GO TO SESSION 1 GO TO SESSION 2

Panel 8. Emerging Technologies: Negotiation and Transformation

Convenors:

Suania Acampa, Università di Napoli, Federico II

Biagio Aragona, Università di Napoli, Federico II

Francesco Amato, Università di Napoli, Federico II

Keywords: Emerging Technologies, Methodological Challenges, Public Interest, Sociotechnical Systems

The growth of emerging technologies (ET) such as Artificial Intelligence (AI), High- Performance Computing (HPC) and Quantum Tech (QT) raises crucial questions about their social implications. These technologies are not only shaped but are also profoundly shaped by social, political, and economic dynamics. Science and Technology Studies (STS) and Critical Algorithm Studies (CAS) have highlighted how the sociotechnical construction of ET is based on an intertwined and complex web of technical and social apparatuses in continuous (co)-evolution, where different agencies play a fundamental role. Adopting research strategies that try to stabilize these phenomena is essential to analyse the processes of negotiation and interaction that take place between human and non-human actors, as this makes them accessible to empirical investigation.

This session aims to open a space for reflection in which researchers from various disciplines can examine ET through a sociotechnical and sociodigital (Halford and Southerton, 2023) perspective, highlighting the negotiation, appropriation and adaptation processes that characterize their development and implementation. This type of research can be essential for understanding the inequalities and ethical challenges arising from the adoption of ET in specific domains (i.e. healthcare, labour, etc.).

Methods such as ethnographic studies in technological development contexts, discourse analysis to deconstruct innovation narratives, and case studies on the daily use of technologies have proven to be valuable tools for this investigation, but further methods that tackle the intertwine between the social and the technical, and that take the materiality of technology seriously, are needed.

The session aims to stimulate the STS community to reflect on the ways in which it is possible to investigate and intervene in emerging technologies' innovation processes, promoting a debate on how these research practices can transform ET into tools of emancipation and wellbeing for society.

The panel invites contributions that explore the social implications of ET and examine their implementation in domains of public interest such as health, education, work, mobility, and security. It also welcomes epistemological and empirical contributions that investigate research strategies and methods.

11 JUNE 2025 14.30 - 16.30 SESSION 1

ID 196 - AI systems as experimental technologies: emergent risks and uncertainty

Giacomo Zanotti, Politecnico di Milano
Viola Schiaffonati, Politecnico di Milano

Keywords: AI, Experimental Technologies, Uncertainty, Risk

Technologies have been defined as experimental "if there is only limited operational experience with them, so that social benefits and risks cannot, or at least not straightforwardly, be assessed on basis of experience" (van de Poel 2016, 669), and the different degrees of uncertainty concerning their social effects can be reduced only after their actual introduction into society. This difficulty is well exemplified by the so-called control dilemma elaborated in (Collingridge 1980). According to it, the social effects of radically innovative technologies are highly uncertain in their early phases of development. However, when these technologies are well developed at later stages, they might be so embedded into societies that it can be difficult to avoid their negative effects or even to stop them. Different strategies to deal with the control dilemma have been elaborated within the ethics of technology. One possibility is to try to anticipate negative effects at the design stage. Another one is to promote an incremental approach, namely the gradual introduction of experimental technologies in their contexts of use, such that their emerging negative effects can be monitored and, in case, mitigated.

