritime traffic rules offer limited explicit guidance for such scenarios. However, historical AIS (Automatic Identification Systems) data, recording ship positions, headings, speeds and other key variables at fixed time intervals, contains a rich collection of navigational decisions made by skilled human navigators over many years. In principle, good seamanship is embedded in this data. This work aims to develop a Good Seamanship Model (GSM) to support autopilot decision-making, with a focus on multi-ship encounter situations. To achieve this, we leverage historical AIS data and apply advanced machine and deep learning techniques. We propose a graph-based trajectory prediction method designed to model complex interactions between ships. First, multiple spatial graphs are constructed to capture interactions features, such as ship type, navigational obligations, distance to closest point of approach (DCPA), time to closest point of approach (TCPA), etc. These graphs represent the spatial relationships and safety constraints among vessels. Next, a transformer-based self-attention mechanism is applied to model temporal dependencies within these interactions. Finally, a Variational Auto Encoder (VAE) architecture is employed to represent the spatiotemporal interaction patterns and infer future ship trajectories. The presented method effectively captures and integrates complex interaction features, enabling accurate prediction of ship movements in complex encounter situations. This method offers a data-driven path towards embedding good seamanship into autonomous navigation systems, improving their ability to make safe and human-like decisions at sea.

E6. Cognitive Load in Cyclists while Navigating in Traffic: Effects of static and dynamic route events on neural activity of cyclists
Funda Yildirim, Fenja Heine, Aykut Eken, Pookhao Chinpongsuwan, Mario Boot, Karst Geurs, and Baran Ulak

Increased cognitive load during cycling can lead to safety issues, particularly during complex situations such as participating in motorised traffic or manoeuvring at

intersections. Understanding the patterns of cognitive activity in cyclists across various events can provide valuable insights into cyclist's cognitive load. Therefore, this study aims to investigate when cyclists undergo cognitive load changes during cycling and how these changes manifest in neural activity and connectivity. For this purpose, we analysed neural activity data collected during a real-life field experiment by a non-invasive portable method namely Functional Near-Infrared Spectroscopy (fNIRS) sensitive to neural activity in the prefrontal cortex region. Findings indicate differences in cognitive load, as shown by varying oxygenation levels, during both static (i.e., presence of traffic lights, intersections, roundabouts, or crosswalks) and dynamic (i.e., presence of motorized vehicles, cyclists, pedestrians, or avoiding objects) route events. Neural activity patterns highlight how different road events elicit varying cognitive and neural demands in cyclists. Events like intersections and pedestrian encounters show dense connectivity, particularly in regions related to decision-making, attention, and motor planning implying a high cognitive load on cyclists. Roundabouts and traffic light scenarios demonstrate intermediate connectivity, indicating the need for adaptive attention and action selection. This study contributes in understanding the underlying cognitive mechanisms during cycling in real life conditions and the neural markers that can identify different route events encountered while cycling.

E7. Individualised multimodal performance in a whole-body dance motor sequence learning task

Russell Chan, Victoria Lakomski, Johannes Pannermayr and Willem Verwey

Fundamental research in motor sequence learning has typically relied on the use of fingers to uncover neurocognitive mechanisms. In recent years, there has been a shift towards more whole-body tasks to truly understand the 'motor' aspect of sequence learning. In the current research, we will utilize a successfully ported whole-body version of a popular sequence learning paradigm called the Discrete Sequence Performance (coined Body-DSP) task. We plan to unravel if participants use different strategies to perform the task due to individual limitations in working memory. We predict that if this is true, then different concatenation points (items whereby response times are slower) will arise between participants. This will also be coupled with higher cortical activations for participants who learn the sequence more poorly than those who learn the sequence better. Our goal of this research is to unravel both neurocognitive and behavioural differences at an individual level with the long-term goal of providing idiosyncratic training approaches.
Data collection will be multimodal and involve the use a mobile EEG set (ANT Neuro eego™sports), Movella's MTw Awinda (inertial-based kinematics), behavioural performance (response times, accuracy), and self-rated questionnaires. Because of the complexity of the data, we will also perform non-linear analyses in the form of Lorenz Attractors in addition to more established linear-based representational similarity analyses. Linear approaches will help to uncover working memory mechanisms whilst non-linear approaches will showcase participants' stabilization of motor learning states.

CONCEPTUALIZE: LEARNING

L1. Weaving stories of interconnection: A teacher development module for supporting ecological morality

Tore van der Leij and Kirsten Stadermann

His qualitative design study is aimed at the development of a research-based module enhancing science teachers' storytelling competencies. The module's core focus is storytelling as a pedagogical tool for supporting students' morality development in relation to the more-than-human world. Also, this study aims to develop more universal design principles for integrating storytelling into secondary science education to foster ecological morality.
Storytelling in science education has the potential to be a powerful pedagogical tool to support students to critically examine our disrupted relation with the more-than-human world, as well as to encourage them to reflect upon (alternative) hopeful forms of relations in it.
Activities during the different phases of this study are interviews with/ training by (professional) storytellers; development of sample stories/materials to inspire science teachers; design of a storytelling module; set-up a professional learning network (PLN): teacher training, exchange experiences, mutual feedback during (follow-up) meetings.
Data sources for this study include PLN teachers' reflective diaries, kept during the implementation phase; interviews with both students and PLN teachers about their findings and experiences with storytelling.
During the conference interactive poster presentation, we will share some (preliminary) findings from the orientation and design phases, including initial design principles for storytelling modules and feedback from PLN teachers. Also, the poster will include some visual representations of key concepts central to the module, as well as QR codes that link to additional resources and references. Likely, we will bring some tangible objects, to be used as starting points for conversations.

L2. Beginning Teachers' Lesson Quality; do they know what Support they need?

Sara de Bruin, Marieke van Geel, and Kim Schildkamp

Beginning teachers are expected to develop their professional competencies during their first years of teaching (Van Aken, 2016; PO-raad, 2014) and are, ideally, supported by various induction activities. It is assumed that for optimal professional development (PD), induction activities should be adapted to beginning teachers' needs (Wood & Stanulius, 2009). However, it is unknown how and by who those needs for development should be identified. As teachers are often more positive about their own performance than external observers (Dobbelaer, 2019), it can be questioned whether beginning teachers are able to accurately assess their own performance and needs for PD.
This current study therefore explores the relation between teachers' self-efficacy, PD needs, and lesson quality by combining self-reports and classroom observations of Dutch primary school teachers.
Research questions are:
A. To what degree does beginning teachers' self-efficacy reflect classroom observation scores on various subdomains of teaching?
B. To what degree is beginning teachers' self-efficacy related to indicated needs for PD on various subdomains of teaching?
Preliminary analyses only show significant correlation between self-efficacy and

classroom observations for the construct of classroom climate and classroom management. For the constructs of instruction and adaptivity, no significant correlations were found. Overall, beginning teachers indicate a (strong) need for PD. However, there were no significant correlations between beginning teachers' self-efficacy and their PD needs across all constructs. These findings indicate that beginning teachers do not identify their PD needs based on their own feeling of competence. Monitoring development over time and evaluating PD impact seems essential for building an effective support system for beginning teachers.

L3. Research Project on Entrepreneurial Identity Construction

Maynara Furquim, Iulia Stroila, Pauline Weritz, and Rainer Harms

This research project investigates how entrepreneurial identities are constructed among women at the intersection of gender, education, and context. While entrepreneurship is globally recognised as a driver of innovation and socio-economic development, it remains a gendered domain, frequently embedded in masculine norms and practices. This structural imbalance contributes to persistent gender gaps in entrepreneurial participation, with over 25 million "missing" women entrepreneurs in the EU and OECD countries. As gender equality in entrepreneurship enhances innovation, diversity, and economic resilience, this research explores how Higher Education Institutions (HEIs) can foster inclusive entrepreneurship and entrepreneurship identity through context- and gender-sensitive entrepreneurship education.

However, existing entrepreneurship education often prioritises skills acquisition while neglecting the deeper, value-based processes through which students come to see themselves, and are seen, as entrepreneurs – i.e., entrepreneurial identity. This creates a gap between technical competence and the moral, social, and cultural legitimacy required for entrepreneurial participation, particularly for women whose identities are often misaligned with prevailing masculine entrepreneurial norms. Thus, cultural and institutional contexts, along with gender social norms, play a critical yet underexplored role in the process of entrepreneurial identity construction.

To address these gaps, the research project is structured around four interrelated studies, each exploring different dimensions of entrepreneurial identity construction.

- Study 1 uses quantitative data from the GUESSS survey to examine which contextual factors affect the entrepreneurial identity construction of female students.
- Study 2 qualitatively investigates how and why entrepreneurship education impacts these identity construction trajectories, focusing on female students' experiences at an entrepreneurial university.
- Study 3 qualitatively explores which teaching methodologies influence female entrepreneurial identity formation and how HEI facilitators handle gender and societal norms in HEI entrepreneurship courses.
- Study 4 tests, in a design-oriented format, how an entrepreneurship education framework can be designed to foster entrepreneurial identity construction among female students.

This research project contributes to multiple academic conversations. First, it advances theoretical understanding of entrepreneurial identity construction by integrating gender, education, and context factors. Second, it addresses the scarce literature on gender in entrepreneurship education, offering empirical evidence on how gendered norms and contextual dynamics shape both educational practices and student experiences. Third, it generates actionable knowledge for HEIs, providing a transferable, evidence-based

framework for fostering context- and gender-inclusive entrepreneurship education programmes.
By positioning entrepreneurial identity construction as a dynamic, socially embedded process influenced by gender and different contexts, this research project offers a nuanced and transformative perspective on how entrepreneurship education can become a more inclusive and empowering force, especially for women. The findings support global policy agendas such as the UN Sustainable Development Goals and the EU Gender Equality Strategy 2020–2025, contributing to a more equitable and diverse entrepreneurial landscape.

L4. Breaking down media use: exploring the media diets of secondary school students

Sara de Ruyter, Hanneke Scholten, Eddie Denessen, and Alexander van Deursen

In recent years, digital media have taken a prominent place in the lives of early adolescents (10 -14 years). The pervasive nature of these media raises growing concerns about their effects. Think about the many news items regarding the minimum age of social media accounts, the ban of smartphones in schools, and, more recently, the discussions around the Netflix series Adolescence. Research shows that, although some of these concerns are grounded, the effects of media use are highly dependent on the types of media consumed, the broader media diet of the user and the individual characteristics and background of user. The JEDi consortium investigates the effects of digital media use and inequality on cognitive, social and identity development within the context of the cross-contextual media landscape. As part of this project, this specific study aims to get an in depth understanding of which media are actually used by early adolescents and how this differs between groups with distinct backgrounds. To answer these questions, a quantitative survey study was conducted with first year students of Dutch secondary education, as part of a larger longitudinal study. Media use was measured by a newly designed instrument that gathers information on the devices and types of platforms that are used by adolescents as well as the digital and non-digital activities they engage in and the content they consume. First wave data collection took place between October 2024 and February 2025 and the data of 1345 students, and their parents was used for analysis. This poster presentation will zoom in on the first question this project: What media (devices, platforms, activities and content) do Dutch secondary school students use? We will present the descriptive results of media devices, platforms, activities and content used within our sample. These results will help us to gain more insight in the different types of media that adolescents use and will set the stage for more in depth research on media use patterns.

L5. Understanding Self-Reflection Through Personality: An Investigation of Traits and Individual Differences

Ben Adelberg

This study examines how differences in personality influence self-reflective thinking and whether this relationship is moderated by contextual or demographic factors. Building on established models of personality (Goldberg, 1992) and self-reflection (Grant et al.,

2002), the study assessed the predictive power of the Big Five traits on three subdimensions of self-reflection: Need for Self-Reflection (NSR), Engagement in Self-Reflection (ESR), and Insight (ISR). Data were collected from 158 international participants and analysed using hierarchical regression and moderation analysis. The results show that Openness to Experience is the most consistent and robust predictor across all three subdimensions of self-reflection, confirming its theoretical link with cognitive flexibility, tolerance of ambiguity, and a general orientation towards self-exploration. Neuroticism also emerged as a significant trait, positively predicting the need and engagement in reflection, but negatively predicting reflective insight – highlighting both the adaptive and maladaptive facets of reflective thinking. Other traits, such as Extraversion and Conscientiousness, showed more limited or dimension-specific effects. Of six potential moderators – age, educational background, emotional disclosure, sexual orientation, therapeutic experience, and major life events – only age and education significantly moderated the relationship between Openness and the need for reflection. No moderating effects were found for ESR or ISR, suggesting that these dimensions may be more trait-like and less dependent on external context. Taken together, these findings underscore the importance of personality in shaping self-reflective tendencies, with Openness and Neuroticism playing a particularly central role. Contextual factors appear to influence reflection more selectively, suggesting the relative stability of reflective engagement and insight across individual backgrounds. Implications for education, coaching, and personality research are discussed, such that fostering reflection may require more than teaching techniques – it may involve addressing individual personality-based barriers or supports.

L6. Accelerating Learning and Innovation in (Cyber)Security Innovation Teams

Amber van Kampen, Marcella Hoogeboom-Hendriksen, and Maaike Endedijk

Society has to deal with a lot of (cyber)security challenges lately. Since the end of 2023, the Terrorist Threat Assessment of the Netherlands has been raised to a threat level of 4 out of 5, meaning that there is a substantial possibility of an attack (National Coordinator for Counterterrorism and Security, 2024). Additionally, rapidly changing technologies require a different course of action. For example, firefighters see an increasing number of incidents with electric vehicles and the ignition of their batteries (Sun et al., 2020). This requires a different extinguishing strategy than traditional internal combustion engine cars. Moreover, cyberattacks have been increasing in recent decades because of digitalisation (Albahar, 2019).

Because the complexity of the (cyber)security challenges exceeds one person's expertise (Salas et al., 2000), countering these challenges often occurs in multidisciplinary teams, so-called innovation teams (ITs). These ITs consist of multiple individuals who possess unique knowledge, expertise, and skills that can lead to the discovery of new ideas, products, processes, and procedures by collaborating and building upon each other's knowledge (Fiore et al., 2010).

In practice, it is noticed that ITs are not optimally using their collaborative problem solving, and innovation potential. ITs have, for instance, difficulties going beyond knowledge sharing and bringing the implementation to practice (Knol & Velzing, 2019). Resulting in the effect that proactive behaviour (i.e., acting to avoid incidents) is often a bridge too far, and organisations stick to reactive behaviour (i.e., responding to incidents).

To be able to support ITs to become more effective, first, a better understanding of the processes that can facilitate effectiveness is necessary. Therefore, a multimodal approach combining both physiology (to get more detailed insights into interpersonal bodily responses) and video observations (to look at interaction and behavioural patterns between team members) is adopted.
Physiological data have been linked to changes when performing cognitive tasks, therefore, it is hypothesised that it can be used to detect moments of learning within teams. By connecting critical moments in learning to behaviours, important interactions and behavioural patterns during meetings can be identified. These can thereafter be used to support the ITs team such that they will be able to counter (cyber)security challenges effectively and proactively, maintaining a safe society.

L7. Identifying Skill Gaps and Learning Needs for the Heat Pump Installers: Preliminary Findings from the HeatCraftHP Project

Mert Tutenkan, Sebastian Dennerlein, Mohammadreza Farrokhnia, Maaike Endedijk, and Wilko Rohlfs

Objective: A rapid pace of energy transition, especially in the installation sector, requires moving to sustainable heating technologies, like heat pumps (HPs), and eventually meeting the demands in this sector for a skilled workforce. Nonetheless, traditional training programs are not keeping up due to a lack of flexibility, speed, and contextual relevance needed to match the pace of evolving changes for the workforce development of installers. In practice, this is already apparent, as many heat pumps are not working efficiently due to the lack of knowledge, skills, and expertise among installers. To address this challenge, upskilling and reskilling programs could fill the gap and offer new opportunities for workforce development. However, in the blue-collar context, these efforts face several obstacles, such as employees' unwillingness, limited resources, and lack of digital skills. One of the main reasons for these challenges is that such programs are typically structured around formal learning activities, which may not align with the needs and preferences of blue-collar workers, as many of them consider on-the-job training as more effective than getting a more formal education. This is where workplace learning –broadly defined as learning through participation in work and practice – could offer a promising and context-sensitive solution by focusing more on informal learning activities with appropriate guidance. Within this context, the HeatCraftHP project aims to co-design a tailored workplace learning curriculum that supports the up- and re-skilling of heat pump installers.
Methods: Conducting a field investigation that includes expert interviews, we analyzed the dataset using inductive qualitative content analysis to explore current learner needs, skill gaps, and recurring installation challenges before designing more effective learning pathways for up- and re-skilling of the installers.
Preliminary Results: Initial results from the interviews indicate several learning challenges: (1) heat pumps are insufficiently covered in traditional training curricula; (2) installers and planners struggle with design and hydraulic principles specific to HP systems, often leading to inefficiencies and malfunctioning; (3) the interdisciplinary cooperation with other trades like electricians, civil engineering, and refrigerant specialists increases complexity; and (4) a general lack of IT competencies and hands-on guidance hinders learning and adaptation. These findings represent an early stage of the study. Further data collection and analysis will continue and be incorporated ahead of the conference.

Conclusion: The results show that existing training programs for heat pump installers are not adequately equipping workers with the skillsets required to deal with the complexity of the installation process. This highlights the importance of understanding the different needs and profiles of heat pump installers, which is crucial for effectively tailoring up- and re-skilling learning pathways. These insights will directly inform the project's next steps, including the co-design and evaluation of a workplace learning curriculum by using an educational design research (EDR) approach.

TOPIC SESSIONS

IDEATE: EMERGING TECHNOLOGIES

E8. AI art: aesthetics (and ethics) in a digital age

Y.J. Erden

AI generated art offers scope to explore familiar questions in aesthetics in new ways. This includes on the function and value of art, and on creativity and authenticity, concepts which can be challenged or strengthened as a result. Meanwhile, the use of these technologies and how they are developed raise deep philosophical and ethical questions about the labour and recognition of creative people. In this paper I explore these issues by asking what might be some differences between human and AI generated art, and when and how such differences matter.

Generative artificial intelligence (GenAI) is sometimes described as providing "complex models that generate high-quality, human-like material", with the "production of previously unseen synthetic content, in any form and to support any task "" (García-Peñalvo & Vázquez-Ingelmo 2023). Applied to art, this can take the form of image generators that 'translate' text-to-image models or from image to image. Some of these models have scope to generalise beyond their original training. Yet in all this, the 'human-like' nature of the output is a quality that is very difficult to quantify, especially in relation to art.

Some consider these changes part of the evolution of art: "As creativity is reimagined, so too may be many sectors of society… We argue that generative AI is not the harbinger of art's demise, but rather is a new medium with its own distinct affordances" (Epstein et al. 2023). Meanwhile, others point to values that go beyond the production of outputs, arguing that art is tied with the lived experiences and cultures of humans (Jiang et al. 2023). Without agency, intentionality, and understanding, AI generated art cannot be considered to be 'inspired', they say, but as something that 'merely imitates' what humans do. To call AI an 'artist' "devalues artists' works, robs them of credit and compensation, and ascribes accountability to the image generators rather than holding the entities that create them accountable".

Such disputes about art are not new. In 1935, Walter Benjamin talked about emerging methods for the reproduction of art. "In principle a work of art has always been reproducible", he explained, while pointing to a long tradition of imitation, replicas, and forgery. Yet he considered mechanical reproduction a particular risk to what he considered the "uniqueness" of a work of art, that which is "inseparable from its being imbedded in the fabric of tradition […even if] This tradition itself is thoroughly alive and extremely changeable". He explained this uniqueness in terms of authenticity, or

“presence in time and space” with a unique existence and history, including condition (chemical, physical) and ownership (tradition, situation). The original is the authority, on this account, and it brings a uniqueness that he calls an aura, without which, authenticity withers. For this paper, I explore whether such arguments stand up against our newest methods for the (re)production of art, and what it could mean to deny AI art the label of art as a result of a failure to meet authenticity and uniqueness criteria.

E9. Welcome on Board! Envisioning an employment negotiation within a social robot from the users’ perspective

Giorgio Rettagliata, Tanya Bondaoruk, Guido Hertel, and Jan-Willem van t Klooster

This paper aims to investigate how social robots might be integrated into the employment negotiation stage by considering the perspectives of their future users: HR managers and job candidates.
The HRM field is already experiencing new work dynamics due to the introduction of AIs. However, the key distinction between social robots and other AI-embedded technologies is their capacity for natural interaction through physical presence, enabling richer communication in areas demanding strong social skills, like employment negotiations. Employment negotiations are more than just transactional exchanges; they involve nuanced communication, trust-building, and persuasion. Thus, introducing social robots into this process requires a thorough understanding of users’ needs, both from HR managers and job candidates. Indeed, by adopting a proactive work design perspective (Parker & Grote, 2022), we want to put ourselves into the perspective of the robot designer in order to be able to design a robot that does not only aim at process efficiency but also at improving the work of the actors involved and that their needs are taken into account.
For this reason, we borrow an approach from the requirements engineering field to follow a user-centred approach by adopting a requirement elicitation process based on interviews and workshops with HR managers and job candidates. The goal is to encourage them to share their vision of the possible uses, advantages, and drawbacks of implementing social robots in negotiations. The workshops will follow the Scenario-Based User Need Analysis (SUNA) (van Helvert & Fowler, 2005), a technique used in the initial stages of the design cycle, in order to discover users’ initial requirements of the technology. Scenarios are powerful tools to generate narratives that capture how users might interact with social robots in future employment negotiations. By building upon this method, we aim to gain insights into the real-world applicability of social robots and answer our research question: What are the key desires and requirements of HR professionals and job candidates regarding the integration of social robots in employment negotiations?
This research will contribute to the HRM field in several ways. First, it will explore current ways of conducting employment negotiations within various sectors. Second, it will identify key functionalities and requirements that social robots should possess for employment negotiations, these would contribute to future design of social robots. Second, it will demonstrate the value of using scenarios as a user-centred research innovative method in HRM. Lastly, it will offer a foundation for future experimental studies on integrating social robots into HR practices.

E10. Desire, Anxiety, and Toxic Positivity: The Lacanian Subject in Marketing Theory

Maaike van der Horst and Yasin Sahhar

Marketing theory predominantly conceptualizes the consumer as a rational, conscious subject whose needs and desires can be identified, articulated, and fulfilled. This view underpins the magical promise or marketing that firms can know consumers better than consumers know themselves, and that satisfaction and happiness are achievable through offerings and experiences. While interpretive approaches have in parallel emerged to provide richer accounts of lived experience, they still rest on the assumption of a coherent, self-knowing subject.

We problematize the conceptualization of the subject in marketing by arguing that it overlooks the unconscious dimensions of subjectivity, in particular the central roles of desire and anxiety, as theorized in Lacanian psychoanalytical theory. Lacan posits that subjectivity is defined not by completeness and coherence but by structural lack – an ontological and existential absence that fuels insatiable desire and inescapable anxiety. In today's techno-capitalist climate, increasingly shaped by toxic positivity (i.e., the imperative to enjoy, feel good, and self-optimize, preferably through new technology), marketing amplifies 'false' promises of complete fulfillment. It also denies the ontological and existential tensions that subjects unavoidably face.

In our paper, we ask ourselves: How can Lacanian psychoanalytical theory – and specifically the Lacanian notions of desire and anxiety – inform marketing theory's understanding of the subject?

Through a Lacanian perspective, we expose the limits of current understandings of subjectivity and disclose a new conceptualization of the subject in marketing theory. We challenge the dominant reductionist paradigm in marketing theory by disclosing the consumer as split, lacking, and driven by unconscious drives. We illustrate our theorizing through the case of the sex robot, an emblematic example of contemporary marketing's efforts to simulate complete satisfaction. We find that such technologies do not solve desire or alleviate anxiety but may intensify them and fundamentally alter human interaction.

Our contribution to marketing theory is threefold. First, we propose a Lacanian view on the subject, informed by desire and anxiety, in the context of toxic positivity. Second, we incite critical reflection on marketing's ethical complicity in reproducing unattainable fantasies, its epistemological (im)possibilities of knowing the subject, and the ideology of continuous innovation as inherently positive. Finally, we offer multiple tenets that can help marketing theorists in understanding and researching the subject as well as the practice and ethics of marketing differently.

E11. A BMS perspective to researching energy transitions

Thomas Hoppe, Ewert Aukes, Frans Coenen, Peter Stegmaier, and Le Anh Long

The behavioral, management and social sciences dimensions of the energy transition management, politics, and policy track includes posters, papers and a round table discussion showcasing BMS energy research related to research on the energy transition research, in the Twente region, the Netherlands and beyond.

The impacts of a changing geopolitical energy system are increasingly felt in societies across the globe. Challenges include the indirect effects of climate change due to excess greenhouse gas emissions from energy production, the direct effects of the

ageing energy infrastructure and the political and governance arrangements surrounding it, both domestically and internationally, the new geopolitical dynamics, arising from the emerging energy system (e.g., the increasing dependencies and tensions related to the issue of transition minerals). Developing solutions that can address these challenges is a priority in times of transition, and this endeavour requires an understanding of the underlying phenomena connected to socio-technical transition dynamics in society. Accordingly, questions arise how to achieve transitions faster, broader and deeper (Andersen et al., 2023) while ensuring a just energy transition (Heffron and Fontenelle, 2024). Possible solutions are sought in new governance arrangements, policy mixes, social innovation (with alignment to technical energy and digital innovations), innovative regulatory frameworks, more appropriate forms of social organization, explicit deliberation of socio-political visions, and fundamental re-consideration of our relationship with one another, technology, nature, and the environment. In addition, there is attention to cross-sectoral issues like nexus governance highlighting nexi between energy transition and other sociotechnical and socio-ecological transitions like circular economy or water. The range of disciplines at the University of Twente enables us to examine solutions and underlying phenomena related to energy transitions via an interdisciplinary lens with contributions from governance scholars, economists, sociologists, psychologists, communication scientists, computer scientists, engineers, health scientists, etc.
For the posters and papers, we welcome contributions presenting research results, proposals, ongoing work, as well as budding research ideas relating to the following topics and themes:
- Energy citizens, communities, hubs, and other configurations;
- Social acceptance, resistance, conflict and other social dynamics;
- Policy – Science – Innovation nexus in energy transitions;
- Governance and policy in energy transitions – governance arrangement and policy instruments & mixes;
- Energy Justice & Energy Democracy;
- Business models accommodating smart energy communities, smart grids and energy hubs, and flexibility (to resolve a.o. net congestion);
- Key enabling methodologies in energy transition research (e.g., participatory approaches, visioning, back casting, co-creation, living labs, ELSA labs, ABM, etc.)

E12. Against nature – How sustainable developments, technologies and policies are being marginalised or discontinued

Peter Stegmaier

Transitions to greater sustainability are complicated endeavours and processes. They are not linear and are constantly threatened by inadequate implementation, resistance, and failure. Those transitions that are intended to protect nature and the climate, are increasingly being discussed as an imposition and actively opposed in the political arena, which blocks the transitions, slows them down, waters them down, and/or subverts them (or their governance, institutions, knowledge infrastructure, and political commitment).
In this paper, we will look at cases of blocked and/or undermined renewable energy and other sustainability measures. Sometimes these processes of direct or indirect discontinuation of sustainability transitions are masked by efforts to initiate, drive forward, or save the desired change. Nevertheless, it should not be overlooked where

they are de facto being deprived of their foundations. This does not mean that these transitions have been stopped forever, but for a time. They can also lead to a situation in which the use of sustainable technology as such is not stopped, but the further expansion or creation of the apparatus and infrastructure, the means of governance and institutional arrangements, the knowledge and political commitment.
We attempt an initial reconstruction of the destabilisation, suspension, dissolution and discontinuation of the wind energy and photovoltaic industries in Germany over specific periods of time and compare this with similar processes in the Netherlands and the USA.

E13. Multimodal mobile brain and body imaging for quantification of dance motor sequence learning

Russell W. Chan, Victoria Lakomski, Johannes Pannermayr, Emma Wiechmann, Jan-Willem van 't Klooster, and Willem Verwey

Understanding motor learning in naturalistic settings presents a key challenge in neuroscience. While paradigms like the Discrete Sequence Production (DSP) task have advanced our knowledge, investigating more naturalistic tasks like dance with multi-limbed coordination can help further advance the understanding of complex mechanisms. It can advance motor learning by providing more profound insights into coordination dynamics, movement execution, balance, and decision-making. We have developed a modified DSP methodology that replaces keyboard pressing with dance-stepping, allowing simultaneous electroencephalography (EEG), behavioral, and kinematic recordings to quantify neurophysiological and motor dynamics. Using an E-Prime® script in a go/no-go approach, our method accommodates both a setup with minimal hardware and also a scalable approach with markerless motion capture and mobile EEG for neuroimaging. By leveraging Mobile Brain and Body Imaging (MOBI), we enhance the investigation of neuro-mechanisms underlying motor learning. We also discuss future directions and accessibility, including a publicly available video of the experimental procedure (https://youtu.be/zFP1rWJ2FJ8?si=DJ8q7fbfhltSLehz), enabling broader replication and application of our methodology.

INSPIRE: LEARNING

L8. Academic Procrastination and the Use of Electronic Devices

Eo Jin Lee, Alieke van Dijk, and Pascal Wilhelm

Academic procrastination is a known and recurring problem among university students, having an impact on students' academic performance as well as their psychological well-being. A possible factor contributing to procrastination is the widespread use of electronic devices. While electronic devices have become essential for students in Higher Education, increased reliance raises concerns about their role in procrastination. Therefore, this study explored how digital devices influence students' procrastination and what coping strategies they use to deal with the consequences of device-induced procrastination. To achieve this aim, six focus group interviews (five to six students per group, n = 31) were conducted. A hybrid coding approach was used, combining

deductive coding based on a functional model of academic procrastination by Svartdal and Løkke's (2022) and inductive coding based on discovered patterns in the data. The findings confirm that electronic devices are considered major distractions by students, leading to academic procrastination. Smartphones, specifically, were identified as the main source of distraction. The use of devices especially delay students' start of study sessions, challenge them to resume focus, and are used as an escape from challenging and tedious tasks. Short breaks involving electronic devices frequently turn into extended distractions, ultimately undermining time management and study readiness to engage in academic work. Students expressed to use different strategies to manage distractions from their electronic devices and enhance productivity, like using device settings to manage interruptions and physically separating themselves from their devices. However, students often indicated to encounter challenges in maintaining these boundaries, challenging digital self-regulation and leading to normalization of distractions. This often led to further distraction and reduced focus – occasionally even enhancing procrastination. The findings of this study highlight the complexity of managing procrastination due to the use of electronic devices. The complex interplay between technological limitations, psychological elements such as fear of missing out and low self-control as well as social factors emphasizes the need for adaptive digital solutions in the context of education, and the need to stimulate self-regulation among students.

L9. A taxonomy of organizational learning in venture studios

Matthias Neumann, Vincent Göttl, and Rainer Harms

Venture Studios are venture organizations that create multiple startups simultaneously and sequentially from ideation and resource deployment to scaling (Rathgeber et al., 2017). Unlike incubators or accelerators, which support external ventures (Bergmann & McMullen, 2022), venture studios initiate and co-own the ventures they build (Gutmann, 2019).

As the number and diversity of venture studios worldwide grow—currently estimated at around 1,000 (ENHANCE Ventures, 2025)—a classification tool is needed to distinguish between their different approaches. This study proposes a taxonomy of organizational learning in venture studios, as the ways in which knowledge is captured, codified, and transferred across ventures is critical for venture studios.

Drawing on the taxonomy development methodology by Nickerson et al. (2013), the study integrates a literature review of organizational learning discourse with empirical insights derived from 29 semi-structured interviews with senior leaders of global venture studios. The research investigates organizational learning in venture studios and uses the Gioia methodology in data analysis (Magnani & Gioia, 2023).

The resulting taxonomy consists of nine mutually exclusive and collectively exhaustive dimensions, each with three subdimensions. These include, for example, the studio's role in its learning relationship with entrepreneurs (teacher, learner, balanced), the breadth of external learning networks (narrow, medium, wide), the dominant type of knowledge (tacit, explicit, or mixed), and the level of organizational reflection (single-loop, double-loop, triple-loop).

The study identifies three overarching types of venture studios: structured knowledge studios (process-driven), flexible learning studios (adaptive), and semi-structured learning studios (a balanced hybrid). These types reflect differences in how studios codify and apply knowledge in venture building. While many ventures studios utilize

formalized “playbooks” to codify knowledge, these are often complemented by tacit knowledge and experiential exchange. The research shows that learning relationships are in many cases dynamic and bidirectional, with studios often learning from and teaching their portfolio companies and entrepreneurs-in-residence.
This taxonomy advances organizational learning theory by introducing venture studio-specific constructs and provides researchers with a grounded framework for analyzing how different learning configurations may influence venture performance. Policymakers can use these insights to design tailored entrepreneurial ecosystems. By promoting higher-order (triple-loop) learning, the taxonomy fosters deeper organizational introspection and strategic adaptability within venture studios and related venture organizations.

L10. Behavior, physiology, and movement; A multimodal approach to collaborative learning

Marcella Hoogeboom, Amber Van Kampen, Vana Hutter, and Lotte de Weert

This paper describes and demonstrates how multimodal methods can capture collaborative learning processes within ecologically valid, simulated learning environments. We elaborate on the different modalities that produce process measures —video observation, speech, physiological measures, and movement data— and how these can be synchronised and integrated. Moreover, we explain what type of insights are revealed when combining the different modalities and the advancements of these combinations for understanding rich and complex collaborative learning processes. We illustrate this with the results where a multimodal assessment of team collaboration and learning in a simulated learning environment is conducted. The resulting output of this paper entails a discussion of the opportunities and drawbacks for each step of adopting a multimodal approach in an ecologically valid, simulated learning context. This can be seen as a roadmap related to the different choices and caveats of each step in the research process, including the scope of the study, selection of modalities, collection and storage of the data, analysis of the data, and interpretation and presentation of the results.
Taking a multimodal approach
Training teams that operate in high-stakes settings—aviation, healthcare, education, crisis response—demands methods that capture the inherently cyclical interplay of behavioral, cognitive, and emotional processes(Malmberg et al.,2019). While scholars have long called for richer measurement(Noroozi et al.,2020), most studies still analyze single modalities or dyads, limiting understanding of nuanced aspects of collaboration and coordination(Lehmann-Willenbrock & Hung,2023). We argue for a multimodal method that synchronously records speech, visual, embodied, and spatial cues(Jewitt,2013) to illuminate how teams collaborate and adapt under stress.
Recent work emphasizes that integrating video, physiological, and movement streams can reveal the fine-grained interplay of affect, cognition, and action in team interactions(Fusaroli et al., 2016; Malmberg et al.,2017; Misal et al.,2020). Video captures interactional patterns(Lehmann-Willenbrock & Chiu,2018), physiological data unveils arousal and mental workload(Christopoulos et al.,2019), and spatial traces map coordination in situ(Müller et al.,2019). Such triangulation makes otherwise hidden dynamics—e.g., stress responses and adaptation in emergency teams—empirically tractable(Van Eijndhoven et al.,2023).
Advances in wearable sensors, automated coding, and cross-disciplinary analytics now

make large-scale multimodal data collection feasible(Fischer et al.,2020;Hemshorn de Sanchez et al.,2022). These tools allow researchers to move beyond self-reports and address new, important questions, such as how teams maintain effective collaboration under escalating pressure and design evidence-based training that targets the processes most contributive to performance(Dias et al.,2019;Hoogeboom et al.,2021).
Illustrative example with a case study
Recent sensor and signal technologies developments create new opportunities for capturing the moment-to-moment dynamics of collaborative learning. This paper delineates a multimodal framework—integrating physiological data (heart-rate variability), synchronized video, and movement trajectories—to examine collaborative learning in an ecologically valid police-training simulation. In a Spring 2024 pilot, eleven police teams completed three progressively stressful scenarios, engaging in structured reflection between rounds. Multimodal data, coded with specialized software to capture actual behaviors and interaction patterns, revealed associations between heart rate variability and collaborative behaviors. The findings demonstrate that fine-grained process-measures in realistic settings can generate novel insights into collaboration and learning.