The notion of experimental technologies has been proven useful also when applied to Artificial Intelligence (AI), and in particular to AI-related risks (Zanotti et al. 2024). Yet the strategies to deal with the control dilemma and emerging risks in the case of AI technologies appear problematic and deserve a careful analysis. Anticipation is indeed extremely difficult with AI technologies, which are characterized by high levels of complexity in both their design and the interaction within their contexts of use. At the same time, a tension in incremental approaches emerges. On the one hand, while controlled and well circumscribed testing environments allow us to meticulously monitor and possibly mitigate potentially emerging risks, they may not be an epistemologically reliable ground for evaluating the risks stemming from the large-scale use of AI systems. On the other hand, experimenting AI systems at larger scales is ethically challenging, for it may imply exposing a considerable number of people to hardly predictable risks. After analysing the reasons why AI technologies may exhibit specific characteristics compared to other experimental technologies, this work will elaborate on the notion of experimental technologies from an philosophical perspective, conceiving of it in terms of uncertainty. Moreover, it will evaluate possible new epistemological and ethical frameworks for dealing with those AI-related risks that can be dealt with neither the traditional risk mitigation tools (e.g., cost-benefit analysis) nor the usual strategies for addressing the control dilemma (e.g., Value-Sensitive Design, ethical incrementalism).

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11 JUNE 2025 14.30 - 16.30 SESSION 1

ID 244 - Digital ID: Systems: The Genesis of Data Harm

Silvia Masiero, Universitetet i Oslo

Keywords: Digital ID, infrastructure, data herm, digital welfare, platforms

Digital identity schemes convert human beings into machine-readable data, which are amenable to be administered and analysed for better service provision. At the same time, critiques have impinged on the

undue exclusions produced through digital identity systems, where entitlements of vital importance – including food, cash, assistance to refugees – have been denied to people due to the inability to authenticate digitally. More problematic points emerge with the production of informational injustices, where people are not put in the position to meaningfully enquire the use of their data through digital ID and with design injustice, where unfair practices are scripted in the body of the designed technology. As powerfully summarised by the Centre for Human Rights and Global Justice (CHRGJ), while evidence of benefits from digital identity schemes is limited and scattered, evidence of harm is substantial.

In such critical perspectives, however, a point remains silent. It deals with the enabling conditions of harm produced through digital ID, conditions that verify when the events generative of digital identity harm take place. Asking what makes digital identity harm possible in the first place is important for two reasons: first, it makes it possible to reflect on the genesis of harm, and on the ways it is produced on the individual. Second, by mapping the same genesis, it makes it possible to counter the emergence of such harm, enabling the possibility to imagine fairer models of ID, which actively work against the production of injustice.

In this paper I introduce the concept of data harm as enabler of the harm developed and enacted through digital ID. I first define data harm as harm produced, sustained and enacted on people through the means of datafication. I then position data harm in the novel literature that sees data as an independent object of research, and derive three routes – misrepresentation, erasure and interoperability – through which data harm is perpetrated. Each route shows a distinctive, complementary aspect of data harm production, and it is argued that each is crucial to understand in order to form the comprehensive picture needed for data harm to be tackled.

11 JUNE 2025 14.30 - 16.30 **SESSION 1**

ID 459 - Big Model Good? Investigating how sociotechnical imaginaries about digital twins are told, sold, and operationalised in conservation contexts

Lucy Maun, University College London

Keywords: Digital twins, conservation, sociotechnical imaginaries, emerging technologies

Digital twin technologies are a group of emerging technologies that have emerged out of manufacturing and engineering industries, designed to link an object, product, or system – the 'physical twin' – with a virtual 'digital twin' – an identical, mutually-affecting representation that updates in real time. In the last five years however, digital twins are starting to be applied in conservation contexts as a novel technology that promises to transform the industry by 'saving' threatened species and landscapes through digitisation; both by creating a digital replica for posterity, and by offering insights into changing conditions and how to manage resources. However, the stated and promoted aims of digital twin projects are often different from what these projects actually do – conservation is used as a justification to gain funding and awareness, whilst insights from the models are used for purposes that contradict conservation aims. Additionally, digital twins of the natural environment can never truly be mutually-affecting, undermining their status as 'digital twins'. Rather than being just 'big models', digital twins for conservation comprise a complex interrelation between sociopolitical factors, climate-impacted landscapes, digital infrastructures, data generation and appropriation, and idealised (though as yet unrealised) future benefits. With little critical work having been conducted on the topic thus far, this research investigates the impacts, efficacy, and utility of applying digital twins in novel conservation contexts. This project uses sociotechnical imaginaries and responsible innovation as theoretical frameworks, to explore the narratives that are being constructed and how these are affecting the hype, impacts, and development of the technology. Through considering the Destination Earth project, other digital twins of the oceans, and the digital twin of threatened Pacific Island nation Tuvalu, this research investigates the continual processes of negotiation and transformation that drives these projects, and the ensuing social and environmental impacts that result from them. It aims to move past the hype to untangle the complex socio-political tensions and examine the realities of applying a technology designed for urban infrastructures to the natural world.