L11. Designing Curricula for an Uncertain World: A Critical Action Learning Approach

Chandan Dasgupta, Preeti Raman, Renato Carvalho, Hannie Gijlers, and James Slotta

In this paper, we focus on engaging student educational designers in critical action learning and design. While ongoing efforts have investigated how to build capacity amongst schoolteachers, we argue for building capacity amongst student educational designers who will be engaged in designing resources for schoolteachers and students. This research builds on theories of critical pedagogy and critical action learning. We follow a design-based research approach to iteratively design a critical action learning toolbox that can be used to foster a generation of designers capable of producing educational technologies that prioritize equity and social responsibility. Findings suggest that adopting a layered approach – CALE researcher/educator (Layer 0), student educational designer (Layer 1), and schoolteacher (Layer 2) – provide the required reflective space to design curricula using critical action learning approach. Scaffolds such as designing a collective problem case and emergent mirrors are important constituents in this reflective space.

LEARN-X: RESILIENCE

R1. Navigating the evolving consumer landscape: The role of (online) deception and sustainability in consumer decisions

Michelle Walther, Marielle Stel, and Funda Yildrim

Consumer behaviour has evolved significantly over the past years, with consumers increasingly prioritizing both convenience and sustainability in their purchasing decisions. The rise of online shopping reshaped how people make purchase decisions, while environmental concerns have led to a growing demand for more sustainable and

eco-friendly options. In this symposium, insights from marketing and psychological research will be combined to increase understanding of the processes involved in consumer's decision-making.
In the first talk, Michelle Walther will give an overview over how online purchase decisions are made by consumers. During her presentation she will zoom in on how consumer reviews are processed, and which cues are used to identify fake reviews. Lastly, she will discuss how information can be used to improve the detection abilities of consumers.
The role of false information is further addressed by Marielle Sel, who will talk about the growing issue of misleading information in the marketplace. While consumer concerns for health, animal welfare, and the environment grow, some companies exploit these by engaging in "washing" (i.e., disinformation spread by an organization to falsely appear responsible for issues like health, animal welfare, and the environment). Marielle's research reveals that most consumers are unaware of such practices, making it difficult for them to make informed decisions that align with their values.
Finally, Funda Yildrim's talk expands on the theme of consumer's decision-making. Cumulative insights from marketing research and psychological bias studies offer a valuable foundation for guiding more sustainable food consumption. Funda presents how investigations into consumer awareness of sustainability, personality traits, and motivational factors—examined across varied consumption environments such as menu selection, social dining, and supermarket contexts—inform the development of technological choice architecture. These applications are designed to nudge individuals toward sustainable food choices while maintaining consumer satisfaction, translating behavioural insights into practical interventions.

INFORM: SMART INDUSTRY & ORGANIZATIONS

I1. Dynamic resource flow optimization in waste management center for H4C

Jiayun Wang, Alessio Trivella, Daniela Guericke, and Devrim Yazan

Industrial Symbiosis Networks (ISNs) are becoming increasingly important as a strategy for sustainable resource management. They are clusters of industries interacting in a way that one's waste, e.g., materials and energy, can be used as input of another, potentially after treatment. The hub for circularity (H4C) extends the traditional boundaries of ISNs by facilitating resource exchanges not only within industrial clusters but also with surrounding urban and rural areas. Within this context, Waste Management Center (WMC) plays a central role in coordinating production, storage, and logistics for treatment plants. In this study, we aim to develop decision-making tools for WMC to support its daily operations, taking into account uncertainties in waste availability and resource demand. We formulate a Markov decision process (MDP) where a set of interconnected treatment plants dynamically decide on production planning, inventory levels, and resource exchanges. As this MDP is intractable to solve to optimality due to state and action spaces that grow exponentially with the network size, we leverage state-of-the-art approximate dynamic programming (ADP) methods to compute near-optimal policies and dual bounds. Our results highlight the value of collaboration and provide insights into production and inventory strategies in relation to the evolution of uncertainties.

I2. Structural Homologies in Entrepreneurial Ecosystems and Gender Inclusivity

Elina Isakova, Lulia Stroila, Pauline Weritz, and Rainer Harms

This paper investigates whether entrepreneurial ecosystems (EE) can serve as platforms for societal change towards gender equality, assessing their potential role in women's emancipation. It questions whether entrepreneurial ecosystems reproduce societal norms or challenge them (Ahl, 2007; Welter et al., 2014). We ask, how do structural homologies in the EE fields mirror societal structures? Structural homologies reveal shared patterns across diverse fields, illustrating recurring hierarchies and relational dynamics (Anderson et al., 2012). Homology, defined as the similarity of structures across different fields, plays an important role in either sustaining or challenging societal norms (Bourdieu 1991). Agents in dominant positions often consolidate their power by allying with equally dominant entities in the field, while those in marginalised roles may collaborate to challenge the established order (Hilgers & Mangez, 2014).

Guided by an interpretivist paradigm, we conducted three iterative rounds of semi-structured interviews in Tel Aviv, Israel, an established, resource-rich entrepreneurial ecosystem. Interviews were analysed abductively, combining inductive coding with concepts from Bourdieu's (1986) field theory. Cross-case pattern matching then revealed how women accumulate, convert, and sometimes contest different forms of capital to navigate and recalibrate opportunity structures. Our preliminary analysis reveals a pronounced structural homology between Tel Aviv's venture-capital field and the wider entrepreneurial domain, both of which echo and thereby reproduce Israel's broader gender hierarchies. This structural homology is not just about who holds which resources; it also reflects identical patterns (Bourdieu, 1986) of interpersonal norms, gate-keeping practices, and everyday interactions that reproduce gendered power dynamics. The result is a virtually isomorphic reproduction of societal gender norms: women are judged by the same benchmarks, yet start with a structural deficit in the very forms of capital those benchmarks privilege. Women from both fields form women-only angel groups and peer-mentoring circles that mobilise relational and cultural capital to level the playing field. Taken together, these findings demonstrate how structural homologies between adjacent fields reproduce gendered power dynamics, while also highlighting the subtle agency women exercise to recalibrate capital exchange rates.

Our study makes three key contributions to the existing literature. Firstly, we contribute to research on gender and entrepreneurship (Brush et al., 2019; Marlow & McAdam, 2015) by providing a nuanced examination of gendered experiences, showcasing how entrenched power structures impact women's agency and opportunities. By focusing on the interplay between structure and agency, the study offers insights into how women entrepreneurs can navigate and potentially transform the ecosystems they inhabit. Moreover, it highlights the importance of structural homologies as a tool for mapping shared dynamics across different fields, providing a framework for future research and policy development aimed at fostering gender equality in entrepreneurship. Secondly, we advance the understanding of entrepreneurial ecosystems as socially constructed fields of power (Bourdieu, 1986). Our study highlights that entrepreneurial ecosystems function not only as engines of innovation but also as arenas for potential societal transformation. We emphasise the critical role of fields within entrepreneurial ecosystems, where the collective and distributed agency can promote equity and inclusivity. Finally, we contribute to the importance of contextual setting in

entrepreneurship (Welter, 2011) by showcasing the role of the context and the structures on women in the entrepreneurial ecosystem.

I3. Organisational agility from a microfoundational perspective: A qualitative study

Risgiyanti, Pauline Weritz, Desirée van Dun, and Michel Ehrenhard

Organisational agility is of increasing importance and a key dynamic capability for organisations' competitive advantage. However, few studies considered the development of organisational agility at the team and individual levels, and the interactions between those levels. This study therefore aims to qualitatively explore how organisational agility develops through individual and team agility and investigate how these levels interact in the Indonesian Railway Company. This study applies a single (embedded) case design to qualitatively explore the microfoundations of how organisational agility develops through team and individual agility, and how these levels interact at the Indonesian Railway Company. Data were collected through interviews with five key informants, 25 team members, and 17 supervisors, as well as field observations and archival documents. Thematic analysis and the Gioia methodology were employed using ATLAS.ti software. Using an abductive approach, the findings suggest that personal resources (such as intrinsic motivation and agility supportive mindset), coworker behaviour (such as coworker agility and coworker support), and team leader behaviours (such as team transformational and instrumental leadership), positively impact individual agility and, ultimately, its individual-level outcomes. At the team level, team design factors (such as competent and agile team member composition, team learning orientation, and team cohesion) and team leader behaviours (such as team transformational and instrumental leadership) positively impact team agility and, ultimately, its team-level outcomes. Furthermore, the study proposes that individual agility can positively influence team agility, and vice versa, both of them contribute to organisational agility and, ultimately, its organisational-level outcome. This research extends the micro foundations of dynamic capabilities theory by highlighting the individual and team-level mechanism that underpin the development of organisational agility

I4. The key to successful change

Mireille Post

Many researchers deal either explicitly or implicitly with whether or not (groups of) individuals make changes. This can vary from managers and/or employees changing their ways of working, patients adhering to a certain treatment, civilians changing their behavior and to changing pedagogies and/or pupils' engagement in schools. There are many tools, materials, and insights available to implement change, and they can lead to sufficient results. However, in many situations, it appears to be quite challenging to have (groups of) individuals make changes. How is that possible? And what is truly the key to successful change? You might think of formulating a clear vision, gathering input from all levels of the organization, and/or presenting convincing arguments. These kinds of initiatives are important, but certainly not sufficient.

So what does work? Scientific research shows that the way we give meaning to our experiences plays a key role. For example, it turns out that with every change, we evaluate whether it threatens our sense of connection with others and/or our autonomy. These two core values are something we want to protect at all costs. How that works exactly and what that means for generating impact with our work will be discussed.

I5. Team effectiveness research: evolution, trends, and future directions. A three-decade systematic review

Yeray Barrios-Fleitas, Marcella Hoogeboom, Tessa Eysink, and Arend Rensink

The widespread use of teams across society has driven interest in understanding team effectiveness. Prior reviews often focus on specific disciplines or contexts (e.g., sports or medicine). Using systematic bibliometric protocols enriched with machine learning, this study synthesizes 6051 peer-reviewed publications from Scopus and WoS, covering 1992–2022, to examine the evolution of team effectiveness research, key contributors, influential publications, and emerging trends. Results reveal exponential growth, and co-authorship, co-citation, and co-word analyses identified influential venues, authors, publications, and 10 thematic pillars: team processes, team composition & diversity, emergent states, team cognition, leadership, technology, virtual & hybrid teams, team outcomes & effectiveness indicators, organizational context & team support, team development & training, and multi-team systems & inter-team dynamics. Emerging trends include AI integration, adaptive leadership in diverse environments, and conflict resolution in virtual or hybrid teams. The study offers a roadmap for future research and an open-access resource for scholars.

CONCEPTUALIZE: HEALTH

H1. Sustainability and Public Health Systems: Connecting Innovations and Sustainability in the Global North and South

Hendrik (Erik) Koffijberg,Thomas Hoppe, Monika Kuffer, Xavier Pouwels, and Shiva Faeghinezhad

Globally, climate change imposes societies to cope with its consequences and to design strategies to reduce their impact on the planet. This symposium explores the role of science, including data, knowledge, and analytical methods in supporting sustainability questions and challenges in public health systems in both the Global North and Global South. It brings together perspectives on health technology assessment, governance, and technological innovation.
While links may exist between how sustainability efforts affect health and well-being of individuals and how healthcare innovations may affect the sustainability of healthcare, these questions are rarely assessed simultaneously. This is because each research field (health technology assessment and governance) appears to comprise extensive field-specific assessment frameworks. This symposium will explore how methods and knowledge on environmental sustainability can be transferred and used to inform

healthcare design, delivery, and policy.
HTSR researchers will present how science plays a growing role in evaluating the environmental and organizational impact of healthcare innovations in the Global North, particularly in Europe, but methods to assess sustainability, e.g., environmental effects, remain under-explored (15min).
CSTM researchers will present on sustainability challenges in health care provision in the Global South, reflecting on how sustainability questions and challenges have been addressed and how a Global South-North learning can be achieved (15min).
During the presentations, CSTM and HTSR researchers will share ideas and concrete examples on how and when the governance, sustainability, and health technology assessment research fields can be connected to improve insights in policy decisions. Each presentation will focus on the data and methods used to assess improvements in health-related outcomes and/or sustainability indicators, and end with at least one idea for adapting methods applied in one research field to the other research field.
Bridging these diverse perspectives enables learning pathways and comparative insights across systems. Our discussions will focus on highlighting how science helps navigate challenges at the intersection of healthcare, environmental risk, and organizational design. We aim to develop a dialogue on what “sustainable healthcare” means across contexts, and how research can use data and innovations in complex and diverse public health systems. The symposium will end with a discussion with the audience on how to better connect sustainability and healthcare through collaborations and initiatives to support methods development and applications (15min).

CONNECT: SECTOR PLAN

EP2. Fostering University Students' AI Literacy: The Interplay Between Individual Factors and Levels of Engagement with Generative AI

Mohammadreza Farrokhnia and four bachelor students at the University of Twente

As Generative AI (GenAI) tools become increasingly embedded in higher education, the development of AI literacy—students’ ability to critically evaluate, interact with, and apply AI-generated content—has emerged as a crucial competency. This study explores how engagement with GenAI contributes to AI literacy and how such engagement is shaped by both individual learner characteristics and the nature of AI use. Specifically, the proposed model investigates the influence of self-regulation skills, critical thinking skills, and digital competence on students’ engagement with GenAI, while also examining the purpose of AI use—defined as engagement with either simple or complex tasks—as a moderating variable.
To test this model, Structural Equation Modeling will be conducted using survey data collected from undergraduate and graduate students, a population well-positioned to provide diverse insights due to their frequent academic and personal use of GenAI tools. Validated instruments will be employed to measure the key constructs, including self-regulation, critical thinking, digital competence, AI engagement behaviors (classified into deep vs. surface engagement), and levels of AI literacy. The moderating role of task complexity will be assessed based on the self-reported purposes for which students utilize GenAI tools.
It is hypothesized that higher levels of self-regulation, critical thinking, and digital competence will predict deeper engagement with GenAI—characterized by critical evaluation, purposeful interaction, and reflective use—which in turn is expected to

enhance AI literacy. In contrast, surface engagement, marked by passive or unquestioning reliance on GenAI outputs, is anticipated to correlate with lower levels of AI literacy. Furthermore, the complexity of AI tasks is expected to moderate these relationships, with complex tasks fostering deeper engagement and stronger literacy outcomes.
This study aims to provide a clearer understanding of how students cultivate AI literacy through their interaction with GenAI, offering valuable implications for designing learning environments that promote thoughtful and informed use of AI tools. Data collection is currently in progress, and full analysis will be conducted upon its completion.

EP3. Humanoid robots as effective social agents: the role of eye gaze and human-likeness in human-robot interaction through the lens of social cognition
Cesco Willemse

One of the most prominent developments in emerging technologies is the integration of humanoid robots as social agents in various domains, including education, healthcare, and customer service. A key factor in their perceived effectiveness lies in how humans interpret and respond to their social cues. Individuals who interact with these robots readily perceive them as human-like, as supported by evidence ranging from self-report measures to neuroscientific data. However, the term “human-likeness” remains somewhat ambiguous. In this talk, I argue that human-likeness extends beyond mere anthropomorphisation, and includes other cognitive inferences, such as the attribution of mental states and intentions.
|The presentation will focus in particular on the underpinning role of eye movements; considering certain characteristics of robotic eyes on the one hand, and eyetracking data collected from participants during interactions on the other. In order to understand human-robot interaction, it is useful to examine the commonalities and differences with respect to gaze behaviour in inter-human communication, such as eye contact, gaze aversion, and referential gaze shifts as directional cues to establish joint attention. Interestingly, our data suggest that robots oftentimes elicit gaze patterns similar to those evoked by human agents. These patterns are not only affected by human-likeness, but in turn also affect the attribution of mental states, anthropomorphism, likeability, trust, etcetera. Whereas carefully designed eye characteristics may indeed facilitate interaction, such effects appear to be context-sensitive and may even be disrupted by features that evoke an uncanny response. Consequently, it may be contended that robots do not always need to be “like humans”, much like a hammer does not need a face to be an effective tool. Rather, social robotics should prioritise on optimising specific social signals to increase the effectiveness of humanoid robots.

LP1. Future proofing school teachers: What are the trends for the future of education?
Natasha Dmoshinskaia, Chandan Dasgupta, and Sara van der Linden

Making sure that today’s children are prepared for tomorrow’s world is a challenging yet critical role of education. Changes are a constant part of developing education curricula and training teachers, however, in the recent years the development in technology,

geopolitics, economics and other aspects of society life have been so big and fast that the education should adjust and adjust fast. Therefore, it is important to “future-proof educators” meaning to identify trends that are likely to influence future education and based on that trends that can shape professional learning architecture for teachers. Thus, the aim of the study was to answer two research questions: What are the main challenges and opportunities for educators’ professional learning for holistic student development? and What are the specific capabilities educators need to develop instruction for future-focused holistic student development?

The first step was to analyse the changes and prognoses on how they can influence the education. For that the first sub-study looked at a subset of 50 reports selected from more than a thousand policy documents from world and regional organisations (e.g., OECD, UN, EC) to identify the most prevailing trends that will shape the future of education. As a results a framework consisting of eight trends and 20 sub-trends was created. The identified trends were grouped at three levels showing a progress from the reason to modify the education (level ‘why’) through the ways of organising the education (level ‘how’) to the content of education (level ‘what’). This approach shows how different trends interact and influence each other. The identified ‘why’ trends are Education for well-being and Education to navigate uncertainty; the ‘how’ trends are Equitable and inclusive education, Interdisciplinary education, Personalised & flexible education, and Responsible digital education; and the ‘what’ trends are Active and global citizenship education and Education for green and sustainable futures. This framework as discussed at an expert panel which revealed that the prioritisation of the trends and educators support can vary per educational level (i.e., primary, lower secondary, and upper secondary).

Next, a survey to check teachers self-efficacy in identified sub-trends was constructed and distributed among the teachers of more than 500 programmes (.e., primary, lower secondary, and upper secondary) all over the world. The results of the survey (in progress) will not only show areas in which educators world-side need support but also if this need is influenced by factors, such as the educational level, region, or teacher characteristics. Additionally, the results will inform the literature review on how professional development programmes can support teacher self-efficacy development in the identified areas.

The results of this work will be presented and the importance of the findings for creating a teacher capabilities framework as well as directions for the further research will be discussed.

HP1. Active Inference Meets Design: A Free Energy Principle Approach

Luca Possati

This paper examines human–technology relationships through the frameworks of active inference and the Free Energy Principle (FEP). Active inference, rooted in Bayesian brain theory, proposes that organisms generate predictions about sensory inputs and update beliefs to minimize prediction errors and uncertainty. The FEP, formulated by Karl Friston, generalizes this concept by asserting that biological systems strive to minimize free energy—the divergence between expected and actual sensory data—to maintain homeostasis and adaptive behavior (Friston 2005, 2013; Parr et al. 2022).

We propose to use active inference to conceptualise human-technology interactions. Artifacts themselves encode and mediate generative models shaped by designers and users. Each artifact embodies assumptions about its intended use, environmental

context, and user behavior, forming a dynamic network of predictions. Human–technology interactions thus emerge from the continuous coordination and adaptation of these models over time.
How can these principles inform UX design? By framing the designer–artifact–user relationship as an evolving triad of generative models, designers gain tools to boost engagement, optimize functionality, and accommodate system dynamics.
To operationalize this framework, we present the Designer-Artifact-User (DAU) tool, a software platform that simulates and analyzes artifact-based interactions via active inference formalism. Leveraging computational modeling, the DAU tool visualizes how predictions evolve across the triad and supports iterative refinement. We applied DAU to investigate the causes of addictive behaviors in smartphone use, uncovering how design features amplify prediction errors and drive compulsive engagement.

IMAGINE: RESILIENCE

R2. Understanding and Addressing Eco-Anxiety
Michel Bourban

This paper investigates a new but rapidly spreading form of anxiety: ecological anxiety. Global environmental changes such as climate change and biodiversity loss affect people psychologically on an ever wider scale. Given the gravity of contemporary ecological problems, it has become difficult not to feel anxious about the future of the planet, especially the future of the species and the sentient individuals the Earth hosts. But what is eco-anxiety, precisely? Who is the most vulnerable to it? And how can we respond to it, both individually and collectively?
This paper starts answering these three questions by:
1. Highlighting that eco-anxiety relies on three main features: future orientation and uncertainty, fear and insecurity, and paralysis and inaction.
2. Stressing that three categories of people seem more vulnerable to eco-anxiety: people directly exposed to ecological disasters, environmental scientists, and children and young people.
3. Adopting the normative framework of ecological citizenship to propose a possible way to cope with eco-anxiety and its potentially pathological consequences.
The objective is not only to better understand eco-anxiety, but also to find possible ways to live with it. This is why it links ecological anxiety with ecological citizenship. On the one hand, by having a high level of ecological awareness, ecological citizens are particularly vulnerable to eco-anxiety: their knowledge and beliefs about the state of the world and their feeling that many other people do not share their concern and do not respond to the urgency of the situation fuel their sense of distress. On the other hand, by helping to build a moral and political community of environmentally aware people, ecological citizenship can help eco-anxious people to deal with their feeling of alienation. Ecological citizenship can serve to build communities around pro-environmental actions and policies, pushing eco-anxious people to turn outwards and to find like-minded people.

R3. A book for societal impact: The Green Handprint at Work
Barbara Kump and Babette Brinkmann

As academics, we often strive for scientific impact—publishing in high-ranking journals, advancing theory, and contributing to disciplinary debates. Yet, especially in fields such as BMS, practical relevance is just as critical. In this session, we present a forthcoming book, The Green Handprint at Work: How to be an Employee Activist for Sustainability (to be published late 2025), which seeks to translate academic insights into real-world impact.

The book draws on research in sustainability transitions, organizational studies and social psychology, to explore how employees can become active drivers of environmental change within their workplaces. Rather than focusing solely on individuals' environmental footprints—the damage we seek to reduce—it introduces the concept of the green handprint: the positive environmental impact people can create through their professional roles.

Structured around three core messages, the book argues that (1) individual agency within organisations is a powerful lever for change, (2) meaningful impact is possible from any position—not just leadership roles, and (3) action, even if imperfect, is critical to build momentum. It also offers a practical guidance for employee activism, including strategies such as coalition-building, navigating organisational power dynamics, framing environmental issues as strategic opportunities, and remaining persistent and resilient over time.

By sharing the development and core insights of this work, the session invites discussion on how academic research can inform solutions real-world problems—while also reflecting on the challenges of creating knowledge that goes beyond university walls.

R4. Climate Conscience at Work: A Process Model of Value-Driven Employee Turnover in the Context of Corporate Sustainability

Celina Borko and Barbara Kump

As climate change awareness is increasing globally, ecological sustainability is also gaining more relevance in the labor market. This has given rise to a phenomenon called "Climate Quitting", which describes voluntary employee turnover out of reasons related to ecological sustainability. While this is already being frequently discussed in the media, no academic literature exists on the matter yet. Given that knowledge gap, this study aims to answer the research question "How does the process of climate quitting unfold?" To that end, a qualitative inductive research design was adopted. Data was collected by interviewing 17 people who have quit a job out of ecological sustainability-related reasons. These interviews were analyzed based on the Gioia Method, and synthesized into a process model, named the "4-E Model" which divides the process into the four phases: 1. Expectations: Entering the job with varying levels of sustainability expectations; 2. Evaluation: Assessing value alignment and experiencing cognitive dissonance; 3. Exploration: Attempting dissonance reduction and deliberating turnover, and 4. Exit: Preparing for and executing the turnover decision. These findings provide important insights for both theory and practice, i.a. by proposing a turnover model that includes values related to broad societal issues, which were not accounted for in previous turnover literature, and by being the first to connect turnover theory with Cognitive Dissonance Theory, which appeared as a central concept in climate quitting. For practice, the findings emphasize the need for adjusted employee retention strategies, such as improved means for employee sustainability engagement, and highlight the general necessity of serious corporate sustainability efforts.

R5. The Role of Environmental, Social and Governance (ESG) in Credit Rating Revisions During the COVID-19 Pandemic
Cíntia Meireles Urbina, Xiaohong Huang, Tatiana Albanez, Lucas Barros, and Laura Spierdijk

This research explores the potential impact of Environmental, Social, and Governance (ESG) practices on mitigating firms' negative credit rating revisions (downgrades) during the COVID-19 pandemic—periods when stakeholders tend to exhibit diminished trust in corporations. It contributes to ongoing discussions regarding the effectiveness and underlying motivations of ESG in corporate decision-making. The COVID-19 pandemic, as an exogenous event, offers an opportunity to investigate whether credit rating agencies perceive ESG practices as a signal of risk mitigation. Limited research has examined how ESG dynamics affect the relationship between the pandemic and credit rating revisions across a broad international context. Specifically, this study analyzes changes in ESG scores over time, referred to as ESG changes (∆ESG). To empirically test the hypothesis that the negative impact of the COVID-19 pandemic on credit rating revisions is less pronounced for companies experiencing positive ESG changes (∆ESG), we use a global sample of non-financial listed companies from 47 countries—including advanced and emerging markets—collected from Refinitiv-Eikon covering the years 2015 to 2022. We employ a Least Squares Dummy Variable (LSDV) regression to analyze credit rating revisions as a continuous variable and a probit model to assess the likelihood of negative credit rating revision (a binary outcome) during the pandemic. The key explanatory variable is the interaction between the COVID-19 pandemic and ESG changes (∆ESG) during the virus wave in 2020 and 2021. This approach enables a more accurate assessment of the pandemic's financial implications. Our findings confirm the hypothesis, demonstrating that the ESG's moderating role is positive and statistically significant. Firms with stronger ESG practices experienced fewer negative credit rating revisions during the COVID-19 pandemic. This suggests that stakeholders were more willing to support such firms during the crisis, which in turn enhanced opportunities for profitability, improved gross margins, and sales growth. The results remain robust across various tests. Overall, this research provides insights into sustainable strategic responses during crises, providing managers with guidance and practical applications.

PLAY: RESILIENCE

R6. Understanding Supply Disruptions in Critical Raw Materials for Electric Vehicles: Causes, Patterns, and Implications
Kaiyu Xie, Marcos Machado, Laura Spierdijk, and Devrim Yazan

The transition to a sustainable energy system relies heavily on critical raw materials (CRMs) (Pommeret, Ricci, and Schubert 2022), particularly those essential for electric vehicle (EV) applications (Koese et al. 2025; Lehtimäki et al. 2024). However, CRMs supply chains are highly vulnerable to disruptions driven by various factors—such as geopolitical tensions—which lead to significant price volatility. These fluctuations not only undermine the stability of EV supply chains but also generate economic uncertainty for manufacturers and policymakers (Jones, Nguyen-Tien, and Elliott 2023; Riva Sanseverino and Luu 2022). The circular economy (CE) is increasingly regarded as a

promising strategy for addressing these CRMs supply challenges (Salim et al. 2022). While existing studies have broadly explored CRMs-related risks, there remains a lack of systematic, data-driven research that analyzes these disruptions using empirical evidence. This study aims to fill that gap by investigating abnormal price movements in the CRMs market, thereby contributing to a deeper understanding of CRMs supply dynamics and the potential integration of CE strategies (Cimprich et al. 2023). Building on this foundation, the research will further examine the financial mechanisms that can support the adoption of CE solutions in the EV sector. At this stage, the following research questions will be addressed in the initial phase of the study:

1. What are the primary drivers of supply disruptions in the CRMs market, and how do these disruptions affect the availability of CRMs in the EV sector?
2. What dynamics and correlations exist among different types of CRMs supply disruptions, and how do these supply status influence financial risks and investment decisions in CRMs market?
3. What CE strategies can be employed to mitigate the negative impacts of CRMs supply disruptions, and can these effects be observed and validated using real-world data?

This research follows a multi-step empirical approach. First, we define the scope by selecting seven essential CRMs for EV application: lithium, cobalt, nickel, copper, manganese, graphite, and rare earth elements (REEs). Next, we collect historical price data from publicly available industry reports, commodity exchanges, and market intelligence platforms. By applying statistical techniques to identify abnormal price fluctuations, the study isolates potential supply disruptions. To be more clear, we classify them into four groups: ①Geopolitical factors – including trade restrictions, export bans, and political conflicts. ②Unexpected events – such as natural disasters, pandemics, and infrastructure failures. ③Market power behaviours – involving price manipulation, supply concentration, or strategic stockpiling. ④Environmental and ethical pressures – arising from regulatory changes, ESG (Environmental, Social, and Governance) compliance, and community opposition to mining activities.

Then, this study conducts a statistical analysis to identify dynamics in supply disruptions, examining the frequency of disruptions across different CRMs and the correlation patterns to assess their interconnectedness and market impact. Additionally, it explores empirical evidence to evaluate the effectiveness of CE strategies in mitigating these disruptions, using real-world data to better understand the role of circular practices. Overall, this research provides new insights into the frequency, severity, causes, and financial implications of supply disruptions in CRMs for EV business, contributing to a better understanding of which CRMs are most vulnerable and how disruption types vary in frequency and severity. by bridging supply chain research, financial analysis, and sustainability, this study offers a framework for understanding and managing CRMs supply risks. It also lays the foundation for future research on CE strategies that can buffer the EV sector against supply shocks and accelerate the adoption of circular practices across CRMs-dependent industries.

R7. Risk Disclosure as a Resilience Capability in Central Governments: Assessing Current Practices in the UK and the Netherlands

Ekaterina Svetlova, Tjerk Budding, and Silvia Pazzi

To be resilient, governments must quickly adapt their policies and working methods to new and uncertain situations. This paper examines whether risk disclosure, as part of

the anticipatory capabilities of these entities, can help identify and mitigate vulnerabilities. To explore these issues, we conducted a textual analysis of departmental annual reports and 15 semi-structured interviews with regulators, accountants, and risk management specialists from three governmental departments in each of two countries: the UK and the Netherlands. Our findings indicate that current risk reporting practices are rather insufficient to enhance the resilience of governmental entities. Reported risks are predominantly backward-looking, with limited recognition of changes over time and a reluctance to acknowledge vulnerabilities. This approach to risk reporting is shaped by a disconnect between internal risk management practices and risk disclosure, the complexity of governmental risks, scepticism about users' ability and willingness to understand technical details, departmental cultures, and political influence. Nonetheless, significant variation exists in risk management and reporting practices among departments.
Based on the identified drivers of risk reporting styles, we provide recommendations on how to better use risk disclosure as a tool to enhance the resilience capabilities of central government departments.

R8. Confidentiality, Integrity and Availability in Information Security Incidents and Firm Value: The Dynamic Interplay between Investors' Reactions and Social Media Fear and Anger
Agata Leszkiewicz, Letizia Alvino, Lily (Xuehui) Gao, Abhishta Abhishta, and Javier Sese

Service firms rely on information systems to deliver value to customers, becoming vulnerable to information security breaches. Those negative events evoke persistent emotion of fear and anger that emerge publicly on social media leading to a lasting damage in shareholder value. To address this challenge, this research adopts a service crises lens to investigate shareholders' reactions and social media users' emotional response to information security breaches classified according to their impact on information confidentiality, integrity, and availability. We also investigate whether investors react to negative emotions expressed on social media following CIA breaches. Our empirical analyses involve an dynamic panel VAR study of a sample of 158 information security breaches, including the emotion recognition analysis of more than 2 million social media posts written about those events. We found that availability breaches are most damaging and lead to -1.5% loss of the shareholder value. We did not find that shareholders react differently to confidentiality and integrity breaches. Availability also leads to the strongest emotional reaction from social media users, followed by integrity and confidentiality breaches. Finally, we found evidence of a delayed shareholders' reaction to social media anger, which leads to an estimated damage of .043% in shareholder value.

R9. Valuing circularity for mainstream funding: A Machine Learning approach from single-firm initiatives to scalable Hubs for Circularity
Aditya Tripathi, Marcos Machado, Laura Spierdijk, and Devrim Yazan

The transition towards a Circular Economy (CE) offers considerable potential for enhancing resource efficiency, waste valorisation, and regional economic resilience. Europe supports this ambition by promoting Hubs for Circularity (H4C), regional ecosystems designed to bring multiple stakeholders together to pursue integrated economic, environmental, and social benefits. The Horizon Europe project Sustainable Circular Economy Transition: Industrial Symbiosis-to-Hubs for Circularity (IS2H4C) explicitly expands upon the concept of Industrial Symbiosis (IS)—regional collaborations where firms exchange resources, infrastructure, or services for mutual benefit—toward the structured formation of regional H4Cs.

Although these initiatives are promising, literature indicates that businesses adopting Circular Business Models (CBMs) frequently face notable challenges accessing mainstream financing (e.g., bank loans, equity investments). Financial institutions often perceive circular ventures as riskier than linear models due to uncertain economic returns and forecasting difficulties. Additionally, private investors increasingly demand transparency on how financial returns align with Environmental, Social, and Governance (ESG) criteria, while firms may hesitate or be unable to disclose sensitive operational details. Limited disclosure further intensifies information asymmetry, restricting private investment and increasing dependence on governmental support.

In response, this study proposes an economic valuation framework utilizing financial data from firms involved in the IS2H4C project. We adopt an incremental, case-study approach: first evaluating an individual firm’s valuation, then expanding to a collaborative valuation of two firms involved in IS, and finally assessing the entire H4C operating within an IS network. At each stage, we quantify both individual and collective valuations, highlighting the added economic value of collaborative circular practices when firms jointly approach traditional finance sources (e.g., banks and investors). This incremental analysis illustrates economic viability at each collaboration level and can serve as an initial roadmap toward broader circular collaborations in the form of H4C.

The valuation explicitly compares two scenarios: a baseline (""Without Circularity"") and a circular alternative (""With Circularity""). Both employ a Discounted Cash Flow (DCF) model, wherein selected financial inputs (e.g., revenues, operational expenditures) are forecasted using historical performance data and Machine Learning (ML)-based forecasting methods. Forecast reliability is evaluated through cross-validation and sensitivity analyses to manage uncertainties effectively.

Under the baseline scenario, key financial parameters such as OPEX and revenue define business value via the DCF model, which is then used to estimate future value. Conversely, in the circular scenario, additional ESG-related benefits—such as carbon capture sales, energy or resource savings, and employment effects—are monetized through governmental incentives or taxes and integrated into the valuation. This dual-scenario approach enables stakeholders to assess potential economic impacts associated with circular strategies (see Figure 1 for a detailed explanation of our framework).