11 JUNE 2025 14.30 - 16.30 SESSION 1

ID 471 - Investigating Responsible AI in practice: the concept of boundaries

Pierluigi Masai, Università degli Studi di Trieste

Keywords: sociotechnical systems, responsibility, research design, boundaries, AI governance

The governance of Artificial Intelligence (AI) systems is a relevant topic given their applications in a wide range of contexts: from academic research, healthcare, and entertainment to law enforcement, the military, and the insurance industry. Studying the management of emerging technologies such as AI systems can be very hard though, since they are sociotechnical systems, which is to say that their functioning cannot be addressed without considering the social actors involved. As a matter of fact, the development of an AI system is, in principle, a lengthy and complex process that involves numerous parties: sponsors, designers, developers, technicians, legal experts, policymakers, and users. Consequently, it can be difficult even from a theoretical perspective to deal with the theme of responsibility, let alone to research it in practice. The question arises: how to effectively investigate the innovation processes related to AI systems? Even more: how to highlight a responsible use of AI systems?

Adopting an STS perspective can be useful to properly study all the elements involved in such a landscape. The key is to first define a theoretical framework capable of identifying where to focus the attention.

Especially fruitful can be the concept of boundaries to characterize those spaces where the interactions between this heterogeneous set of actors occur. Boundaries are sites where bridges spanning different disciplines, organizations, ecc. emerge to shape relationships and interactions, but also sites for demarcation where division of sociotechnical labour takes place.

The presentation outlines an interpretive framework aimed at examining how Responsible AI is configured in the context of a large, multinational financial company, highlighting three boundaries that seem important for studying the forms of de facto responsibility of AI within an organizational context: internal to the company, between the company and regulators, and among the company and AI developers . The former refers to an intra-organizational level of analysis, the latter two concern both public policies and regulation, and developers. These three areas of attention are articulated either on the discursive or practical level.

Such a framework is used in a currently ongoing project that aims to investigate how the theme of responsibility is embedded in the practices and discourses around AI systems. The project performs qualitative research and its example will show how STS concepts can help design researches on emerging technologies overcoming many methodological challenges.

11 JUNE 2025 14.30 - 16.30 SESSION 1

ID 542 - Sustainability and the Development of Urban Digital Twin.

Mattia De Angelis, Università di Napoli Federico II

Keywords: Digital Twin, urban governance, sustainability

Current technological development and socioeconomic and environmental challenges have led national and supranational public institutions to a growing interest in implementing technologies to manage and develop government practices. One of the widespread paradigms for developing governance practices, in this case of urban settings, is sustainability, which is interconnected with the need for data acquisition and the development of new and increasingly sophisticated analysis techniques. One of the technologies attracting institutional actors' attention is the Digital Twin.

This study intends to understand the relationship between Digital Twin and sustainability through the scientific literature produced on the topic, the analysis of European projects (funded through Horizon Europe, Horizon 2020) and the study of two cases of implementation of these technologies to understand what the main topics are considered of the research, from the actors involved in the implementation and de-

velopment, coming to the analysis two cases of application. It proceeds through studies and technological developments in the field of social sciences. As a connection is developing between Digital Twins applied to urban contexts and the sustainability paradigm, consider that when referring to concepts related to sustainability, we are not only talking about aspects related to environmental issues but also social, economic and cultural ones; this is precisely where the need and relevance of the contribution made by the social sciences arises. Since the subsidy of these technologies is intended to achieve an informed management model through data flows, setting sustainability as a goal both in development and as an end is relevant to understanding how this actor intervenes and is applied within governance processes.