By quantifying economic differences between baseline and circular scenarios—progressing from single firms to IS networks—this valuation approach offers preliminary yet robust data-informed insights. These insights can support banks and investors in evaluating CE investments, helping reduce information barriers and advancing Europe’s sustainability goals under the European Green Deal.

INTERACTIVE SESSIONS

IDEATE: ALL ROUNDTABLES

L12. Co-designing a wellbeing intervention for beginning teachers in the context of a professional learning network: sharing perspectives

Susanne Spiele, Sara van der Linden, Mark Timmer, and Susan McKenney

Introduction

The professional learning network PLONS aims to learn more about demands on and support for beginning teachers in secondary education in the Netherlands and in the educational region of Twente, Achterhoek, Oost-Salland and to further develop available support for teacher needs in the region, to support their wellbeing and promote teacher retention. Currently, we are co-designing an intervention aimed at beginning teachers and stakeholders such as teachers, coaches and leadership. Together with these stakeholders, we will design and try out interventions aiming to amplify strengths or reduce challenges of beginning teachers, based on data from a national questionnaire (329 respondents), 25 interviews with beginning teachers, leadership and coaches, and document analysis. The intervention will focus on aspects of onboarding and professional growth in the context of HR, school and peer support.

Theoretical framework

To learn more about the experiences and wellbeing of beginning teachers and their interaction, we integrate variables from a teacher wellbeing framework into a model for professional growth. This model consists of four domains: the personal domain (individual teacher beliefs, motives and skills), the domain of practice (professional experimentation as a teacher), the external domain (sources of information, stimulus or support) and the domain of consequence (salient outcomes).

Research questions

What are design criteria that can guide the development of an intervention for beginning teachers?

Methodology

Based on the data, several interactions with stakeholders will take place. Intervention options will be considered, a viability check will be performed, and after deciding on design criteria and constraints a prototype will be elaborated, built and tried out. In several iterations, these interactions will move from experts to stakeholders and from paper to practice.

Expected results and discussion

Designing these prototype(s) together with and for beginning teachers and their leadership and coaches will hopefully result in interventions that connect to stakeholder needs in our region. The co-creation process will serve as a way to let schools and institutes learn from each other, to strengthen regional networks and to inspire further exchanges on this theme.

During this round table, we hope to elicit the research and regional perspectives of our BMS colleagues (for instance from psychology, communication, management, administration or engineering) to help us in the development phase and to cultivate participant insight into themes or fields that relate to or can build on each other. During the discussion, round table participants will discuss the initial design, focus on the viability of the intervention ideas and elicit ideas about design criteria and constraints.

L13. AI literacy: Implementation of an evidence-based framework
Ilona Friso-van den Bos, Maarten Renkema, Kim Schildkamp, Ingrid Breymann, Iwan Wopereis, Hanneke Theelen, and Elske van den Boom-Muilenburg

The possibilities offered by Artificial Intelligence (AI) are expanding at an exponential rate, challenging educational institutions to prepare both students and staff for a future in which intelligent technologies play a significant role. For example, AI-based applications are already being used by students for personalized learning and writing, while teachers deploy AI to generate innovative lesson plans and construct assessment materials. To navigate a world in which AI is integrated in both visible and invisible ways, students and staff must develop AI literacy. This term refers to the knowledge, skills, and attitudes necessary to effectively and critically manage AI systems in various contexts.
In response to the increasing need for an AI-literate population, a variety of conceptual frameworks has been developed to define and describe AI literacy—varying in scope, level of detail, and target audience. These frameworks are frequently used to guide initiatives that aim to prepare students and teachers for the challenges of AI integration in higher education. However, many of these frameworks lack a solid foundation in research. Therefore, we developed an evidence-based AI literacy framework with a strong focus on the educational context using an umbrella review. The framework includes knowledge domains, skillsets, attitudes, and a set of ethical principles, systematically synthesised from 31 review studies. Our framework can support educational practice by guiding effective and ethical curriculum development, teacher training, and policy aligned with authentic, human-centred AI integration.
The proposed round table discussion focuses on the specification and validation of this framework for BMS education and research. Moreover, requirements for successful implementation of AI literacy education within a lifelong learning perspective will be discussed. The discussion will be structured around open-ended questions aimed at the framework's applicability in its current form, as well as alternative approaches informed by the context of BMS education and research.

LP2. Collectively analyzing and theorizing data: A pathway towards participatory and inclusive ways of conducting research
Stina Rydell Brøgger, Ellen Nathues, Martyn Griffin, David Hollis, and Monica Nadegger

Much of what we do, as interpretive researchers when making sense of our data, continues to remain implicit, hidden, or hard-to-grasp, especially those first moments of exploring the material for intriguing hooks, surprising puzzles, potential theoretical connections, and so on. Common questions abound, particularly so for Early Career Researchers, such as: Is what I am seeing in the data interesting and relevant? Do others share my observations and interpretations? What additional angles could be useful for my work, and which theoretical notions could I maybe contribute to? In our experience, such and similar questions are best answered when coming together as a collective which is why since 2020, The CCO Data Collective has provided a, primarily online, space for CCO (Communication as constitutive of organization) scholars to come together virtually to share, analyze, and theorize data. The CCO Data Collective has generated a wealth of novel perspectives on data that have helped develop members' working papers and theses, offered titles for prospective journal articles, and led to collaborations between members. By now, based on the conversations we had in The CCO Data Collective, many papers have been written, have been presented at

conferences such as EGOS, ICA, and AoM, or have already found their home in a journal. Therefore, we have recently gained an interest in the experiences of the group's members, for example what draws people to want to collectively analyze empirical material and how do they experience this collective process, as well as what generally attracts scholars to engage in collective analysis, but also what possible concerns or apprehensions members might have regarding this form of participation. In trying to further our understandings of potentially more participatory and inclusive ways of conducting research, we are currently interviewing between 30 to 40 members of the CCO Data Collective about their experiences with the group, and with this roundtable, we would like to invite our colleagues at BMS to discuss our preliminary findings while also engaging in a conversation on how they themself take part in collective meaning making in their work.

RP1. Wired to Divide: How Technology, Emotion, and Power Reinforce Polarization

Maximilian Friehs, Elifcan Karacan, and Alejandro Dominguez Rodriguez

Climate Change (CC) poses one of the biggest threats to all humans. Consequently, governments must deal with this challenge, and individuals may be dissatisfied with how the government decides to proceed. Accompanying the top-down policies (e.g., European Green Deal) that influence people's lives is the constant stream of news about climate change disasters. Research shows that dread induced by CC can cause anxiety, and depression for many people. However, people can also be motivated to action to change the world for the better. This may mean joining a political party, founding a Non-Governmental Organisation (NGO) or adjusting their personal lifestyle. Without a fine-grained understanding of the individual as the basic building block of societies, it is not possible to uncover what drives people into action and how societal groups (e.g., farmers' associations or climate activists) act.

In this roundtable discussion we will explore the reinforcing dynamics between technology, emotion, and power in shaping contemporary polarization. We will discuss and examine the emotional toll of polarized digital environments—such as anger, anxiety, loneliness, and exclusion—alongside the role of algorithmically-driven media in amplifying division and shaping public discourse. At the socio-political level, polarization influences civic trust, democratic engagement, and the rise of populist movements. Emotional experiences on the individual level, evoked by content on digital platforms, and political systems interact in a reinforcing loop that fuels social fragmentation.

We pose also a question to everyone participating in the discussion: How can more human-centred technologies disrupt this disruptive pattern? What should and could the future feasibly look like?

RP2. Smart Home Privacy and Security: Understanding and Enhancing User Resilience in the Age of Connected Living

Nicole Huijts, Boudewijn Steenbreker, Michelle Walterscheid, Max Friehs, Simone Borsci, and Abhishta Abhistha

In this roundtable, we will bring together multidisciplinary perspectives on privacy and security challenges in smart home environments, focusing on user behaviour, awareness, and resilience. We will discuss recent BMS research on e.g., the use of AI for attacking and defending against a cyber-attack on smart home devices, awareness of company and government use of smart device data, and misconceptions about privacy and security of smart devices. Building on the insights of the studies, an expert panel discussion will address concerns and strategies for improving user resilience to smart home privacy and security threats. Key discussion points may include:
- Should we focus on changing user behaviour or device design?
- How can we effectively increase protective action by users of smart home devices?
- How can we anticipate and mitigate criminal exploitation of smart home vulnerabilities?
This session aims to synthesize current research and practical insights to develop more effective approaches to smart home security, while at the same time looking for new, multidisciplinary research opportunities for BMS researchers on this topic.

INSPIRE: LEARNING WORKSHOPS

L14. A Decade of Research Projects at UTwente's EL-IPS: 10 Years of Projects at EL-IPS – From Education to Policy Impact

Klaas Stek, Louise Knight, Holger Schiele, and Vincent Delke

Since the launch of Project PERFECT in 2015, UTwente's EL-IPS (European Lab of Innovative Purchasing and Supply) at the faculties BMS and ET has coordinated a remarkable sequence of interconnected EU-funded initiatives: PERSIST, PERISCOPE, PROCEDIN, PRECIUS, CustMaS, EXPERTISE, HERCULES, and most recently InnoHSupport. These projects reflect a growing ambition to move from advancing procurement education in BSc/MSc programs to shaping lifelong learning and cross-sectoral capabilities and finally to informing procurement policy, particularly in public and healthcare contexts.
This 45-minute workshop offers a reflective and forward-looking space for participants to explore the development trajectory of the EL-IPS projects and draw lessons for future proposal development. First, we will present the “follow-up logic” of the EL-IPS project portfolio, illustrating how themes, consortia, and target audiences evolved over time. We will highlight the transition from academic partnerships under Erasmus+ to broader innovation ecosystems involving public and private partners under Interreg and Horizon Europe.
In the second part, participants will engage in a creative breakout discussion: “Imagine you have a bright idea and a reliable partner—where do you start your journey?” Participants will be invited to share motivations, barriers, and experiences in initiating project proposals financed by third parties' money streams.
We will close by summarising outcomes and identifying shared drivers and support needs. This session is ideal for academics and practitioners looking to scale their impact through externally funded projects, and especially relevant for those active in education, innovation, and procurement domains.

L15. Student agency in higher education: research findings and concrete approaches

Anna Bos-Nehles, Alieke van Dijk, Adina Imanbayeva, Myrthe Lubbers, Kim Schildkamp, Priyanka Pereira, and Cindy Poortman

Student well-being, engagement, and performance are increasingly at stake in secondary and higher education internationally (Douwes et al., 2023; Meelissen et al., 2023). Student agency in education(al decision-making) and student empowerment are concepts associated with positive effects on student well-being, engagement, and performance (Yonezawa & Jones, 2007; Jones & Hall, 2022). Empowering, student-centred education is explicitly mentioned in the UT Vision, intended to be addressed in interdisciplinary and collaborative education. In reality, however, it can still be a challenge to empower students and implement actual participation in education(al decision-making).

In this workshop, colleagues from different departments and educational programmes share their insights from research and teaching to critically examine and discuss opportunities for participants' teaching and further research.

Each (set of) presenter(s) will briefly present their study. In groups, questions related to the findings are discussed, including whether and how these ideas can be implemented in participants' own education. Workshop presenters each moderate a group, after which general, plenary conclusions are drawn.

Anna Bos-Nehles (HBE) has applied a co-created 360 degree peer-feedback process in a master course for student participation and learning. Peer feedback has proven to be a powerful tool for students to actively communicate and collaborate. Involving various feedback sources and perspectives has very positive effects on students' writing performance and student learning . During the course, students provide written feedback to peers and additionally collect feedback from the tutor and external stakeholders. By actively engaging with the assessment rubric during the course, students take an active, reflective role in their own learning process.

Alieke van Dijk (IST) involved students in formulating assessment criteria themselves, to boost their autonomy, motivation and ownership over their own learning. Her project showed that students very much appreciate being involved in shaping their education and increasing their engagement.

Adina Imanbayeva's (PhD-ELAN and CELT) work explores how student empowerment is currently manifested, practised, and experienced in the context of higher engineering education. This research forms part of a broader project on teacher professional development for fostering student empowerment in HEE, aimed at equipping students with the knowledge, skills, and attitudes necessary to proactively address complex, real-world societal challenges.

Myrthe Lubbers, Cindy Poortman and Kim Schildkamp (ELAN) studied student ownership and student voice in schools. While students have key knowledge about how they experience or understand teaching, they are often not actively involved in what impacts them the most. We will present the approaches from our recent (international) research, focusing on students working as co-enquires and knowledge-creators alongside teachers to solve educational problems.

Priyanka Pereira's (ELAN) work is stimulated by students becoming more aware of their rights when it comes to the collection and processing of their data (especially in light of the GDPR and the European AI Act). The research looks into how much students understand about what data is collected, how it is used, who can view it, and what the benefits are. The results inform the design of material that increases their knowledge and understanding before they make these decisions.

LEARN-X: METHODS & REPORTING WORKSHOPS

M1. Hands-On with Bookdown: Building Reproducible and Accessible Research Compendia and guideline

Minsi Li

To make research reproducible, it's important that manuscripts, data, and code are not only available but also clearly connected. However, research articles, code, and data are often stored separately and managed through different platforms, which can hinder reproducibility. Bringing them together in a single, organized format can significantly improve transparency and replicability.

This session will demonstrate how to create a publishing compendium, a unified package, that combines a study's manuscript, data, and code while clearly showing their connections. The compendium is built using the Bookdown template. Bookdown is a free, open-source R package for creating books and structured documents with R Markdown. It supports dynamic content, interactive visualizations, and code in many languages, including R, Python, C/C++, Julia, Fortran, Shell scripts, and SQL.

The publishing compendium allows researchers to compile manuscripts, datasets, and analysis workflows into one cohesive, reproducible format. By linking input data, code, and outputs like analyses and figures, it ensures the entire research process can be transparently replicated. Creating a compendium with Bookdown also encourages authors to review every step of their workflow, leading to more thorough documentation. Final outputs can be interactive websites, PDFs, or both, and can be published on platforms like GitHub, bookdown.org, or any web server, making them easy to share and access.

Beyond research compendia, Bookdown is useful for research support staff and anyone interested in developing clear, well-organized guides for broad audiences. It helps create long-form documents with structured sections, interactive features, and easy navigation, which benefits both researchers and support teams.

M2. Automating Text Analysis using local LLMs

Anna Machens

Large Language Models (LLMs) have taken the world by storm, transforming how we interact with and analyze text. What once required deep expertise in natural language processing and machine learning can now be accomplished by anyone with basic programming skills. This workshop offers an accessible, hands-on introduction to using LLMs for automated text analysis — with a focus on running models locally to preserve data privacy.

While commercial LLMs like ChatGPT and Claude offer astonishing capabilities, they require sending data to external servers. For projects involving sensitive or confidential information, this is not always an acceptable option. Fortunately, smaller LLMs that can run on consumer-grade hardware provide a powerful alternative. These local models can be deployed without an internet connection, ensuring full control over your data and workflows.

In this workshop, we'll walk through the process of setting up a local server to host your own LLM. You'll learn how to connect to it via the familiar ChatGPT API, enabling you to switch seamlessly between locally-hosted and cloud-based models.

The session will also cover:
- Writing effective prompts to generate structured and consistent output from LLMs
- Setting and tuning hyperparameters for different tasks and performance needs
- Using LLMs to automate common text analysis workflows
- Bringing your own text (optional) to explore real use cases

Participants with basic Python knowledge will profit most from this workshop. If you'd like to code along, please come with a running python installation.
Whether you're analyzing survey data, extracting structured information from documents, or building intelligent text-driven tools, this workshop will give you the foundational skills to harness the power of LLMs—without compromising on data privacy.

INFORM: STRATEFY & SUPPORT WORKSHOPS

S1. Financial project management
BMS Finance

This workshop offers a comprehensive overview of the financial operations within the Faculty of Behavioural, Management and Social Sciences (BMS). Designed for both academic and support staff, the session aims to demystify the financial structure, processes, and responsibilities of the BMS financial department, providing participants with a clearer understanding of how financial decisions and workflows are managed within the faculty.
We will begin with a global overview of the financial organization at BMS, including budgeting cycles, key stakeholders, governance structures, and financial support services.
The session will then zoom in on the financial project management of externally funded projects, such as those supported by national or European funding bodies. This segment will highlight common financial challenges, project lifecycle management, and compliance with funding requirements.
Ample time will be reserved for questions and open discussion, allowing attendees to raise specific concerns, clarify unclear aspects, and share experiences related to financial management. Whether you are involved in preparing grant applications, managing project budgets, or simply wish to better understand the financial framework at BMS, this workshop will provide valuable information and facilitate stronger collaboration between academic and support units.
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S2. Stimulate discussion on Recognition & Rewards with mmmAcademia
Frank Leoné and Tom Boogerd

The Recognition & Rewards of academic and service personnel is a topic of ongoing importance. However, currently it understandably is overshadowed by the budget cuts in Higher Education. To get out of those shadows, we will in this session discuss the breadth and depth of the Recognition & Rewards topic and help you stimulate c with your colleagues.
We will do so by playing the mmmAcademia card game. The game captures experiences of academic and service personnel and stimulates associated conversation and discussion. It includes four pillars of Recognition & Rewards (how to define quality, how to stimulate collaboration, how to stimulate diverse career paths and how to uphold the human touch) and across academic tasks (education, research, impact, and management). The game can be used at the coffee table and at more extensive workshops and retreats. Depending on interest, all participants can take a set with them. Academia has originally been designed for the Radboud University, but is published under a creative commons license with all source material. Hence the game can also be adapted for UT purposes. We will also shortly discuss how (a variant of) the game can be of wider use for the UT and specifically BMS. The presenter is the original designer of the game and also plans to work with this and similar games in his design-based research

CONCEPTUALIZE: METHODS & REPORTING + STRATEGY & SUPPORT WORKSHOPS

M3. Graphical abstracts in a nutshell
Kasandra Mingoti Poague

Graphical abstracts (also known as TOC or thumbnail views) are stand-alone pieces that capture the essence of an article at a single glance. They should highlight the key take-home messages to encourage further reading.
Although not always mandatory, graphical abstracts can significantly boost the visibility of your research—especially when shared on social media. The more eyes on your paper, the more reads, citations, and engagement it can generate. Journals and publishers are increasingly encouraging the submission of graphical abstracts.
In this short workshop, we will explore both the mandatory and optional elements of a graphical abstract, review various layout styles, introduce tools ranging from basic to advanced, and work through a practical example.
Right now, you might feel uncertain about your ability to create a graphical abstract and even consider hiring one of the many online services that offer this. But by the end of this workshop you will realize that as a scientist, you've already been producing the key components of a graphical abstract—scientific images and traditional written abstracts. Now, it's just a matter of combining them and refining the result. Even better, we will see all the tools UT offers to support you in this process!

S3. Capturing your impact using an impact case
Tom Boogerd and Letizia Alvino

The topic of "impact" is all around: you might see it in grant applications, career evaluation formats, the news, but also in the passion that many colleagues have to "make a change". How can we ensure that we capture impact in a systematic and realistic way?
To do this, we need effective tools that help us communicate clearly with our target audience and stakeholders. One such tool is the impact case, which serves as a narrative framework to explicitly outline the steps taken to achieve the intended impact. Impact cases are grounded in the concept of an Impact Pathway—a perspective that goes beyond activities to trace the actual changes those activities bring about.
Impact cases are a powerful tool but mastering them can be challenging. For this reason, Tom Boogerd (BMS Research Support) and Letizia Alvino (HBE-ETM) offer a workshop on impact cases. We offer a 90-minute workshop, structured as follows:
- An overview of the concept of "impact" and its interpretation within BMS
- Step-by-step guidance on how to write an impact case
- A practical template to help you begin drafting your own impact case

CONNECT: SECTOR PLAN WORKSHOPS

EP4. Disruptive technology and the workplace
Jan-Willem van 't Klooster, and Jordi Weldink

What do Extended Reality (XR), AI and Brain Computer Interfaces have in common? They are all examples of disruptive technologies that can transform our jobs, now and in the near future. Therefore in this session, we will dive into disruptive technologies influencing our workplaces! We will:
- Discuss possibilities of important current technology trends (including XR, AI and BCI)
- Discuss personal attitudes and competences important to succesfully embrace and engage with possibilities of these disruptive technologies in our day to day work,
- Show how our BMS Lab innovation lab may help doing so, including a novel appealing XR & AI demo!
- Together generate new ideas advancing our workplaces
After this session, you will:
- Have learned relevant disruptive technologies and how to use them
- Know what it takes to keep adapting to disruptive technological trends in the workplace
- Have generated concrete ideas on how to implement relevant advances in the workplace
- Have an understanding of how services already available can be of direct help.
This session is for you, if: regardless of ‘WP’ or ‘OBP’, you are into an interactive, energetic and inspirational session on innovating your day to day job!

MP1. Learn to use and create a basic course on Eye Tracking Technology in Higher Education
Simone Borsci, Peter Slijkhuis, and Martin Schmettow

This hands-on workshop is designed for university educators who wish to integrate eye tracking technology into their curriculum or develop dedicated courses on eye tracking methodology. Based on the University of Twente Eye Tracking Education Starter Pack, this workshop provides instructors with both theoretical knowledge and practical teaching strategies. During this 90 minutes session (45+45), participants will learn how to structure and deliver eye tracking courses while gaining hands-on experience with eye tracking technology.
Practical aspects
The workshop includes hands-on sessions where participants (Max. participants: 20) will:
- Practice setting up and calibrating eye tracking equipment
- Learn to troubleshoot common technical issues
- Design sample lesson plans
- Create assessment criteria for student projects
- Develop teaching strategies for different class sizes and formats
Target/audience
YOU HAVE NO EXPERIENCE WITH EYE TRACKING, and you are: a Researcher \ Lecturer, PhD, teaching and learning support staff, educational technology specialist.
Key Learning Areas
- Fundamentals of eye tracking technology and visual attention
- Utilization of eye -trackers in groups
- How to utilize the toolkit to create a course and assignments

Teaching Resources
Participants will receive access to ready-to-use teaching materials developed by experts Dr. Simone Borsci, Peter J. H. Slijkhuis, and Dr. Martin Schmettow.
These materials include:
- Lecture slides and presentation templates
- Exercise guides
- Student assessment tools
- Practical demonstration scenarios
- Case studies and example datasets
Learning Outcomes
By the end of the workshop, participants will be able to:
- Design and implement eye tracking courses tailored to their institutional context
- Effectively communicate technical concepts to students
- Create engaging practical exercises
- Assess student understanding of eye tracking principles
- Integrate eye tracking technology into various research methods courses

IMAGINE: ALL DEMONSTRATIONS

L16. Practicing Academically Productive Talk with AI: A Demo of an Innovative Practice Tool for Pre-Service Teachers

Sara van der Linden, Wisse van der Meulen, Tom Coenen, Talitha Visser, Kirsten Stadermann, Jenna Zaagsma, Marc Vreeswijk, and Susan McKenney

Engaging secondary school students in academic productive talk (APT) is a powerful way to support their learning. Effective teacher facilitation of APT helps students to (1) share, expand and clarify their own thinking, (2) listen carefully to one another, and (3) deepen their reasoning, and (4) think with others. However, facilitating APT can be considered a complex task, especially for pre-service teachers. It demands real-time interpretation of student contributions and the ability to respond in ways that meaningfully advance the discussion. In addition, the topic of the discussions can increase complexity for teachers. For example teachers often struggle with discussion on socio-scientific issues (i.e. open-ended societal problems that involve the intersection of scientific knowledge with complex social and cultural considerations). To better prepare future teachers for this challenge, we need more opportunities for deliberate practice in safe, structured environments.
This demo session introduces a minimally viable prototype of an innovative training environment featuring AI-simulated learners, developed in collaboration with the University of St. Gallen, Switzerland. This environment allows users to configure settings for the discussion (e.g. education level, number of students, topic) and to practice their facilitation by engaging in a chat discussion with a class or group of AI-simulated learners. During the session at the BMS Research Conference, participants will: (1) receive a short introduction on APT and facilitation strategies, (2) try out the AI-based environment to lead a discussion with simulated learners, and (3) share and reflect on experiences with (the use of AI-powered environments to engage in deliberate practice of) facilitating academically productive discussions with groups of learners.

EP5. A Look Inside the Oost Simulation Centre Driving Research with XR
Funda Yildirim, Martin Schmettow, Simone Borsci, Jan-Willem van 't Klooster, and Stéphanie van den Berg

This demonstration session invites participants to experience first-hand how extended reality (XR) and simulation technologies are shaping the future of transportation research and education. Hosted by the newly established Oost Simulation Centre, an initiative supported by the University of Twente's BMS Lab and Green Dino, this session offers a unique opportunity to engage with advanced driving simulators and immersive systems designed for studying human interaction in complex transport environments. Participants will explore how disciplines such as human factors, applied psychology, cognitive science, and XR development converge to investigate topics like human-vehicle interaction, automation, and AI-supported mobility. Attendees will have the chance to interact with real-time simulation scenarios and observe how human behavior can be measured and analyzed in controlled yet realistic settings.
By joining this session, you can:
- Get a hands-on look at how XR and simulation tools help us study human behavior in transport settings.
- Learn how immersive technologies can inform the design of safer, more user-friendly systems.
- See how simulation research can support both academic inquiry and real-world public engagement.
Join us to try the simulators, exchange ideas, and help shape the direction of immersive, human-centered transport research.

RP3. Safe and Pleasant Parks - High and Low Tech Investigation Avenues
Maximilian Friehs, Eduardo Simao de Gracia Dias, Lynn Bouwknegt, Thomas van Rompay, Iris van Sintemaartensdijk, Colby Johanson, Camilo Gonzalez de Leon, Gus Degioris, Marie Feldmann, Prisca Koppelaar, and Erin Mc Culloch

In this project we want to investigate a park's perception of safety and pleasantness. Because of a Park's divergent perception (e.g., from leisure during the day to potential illegal or dangerous activities at night), public parks occupy a special role in the public eye. Inspired by citizen science methodologies, the research emphasizes an inclusive and playful approach to public park design by harnessing the motivational pull of interactions as a starting point. We utilize high- and low-tech approaches to uncover what makes people choose one design feature over another and why they pick it in the first place; what makes a park safe and pleasant and how much of this is universal? Does it depend on the person and their characteristics and the background? How much is it influenced by the location of the park itself, does it matter if it is in a rural or an urban environment?
The goal is to evaluate individual approaches to designing subjectively safe and appealing public spaces. Depending on the individual's characteristics (e.g., gender, physical capabilities, past experiences, being a parent) different aspects of park-design can be in focus. Based on these results we aim to extract general design-guidelines that we can use to design "prototypically safe and pleasant" parks for each perspective. With

this in hand we want to apply our knowledge and classify and rate existing parks for the benefit of everyone.
At the BMS Research Conference 2025 we will present the methodology, design and (partial) outcomes of two studies: (1) a mixed-method study wherein people were able to design their ideal parks using a video game and (2) a low-tech approach, which prompted participants to use stamps made in the Design Lab at UT to re-design the Volkspark in Enschede.
Notably, this project would not be possible without Secure Societies VU-UT Seed Funding. This project is a collaborative efforts between people from a variety of fields such as psychology, communication science, geography, human-computer interaction, spatial economics and design studies.

PLAY: ALL ASK-THE-EXPERT HELPDESKS

M4. Data availability Statements by Publishers: How to make you research data available?
Deniece Nazareth

When submitting your article, many publishers, including Elsevier, Springer and Taylor & Francis, require a data availability statement as part of their submission policies. Publishers encourage researchers to clearly indicate how and where the underlying research data can be accessed. Making your data (publicly) available not only increases the visibility and impact (i.e., more citations) of your work but also promotes scientific integrity, encourage re-use of the data and can lead to new opportunities.
Making your research data (publicly) available involves selecting a (trusted) repository and ensuring your research data is well documented. Upon depositing your research data, you will receive a persistent identifier (e.g., DOIs) which can be cited in the data availability statement to link your research data with your publication.
In practice however, making your research data available can be challenging. Not all research data can be easily shared, for example due to legal/privacy/ethical restrictions (i.e., personal identifiable data, confidential data, consent of participants) or third party restrictions. Some publishers have template statements that can be used or adapted to conform to these restrictions.
There are also various options how to make your research data available in a repository. Different repositories may support different access levels (open access, restricted access (i.e., upon request), embargo or closed access). Different licenses are available for your type of research data, such as CC-BY (to be cited) or CC-BY-NC (to be cited but cannot be used for commercial purposes).
For instance, DANS data stations, a commonly used repository in the Social Science and Humanities, now offers a Data Access Protocol. This allows data owners to restrict and set conditions on who can re-use the data and for what purpose.
Lastly, a key question to consider when making your research data available is: what research data should be shared? This depends on the publisher or journal requirements, repository policies and the legal/privacy/ethical considerations. If you choose to publish your data in a repository, it is important to document your research data (i.e., adding metadata and a README file) to ensure your research data is understandable and re-usable for others.
If you would like to learn more about publishing data in a repository, determining the

appropriate access levels and licenses or have questions about data availability, let’s connect in this session!

S4. UT's Global Academic Partners (Strategic partners)
Arturo Susarrey Arce and Margriet Dekkers

University of Twente has three Global Academic Partners (also known as strategic partners):
1) Tecnológico de Monterrey (Tec) in Mexico (Tec);
2) University of Münster in Germany (UM);
GAP Coordinators Margriet Dekkers (UM, UW) and Arturo Susarrey Arce (Tec) will provide interested BMS colleagues about the opportunities to collaborate with these partners and/or the broader ecosystem(s).

S5. Creating impact today instead of tomorrow. What works when you have no time (to waste)
Maaike Endedijk and Evelien Ydo

Whether we focus on the energy transition, digital transformation, accessible healthcare, inclusive education, or another grand challenge, we all aim to make an impact with our research. Yet, despite our intentions, own busy agendas, consortium complexities, or delays in our research results often delay or dilute our impacting practices. Given our limited resources - time, money, and support structures - we believe it is essential to learn from one another’s lessons learned. In this ask-the-expert session, we will therefore share practical tools and strategies developed in the PLT research group. Building on the work of Wegener et al. (2025), Reinecke et al. (2022), and the BMS “Impact by Design” position paper (2024), we take a co-creation, pragmatist perspective on impact. Rather than viewing societal impact as a distant, post-project outcome, we have developed impacting practices (Wegener et al., 2025) that allow for continuous contribution to change in co-creation with stakeholders. In the past five years, we kicked off seven large-scale consortium-based research projects (NWO, NWA, and Groeifonds). We pooled the knowledge utilization budgets of these projects to appoint a dedicated consortium & impact manager. This allowed us to experiment with and develop several consortium management and impacting practices. During the session we will share:
- Our step-by-step plan for impacting from day one – even before research results are available
- Practical approaches to maintain consortium commitment and engage in co-creation
- Strategies to enhance the visibility of your project (or research group) to increase your sphere of impact
- Our honest take on what software or tools help – or hinder – your project management and impacting practices
- A list of lesser-known but freely available university resources to support impact work
We invite all researchers, from Phd students to experienced project leaders, to join the discussion, share experiences, and strengthen our collective capacity for meaningful impact today for a better world tomorrow.

AFTERNOON POSTERS

IDEATE: STRATEGY & SUPPORT + SECTOR PLAN

S6. A BMS International network Initiative: FOSSTER
Inge van Haare, Lotte Sander, and Janke Rademaker

The BMS International Network Initiative, which was started by our dean, was the starting point for explorative meetings between the faculty of BMS and faculties from interested potential partner universities of the network. These meetings have been set up with the non-technical faculties of a number of selected technical universities across Europe. These faculties are all unique in the fact they are a non-technical faculty in a technical university. It was agreed that this is a special position and that therefore faculties should partner with faculties from universities that share the same feature. As a result, all universities expressed their interest in joining the international network for non-technical faculties within technical universities.
Resulting in our currently up and running FOSSTER network, which aims to collectively work together on:
- Leadership practices
- Staff/student/PhD exchange
- Dual degrees (student/phD)
- Integrated summer schools
- Research collaborations (grant writing: development of a COST proposal)

By means of the poster we would like to provide more insight into the network, its partners and its goals.

S7. Open Science Community Twente
Florian Schuberth, and Raul Zurita Milla

We want to introduce the Open Science Community Twente (OSCT; https://www.openscience-twente.com/).
The OSCT was founded in 2020 by employees of the University of Twente (UT). The community is open to staff and students and currently consists of more than 140 members from the UT and Saxion University of Applied Sciences.
We are a grassroots, inclusive learning community. To achieve our goal of making Open Science the norm at the universities in Twente, we are dedicated to advocating and mainstreaming of OS practices. For example, we organize training and information events about OS, offer our members a platform to present their latest OS practices and send regularly newsletters to inform our members about recent Open Science developments.

S8. Supporting Internationalisation at BMS: the role of the International Office
Inge van Haare

The International Office of BMS plays an important role in supporting and promoting internationalisation within the faculty. With growing global challenges and a need for cross-cultural competencies, international experiences have become an essential part of both student and staff development. This poster aims to inform and engage colleagues across the faculty about the wide range of support and opportunities offered by the International Office, and to foster collaboration in furthering our internationalisation ambitions. The poster highlights key services, showcases recent initiatives and collaborations, and outlines opportunities for researchers and support staff.

S9. Research Support at BMS – support along your journey

BMS Research Support

It takes a village; BMS has a complete research support system to support researchers along the full pipeline: funding strategies, funding acquisition, data management plans, systematic literature review, impact cases, and much more. It is valuable to capture the width of the available support and communicate this to researchers, the BMS Research Conference provides a good opportunity for this. In addition to using the poster as a means of sharing information, input could also be connected on possible gaps in our support.

S10. What can your Management Assistant do for you, and what can you do for your Management Assistant

Odille Strootman-Snijders and Ellen Hofstede

As a dedicated support personnel, we play a vital and often invisible role in ensuring the smooth operation of our faculty/department/section. Our work extends far beyond traditional administrative tasks; we serve as the central hub for coordination, communication, and logistical support. This poster outlines the key services we provide to the colleagues and teams at BMS, highlighting how our work contributes to efficiency, continuity, and a positive working environment.
Our core responsibilities include agenda management, meeting preparation and follow-up, travel and event coordination, and document processing. We take pride in our proactive communication, ensuring that schedules are aligned, information is clearly shared, and deadlines are met. In addition to these standard tasks, we offer tailored support for project administration, including budgeting assistance, reporting, and stakeholder communication.
We also play a crucial role in onboarding new staff, helping them navigate organizational processes and settle in quickly. Our knowledge of internal systems, policies, and informal networks allows us to serve as an important resource for both new and long-standing team members. Moreover, we actively support internal communication efforts by maintaining shared calendars, organizing team events, and managing intranet content.
What sets our team apart is our collaborative approach. We coordinate closely with one another to ensure continuity of service and flexibility in support. We strive to anticipate needs, adapt to changing circumstances, and offer solutions that help our teams focus on their core responsibilities.

In a fast-paced and evolving work environment, our role is to provide reliability, structure, and human connection. By highlighting our services in this poster, we aim to make our support more visible and accessible, and to invite colleagues to reach out whenever we can be of assistance. Our goal is simple: to help others succeed by taking care of the details that matter.