11 JUNE 2025 14.30 - 16.30 **SESSION 1**

ID 623 - "Will A.I. Ruin the Planet or Save the Planet?": An STS Approach To the Connection Between A.I. and Climate Challenge

Elli Danae Vartziotis, Εθνικό και Καποδιστριακό Πανεπιστήμιο Αθηνών *(National and Kapodistrian University of Athens)*
Aristotle Tympas, Εθνικό και Καποδιστριακό Πανεπιστήμιο Αθηνών *(National and Kapodistrian University of Athens)*
*Tina Vartziotis, National Technical University of Athens (*Εθνικό Μετσόβιο Πολυτεχνείο*)*
Ippolyti Dellatolas, Massachusetts Institute of Technology

Keywords: AI, Climate Change, Media, STS

Artificial Intelligence (A.I.) is frequently celebrated as a revolutionary tool for addressing environmental issues by both the scientific community and the media. Building on prior research on analyzing A.I. narratives in leading scientific journals (Nature, Science), we will present research that focuses on mainstream media sources (The Guardian, The New York Times, Der Spiegel) in order to explore how A.I.'s role in environmental sustainability is portrayed beyond academic discourse. By examining how AI is framed as both a potential environmental savior and a source of ecological harm, our research sought to critically engage with the binary narratives that dominate public and scientific discourse. Using an STS methodology, we sought to retrieve similarities and differences in how artificial intelligence is depicted in scientific and journalistic contexts. Our research, therefore, seeks to usher in understanding how these narratives influence the public's understanding of A.I.'s ability to address environmental issues. To this end, our presentation will focus on the socio-technical imaginaries of these narratives, as they are overwhelmed by contradictions between critical attitudes and technological optimism.

11 JUNE 2025 14.30 - 16.30 **SESSION 1**

ID 665 - Let people decide — making and negotiating technology with and for the people by employing Citizen jury as a tool

Ana Pop Stefanija, Vrije Universiteit Brussel
Rob Heyman, Vrije Universiteit Brussel

Keywords: citizen jury, participatory methods, experimental ethics, future imagining

The last decade has seen a tendency towards techno-solutionism — with the advancement of digital and AI technologies, the idea that deeply societal issues can and should be solved with technology becomes predominant. While emerging technologies (ET) can indeed solve many issues, benefiting from their full potential requires careful threading. One important aspect of this careful approach is building the technology for the people with the people themselves. This is especially important when the envisioned consequences of the deployment of the very technology introduce serious harms for the people affected. One such case is the introduction of autonomous decision-making agents (AI proxies) to make the complex decision of who should be prioritized (as a household) to receive energy in times of energy crisis and brownouts.

With this presentation we would like to elaborate and critically discuss one innovative manner of actively including citizens in the processes of ET design and development. We build our case on insights collected through participatory research that uses Citizen jury as a method to investigate, probe, and intervene in a technology-in-the-making, and captures the negotiations and tradeoffs taking place between what is desirable and necessary, between the public interest and the individual, and between the societal and the technological. Organizing three 8hrs jury sessions with a representative sample of Brussels' residents illustrate the delicate interplay and balance between these negotiations. To probe into the potential future of automated and autonomous technology making life-impacting decisions, we inquired how our jurors envision this decision-making interaction, the guiding principles, and the redlines that must not be crossed, in a human-machine-society interaction of this kind.

Citizen juries are well-established and codified way of soliciting insights from citizens for complex issues that involve value judgements, trade-offs underpinned by values-based dilemmas, affecting different people in different ways and scales. Despite this, they remain under-used in the innovative ET processes. Using speculative fiction and experimental AI Ethics, among other tools, we adapted the strict format of citizen jury to fit the specifics of the envisioned ET. AI technologies are abstract, complex, and not easy to grasp. Using the tool of future scenarios, where the jurors had to write a Utopian or Dystopian story, we solicited valuable insights about the values, the imaginaries, the needs and requirements of the jurors as individuals and as members of a community. The affordances of GenAI for visualising the stories helped in making these speculative future scenarios more tangible, and hence closer to the participants. Our interventions in the codified format of Citizen jury contributed in "making the future predictable/imaginable" and the technology graspable, thus helping our jurors to form informed opinions regarding the potential harms, advantages, and implications of use, serving as the basis for the (future) interventions regarding the technology- in-the-making.

We will critically discuss the possibilities, affordances, but also the shortcomings and constraints, of using Citizen Jury as a research practice and method to imagine, negotiate, and intervene in ETs, especially ones that hold the potential to be transformed into tools for equity and solidarity.

11 JUNE 2025 17.00 - 19.00 SESSION 2

ID 239 - The Making of a Communitarian Quantum Ecology: Ideas for a Republican Governance for Quantum Information Technologies

Luca Possati, Universiteit Twente

Stefano Calzati, Technische Universiteit Delft

Keywords: Quantum information technologies, quantum ecology, governance, ethics, republican approach

Among emerging technologies, quantum information technologies (QITs) – e.g., quantum computers, quantum communication, quantum networks – are expected to bring profound disruptions in our societies, insofar as they will constitute the key enabling technologies for other services and applications (Timmers, 2023). In this regard, it is crucial to explore, since today, QITs' ethical, legal, social, and policy implications (ELSPI; cf. Kop, 2021; de Jong, 2022), even if such an exploration might fuel a "quantum hype" (Smith III, 2020). This is especially relevant because discourses and expectations on tech innovation contribute to shape those same scenarios they envision (van Lente, 2012) requiring forms of responsible research for QITs (Coenen & Grunwald, 2017). At stake are, above all, questions concerning the kind of QITs we want, for which purposes, how to shape both, and the nature of this we. In other words, an issue of collaborative governance (Micheli et al., 2020).

While regulation on QITs risks being entrapped into a "Collingridge dilemma" (cf. Genus & Stirling, 2018), a "precautionary approach" remains advisable given the duality of QITs as both an unprecedented opportunity and a serious threat (Taylor, 2020). Normative proposals for QITs' governance already exist (Perrier, 2022; 2025). However, these rest on a top-down path-dependent approach which risks reinforcing today's multipolar scenario (Winseck, 2017), triggering the geopoliticization and siloing of QITs (Taddeo et al. 2024; Shelley-Egan & Vermaas, 2025). Hence, it is necessary to avoid such a trend as it could black box QITs and expose them to co-optation by individual interests of countries or private companies.

To contrast this, we advocate for an alternative communitarian standpoint for the development, implementation, and use of QITs, whereby communitarian etymologically denotes a bond among people based on mutual deficiency and collective necessity (Calzati & de Kerckhove, 2024). Put differently, QITs are part of a technological ecology in the making where non/normative factors, diverse non/institutional actors, and sociotechnical processes are all codependent. So, how can we operationalize this insight from the perspective of collaborative governance?

The idea we propose is to look at republican approaches to the digital transformation (Susskind 2022; Hoeksema, 2023; Calzati & van Loenen, 2023; 2025), seeking to foster a digital polity within/through which mechanisms for guaranteeing power distribution across actors, mutual accountability via checks and balances, and forms of collegial decision and control are systemically devised. Calzati and de Kerckhove (2024) already mention the idea of a "quantum republic" which should take inspiration from nuclear non-proliferation treaties and envision a two-tier model of QITs' governance, whereby principles (and their supervision) are global, while their implementation is ecosystemic, across scales, sectors, and contexts. However, the two authors do not provide further specifications.