EP1. Promoting Pro-environmental Behavior through Immersive Animal Perspective-Taking: A Pilot Study
Yue Li, Marcello Gómez-Maureira, Stéphanie van den Berg, and Funda Yildirim

Despite longstanding efforts to promote pro-environmental behaviors, adoption remains challenged by knowledge gaps regarding behavioral outcomes and insufficient affective engagement. Visual perspective-taking in immersive contexts offers a promising solution by reducing psychological distance between self and environmental situations, suggested to promote from understanding to action. This study aims to explore how animal perspective-taking experiences in immersive Virtual Reality (VR) contexts could influence pro-environmental attitudes and behaviors. Participants took the perspective of a deer, experiencing its daily life (wandering, foraging, social interactions) while witnessing environmental challenges i.e. forest fires and human rescue efforts. A pilot study (N=8) employed a between-subjects design comparing first-person perspective-taking in immersive VR with traditional narrative reading. Measurements included animal attitude and general ecological behavior (pre- and one-week post-intervention), along with ingroup presence, and donation behavior (immediate post-intervention). Results revealed higher presence levels in VR participants compared to controls. All participants successfully identified their perspective-taking object as a deer and could recall what they have experienced in intervention. While both conditions showed minimal changes in animal attitude and general ecological behaviors, the VR condition enhanced altruistic behavior, demonstrated through higher willingness and allocation of compensation towards environmental protection institutions. These preliminary findings suggest the potential efficacy of immersive ecological perspective-taking in promoting pro-environmental behavioral outcomes. Building on these results, our ongoing research will systematically examine the mechanisms through which perspective-taking and immersive experiences enhance embodiment and empathy, and how these interventions ultimately drive positive sustainable attitude and behavior change.

IP1. Dynamic Electric Vehicle Charging for Delivery Logistics
Fabian Akkerman, Stephan Meisel, Albert Schrotenboer, and Martijn Mes

The rise of same-day delivery services in the online retail sector has introduced new complexities in logistics and fleet management, especially with the transition toward fully electric vehicle (EV) fleets and the adoption of renewable energy sources such as solar panels. This paper addresses the integrated challenge of real-time delivery planning and dynamic energy management in such systems. Specifically, we consider a logistics service provider (LSP) operating an EV fleet from a single depot, equipped with a renewable energy source and connected to the energy grid. The LSP must make decisions every 15 minutes on vehicle dispatching, energy purchasing, selling, and fleet

charging, balancing customer satisfaction, operational efficiency, and energy costs. We introduce a dynamic planning model that jointly considers the dispatching of deliveries under time windows and the management of bidirectional energy flows. Our setting includes a backup combustion fleet, used at a higher cost when the EV fleet cannot meet delivery demands. The model incorporates realistic constraints such as limited energy capacity per period, deterministic time-varying energy prices, and homogeneous charging infrastructure. We allow deliveries outside time windows at a penalty and evaluate the impact of vehicle battery capacity, energy storage decisions, and grid reliability on system performance.
Through this model, we aim to answer key managerial questions: Under what conditions can a fully electric fleet become not just cost-efficient but also profitable through smart energy trading? What are the trade-offs between immediate dispatch and delayed consolidation in terms of energy use and delivery performance? When does investment in renewable energy infrastructure pay off? Our results offer strategic insights into the design of resilient and sustainable urban logistics systems and provide a foundation for decision support tools that optimize both logistical operations and energy market participation.

RP4. Prioritizing Sustainability Adoption Factors in Food Supply Chains: An AHP-Based Multi-Stakeholder Analysis
Arjun Chaudhuri, Mahak Sharma, and Devrim Yazan

This study identifies and sustainability adoption factors in food supply chains (FSC) by integrating multi-stakeholder perspectives using the Analytic Hierarchy Process (AHP). Pairwise comparisons from three individuals across six barrier categories (technological, policy, social, infrastructural, organizational, economic) were elicited and structured. Individual priorities, derived from Saaty scales, were aggregated using the geometric mean, with consistency ratios below 0.10. Results indicated technological barriers as most critical (0.200), followed by economic (0.199) and policy (0.189) barriers. Lower priorities were assigned to social, infrastructural, and organizational barriers. The findings emphasize the urgent need to address technological limitations and economic viability for enhanced FSC performance, highlighting the crucial role of supportive policy frameworks. This research provides empirical evidence for targeted interventions and demonstrates AHP's utility in incorporating diverse stakeholder perspectives for barrier analysis in supply chain management.

CONCEPTUALIZE: METHODS & REPORTING + RESILIENCE + SMART INDUSTRY & ORGANIZATIONS + HEALTH

M5. Research data pseudonymisation and anonymisation: A practical guide
Deniece Nazareth, Alice Nikuze, and Minsi Li

Social science researchers often work with diverse and personal data, such as name, phone number, facial picture, security numbers, audio/sound, video, occupation, location, health-related records, ethnic group, which are collected through interviews, surveys, observations, and experiments. To help manage personal data responsibly, our

team of data stewards created a practical guide with examples and techniques, in line with the General Data Protection Regulation (GDPR) requirements.
The guide outlines general principles of anonymization and pseudonymization, offering transferable insights that cover multiple steps of data management, including collection, processing, and sharing. It walks through the anonymization process step by step and highlights key questions to consider when handling personal data, making it applicable across many data types.
The guidebook addresses a wide range of data types, including textual, numerical, audio, video, and geospatial data. For each type, it points out common personal information that may appear in research, helping researchers spot potentially identifiable data. It also provides techniques tailored to handling each data type securely.
To support practical application, the guidebook includes executable functions and scripts and demonstrates examples of personal data before and after anonymization. Techniques are presented using widely used tools such as Excel, Python, and R, ensuring accessibility across different levels of programming skills.
This poster presents the structure of the guidebook, anonymization workflows, and real-world case examples. By emphasizing both the importance and complexity of handling personal data, we aim to equip social science researchers with practical tools and knowledge to uphold data privacy without compromising research utility. The anonymization guidebook will be available during the conference.

R10. Analyzing Organizational and Resource Flow Networks for Hubs for Circularity: A Social Network Analysis Approach

Aidana Tleuken, Patricia Rogetzer, Luca Fraccascia, Devrim Murat Yazan

Hubs for Circularity (H4C) facilitate resource efficiency and sustainable development by developing inter-organizational collaborations in terms of urban-rural-industrial symbiosis of resources and by-product sharing in the context of local region. In industrial symbiosis systems, social connections are fundamental building blocks of the network. These ties enable interaction between actors, fostering a sense of belonging, shared values, and a broader network of trust and reciprocity. To achieve an effective transition to CE, various stakeholder categories (e.g. academia, industry, policy, community) need to collaborate, broadening the scope beyond industry-to-industry cooperation. Frequent communication and knowledge sharing is very important for trust-building, which is a crucial requisite for industrial symbiosis relationship and mutual benefits building for organizations involved in H4C.
Social network approach offers a structure for comprehending the social dimensions of information systems, shedding light on how agents are organized and interact within IS networks. Such analysis enables exploratory investigation of symbiotic relationships within networks. In the context of industrial symbiosis, Social Network Analysis (SNA) represents facilities as nodes, and synergy links as edges connecting them. Existing literature recommends studying communication and information-sharing patterns in the context of IS, which is usually studied through proxy of resource sharing. This study employs SNA to examine knowledge-sharing and resource-flow bipartite networks within H4C across four regions (Basque, Turkiye, Netherlands, and Germany). By applying clustering analysis, centrality measures, network density evaluations, and core-periphery classifications, we examine structural characteristics of the networks, their inter-dependencies and knowledge diffusion patterns. Clustering analysis helps to visualize clusters through community detection algorithms. Centrality measures quantify the

positioning of nodes within the network based on different theoretical foundations, such as degree centrality (number of direct connections), closeness centrality (how close a node to other nodes in the network), betweenness centrality (extent to which a node is positioned on the shortest paths), for each node in the network of organizations communications and resource flow. Core-periphery analysis helps to explore the relationships between nodes located at center and outskirts of the network.
We analyze two interlinked networks: (1) an organizational network representing knowledge exchange and communication, and (2) the resource network reflecting resource flow exchanges. Centrality measures, including degree, closeness, betweenness, eigenvector, and eccentricity, highlight key organizational actors facilitating knowledge transfer and resource utilization. Network density analysis reveals that organizational interactions are more interconnected than resource exchanges, suggesting stronger knowledge-sharing. Core-periphery analysis indicates that most resource exchanges occur within the core network, while organizational communications extend beyond the core, integrating peripheral actors.
Findings suggest that H4C exhibit distinct symbiotic structures, with German and Turkish hubs displaying centralized, industry-led networks, while the Dutch and Basque hubs demonstrate more collaborative structures involving community and research institutions. In general, all the hubs have top-down structure due to IS2H4C project leading the H4C organization management and development. The results provide policy and managerial implications for policymakers and industrial stakeholders aiming to facilitate effective inter-organizational collaboration, increase H4C network resilience, expand H4C networks, and enhance resource-sharing mechanisms within industrial ecosystems. The findings of the study also have academic contributions in terms of empirical data of SNA in IS cases and general theoretical understanding of H4C concept.

R11. Advancing Hubs for Circularity Through Digital Twin Technology: An Analysis of Quantifying Performance Indicators

Hisham Afash, Mila Koeva, Yifei Yu, and Devrim Yazan

Hubs for Circularity (H4C) represent a new paradigm in industrial ecosystems, aiming to close energy, resource, and data loops by facilitating exchanges of materials, waste, and by-products across sectors. By integrating Industrial Symbiosis (IS) practices, H4Cs promote resource efficiency and societal well-being through collaborative, cross-industry networks. DigitalH4C, a digital collaboration platform, underpins this transformation by supporting secure data sharing, supply-demand matchmaking, performance assessment, and decision-making. Among the enabling technologies of DigitalH4C, Digital Twins (DTs) offer a powerful tool to visualise and evaluate the synergies and dynamics within these complex ecosystems.
DTs are more than static representations; they are dynamic, continuously evolving systems that integrate diverse data sources to reflect the past, present, and anticipated future states of physical environments. In the H4C context, DTs offer the potential to model the intricate flows and exchanges between industrial actors and their surrounding urban and rural environments. These flows are influenced by a range of socio-economic and operational factors, which necessitate a systematic performance assessment approach. To support this, well-defined Performance Indicators (PIs) are critical. These may include metrics such as waste reduction, resource recovery efficiency, or by-product valorisation. However, integrating such indicators into a DT requires careful

definition, quantification, and validation to ensure reliability and relevance for decision-making.
The development of IS-based DTs remains in its early stages, and several key challenges must be addressed. First, the diversity of stakeholders in H4C means that priorities can vary widely. This diversity complicates the selection of common PIs that align with shared goals. Second, the indicators themselves span economic, environmental, operational, and functional dimensions. Many lack standardised definitions or universally accepted calculation methods, making comparison and benchmarking across contexts difficult. Finally, understanding the relationships and interdependencies between different indicators adds another layer of complexity, as actions in one area (e.g., cost optimisation) may unintentionally affect others (e.g., environmental performance).
This research aims to (1) explore the applications of DTs throughout the lifecycle of an IS network and (2) define and quantify the PIs necessary for assessing synergies within the H4C context. The proposed indicators tackle the aforementioned challenges and offer a flexible and integrated framework that make up a solidified DT.
Using a top-down approach, indicators are identified through a combination of literature review and stakeholder engagement. These are then tested within a case study from an H4C initiative in the Netherlands, where operational parameters are extracted and used to inform the development of a DT prototype. This research provides a foundational knowledge base that (1) advances the integration of DT technology into the IS field, (2) facilitates complex dynamics of stakeholder interaction within H4C, and (3) guides the future demonstration and evaluation of an IS-based DT. We view this research as a preliminary step towards developing an IS-oriented DT component for H4C, recognising that PI quantification is a critical step in DT development. Ultimately, this research contributes to the transition from IS to H4C via providing a digital decision-support tool for practitioners.

R12. Energy Management in Hubs for Circularity using a Modular Network Representation

Tobias Løvebakke Nielsen, Daniela Guericke, Alessio Trivella, and Devrim Yazan

With the Clean Industrial Deal, the EU aims to increase its competitiveness while decarbonising its industrial sector. The EU has identified improving the efficient use of clean energy and integrating circularity into industrial processes as key measures. Hubs for Circularity (H4C) represent integrated systems that combine these strategies to enhance circular resource efficiency within a region. H4C benefit from the geographic proximity between different industries within industrial zones and the surrounding urban/rural areas allowing them to share resources, technology, and infrastructure and to operate under the principles of circular economy.
Energy plays a significant role in H4C since the involved industries are often energy intensive. To utilise the operational synergies between the energy supply and the resource sharing enabled by industrial-urban-rural symbiosis, advanced energy management models are needed. Despite the introduction of the H4C concept in 2021, no prior studies have developed such models specifically for this context.
This poster presents a modelling framework outlining key aspects to consider when developing energy management models for H4Cs. While building on conventional modelling approaches, we argue that the symbiotic relationships within H4Cs may influence how information is exchanged and how actors collaborate within the hub.

We also present results from a developed energy management model that investigates the synergies between energy supply and resource sharing enabled by industrial-urban-rural symbiosis. The model is formulated as a stochastic, modular energy management framework tailored for H4Cs. It represents the hub as a network of nodes and arcs, where processes at each node convert incoming energy and resource flows into outputs, guided by modular process definitions. These modules capture operational characteristics such as ramping constraints, storage behaviour, and co-generation of resources. This structure makes the model applicable for analysing a variety of hub configurations with different technologies, while also accounting for uncertainties such as fluctuations in renewable energy production.
By applying the model to a real life case study from the project “Sustainable Circular Economy Transition: From Industrial Symbiosis to Hubs for Circularity (IS2H4C)”, we demonstrate how energy management in H4C can support industrial-urban-rural symbiosis taking place within a hub.

I6. Understanding and Shaping the Continuous Development of the Production Workforce in Industry 5.0

Lisa Winkelman, Marcella Hoogeboom, Maaike Endedijk, and Jessie Koen

Industry 5.0, characterized by the integration of advanced technologies such as Virtual and Augmented Reality, predictive maintenance systems, and collaborative or welding robots (Alsaadi, 2022; Kang et al., 2016), introduces unprecedented challenges in the workplace. Rapid technological changes demand continual re-skilling for workers to remain productive and competitive, particularly as consumer demand for individualized products accelerates innovation (Veza et al., 2015). However, technology is not the only factor driving the urgent need for continuous learning in this smart industry context: demographic shifts also play a significant role. The workforce in many sectors is aging, and a large proportion of experienced employees—possessing invaluable tacit knowledge—are on the verge of retirement (Bakens et al., 2023). Their departure will result in substantial knowledge loss, making it crucial for organizations to foster lifelong learning and knowledge transfer. Without robust continuous learning strategies, companies risk losing critical expertise and facing a widening knowledge and skill gap in the rapidly evolving environment of Industry 5.0 (van Houten & Russo, 2020).
In order to be able to cope with these continuous changes in the workplace, workers must engage in continuous learning. Engaging in continuous learning empowers workers to adapt swiftly, ensuring they remain competitive and capable of driving innovation. To facilitate this, organizations can implement workplace learning initiatives. Workplace learning offers numerous benefits and has become one of the key drivers of the overall competitiveness of organizations. By integrating learning and work the general well-being of employees can be improved and they are better equipped to adapt to changes (Ellström, 2001; Parker, 2014). Such learning within the flow of work occurs on a daily basis through, for example, interactions with colleagues, making mistakes and experimenting (e.g., Gijbels et al., 2010). Earlier research on workplace learning identified three aspects that influence the engagement in workplace learning. Firstly, the degree to which an organization provides enabling conditions, such as clear expectations about what should be learned (e.g. Billett & Choy, 2013). Second, direct- and indirect interventions that promote workplace learning, such as creating a shared vision on workplace learning within the organisation (e.g. Coetzer et al., 2019). And finally, personal antecedents that influence the participation in workplace learning, such

as to what extend someone experiences responsibility for career development (e.g. Kyndt & Baert, 2013). However, the current knowledge is not directed towards Industry 5.0, but challenges specific to this industry require an individualized approach.
This poster presents initial insights from ongoing research by the PLT group into workplace learning for production workers in Industry 5.0. Collaborating closely with practitioners, the study uncovered specific elements influencing learning and revealed both unique findings and new directions for exploration. The audience is invited to reflect on the role of practice and contribute ideas for advancing this research.

I7. Changing Organizational Identity and Employees' Self-Determination: The Context of Digital Transformation

Anannya Devi, Pauline Weritz, Rashimah Rajah, and Mark van Vuuren

Digital transformation (DT) has become inevitable for organizations to stay competitive in the current market. However, DT has a very high failure rate, and organizations need new ways to facilitate successful DT. As DT results in the formation of a new organizational identity (OI), there are identity conflicts for the employees who strongly identify with their organization, leading to disengagement, stress, or resistance to change. Because employees are often directly responsible for the implementation of DT within the organization, addressing their concerns and ensuring their continued motivation during and after DT becomes crucial for success. We conducted semi-structured interviews with employees working within the manufacturing industries in the Netherlands to understand how the OI changes impact and influence their responses to DT. Drawing upon the self-determination theory (SDT), our study explores the role of basic needs for autonomy, competence, and relatedness in employee responses to OI change in the context of DT. The findings are analyzed with thematic analysis, based on which we forward a new framework. We contribute to the literature on DT and the subsequent OI change, as well as the broader discussion on work-related SDT, by examining how changes in OI impact employees' basic needs for autonomy, competence, and relatedness. Finally, with the study, we offer implications for researchers and practitioners.