Here we build on that, intersecting research on digital republicanism and works in ethics and governance of technology (OECD, 2019; Calzati, 2023; Possati, 2024) towards the design of a communitarian model of QITs' governance. This brings us to identify interdependent sets of principles, bodies, and processes proper to the quantum republic.

11 JUNE 2025 17.00 - 19.00 SESSION 2

ID 266 - From Odesa to Orbit City: Popular Culture and Media Narratives in the Emerging UK Future Flight Innovation Ecosystem

Will Mason-wilkes, University of Birmingham

Keywords: advanced air mobility, drones, popular culture and media narratives, innovation ecosystem

Within the UK, an innovation ecosystem is currently emerging around a cluster of novel civilian aviation technologies (cargo-carrying drones, passenger carrying electric vertical-take-off-and-landing (eVTOL) aircraft, and sustainably fuelled conventional small aircraft) that are being developed under the rubric of the government-industry joint funded ISCF/UKRI Future Flight Challenge. As with other emerging technologies, popular culture and media representations of these, or analogous technologies, both contemporary and historical, play an important role in shaping publics attitudes towards these 'Advanced Air Mobility' (AAM) technologies. Often overlooked, however, is the concurrent role that these broader cultural and media representations and narratives play in shaping the imaginaries which exist within the innovation ecosystem, which in turn influence the functionality, design and positioning of AAM.

Reporting on findings from qualitative exploration within this emerging ecosystem, carried out as part of a wider programme of social science research, dialogue and engagement work led by the University of Birmingham that has been embedded within the Future Flight Challenge upstream of the technologies' emergence, this paper will discuss key popular cultural and media narratives that are mobilised within the AAM innovation ecosystem, how they are drawn on and function, and to what effect. From the widespread news coverage of the use of drones in military contexts, particularly the conflict in Ukraine, to key science fiction touch points such as Star Wars, The Fifth Element, Blade Runner or The Jetsons, popular cultural and media narratives play a key role in how innovators make sense of, and make sensible, these emerging technologies and their potential use cases.

11 JUNE 2025 17.00 - 19.00 SESSION 2

ID 285 - Power and the ethics of innovating: discursive injustice in the context of new and emerging technologies

Benedict Lane, Technische Universiteit Delft

Keywords: Epistemic injustice, Discursive injustice, Emerging technologies, Technology assessment, Hermeneutic technology assessment

This paper starts from the claim that modes of technology assessment based on either the consequences of a technology (e.g., Brey, 2012) or the moral properties of the technology itself (e.g., Winner, 1980; Latour, 1992) are not suitable for moral assessment of new and emerging technologies (Swierstra & Rip, 2007). Such technologies, I argue, are at such an early stage in their development that there are no clear outcomes or moral qualities there to be assessed, and there is little realistic hope of accurately anticipating them in advance. Rather, the most morally salient features of such technologies are the processes by which they are coming into being – specifically, the form of the discourses that are giving meaning to these technologies (Grunwald, 2020), and the dynamics of power operative in those discourses. I develop a theoretical framework for assessing such dynamics of power, drawing on and synthesising several existing philosophical accounts of who has the power to do what in a particular discourse, namely: Fricker's account of epistemic injustice (2007) and Anderson's institutional extension of it (2012); Langton's and Hornsby's accounts of illocutionary silencing (Langton, 1993; Hornsby, 1995; Hornsby & Langton, 1998); and Lewis's notion of the "conversational score" as determining the acceptable conversational "moves" available to participants in a discourse at a particular moment (1979). I argue that the development of 21st century new and emerging technologies embody a particular kind of discursive injustice (cf. Kukla, 2014): those set to be most affected by a new technology are systematically disempowered to contribute to discourses surrounding its development in ways that are in their interests, including offering their own "visions" for

the future development of the technology in question (e.g., Ferrari & Marin, 2014). In other words, the majority of stakeholders in 21st century new and emerging technologies are discursively objectified – the resulting technologies are things that simply happen to them; technology is something they are subjected to. As an illustrative example, I appeal to the form of the discourses surrounding the development of quantum technologies (Possati, 2024): the power to shape the development of these technologies rests in the hands of a unrepresentative elite, while – for a variety of institutional, cultural, and linguistic reasons – the majority of stakeholders are systemically disempowered to participate in the relevant discourses. This situation, however, is not unique to quantum technology, and has persisted due to a failure of power-holding institutional actors to learn the lessons of previous controversies around previous emerging technologies (Rayner, 2004). The paper ends with an optimistic exploration of how the discourses that are giving shape to 21st century new and emerging technologies can be made to discursively empower those with a stake in their development.

11 JUNE 2025 17.00 - 19.00 **SESSION 2**

ID 492 - Open source science as strategic process to shape an emerging technology

Mary F.E. Ebeling, Drexel University
Francesca Borghi, Università degli Studi di Milano Statale

Keywords: Open source technology, neuromorphic computing, emerging technology

As an emerging technological field, neuromorphic computing and engineering is a design method that implements computing hardware and software systems that mimic how the biological system, specifically the brain, functions. In particular, the neuromorphic approach allows for the implementation of highly efficient information processing strategies in hardware systems, beyond von Neumann architecture. In this context, self-assembled materials, which show nonlinear electrical behavior and memristive effects, are promising candidates for the effective implementation of data processing devices based on redundant and adaptive networks (Borghi et al. 2024; Vahl et al. 2024). Some scientists in this emerging field contend that the emerging field of neuromorphic computing could effectively address some of the significant problems associated with the widespread scale-up of computing systems used for AI, such as the massive drain on energy resources required to operate server farms.

As an emerging technology to scale into an established market presents several technosocial challenges. University-based teams developing neuromorphic computing hardware encounter high entry barriers to the established global chip market, primarily due to technical drawbacks and open problems--such as unstable electrical behavior, intrinsic stochastic fluctuations, or the integration of advanced and scalable analog-digital architectures. In the face of these technical challenges, some are turning to an open collaborative model, such as open-source software and open science models, to transfer the technology from bench-level to a scalable application. Open source technology development can encourage collaboration between teams, and increased motivation among the project developers (Di Tullio and Staples 2013). Open source technology development, conceived more as a service than a product, promises more democratic inclusion of expertise from teams developing the technology, and as a result, more robust design (Bottarelli 2024). Yet, open science projects often reflect the technosocial and political commitments of the participants, shaping how the device or technological object is translated into the logics of late capital (C. Kelty 2014; C. M. Kelty 2008; Currie, Kelty, and Murillo 2013; Dunbar-Hester 2020; Levin and Leonelli 2017).

Through a collaboration between an ethnographer and a physicist, in this paper we examine two cases of open-source, open science collaboration in the emerging technological field of neuromorphic computing hardware design. Through comparing an established device maker that used an open-source development model to enter the AI computer chip market with a university-based start-up in the early development stages of a neuromorphic computing device, we examine the sociopolitical negotiations that participants contend with, and the cultural paradigmatic shifts shaping the field, as they take bench-level discoveries to fit into globalized, late-capital markets in AI and computer chips.

11 JUNE 2025 17.00 - 19.00 SESSION 2

ID 532 - "Quantum Technology Development in India: Analysing the Promise and Reality in Addressing Societal Needs"

Nidhi Singh, Indo-U.S. Science and Technology Forum

Keywords: Emerging Quantum Technology, Responsible innovation framework, sustainable development