H3. Joint Planning of Short-Term and Long-Term Home Care Services

Asal Karimpour, Daniela Guericke, Amin Asadi, and Erwin Hans

The demand for home care services has significantly increased in recent decades due to an aging population and the shift of healthcare services from hospitals to homes. While much research in this area has focused on client satisfaction, the role of nurses who are central to care delivery, deserves greater attention. High workload, lack of continuity, and mismatched assignments can lead to nurse dissatisfaction and turnover.
This study emphasizes nurse-centric scheduling to support better work-life balance, increase job satisfaction, and improve the overall performance of home care providers. In particular, we explore how to manage the joint planning of two distinct types of care demand: short-term and long-term. Long-term care involves clients who require ongoing support, such as elderly patients with their activities of daily living. Here, the continuity of care (in this context, avoiding frequent nurse changes) is crucial to ensure client and

nurse satisfaction. On the other hand, short-term care refers to temporary needs that last several weeks (e.g., follow-up on wound treatments of patients discharged from the hospital after surgery), where continuity of care is less critical.
Our research addresses the complexity and potential conflicting objectives that arise from the integration of short-term and long-term care in nurse-centric scheduling and client visit assignments. Using operations research tools, we evaluate whether assigning separate nurse teams for each care type leads to better efficiency and continuity, or if a mixed-care assignment strategy offers more balanced results. The model also considers shift scheduling requirements based on working regulations such as working hours, break times, and nurse availability as well as client requirements. We present preliminary results based on realistic data from a home care provider.

H4. Comprehension of and Preferences for the use of Patient-Reported Outcome data to support decision making: A Systematic Review

Sneha Kannan, Brenda Bergink-Voorthuis, Janine van Til, and Catharina Groothuis Oudshoorn

Introduction: Patient-Reported Outcome Measures (PROMs) provide insights into patients' symptoms, functioning, and health-related quality of life (HRQoL). As the integration of PROMs into clinical care grows, so does interest in identifying the most effective ways to visualize PROM data. Despite increasing attention, evidence remains limited on the formats that best support user preference and comprehension. Moreover, while prediction models are increasingly used to generate prognostic PROMs, communication of uncertainty around these predictions remains underexplored.
Objective: This review evaluates quantitative studies assessing the impact of different PROM visualization formats on user preference and comprehension across clinical domains. It focuses on both retrospective and predictive PROM outcomes, presented at individual and group levels.
Methods: Studies published between 2014 and 2024 were identified through PubMed, Scopus, and Web of Science. Quantitative studies addressing the presentation of PROM data to patients and/or clinicians were included. Studies not available in English or without full-text access were excluded. Outcomes of interest included preferences and comprehension of PROM visualizations. ASReview was used for initial title and abstract screening, with full-text screening and data extraction performed using Covidence.
Results: Thirteen studies of the 7,973 identified met the inclusion and quality criteria. Both clinicians and patients generally preferred and better comprehended graphical formats compared to textual ones. Line graphs, bar charts, and pie charts were the most commonly assessed visualization formats.
For group-level data, both clinicians and patients preferred line graphs for tracking trends, while pie charts were favoured over bar charts and icon arrays for presenting proportional data. For individual-level data, clinicians preferred heat maps to bar charts, whereas patients had a slight preference for bar charts over line graphs. Preferences for visual features such as colour coding, directional arrows, and emojis were commonly reported to enhance interpretability. Clinicians preferred including confidence intervals and p-values in graphs, whereas patients found these confusing. Only one study assessed visualization of predicted outcomes, where most patients preferred not to view predictive outcomes as they found them complex.
In terms of comprehension, both clinicians and patients demonstrated better understanding of line charts compared to bar charts for individual-level data, and bar

charts compared to line charts for group-level data. Pie charts received the highest clarity ratings for categorical data from both clinicians and patients compared to bar and line charts. Scoring directionality influenced comprehension, with ""higher is better"" formats interpreted more accurately. Most studies indicated that red and green shading improved comprehension. Formats such as waterfall plots, tables, and scatterplots generally did not receive high ratings for preference or comprehension from either group.
Conclusion: This review highlights the variation in comprehension of and preference for different graphical visualizations of PROMs between target groups, indicating there is no one-size-fits-all approach to data visualization. Further research is needed to explore effective visualization of predictive outcomes and the optimal ways to present PROMs data. Addressing these gaps can provide more evidence to support individual clinical decision-making and quality assessment in hospital settings.

THEMED SYMPOSIA

IDEATE: EMERGING TECHNOLOGIES

E14. Symposium 'Making sense of sensors'

Kornelia Konrad, Michael Nagenborg, Lars Assen, Simone Borsci, Lenn Gorissen, and Monika Kuffer

In this symposium we would like to bring into an interdisciplinary conversation research on emerging sensor technologies conducted across different BMS research groups and UT faculties. The research studies development and (envisaged) use of sensors at diverse scales, from human bodies to earth observation, and in different contexts, such as health, farming, or smart urban environments and remote sensing. Despite these diverse use contexts, we recognize similar challenges and research topics: How do users make sense and actual use of information gained from sensors in combination with other forms of (often bodily) sensing and knowledge? How is this embedded in practical decision-making and made actionable? How are practices and competences changing with the introduction of new forms of sensoring? What are the politics of sensing: what/who is made visible or concealed, who decides on, has access to, or owns sensors and generated data? These are only some of the social scientific questions raised by the proliferation of sensoring technologies. In this symposium, we would like to present research from ongoing projects at BMS and discuss overarching insights and further research directions.
Sensors as focal points
Sensors are an important building block of smart technologies. My research is concerned with different scales, ranging from the human body to bridges and cities. Sensing the world with "electronic eyes" raises questions about understanding how machines see us, and how we can translate the data for human reasoning. These fundamental questions arise on different sites and scales and are a good reason for the humanities to engage in inquiries of sensors.
Sensing sepsis

Sepsis is a life-threatening syndrome involving a dysregulated immune response to an infection and a common cause of death. The SepsPIC project develops a photonics-based sensor, in order to faciliate timely diagnosis . We study how such a sensor can be embedded in practices of clinical decision-making and care, and whether it may affect understanding of the disease.

Exclusion by design: sensor technologies, policy, and the marginalization of an ecological farming imaginary in the Netherlands

I examine how the future of sustainable agriculture in the Netherlands is shaped by two competing imaginaries: a technocratic “optimized coexistence” imaginary and an ecology-based “integrated harmony” imaginary. Through 20 interviews with farmers, sensor manufacturers and policy analysis, it shows that sensor innovation and agricultural policy overwhelmingly support the former imaginary, marginalizing the latter, which is largely guiding the use (expectations) of agro-ecological farmers.

Sensor design and access gaps to data

Building on the experience of developing a new Nighttime Light Sensor (for an ESA Satellite), this presentation reflects on my C0-PI role in the ESA Night Watch project. NightWatch aims to advance plans for a European satellite to monitor artificial light at night, addressing ecological, urban, and health impacts. It also questions who decides sensor priorities and highlights unequal access to high-resolution data. By defining user-informed requirements, the project promotes inclusive EO design and emphasizes transparency, equity, and broader participation in shaping Earth observation missions and data governance.

INSPIRE: LEARNING

L17. Tracing Teamwork in Action: Applying Different Quantitative Methodologies to Capture Team Interactions and Processes

Marcella Hoogeboom, David Otten, Amber Kornet, and Lida David

Understanding how teams function —and finding ways to enhance that functioning— is vital across many different settings, ranging from extreme, high-stakes environments to healthcare to education and industry. Extant research shows that one of the most crucial factors influencing team effectiveness is the moment-to-moment interactions: who speaks, when they speak, who they respond to, and which recurring patterns lead to success or failure. To capture these micro-dynamics, we need methods that assess processes and patterns of collaborating, coordinating, and innovating instead of a focus on static in- and outputs. This symposium showcases a variety of cutting-edge/novel approaches for observing, modelling, and analysing interaction sequences in teams. The symposium brings together several projects and studies that examine team processes through various research methods: t-pattern & entropy analysis, Natural Language Processing, and multimodal approaches (where different data sources are being combined and synchronized, such as video and physiological measures). The symposium begins with a concise framing of why process- and pattern-oriented designs are pivotal for contemporary team science. After that, by weaving together different quantitative methods and time-series techniques, the symposium aims to showcase and stimulate a greater variety of research methods to capture team processes, by (1) highlighting different analytic choices to understand team processes, (2) discussing the

potential and challenges of integrating several data streams, and (3) discussing the opportunities to translate interaction patterns into actionable feedback for training and design.
The symposium entails four contributions:
- Behavior, Physiology, and Movement: A Multimodal Approach to Collaborative Learning. Marcella Hoogeboom, Amber van Kampen, Vana Hutter, and Lotte de Weert. This paper presents a multimodal framework from a police-training pilot with three escalating stress scenarios. It synchronizes video, speech, movement, and physiological signals to uncover connections, e.g., using Granger Causality, between arousal and collaborative behavior that single-channel studies overlook.
- Utilizing a Large Lange Model (LLM) for the Classification of Collaborative Dialogues: Problems & Possibilities. David Otten, Pantelis Papadopoulos, Maryam Amir Haeri, and Maaike Endedijk. LLMs, such as GPT-4o, have also been used to classify (text)data. We illustrate how we used ChatGPT to classify novelty and reference within collaborative chats and address several explorative findings on prompting, output, limitations, and possibilities.
- Facilitating Generative Groups: Supporting Team Learning and Reflexivity Processes. Amber Kornet, Sebastian Dennerlein, Tijmen Schipper, and Maaike Endedijk. Empirical evidence on the evolution of facilitation behavior is limited. This explorative multiple case study provides a temporal view and empirical evidence on how facilitators adapt their conversational interaction over different team development phases.
- Using a digital data analytics tool to capture dynamic change in coordination patterns: the Apollo 13 mission. Lida David, Marcella Hoogeboom, Maaike Endedijk, and Jan Maarten Schraagen. T-pattern analysis was applied in this study to capture moment-by-moment coordination restructuring in NASA's Apollo 13 mission. The study shows how the team restructures their patterns of coordination before (routine) and after the crisis situation (non-routine).

LEARN-X: RESILIENCE

R13. Improving Organization Cyber Security through Empirical Decision Making

Abhishta Abhishta, Yasir Haq, Jan-Willem Bullee, Christina Kolb, Wouter van Heeswijk, Reinoud Joosten, Siraj Anand, Nadia Lorraine Niyonsaba, Raphael Hoheisel, Aswin Sanil, and Ghusen Chalan

Cyberattacks pose a growing and persistent threat to organizations across all sectors. As cyber threats become more frequent and sophisticated, the need for effective cybersecurity risk management has never been more urgent. However, many organizations—particularly small and medium-sized enterprises (SMEs)—lack the in-house expertise and resources to make informed decisions about cyber risk mitigation. Budget constraints and limited technical knowledge often result in reactive or suboptimal strategies that fail to address the most critical vulnerabilities.
To improve organizational resilience, it is essential to move beyond intuition and subjective judgment. This symposium will highlight how empirical decision-making—grounded in data and analytical rigor—can significantly enhance cybersecurity planning and response. By leveraging real-world data and evidence-based methods, organizations can make more accurate and cost-effective decisions in areas such as risk assessment, mitigation prioritization, and continuous monitoring.
The symposium will feature presentations from researchers at the Faculty of

Behavioural, Management and Social Sciences (BMS), showcasing empirical research and applied methodologies aimed at improving cybersecurity decision-making. These methods span a range of analytical approaches, including traditional surveys, statistical modeling, text mining, and simulation techniques. Our research utilizes diverse data sources such as Internet and network measurements, underground forums, cybersecurity incident reports, and other open and proprietary datasets. By integrating these data sources and analytical techniques, we provide comprehensive insights into threat landscapes, attacker behavior, and the effectiveness of different mitigation strategies.
Attendees will gain an understanding of how empirical analysis can be practically applied to guide cybersecurity investments, prioritize risks, and allocate resources under real-world constraints. Special attention will be given to the needs of organizations with limited budgets and expertise, demonstrating how data-driven tools and frameworks can support better decision-making even in resource-constrained environments.

INFORM: RESILIENCE

R14. The Role of Employees in Sustainability Transitions

Barbara Kump, Celina Borko, Babette Brinkman, Sonia Suciu, Cas Polderdijk, and Miguel Welter

This symposium is a suggestion to combine the two other submissions I have made into a broader topic, namely the role of Employees in Sustainability Transitions. The idea would be to have four presentations plus a discussion. The first presentation could be the submitted paper Borko & Kump on "Climate Quitting", the second presentation the submitted book presentation Kump & Brinkmann on the "Green Handprint at Work". In addition, I have a two (maybe even three) very good bachelor students who are doing work on Employee Activism in the Media, one is studying the case of Amazon (Sonia Suciu), the second one the case of Shell (Cas Polderdijk), and the third one studies Whistleblowing more broadly (Miguel Welter). I could imagine that the bachelor students give very brief presentations of their work and we have a discussion at the end on the role of employees in sustainability transitions. If the symposium is too much for the program, please consider the other two submissions (Borko & Kump on Climate Quitting and Kump & Brinkmann) separately. If you would like to include the symposium, I am happy to provide an abstract that covers the contents, rather than the practicalities.

CONCEPTUALIZE: HEALTH

H5. Women's Mental and Physical Health from a Lifespan Perspective

Marijke Schotanus-Dijkstra, Anique Bellos-Grob, and Nienke Bosschaart

Historically, healthcare has primarily been designed around male physiology, leaving women's specific health needs underrepresented. Researchers from the Faculty of BMS collaborate with researchers from the Technical Medical Centre and the DesignLab to understand gender differences and create innovative healthcare solutions to improve the health and wellbeing of women. As part of this collaboration, they launched the minor Technology for Women's Health in a Life Span Perspective, which offers a unique

approach to women's health across the life cycle, with a focus on diversity-sensitive design and technology development. In this symposium, three of the involved researchers present their latest research projects:
1. Marijke Schotanus-Dijkstra from the department of Psychology, Health and Technology will present some first results from her research about women's mental health and wellbeing during the menopausal transition and the SPICE-consortium: the Study of Positive experiences, Interventions and Challenges in Everyday female life.
2. Anique Bellos-Grob from the department of Multi-Modality Medical Imaging will illustrate changes in the pelvic floor during the menopause and how this could result in pathology such as pelvic organ prolapse (POP) and urinary or fecal incontinence. She will accordingly present the innovative research within this field done at the University of Twente.
3. Nienke Bosschaart from the department of Biomedical Photonic Imaging will present current challenges and unmet needs in breastfeeding. She will illustrate how novel techniques being developed at the University of Twente can be used to better support mothers in breastfeeding.

CONNECT: SECTOR PLAN

EP6. Collaborating for a desirable future: interorganizational dynamics in tackling grand challenges

Annemarie Dedden, Martin Pit, Britt Smulders, Britt Wiefferink, Ellen Nathues, and Maaike Endedijk

Recently, there have been increasing calls for organizational research on Grand Challenges (hereafter: GCs) such as climate change and the digital transformation (Gümüsay et al., 2022). GCs are defined as "specific critical barrier(s) that, if removed, would help solve an important societal problem with a high likelihood of global impact through widespread implementation" (Grand Challenges Canada, 2011, p.iv). Unsurprisingly, addressing such complex, ill-structured challenges requires coordinated efforts across various stakeholders (e.g., businesses, education institutes, NGOs, governments) as different perspectives, insights, skills, resources, and so forth must be pooled together to set in motion the large-scale transformations that are needed to effectively address GCs (Gehman et al., 2022; George et al., 2016).
While the necessity for interorganizational collaboration (IOC) among stakeholders to tackle GCs collaboratively is widely acknowledged, what exactly these forms of collaboration entail and require remains, at least to a great extent, unclear. In particular, the difficulties lie not only in the intricate processes and practices of working together but also in collectively making sense of what constitutes a desirable future (e.g., Ferraro et al., 2015; Gehman et al., 2022). First, while diverse stakeholders bring together the heterogeneous knowledge needed to tackle the complexity of GCs, these very differences also need to be bridged to achieve the larger common goal of a desirable future. Second, given the complex nature of GCs, a comprehensive understanding of their characteristics is typically only developed as stakeholders work on and make sense of them. This requires actors to act based on an intention of transforming the situation into a desirable alternative, guided initially only by the value they aim to create. Third, co-creating desirable alternatives requires actors to view the context differently, challenge taken-for-granted assumptions, and identify specific interventions for transforming the existing situation into a desirable alternative.

In this symposium we will present four projects from the PLT research group about IOC in different contexts – such as the energy-, sustainability, and circularity transitions as well as the digital transformation – and we plan to further dive into the different and often implicit tensions that occur during the process of solving GCs collaboratively. Bringing together different research contexts and research foci, while at the same time all revolving around the central theme of GCs and the collaborative processes that stakeholders engage in while working on GCs, makes a great opportunity for a nice discussion.

IMAGINE: SECTOR PLAN

HP2. Multiple facets of Virtual Reality applications
Christina Bode, Maggie Sikora, Steven Watson, Max Frieh, Mirjam Galetzka, Judith Austin, and Lina Bareisyte

This symposium will showcase how VR is designed, applied and studied across different sections of BMS. We will present Virtual Reality as experimental environment for validating wearable devices, as a method for suicide negotiation training and to test emergency escapes. Next to the experimental use, we will show how to use Virtual Reality for education and training and how to apply the technology in clinical settings by illustrating the application of VR in different bachelor modules of BMS programmes, by presenting a future home VR for life style recommendations and by demonstrating usability and effects of Virtual Reality in pain self-management of people with chronic diseases. Also conclusions of a review of instruments to evaluate VR will be shared. The symposium will be wrapped up by identifying the next steps for VR research.