The paper examines the status and development of quantum technologies in India, emphasizing their potential to address country-specific challenges in sectors like healthcare, agriculture, finance, defense, and space. The study utilizes a secondary research approach covering the last ten years, leveraging the SCOPUS database for publication analysis, along with a review of National Quantum Mission (NQM) progress reports and the National Science & Technology Management Information System (NSTMIS) digital repository to analyze government-funded research projects. A total of 4,390 research articles on quantum technologies were examined to evaluate India's contributions in comparison to global efforts. The findings indicate that India ranks 12th in quantum research output and has developed a growing research ecosystem through initiatives such as the National Quantum Mission (NQM), the Quantum-Enabled Science & Technology program, and strategic collaborations with leading institutions, including the Indian Institutes of Technology, the Indian Institute of Science, and the Tata Institute of Fundamental Research. The paper argues that while India has made progress, challenges remain, including high costs, limited expertise, infrastructure constraints and non allignment of research with national priorities. It calls for interdisciplinary collaboration, public-private partnerships, and policy interventions to accelerate quantum innovation. The National Quantum Mission's hub-and-spoke model is discussed as a framework to drive quantum research capabilities across computing, communication, sensing, and materials. The paper contributes by exploring the socio-technical dimensions of quantum technology, including governance structures, institutional frameworks, and the role of international partnerships in shaping India's research ecosystem. It highlights the importance of responsible research frameworks to ensure sustainable technological development, equitable access and need specific research outcomes to quantum advancements. Strategic government interventions, steady funding, and deliberate innovation policies are imperative. Drawing on the innovation experiences of the United States the study calls for tailored policy instruments to foster a robust and dynamic innovation ecosystem for Quantum Technolgy Development in India.

11 JUNE 2025 17.00 - 19.00 SESSION 2

ID 632 - Negotiating Sustainable Futures: A Socio-technical Analysis of 6G Development in Europe

Margot Bezzi, CyberEthics Lab
Lucas Pereira Carwile, CyberEthics Lab
Katrina Petersen, Public Safety Communication Europe

Keywords: socio-technical systems, emerging technologies, 6G, value-based technologies, social acceptance, technological governance, sustainability, innovation narratives

6G is the sixth generation of mobile communication networks, currently in the specification phase. This integrated communications system represents a complex interdependence of infrastructure, enabling technologies, services, and applications. At the technological level, it will introduce disruptive innovations including native artificial intelligence, semantic communications, network of senses, and new spectrum technologies. These advances represent a strategic asset with profound societal implications, reshaping both communication capabilities and the global economic landscape. With 6G on the horizon, nations and corporations vie for dominance in this next-generation technology, particularly in the US-China tech rivalry.

As Europe positions itself in the global race for 6G leadership, the European telecommunications industry seeks to recover global competitiveness and technological sovereignty, caught between market pressures and EU sustainability imperatives that demand the simultaneous creation of economic, environmental,

and social value.

Our research is conducted through '6GSociety', an EU-funded project in the Smart Networks and Services (SNS) field, which examines societal dimensions of 6G development and bridges diverse stakeholder perspectives. The study combines analysis of industry vision documents and grey literature with participatory observation of technology development processes within the 6G Industrial Association and the SNS projects' community.

In this context, friction points have emerged between industry priorities, regulatory and institutional requirements, societal concerns, and environmental commitments, requiring careful negotiation and trade-offs. Tensions manifest especially in three domains: performance versus sustainability goals, social acceptance versus technical advancement, and traditional business metrics versus value-based indicators. Our findings highlight the industry's challenge in reconciling performance-driven business models with societal and environmental value creation. The industry adoption of the Key Value Indicators (KVIs) approach helps to identify critical moments in the technological development process where value systems influence technical decisions.

Our work contributes to Science and Technology Studies by mapping how 6G development is shaped through negotiations across international competition pressures, societal acceptance issues, and environmental concerns.

We propose new methodological approaches that bridge technical and social sciences, offering frameworks to analyse value trade-offs in technology development. This research advances the understanding of socio-technical systems while providing practical guidance for industry stakeholders to align emerging technologies with societal needs and sustainability goals, without compromising competitiveness.